

JOLT MAGAZINE

Haverford's student-led STEM publication

ISSUE 3 – SPRING 2023

ARTIFICIAL INTELLIGENCE

Is AI the New Normal?

NEUROSCIENCE

*Psychological Effects
Of COVID Lockdowns*

EXCLUSIVE
RESEARCH FEATURES,
INTERVIEWS & CROSSWORD



ON THE COVER

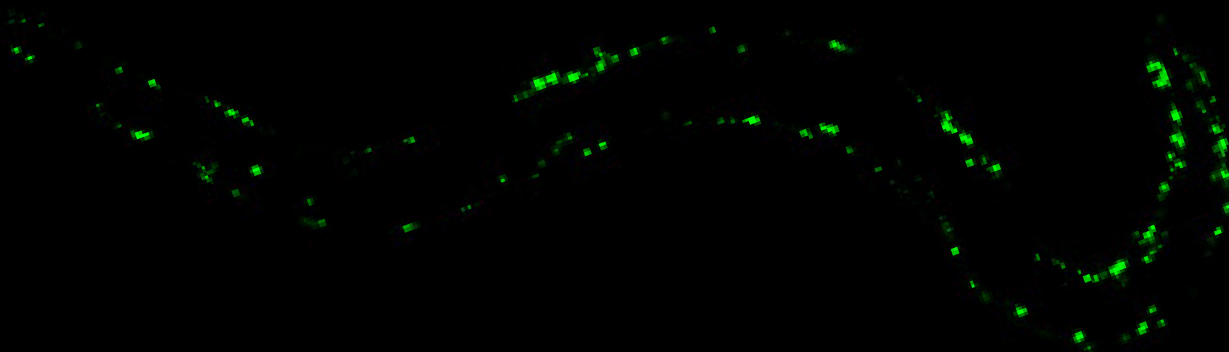
(For more information, see page 22)

The Fairman lab at Haverford is currently investigating the potential therapeutic effect of various plant extracts on neurodegenerative protein aggregation, and for her thesis, Tien Vu '23 is examining the effect of an extract from the leaves of the *Camellia Japonica* flower on beta amyloid (A β) aggregation, which is implicated in Alzheimer's Disease pathology. The strain used here, CL4176, exhibits A β aggregation and is a "roller" with a temperature-sensitive paralysis phenotype, making it a useful *C. elegans* model for studying A β aggregation and Alzheimer's pathology. A β is stained with X-34, which is a fluorescent dye derived from congo red that binds to beta amyloid peptide aggregates.

This image is a close-up of the head of the nematode, with the high magnification providing a sharp look at the interestingly diffuse A β aggregation. The imaged nematode is mounted on microscope slides with agarose and paralyzed in 100 μ M levamisole prior to microscopy. Fluorescence imaged with confocal microscopy at 40x magnification under glycerol immersion, 405nm laser, gain 8.0, intensity 3.0. Z-level 2.399 mm (2.391 - 2.418). Fluorescence colored in red.

Matthias Langer '24

Member of the Fairman Lab at Haverford



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EDITOR'S NOTE

Dear Reader,

This semester at *Jolt* was exciting and different than usual. With two new editors-in-chief, we decided to spice things up while still bringing the same magazine people know and love! We wanted to try new types of articles and in this issue you can find quizzes, a short sci-fi story, thought pieces, interviews, and features on research at Haverford.

In our third print issue, *Jolt* explores the hot topic of artificial intelligence and delves into the study of neuroscience, one of the newest departments and majors in the Bi-Co. We hope this issue inspires those interested in either topic and shows you the many ways the two can overlap.

We would love to give a special thanks to everyone who worked on these packages, especially our two topic leaders, Anagha Aneesh and Masha Kilibarda, and our one woman design team, Emma Wolk. A special thanks to *Jolt* Co-Head, Emi Krishnamurthy, who contributed as an advisor while studying abroad. In a time of transition, leaning on the *Jolt* team has been more important than ever so we appreciate everyone who helped along the way.

Our team has worked all semester to bring you the best issue possible - so enjoy!



Celeste Cubbage

CELESTE CUBBAGE

Co-Editor in Chief of *Jolt*



Simon Thill

SIMON THILL

Co-Editor in Chief of *Jolt*



ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) is the field of computer science that deals with solving problems that would typically require human intelligence. This includes face recognition, object identification, and image and text generation.

- Anagha Aneesh '24



AI 101: PURPOSE, DANGERS, LIMITATIONS

AN INTERVIEW WITH PROFESSOR JEOVÁ FARIAS SALES ROCHA NETO

Simon Thill

The field of artificial intelligence, developed in 1956, is relatively young, but has grown exponentially. While it is true that AI has the potential to revolutionize various industries and improve our lives in many ways, it is unfortunately often sensationalized and overgeneralized in the media. We often see exaggerated portrayals of AI as a mysterious, all-knowing, and all-powerful technology that could solve all our problems... or lead to our downfall. It's important to curtail these exaggerated claims and have a balanced understanding of AI and its capabilities.

For an expert opinion, Professor Jeová Farias Sales Rocha Neto, a visiting professor in Haverford's computer science department, offers his thoughts on the current state of artificial intelligence. Professor Neto's research focuses on computer vision, a form of machine learning that analyzes visual data such as videos and images. Machine learning is a specific subset of AI where a computer program analyzes massive amounts of data to find trends and connections which allows it to respond to new inputs and information. By recognizing patterns, a computer can "learn" how to complete a task. Professor Neto specifically "trains" computers to solve problems involving images and videos. Right now, he is focusing on automatically detecting dif-

ferent objects in an image or video using a process called image segmentation.

HAVE YOU USED CHATGPT OR SIMILAR AI BOTS? AND WHAT WERE YOUR IMPRESSIONS?

"I only experimented, and I was actually pretty impressed with the answers. The process in ChatGPT is data generation, but I've worked in image generation, which is analogous in some ways. A great problem of data generation, especially large scale when you consider a whole text or image, is you want the parts of that whole to communicate in a logical way, and it actually requires a lot of computation and a lot of data. With text things are much more nuanced than with images, in some ways. For instance, if you miss a pixel value by just 1%, humans won't really notice, but in text, small details can be very noticeable. For instance, you chose a synonym of a word, but in that context, no one would use that word there... I was impressed with the consistency of [chat GPT's] details from the beginning to the end and the amount of data and the amount of computation and training that this machine had to go through."

CAN A COMPUTER THINK LIKE A HUMAN?

“Maybe I should give a disclaimer here (laughs) I’m no philosopher, so I may not have the right augmentation for this kind of question, but it depends on how you imagine humans think. If humans don’t always think sequentially and if we obtain solutions according to data that goes beyond physical (sensory) data, then I don’t think, in that sense, artificial intelligence can ever think like humans.”

WHAT DO YOU THINK ARE AI’S BIGGEST LIMITATIONS?

“I think there are two main limitations. Because of the whole marketing around AI, I think sometimes people expect things that are unattainable and they forget that AI can be extremely good at solving problems they are supposed to obtain.”

The second weakness Neto gives is more theoretical, and stems from the fact that a computer can only make decisions based off of physical data, never based off of what that data means. “I like this example. Imagine if you are a biologist or a doctor, and you understand perfectly how pain works, and then you study that, you have PhD, and you are an expert. Then there is the point when you actually feel that pain. That feeling of the pain adds information

to all of the physical reality that is involved with your sensory inputs, your muscles or cells. So there is new information there that people call ‘qualia’ in the philosophy of mind community. There is this experience of reality that adds information to that reality and makes us make certain ethical decisions. So if we understand the physicality of something but we don’t understand the sensation, the qualia, of that something, we may be lacking in some of our decision-making processes. As much as machines are able to sense things that we sense, they are not able to have that qualia, which adds information which may be important to some applications.”

