

科目

外国語(英語)

医学部医学科

注 意

1. 開始の合図があるまで、この問題冊子を開いてはいけません。
2. 問題は1ページから10ページにわたっています。問題冊子に不備がある場合は、直ちにその旨を監督者に申し出てください。
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1 Read the article below and answer the questions that follow. All questions must be answered in English. Words marked with an asterisk * are defined at the end of this article in the Notes section.

Not since World War II has there been as great a threat to mental health as the current COVID-19 pandemic, according to Aiden James. ^(A) The challenges to our mental health won't "stop when the virus is under control and there are few people in hospital," the president of the Royal College of Psychiatrists in the United Kingdom told *The Guardian* recently. "You've got to fund the long-term consequences." With depression, anxiety, and substance abuse in the United States, and likely elsewhere, at record highs, that should not come as a surprise. At least antidepressants can be (B) on to help reduce some of the damage, right? Well, maybe not. Experts ^(C) [our medications / strongly about / helping / disagree / how well / are]. In 2018, *New Scientist* ran an article called "Nobody Can Agree About Antidepressants."

So what do we do? A theory of brain function, particularly involving **serotonin***, recently proposed by neuroscientists Robin Carhart-Harris and David Nutt, at Imperial College London, may point a way forward for effective treatment. The use of antidepressants ^(D) [left / empathy / many of us / toward others / has unintentionally / to feel / less able], laugh, cry, dream, and enjoy life just when we need those things the most: in the middle of a global pandemic.

The good news is that the research coming out of Imperial College's Research Center has shown some impressive results in reducing treatment-resistant depression using **psychedelics***, such as the **psilocybin*** found in "magic mushrooms." In a 2017 study, decreased depressive symptoms were observed in all 19 treatment-resistant individuals one week after their dose. Five weeks later, 47 percent still had reduced symptoms. What is equally exciting is that Carhart-Harris and his co-authors have been using **functional magnetic resonance imaging*** on subjects during the process to show that the mechanism of action is directly related to the amplification of spontaneous cognitive fluctuations.

^(E) Spontaneous brain fluctuations occur across all resting-state brain activity. When our mind wanders, sleeps, or is under anesthesia, for example, our neurons are still firing all over the place. Over time and through trauma, our spontaneous fluctuations can fall into negative resting-state patterns, like water rolls into a ditch. Antidepressants (F) this problem by cutting off water flow. Most work by reducing the functional connectivity of the "default mode network," which is active when we mind-wander, daydream, self-reflect, worry, and ponder. Unfortunately, this means that around 70 percent of people who take antidepressants report "emotional numbness" as a primary side effect. Prescription antidepressants,

anti-anxiety agents, and even many sleeping pills interfere with REM sleep and dreaming. This is ironic since there is well-researched evidence that REM dreaming plays a vital role in regulating negative emotions and depression.

Sleep researchers Antonio Zadra, Bob Stickgold, and Erin Wamsley showed, for example, that dreaming increases these fluctuations and improves how quickly test subjects could pass through a maze. When the subjects dreamt about the maze in any way, or dreamt about the music that played while they navigated the maze, they completed the maze the next day nine times faster than those who did not dream about the maze.

Neuroscientists ^(G)know about spontaneous fluctuations since the 1930s but never ^(H)know what to make of them. ^(I)Researchers chalked the phenomenon up to “random background noise” and proceeded to focus on coding the more easily testable 2 to 3 percent of conscious brain activity, but now they recognize that cognitive fluctuations play a much more significant role and that their patterns aren’t random. In *Consciousness and the Brain*, French neuroscientist Stanislas Dehaene writes that “neurons not only tolerate noise but even amplify it.” Neurons work by amplifying cognitive fluctuations and even make use of their noisiness to help generate novel solutions to complex problems. Cognitive fluctuations may be drawing us nearer to ^(J)a paradigm shift where “noise is the new signal.”

Brain frequencies are how fast certain groups of neurons fire together. The frequencies of cognitive fluctuations form patterns that become “cross-coupled” into higher frequencies, around **the beta*** (12 to 30 hertz) to **gamma*** (30 to 180 hertz) range. As the slower waves, from **infraslow*** (0.0001 to 0.1 hertz) to **theta*** (5 to 8 hertz), continually grow into faster ones and spread like an avalanche across various areas of the brain, we become aware that we are aware or “conscious.” That is, our thoughts are the results of **syncopated*** patterns of noise that emerge like **eddies*** from a turbulent stream.

For instance, if someone flashes an image on a screen in front of us for only 40 milliseconds, we will not consciously see it due to how frequent and how fast conscious thoughts spread. If the image lasts 60 milliseconds, however, we will consciously see it. This is because there is time for these nested frequencies to spread out and become aware of the image. According to the neuroscientist and philosopher Georg Northoff, at the University of Ottawa, these cross-coupled frequencies eventually create **metastable states*** of conscious awareness.

The study of these cognitive fluctuations is leading researchers to approach mental health treatment in new ways. Instead of trying to *reduce* spontaneous fluctuations with antidepressants, they are trying to *increase* them. This is counter-intuitive because spontaneous fluctuations and mind-wandering can also lead to depressive thoughts and

anxiety. ^(K) The flux theory, however, is that these negative habits of thought can be disrupted by flooding the brain with spontaneous fluctuations. The disturbance loosens things up and allows us to change old habits.

If Northoff and Carhart-Harris are right, amplifying the noise might change our minds like shaking a snow-globe changes snow distribution. This is a good thing — such a good thing, in fact, that it is leading to some incredible breakthroughs