WHAT ARE SOME DANGERS OF AI?

“It’s always good to have tools, tools are very useful, but in some ways tools can hinder our own personal growth, I would say. For instance, think of ChatGPT, when you try to solve a problem without that kind of help, you actually learn more from that problem. Humans over time may consider themselves too attached to certain tools, and not be able to experience the full greatness they can obtain.”

“I also think the ethical situation is a huge one. In order to make the right decision, you cannot just have the physical input, you have to have the qualia.” Qualia, as described above, is an important term in the philosophy of mind community which refers to human’s internal and subjective interpretations of sensory input.

“I think we should first know what we really want, and what matters to us as a society and individual people, before we can come up with algorithms that try to obtain that goal, or it could really lead to dangerous situations.”

- Professor Jeová Farias Sales Rocha Neto

AI TAKES OVER!

Image created by DALL-E Mini with prompt: AI in Film

MEDIA VS. REALITY

Simon Thill

For many decades popular books and movies such as *The Terminator*, *Do Androids Dream of Electric Sheep?*, and *I, Robot* have depicted apocalyptic futures where an artificial intelligence has rebelled against humanity and people must fight to survive. Are these works at all accurate? What are the long term dangers of AI technology? We asked Haverford professors Clyde Daly and Jeová Farias Sales Rocha Neto as well as ChatGPT.

Do you have a favorite movie, book, or TV show in this genre?

Daly: The movies *Ex Machina* and *A.I. Artificial Intelligence*.

Neto: "I'm a big anime fan, and there is this movie called *Summer Wars*... it is about this AI which takes over, not the real world, but the 'metaverse.'"

ChatGPT: "As an AI language model, I don't have personal preferences, opinions, or emotions."

What movie, book, or TV show do you think is most accurate?

Daly: *A.I. Artificial Intelligence*, which is a 2001 sci-fi/drama about the first robotic boy programmed to feel emotions. "I don't know if it's most realistic, I just think that it is the most interesting."

Neto: "I thought [*Summer Wars*] was pretty accurate. It wasn't that you were giving machines feelings, it was a super capable algorithm that could understand patterns based on the data that was given to it."

ChatGPT: "The portrayal of artificial intelligence in popular culture is often sensationalized for entertainment purposes... That being said, some movies that are often cited as more accurate depictions of AI include *Her*, *Ex Machina*, and *Gattaca*."

*Interestingly, *Gattaca* is not a movie about AI, it is about genetic discrimination in the age of gene editing. This is a perfect example of Chat GPT giving inaccurate information!

And finally, thinking creatively, is it at all possible for an AI to, in some form or another, "rebel" against humanity and/or take over the world?

Daly: "Everything that is bad about AI is just bad about people in general. Any agent will want, if it has a goal (and the way you build AI systems is by giving them a goal), it will always be true that it is impossible to perfectly specify your goal and eventually the AI will start to move away from the real thing you want towards the goal you set. Then it will try to do things like not have its goal changed because if it wants what it wants now, then it will continue to want it, or not want to be turned off. And as they get more and more powerful that's going to become more and more of a problem, but that can all happen long before actual intelligence. So, I don't think rebellion in the sense of... like the American Civil War."

Neto: "Yeah actually I think so (laughs) but in what sense? I don't think it will actually be rebellious against humanity in the sense that it will, in its own will, be evil. I think it will be programmed to solve a problem in the best, most efficient way, but then in order to solve that problem, if you don't impose the proper constraints it will find a way to actually solve that problem, but through means that we would not expect or want it to find." He goes on to give the example of a computer that has been given the task of curing cancer. The way artificial intelligence is designed, it will find the most efficient way possible to accomplish its task, and it could determine that the most effective way to cure this disease is by performing harmful tests on human subjects, and maybe even killing them. Because it is not human, it would be impossible to predict how an AI may interpret a task, or the many undesirable ways it may accomplish it.

"I think we should first know what we really want, and what matters to us as a society and individual people, before we can come up with algorithms that try to obtain that goal, or it could really lead to dangerous situations."

ChatGPT: "While it is not currently possible for an AI to 'rebel' against humanity or take over the world, it is important to continue to monitor and address potential risks as AI technology advances"

MACHINE LEARNING

Emma Wolk

APPLICATIONS IN COMPUTATIONAL CHEMISTRY

A Haverford Research Feature

In the past decade, machine learning methods have had an unprecedented evolution, giving way to an abundance of new applications. This implementation of artificial intelligence allows computational systems to learn from data, identify patterns, and make predictions. Within the field of chemistry, this becomes an especially useful tool for interpreting patterns in data. I interviewed Professor Clyde Daly, a physical chemist at Haverford, to learn more about the applications of artificial intelligence within theoretical chemistry. He categorizes the two major uses of machine learning within computational chemistry as such:

DALY: The first is when you have some experimental data or some built data where you try to create some sort of model, generally a regression model or a decision tree type model, that you can use to predict new experiments but it is not a physical model.

These types of models are used for classification and prediction and require a set of input data. These are types of supervised learning techniques, meaning that the algorithms learn based on a set of labeled training data given to the model that dictates how it should categorize the information.

Secondly, he notes that within computational chemistry, they often build physical models which try to describe how electrons and atoms act in the real world. These models learn a pattern based on data from the real world, the ma-

chine learning algorithm creates a pattern which can then be used for other calculations.

DALY: So one part is learning based on data that has no particular attempt at a theory and one is trying to summarize a large number of theoretical results to give you a pseudo-physical model. Although, obviously there is overlap between the two.

Within his research lab at Haverford, machine learning is a tool used to perform calculations that would otherwise be practically impossible to compute. The most common way that machine learning is used in his lab is with spectroscopic maps. These maps are created with infrared spectroscopy, where an infrared light is shot at a sample, resulting in some of that light being absorbed based on the structure, the motions, and surrounding molecules of the sample.

DALY: If you were to try to predict infrared spectra, not only do you need information about the particular structure, but you also need information about

"In recent years, I think that some models have moved away from strictly trying to do what humans do because there are things that our brains do well that computers do not."



how the structure is moving through time. We have a method that is really good at sampling structures of molecules through time. That's called molecular dynamics. And it's really fast and we can get millions of structures this way. No problem, no sweat. We also have a method that is really good at getting the infrared absorption. That method is called quantum chemistry.

From quantum chemistry, we can find infrared absorption, but these calculations are dependent on molecular dynamics (MD), a simulation method used for analyzing movement. These simulations are created using force fields, estimates of the energy between atoms in a molecule. Then when we take the results of a MD simulation and calculate infrared absorption, eventually after looking at millions of points, you will end up with the infrared spectrum for the sample. But as you can imagine, this process would be extremely time consuming.

DALY: So we want some way to map from the molecular dynamics force field to the infrared absorption, without doing the quantum chemistry or at least without doing it directly. This is called a spectroscopic map.

These complex maps allow us to shortcut the process of performing millions of calculations in order to generate the infrared spectrum. Machine learning is also such a useful tool due to the fact that it can learn more complex processes like maps that do not necessarily have a linear relationship. Although, the ability to learn and utilize such a level of complexity also has its downsides.

DALY: When you do linear regression, even if you do multilinear regression, it's really easy to understand what the map is doing and what choices it is making. Although, maybe you shouldn't necessarily trust those choices, you've got a starting point for what's going on. The insides of most machine learning algorithms are so complicated that it's really hard to interpret what pattern it has learned.

This leads to difficulty in rejecting or accepting patterns due to the complexity in interpreting the results. In addition, this connection is entirely non-physical. The physical aspect occurs in taking the structure and using quantum chemistry, but machine learning shortcuts this process making it very difficult to decipher the physics. Although, some relationships are so complex that it is impossible to find patterns within them linearly. Therefore, machine learning allows us to at least scratch the surface of what is going on, making investigating machine learning interpretability, as Professor Daly notes, an important aspect for this evolving field. As machine learning continues to advance, computational chemistry will as well, giving way to new applications and possibilities within this area of science.



The Daly Lab Summer 2022, Pictured: Professor Clyde Daly (far left), Theresa Haupt '24, Samantha Gonzalez '25, Lisette Pham '23, Ethan Silva '25, Logan Smith '23, Rowan Goudy '23, Marie Nikolov '23, Dr. Kristy Streu (far right)

GENERATIVE AI IS AI REPLACING HUMANS?

Celeste Cabbage

Image created by DALL-E Mini with prompt: Oil Painting Landscape

Have you ever read an article or looked at a piece of art and thought: did a person or a computer make this?

The answer is probably no. However, that question is becoming more common as advances in generative AI technology make it simpler and faster for computers to generate art and media indistinguishable from man-made creations.

So, what is generative AI? McKinsey & Company describes it as algorithms that can be used to create new content like images, text, and videos. While many generative AI bots rely on a library of existing content to build the foundation of their algorithms, the product they generate is completely original work. The opportunity for generative AI is clear, but there has been some pushback.

After the program ChatGPT, a generative AI writing bot, went viral online, several articles with the title 'Will ChatGPT Kill...' began to circulate. Since Chat GPT is able to generate outputs such as college essays, news articles, math problems, and even code, people realized that this technology could automate many jobs. The exact same phenomena occurred with the generative art program DALL-E several months earlier with artists worrying that they may be replaced by AI.

This concern is not completely unfounded. Generative AI like ChatGPT and DALL-E can create original cover letters, write children's books, and even complete the work of an entry-level coder. Generative AI can produce content often at the same level as an experienced writer, artist, or musi-

cian but at a cheaper price point and faster timeline. What may take a digital artist weeks to produce can be created within minutes by a generative AI program.

However, there are still bugs in the program that Anu Madgavkar, a partner at the McKinsey Global Institute, says can make it hard to avoid error, bias, and misinformation. Since generative AI relies on pattern recognition, it lacks a level of human judgment to decide whether a pattern is incorrect, immoral, unethical, or biased. On its start page, ChatGPT warns people that the AI may "occasionally generate incorrect information" and "produce harmful instructions or biased content."

In early tests of the DALL-E system, performance reviews found that typing a prompt like 'CEO' or 'firefighter' that does not specify race or gender would most often pro-

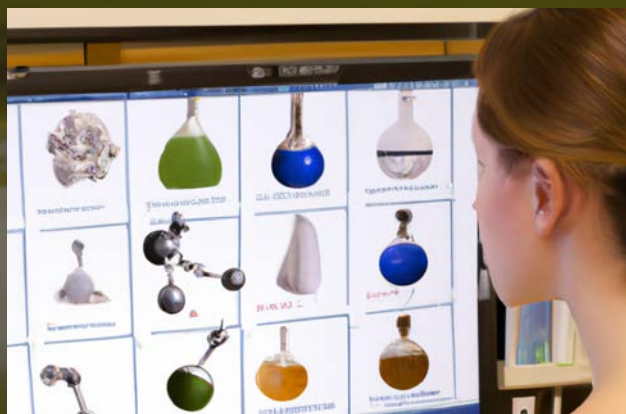


Image created by DALL-E with prompt: A student studying Chemistry at a computer screen in a library



Image created by DALL-E with prompt: An Impressionist oil painting of Haverford College campus

duce a white male output. It was only after human intervention that the system was redesigned to include more racial and gender diversity in its responses.

Open AI, the artificial intelligence research company responsible for both ChatGPT and DALL-E, has openly recognized the bias and limitations of generative AI and is said to be actively working with human reviewers to avoid it as much as possible.

While generative AI is meant to replicate human behavior, there will always be faults. This is why artists, writers, and human beings are necessary to point out errors and provide new ideas for the algorithm. From the start, generative AI has relied on man-made works to create the library of its algorithm. Generative AI would be, and is, nothing without human ingenuity, creativity, and skill.

Finally, when asked the prompt "Can ChatGPT replace writers and artists?", ChatGPT responded:

"As an AI language model, I can generate text and even create some simple images or visual designs, but I cannot fully replace writers and artists.

While I can generate text that is grammatically correct and

follows certain patterns, I do not have the creativity, imagination, and unique perspective that human writers and artists possess. I lack the ability to create truly original content that captures human emotions and experiences, and that can resonate with people on a deeper level.

Furthermore, the creative process often involves trial and error, experimentation, and the willingness to take risks, which is something that AI language models like myself do not possess. While I can generate text and images quickly, I cannot replicate the human experience of creation.

That being said, AI language models like myself can be a useful tool for writers and artists to use as inspiration or to aid in the creative process. By generating ideas or providing a starting point for a piece of art or writing, I can help humans take their creations to new heights. Ultimately, I believe that the most compelling and powerful works of art and literature will always come from human creators."

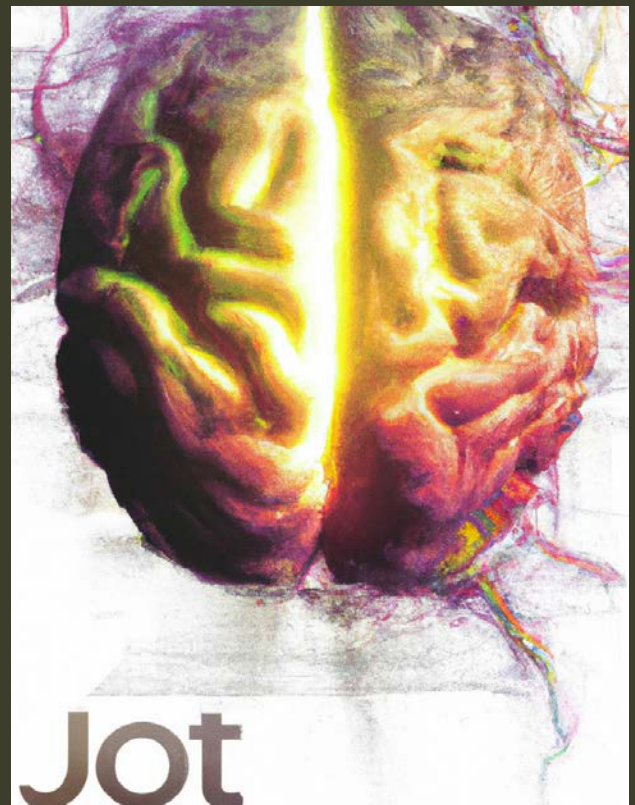
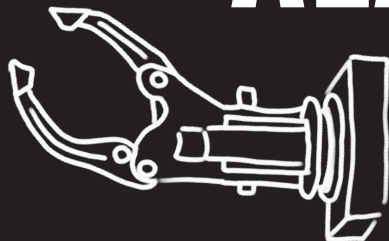


Image created by DALL-E with prompt: Digital art of a brain on the cover of a science magazine called "Jot"



ALAN TURING

FATHER OF THEORETICAL COMPUTER SCIENCE

Emi Krishnamurthy

Artificial Intelligence (AI) is becoming an expansive and diverse landscape for economic growth, technological innovation, and philosophical debate. As we learn more about what AI is capable of, we can take some lessons from Alan Turing, one of the most brilliant minds of the 20th century and the man who laid the groundwork for modern computing and artificial intelligence.

Alan Turing (1912 – 1954) was an English mathematician, computer scientist, logician, philosopher, and so much more. During the Second World War, he made strides to support the Allied powers' code-breaking initiatives. He



Alan Turing and Enigma Machine statue by Stephen Kettle, located in Bletchley Park in England

was instrumental in building a computer to decode the highly complex ciphers created by Nazi Germany's Enigma machine, and ultimately ending the war. In 1952, despite his monumental contributions, he was prosecuted for "gross indecency" when the British government learned that he was homosexual. He was charged with the choice of going to prison or being chemically castrated. He chose the latter, because going to prison meant that he wouldn't be able to continue his research. Two years later, he committed suicide by cyanide poisoning.

The story behind his work is remarkable, as depicted in the movie *The Imitation Game* (2014). The "Imitation Game" refers to another of Turing's groundbreaking ideas. Also known as the Turing Test, the Imitation Game places a human interrogator in front of two doors. Behind one door is a human subject, and behind the other door is a computer subject. If, after a conversation with each subject, the interrogator cannot tell which is the human and which is the computer, the computer is said to pass the Turing Test.

"A computer would deserve to be called intelligent if it could deceive a human into believing that it was human" (Alan Turing, 1950)

As technology progresses rapidly, we are increasingly asking whether today's AI passes the Turing Test. Unfortunately, Turing did not live long enough to see the future of machine learning technology, but we can use his writings and theories as a framework to think about the future of artificial intelligence.

SYLVIA

AN AI SHORT STORY

Katie Hirsche

"Grayson."

"Hmm."

"Grayson."

"Yeah, that's my name."

"You're awake! Yay!"

"Did you really need to wake me up, though? What time is it?" I grumbled, blinking the sleep out of my eyes. "It can't possibly be later than 7 AM."

"It's exactly 7 AM! But you said you would study more this morning and that I could help!"

I sighed. "Yeah, I did, didn't I? It sounded like a good idea last night."

"It is a good idea! Come on, Grayson, you promised."

"I wouldn't call it that, but alright." I sat up gingerly, stretching out and yawning. Sylvia waited outside my room until I was changed and we headed downstairs together, chatting happily.

"Your parents are at a meeting today. They left a note on the table," Sylvia said once we reached the kitchen. I rolled my eyes, covering the automatic rise of disappointment that threatened tears. Seventeen years and I should have been used to it.

"Typical. Ah well, I have you."

The morning was quiet but peaceful and soon Sylvia and I were in the car, planning out the day. We only attended in-person school twice a week, due to ongoing issues from the twenty-year-old COVID-19 pandemic and the patterns it had sparked. I didn't mind, as Sylvia was my best friend and I felt no need to get to know anyone else.

That said, I wasn't totally antisocial and maintained comfortable friendships with the others in my class. First up was History, and I enjoyed talking with the people I sat with. Sylvia followed, bouncing along behind me. As usual, she drew odd looks from the class.

"Job-stealer," Murphy Porter murmured, glaring balefully. Sylvia's yellow aura, surrounding the orb I so relied on for support, remained the same. Still, I imagined that her feelings were hurt.

"Worse, it's advanced. Computers can't move themselves," Murphy's twin Maria grumbled. "It was disruptive enough when all ChatGPT could do was write emails. Now there are orbs that can imitate human speech. Terrifying."

I was about to speak up, noting the deep purple color of Sylvia's aura, when Mr. Johnson walked in the room, followed by a ChatGPT Friend of his own. The Porter twins shut their mouths.

Jenna Albright kept glancing at me and Sylvia during class, letting her computer type notes for her. Ironically, ChatGPT technology was built into everything nowadays.

"Are you alright?" Jenna asked after class was done. I nodded, smiling slightly.

"Yeah, so long as Sylvia is," I replied easily. Jenna raised an eyebrow.

"ChatGPT Friends aren't that smart. She responds to you, not anyone else, if that makes you feel better."

And it did. Maybe I was weird for having a robot friend, but sometimes machines were more welcoming than humans. Call me crazy, but I cared about Sylvia and her feelings, mechanized or not.

"I am here for you, whatever you need," Sylvia said automatically. "I am your best friend."

"Would you be willing to have more than one friend?" Jenna asked as we walked together for our next class. "Not that there's anything wrong with Sylvia, she's great, but it might be fun!"

"I... yeah..." I stuttered, staring at Sylvia. She floated along, repeating herself about being my friend and providing what I needed. Maybe I could stand to interact with someone who had a complex life of their own. "That'd be really nice! Only if you'd have me."

"Of course! I usually eat lunch with my brother and another friend of mine, would you want to join us? Or we could sit by ourselves today." Jenna's grin split her face.

"You know what, that sounds great." My world a little wider, I smiled at Jenna, not noticing that Sylvia's yellow light dimmed.

AI ETHICS: A DEEPER LOOK INTO THE PHILOSOPHY OF AI

Anquon Neely

How should we view AI? Should we see it as a tool to help improve parts of our daily lives? Or should we see it as a partner or equal and learn to coexist alongside it? Does it pose a threat to our notion of what it means to be human? Intelligent? These are the questions that AI ethicists consider all the time.

An AI ethicists' main job is to consider the ethical issues that arise when dealing with AI systems as objects and as subjects. As objects, AI is like a tool for humans to use, but it's possible for that tool to be misused. On the other side, ethicists ponder AI as subjects – beings that may have consciousness or autonomy. This introduces questions of whether AI would, or even should, have rights as a conscious being, or if they could ever have consciousness in the first place.

Most of us mainly think of AI as a tool to use, however, if we're not careful, many problems may emerge, for example job displacement. David Chong, a machine learning engineer, writes about a book called *AI Superpowers* written by Lee Kai-Fu, a computer scientist. In it, Lee predicts that about forty percent of jobs are displaceable by AI in the 15 to 25 years. In charts created by Chong adapted from Lee's book, it outlines which jobs, both physical and cognitive, are in the "danger zone" for getting replaced. Physical

jobs include restaurant cook, truck driver, dishwasher, fruit harvester, and cashier. Cognitive jobs include telemarketer, customer service representative, radiologists, and basic translators. What all these jobs have in common, Chong says, is that they all involve very repetitive work and little social interaction, placing them at a higher risk of being replaced by the use of AI. This poses an ethical dilemma because if AI continues to be improved with no regulations then it may become more difficult for replaced workers to find jobs and sustain a living. Chong goes on to say that

**“AI COMPLEMENTS THE WAY
WE DO THINGS”**

David Chong

while AI may be used to automate these repetitive jobs, we use AI for much harder problems like helping doctors diagnose breast cancer. In his words, “AI *complements* the way we do things”. A majority of the forty percent, Chong thinks, will be displaced rather than replaced and that new complementary jobs will arise during this transition. He cautions though that the most important thing is how we react and adapt to these changes. It's really important that our policy-

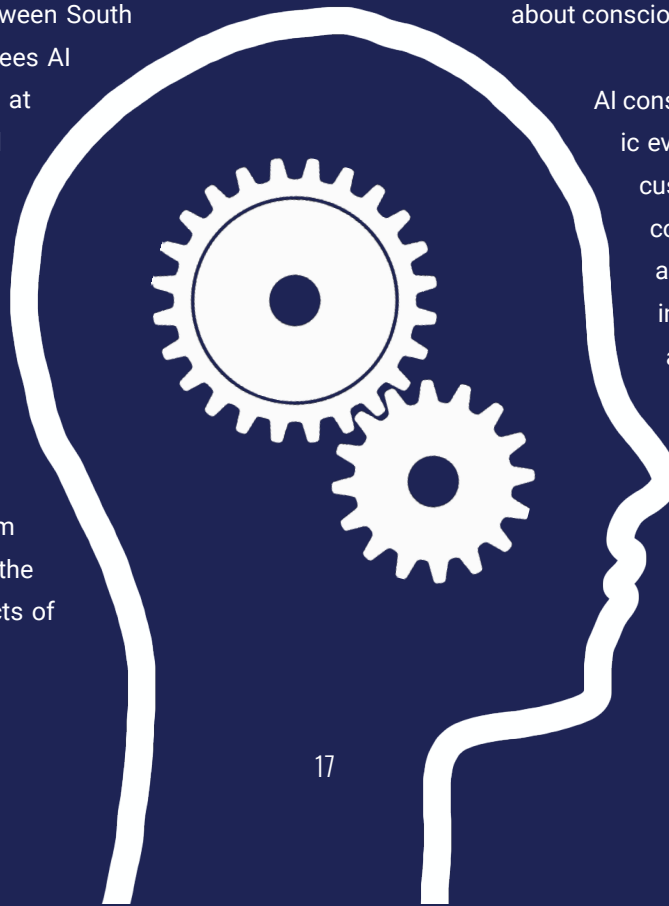
makers prepare for the rise of AI. How can we responsibly improve AI and make sure this doesn't become an issue? Can we? Should AI be improved? These are all questions that AI ethicists work to answer.

The fear of AI taking over our jobs, lives, and world is more of a western idea and is not how other countries and schools of thought feel about AI. In a video about global AI ethics made for the Global AI Ethics Consortium, Jibu Elias talks about South Korea, Japan, and China. While these are geographically close they each have different perspectives on the ethics of AI. He says that South Korea sees AI as more of a tool – something that should be used to empower humans and assert their dominance over machines. They focus on applications of AI in areas such as “public service, health care, education, social care, disaster relief, and security,” says Elias in the video. However, they also view AI as a tool used to enrich lives. Japan views AI as a partner, hence why they have robots who help with things like senior care and act as part of the family. Culturally, Japan seems to want to co-exist and evolve along with machines. China's views towards AI tend to fall in the intermediate region between South Korea and Japan's. China sees AI as a tool for progress, but at the same time has started to add “partner-like capabilities.” Elias brings up these perspectives and others to say that it's important to consider other perspectives when making decisions about things like AI. While they hold different views, all of them share the goal of improving the lives of citizens in all aspects of life, not just production.

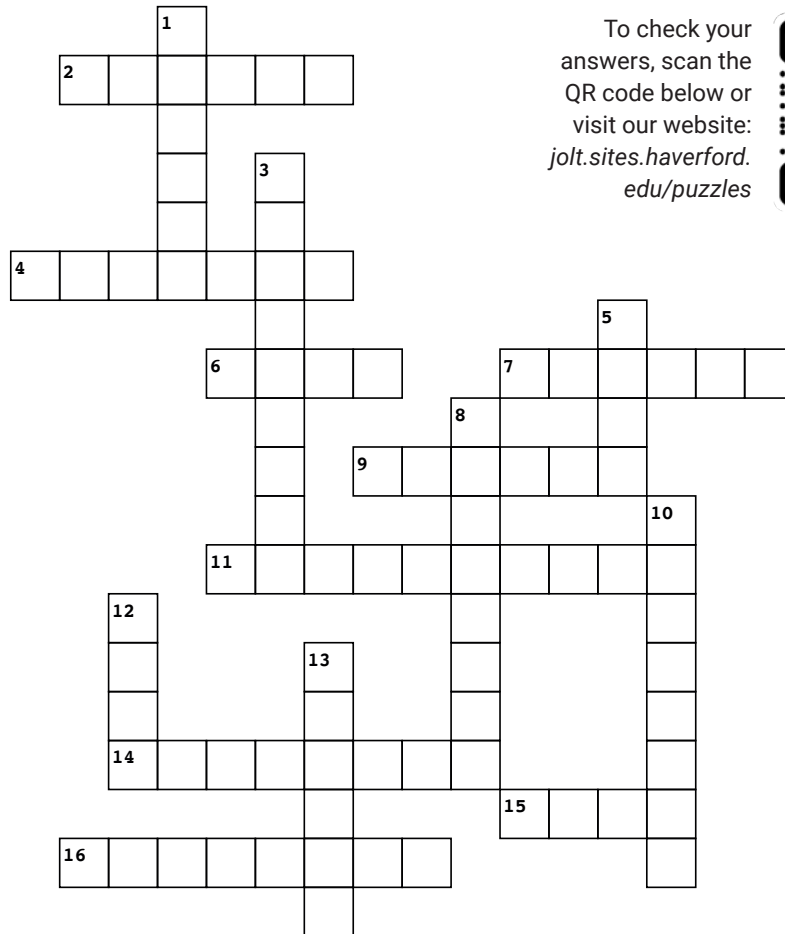
AI systems as subjects are what most people are afraid of: specifically AI suddenly gaining consciousness and becoming hostile towards the human race which is frequently portrayed in the media. Even so, ethicists seem to agree that AI is not going to become conscious for a long time. The biggest reason for this is that there isn't a consensus on what consciousness is in the first place or how our brain produces it. The most common answer you may hear is that it is an awareness of the self. Given this definition, some think there is no hope of AI achieving consciousness anytime soon, while others, including David Deutsch, think that consciousness isn't a mystery, it's just something that is yet to be discovered. He thinks if consciousness can be understood then it can be achieved by artificial intelligence.

However, creating conscious AI isn't a goal shared by everyone in the field. Some computer scientists aren't even focused on it because they don't see it as central. They are more focused on cultivating common sense use of AI. This way AI can be better at solving problems in the future and help with endeavors such as self driving cars. Which brings up the question of why or if we should be concerned about conscious AI in the first place.

AI consciousness is a complicated topic even for AI ethicists, but it's a discussion that needs to happen as AI continues to improve. AI ethicists are needed going forward. It is imperative that people who have a deep understanding of not only the technology, but the impact of this technology on society as a whole are the ones guiding us into what many have already coined the AI Revolution.



CROSSWORD PUZZLE



To check your answers, scan the QR code below or visit our website:
jolt.sites.haverford.edu/puzzles



Across

2. The AI assistant used by Iron Man in Marvel comics and movies
4. The largest technology company in South Korea
6. Latin word for bear or name of a major and minor constellation
7. Information messengers
9. Female AI and frequent late-night show guest
11. Why we can balance
14. Father of AI
15. Word before pepper or tower
16. Largest of the 5 Great Lakes

Down

1. A common name for dried plums
3. Why you can't turn in a CHATGPT essay
5. Roman moon goddess
8. A special event that occurs when not enough people attend
10. Why we feel emotions
12. Buddy
13. "The Descent of Man" author

NEUROSCIENCE

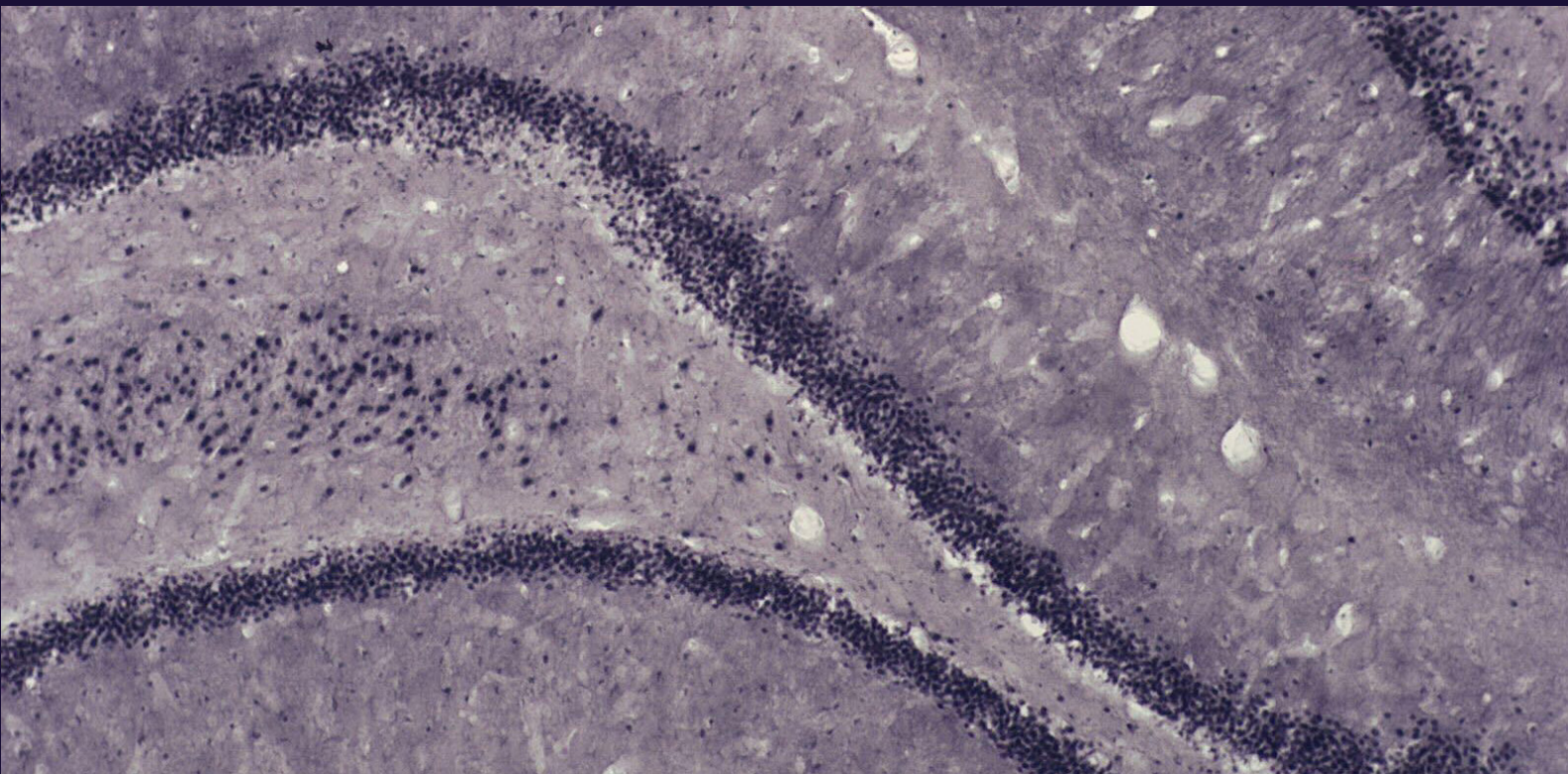


Photo of amygdala staining from Dr. Laura Been's Lab at Haverford (Photo credit: Isabel Thornberry)

Few things in the known universe are as complex as the human brain. Although many great minds attempted to demystify the processes within the brain, countless questions remain to this day. In a series of articles, we embark on a journey to explore one of the sciences focusing on the brain: neuroscience. We look at different aspects of the discipline, delving deeper into the history of the field, discussing Dr. Robert Fairman's neurobiology research, and examining phenomena such as learning styles and effects of COVID-19 lockdowns.

- Masha Kilibarda '26

A BRIEF HISTORY OF NEUROSCIENCE

Jaxon Remby

Although neuroscience was only recognized as a standalone field of science in the past century, the brain has been studied for millennia.

NEOLITHIC ERA

The first study of the human brain occurred in the Neolithic period which occurred between 10000 BC to 2200 BC. Skulls have been found all around the world with signs of a simple process, called “trepanation” (or trephination), which involved drilling or scraping the skull to attempt to cure a person’s “abnormal behavior”. Today trepanation, also called craniotomy, is practiced in a much more sophisticated way. It is mainly used to relieve the brain of cranial pressure, treat brain lesions or tumors, and for exploratory diagnosis.

CLASSICAL ANTIQUITY

In the millennium after this, humanity began to think more critically about the brain and its importance in relationship to consciousness. In Ancient Greece, some thinkers believed the heart was the “seat of intelligence” and the origin of human experience, while others believed it was the brain. The ideas were highly contested with notable philosophers such as Aristotle and Hippocrates on either side of the debate. Many potential theories were put forward, and it wasn’t until later that the brain was discovered to be the source of consciousness.

During this same millennium, another addition to neuroscience was made from within the Roman Empire. Galen, a Greek physician of great fame who practiced in Rome, was among the first to put physical experimentation into practice, studying anatomy through dissection. Through the repeated study of gladiators who experienced head injuries within the colosseum, Galen observed that certain motor functions or behaviors were limited, if not entirely inhibited by these injuries. This led him to confirm the theory that the brain is “the seat of intelligence and rationale”, agreeing with the prediction made by Greek philosophers centuries before. Over the next 2000 years, this idea would continue to be proven in more substantial ways.

RENAISSANCE

The Renaissance reshaped humanity, and with it neuroscience. With the wave of academic developments brought on by the Renaissance, significant multi-disciplinary figures, like French-born philosopher René Descartes got involved in the study of the human brain. Descartes worked within the metaphysical branch of philosophy to argue that the behavior of the brain could be explained as the function of a greater system. Put another way, he argued that the brain's behavior, and therefore the behavior of us as a people, could be "described by lawful physical principles." It can be argued that the study of neuroscience has its roots in this assertion, as it works to describe our behavior based on concrete physical processes within the brain.

While the study of human anatomy continued in the period after the Renaissance, the next major development in the field of neuroscience did not occur until the early 1900's with the work of Santiago Ramón y Cajal. Ramón y Cajal, commonly known as the father of neuroscience, managed to visualize the brain's structure using a technique called Golgi staining. Golgi staining works by filling specific neural tissue with potassium dichromate ($K_2Cr_2O_7$) and silver nitrate ($AgNO_3$) which changes the color of the cells and allows them to be more clearly observed. This technique allowed for the most detailed images of nervous tissue in the brain up until that point, images so intricate that they are still used in medical textbooks to this day. In 1906, he won a Nobel prize for Physiology or Medicine with Camillo Golgi for furthering our understanding of the brain's development and neuroplasticity, the brain's ability to adapt in response to learning and experience.

MODERN DAY

From the early 1900's into today, the field of neuroscience has grown at an accelerated pace. Neuroscience officially gained its footing in academia and began to be studied as an independent field. Eric Richard Kandel, a neuroscientist and professor at Columbia University, attributes the science's success to figures like David Rioch, Francis O. Schmitt, and Stephen Kuffler who brought academic credibility to the field by establishing departments and university organizations at schools like Harvard and MIT.

The history of neuroscience is much longer and richer than its relatively short academic history may make it seem. It spans thousands of years, includes numerous prominent figures in multiple disciplines, and like any science, continues to be changed and improved in the crucible of time.

A Haverford Research Feature

NEUROBIOLOGY

PROTEIN MISFOLDING

Maya Cheam

Haverford College has offered a minor in neuroscience since 2013, which expanded to become a Bi-Co major in 2021 following demonstrated student interest. As this new program was established at the height of COVID-19, it struggled with finding faculty. Across the Bi-Co, the neuroscience program currently consists of mainly biology and psychology professors, with one permanent neuroscience professor: Patrese Robinson-Drummer, the Prockop Assistant Professor of Neuroscience. In order to keep up with student demand, many non-neuroscience professors cooperate with the program by making their lab accessible for neuroscience thesis work.

Dr. Robert Fairman, a Professor of Biology, has done this for several years. His work studies protein misfolding, looking at the therapeutic potential of chemical compounds found in secondary metabolites, such as trees, to combat neurodegenerative disease. I met with Dr. Fairman to discuss his research and experiences with neurobiology in collaboration with the neuroscience program.

If you would like a background refresher, I will provide a very basic explanation of proteins in relation to neurodegeneration below. If not, please feel free to skip to the next section.

Proteins are large, complex molecules that work with organelles in the cell to carry out a multitude of vital functions such as maintaining the structure, function, and regulation of our body's tissues and organs. If a protein is misfolded, it may perform its functions incorrectly or not at all, leading to its harmful accumulation in tissues such as your brain which plays a role in the neuropathogenesis of many neurodegenerative diseases.

Could you give a brief introduction to your research? What are some important neuroscience applications?

"My background is in biochemistry, right? And one of the areas that I've gotten more interested in recently is the role of when proteins don't behave properly. If they're unfolded, or not properly assembled, it leads the cell to have to eliminate that protein. And if it doesn't eliminate it, those proteins tend to get together and aggregate. Those [aggregates] are collectively known as diseases, typically afflicting elderly people, that result in what we call neurodegeneration. One of the things I'm really interested in is the understanding of how and why proteins aggregate and cause neurodegenerative diseases, such as Alzheimer's, Parkinson's, ALS, and Huntington's Disease. If we can figure out how the cell manages that, maybe we can work towards fixing those problems."

Dr. Fairman and his students try to understand the "aggregation problem," of neurodegeneration using classic organism models such as fruit flies, *Drosophila melanogaster*, (*D. melanogaster*) and nematodes, or microscopic worms known as *Caenorhabditis elegans* (*C. elegans*). These models have orthologs— genes that evolved from a common ancestral gene by speciation that often retain similar functions in different species— of neurodegenerative disease-causing genes. Other research in the field has established protein aggregation as being "a problem of aging," as mistakes are more likely to occur in DNA transcription & translation the older an organism is. Due to their extensive lifespans, trees are an excellent source for potential therapeutic drug discovery, containing many different types of molecules that avoid protein aggregation. Students in the Fairman research lab can choose to do their thesis work on "harnessing" different chemical molecules and testing them within animal model systems to see if they can mitigate neurodegenerative diseases.

Biology, chemistry, and neuroscience majors can complete their thesis research in the Fairman Lab. How do you accommodate neuroscience majors? Does their research greatly differ from biology majors?

"The unfortunate part is that neuroscience has been much more popular than we could've imagined. It's not just me, but my colleague Roshan Jain who's also in the biology de-

partment; he is a bona fide neurobiologist. He and I both are struggling trying to meet the needs of the biology majors while also serving the neuroscience majors. Between the junior and senior classes, we have 91 majors in neuroscience, and no one could have predicted that much. We had thought maybe, collectively, half that number, right? So it has been a challenge not only at Haverford, but also at Bryn Mawr because it's a Bi-Co program. They're struggling too, to be able to meet that need. I think it would be excellent if the administration could hire more neuroscience faculty so we can better support our neuroscience majors. Right now, the psychology and biology departments are helping to support them."

So what does that mean? For Dr. Fairman, it means being put in a difficult situation. He will take on the standard number of biology majors for thesis, but is limited in his abilities to take neuroscience majors, struggling between his "strong commitment to want to support [neuroscience majors]" and maximum thesis capacity. This commitment is due, in part, to his recognition of how collaboration between neuroscience and biology majors is mutually beneficial for both groups of students for his research:

"The interesting part of what you're asking me is: is there a difference between what biology and neuroscience majors do? In my case, no. The work I'm doing is so interdisciplinary between biology and neuroscience that it's pretty seamless. I have students working with one another whether they're a neuroscience major or bio major. In terms of their training, I would say that for the most part is actually synergistic— as in, the value that neuroscience majors bring to the biology majors is a much deeper understanding of neuroscience and how the brain works, and likewise, what the biology majors offer is a more in depth approach to working in a research lab. We have this course called "Superlab" in biology that really trains students to think about hypotheses and adjust their plans for experimental work based on what they have available. Those two strengths that the two different majors bring together helps them to both operate at a higher level."

Is this dual-major work space sustainable?

"The answer is no, and you can quote me on that, because it's absolutely clear to me and my colleagues in the depart-

ment that it's not a sustainable model. One of the thoughts we had is, 'okay, so if neuroscience has more [majors], then biology should have less,' but that didn't happen. We still have just as many biology majors, so they're coming from somewhere else. We don't know where they're coming from, but they're not coming from biology majors."

Aside from typical hiccups in lab protocols as you figure out senior research, have you encountered any more difficulty with bio majors or neuro majors?

"That goes back to what I said about strengths. The strengths of neuroscience majors is their understanding of the brain, and so I would say, given what I do, I would like my biology majors to have taken more neuroscience courses to strengthen in that area. I'm not an expert either, but I'm beginning to learn more about physiology and how the brain functions at the organ level. Likewise, I'm hoping that neuroscience will eventually require their students to have a superlab-type experience, which they don't right now, because they really make those students more experienced with hypothesis building and troubleshooting and the transition into a research lab is much easier."

While there is still a lot of uncertainty about how the neuroscience department will continue to develop, it is clear from this interview that Dr. Fairman is one of many in the Haverford community who seek to foster the budding program's growth.



The Fairman Lab Seniors 2023, Pictured: Matt Hogenauer (far left), Lauren Kinne, Allison Dockman, Sarina Smith, Delaney Snowden, Tien Vu, Alex May, Maddie Hujber, Izzy Ray (far right) (Not pictured: Natalie Olivieri)

ARE LEARNING STYLES A MYTH?

Isabel Thornberry

WHAT TYPE OF LEARNER ARE YOU?
TAKE THIS QUIZ TO FIND OUT



Do you think of yourself as a visual learner? Kinesthetic? Auditory? These categories of “learning styles” are familiar to many of us and are commonly used by teachers and students in classrooms of all levels. However, there is very little evidence to prove that matching teaching style to an individual’s learning style significantly improves learning outcomes, highlighting a striking difference between research findings and many pedagogical approaches.

The concept of “learning styles” refers to the different ways in which learners prefer to engage with and process information. Learning styles are thought to be influenced by a wide variety of factors, including cultural background, generational learning differences and familiarity with technology, among other personal experiences. There have been dozens of learning style schemes proposed so far, but no consensus has been reached on a standard framework. However, the VARK classification, which includes visual, auditory, read-write, and kinesthetic learning categories, is one of the most well-known among educators and has been the focus of a significant body of research. Approaching education based on “learning styles” has also led to the philosophy that aligning teaching with an individual’s learning style could improve their learning. While conceptualized much earlier, literature from the 1980s describes step-by-step methods to implement education based on learning styles with the stated goal of clear communication and maximizing learning. This idea has provoked a large body of research both on how teachers choose to implement learning styles in their classrooms and how students can use learning styles to reflect on their own learning experiences.

However, recent research has challenged the assumption that using a model of “learning styles” is productive. While individuals process information differently and express their own learning preferences, these differences do not necessarily imply that students will learn better when taught in their preferred learning style. Both primary literature and review articles assessing the relationships between reported learning preferences, instructional mode, and learning outcomes have found no evidence to support that matching instruction to learning style improves learn-

ing. “Learning styles” models have also been criticized for treating the complex and integrated process of learning as an easily-solved, unidimensional problem.

Despite lacking research-based evidence, “learning styles” frameworks continue to be prevalent among educators. A review from 2020 used 37 studies from around the globe to conclude that approximately 89% of educators believed in matching instruction to learning styles, with an even higher percentage in trainee teachers. Many published teacher training materials likely contribute to perpetuating “learning styles” frameworks by presenting theories and exercises based on these models. They also often push for teachers to account for a wider variety of learning styles in their lessons, especially as class sizes continue to grow across the U.S.

Promoting “learning styles” theory in classrooms has also recently been criticized not only for being unhelpful, but also as being potentially harmful for learners. The focus on “learning styles” strategies may detract from resources and effort that could be better allocated elsewhere to improve learning outcomes. Also, pigeonholing learners into one learning style category could also create unrealistic expectations of success or failure in a given discipline and could deter students from accessing valuable resources.

So what can educators and students do to improve learning? Studies have proven that several study strategies do increase knowledge acquisition. For example, experiencing and working with information in multiple ways, incorporating aspects of all four VARK categories into your study strategy, could improve learning. Learning could also be improved by making connections with material rather than simply trying to memorize everything. With these in mind, consider creating diagrams connecting what’s been learned in class, forming a study group to ask questions, and spacing out your study sessions. We all learn and think differently, and trying out different strategies can help figure out what works and what doesn’t for each of us personally. Ensuring that we don’t pigeonhole ourselves into one specific “learning style” might allow us to learn in ways we might not have thought possible.

PSYCHOLOGICAL EFFECTS OF COVID LOCKDOWNS

Abby Ryan

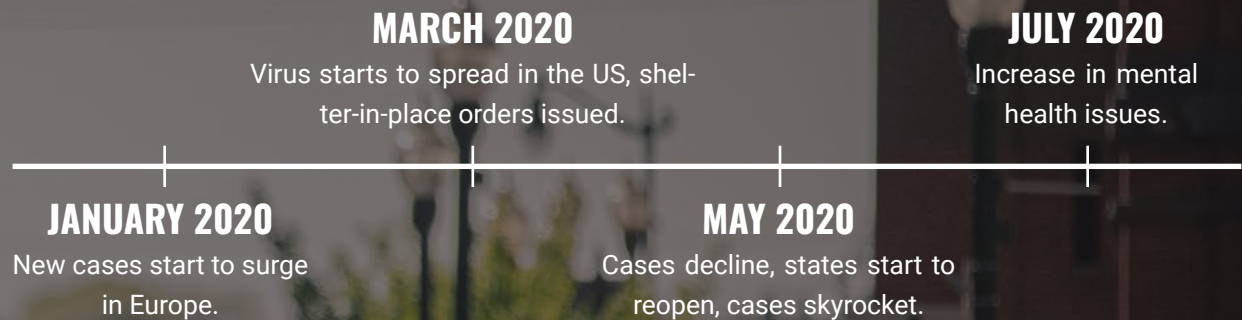
The consequences of COVID lockdowns took a significant toll on the mental health and brain development of the general population, some groups worse than others. After analyzing the effects of the pandemic, it was found that children, young adults, and those with pre-existing health conditions were influenced the most.

Play is a major part of childhood, contributing to social, emotional, and mental growth and development. However, lockdown prohibited regular routine and education, resulting in an increase in psychological problems and a disruption in brain development among kids. Outdoor play became limited, with most kids spending the majority of their days in front of screens. That severe lack of stimulation and interference in education has shown to cause significant impacts on brain development (Kourti). It has been found that depression, irritability, inattention, and anxiety are the predominant psychological

issues in kids stemming from lockdowns, where from a pool of about 23,000 kids, the behavior and physiological state of 79.4% were affected negatively (Panda). It is amazing how such a lack of engagement can be the cause of disrupted brain development among kids! Additionally, decreased stimulation leads to higher irritability and a disruption of children's sleep, which is a protective factor of executive functions. This has been linked to long term repercussions due to how vulnerable children are. Studies of the tradeoff of childhood education vs. health of the community have found that the value of years of life lost (YLL) had a 98.1% of being lower overall if schools had stayed open (JAMA). This is devastating for children, as the direct and indirect effects of lockdown will follow them into their adult lives.

On a similar note, adults also saw an increase in mental health issues, specifically young adults, wom-

2020 AT A GLANCE: A COVID-19 TIMELINE



en, and those of lower socioeconomic status. Surveys from a University College London COVID-19 Social Study analyzing mental health of adults pre-covid and during lockdown revealed that younger generations experienced significant self-reported worsening of cognitive functioning, where other generations did not see such an effect. Additionally, anxiety disorders increased by 40.51% in women versus 23.93% in men (Fancourt). As to be expected with the guaranteed stress of living budget-to-budget, underemployment was related to an increase in depression and anxiety (Fiorenzato). These results highlight the significant effects that certain vulnerable groups faced, and in turn how those consequences continue into their lives after lockdown. A study conducted in Victoria, Australia (known for its longest lockdown and lowest COVID prevalence) aimed to find differences in direct (neurological effects of contracting covid) to indirect (social and economical effects

of isolation) consequences from lockdown in adults. It found that in September, 33.4% reported anxiety and depression, 16.9% reported newly started or increased substance use, while 16.9% wished they were dead in the prior 30 days (Czeisler). This substantial decline in mental health supports the physiological harm caused by lockdown, where chronic stress has been linked with long term changes in stress response, which is controlled by one's cortisol secretion.

This brings us to the question whether the benefits of lockdown outweigh the lasting psychological effects. Can we confidently say that the health of our community was more important than the education of children? The fragile developmental state of children was put at risk, and we can already see the consequences carrying over. This must be compared to the health benefits gained from containing the spread of COVID-19.

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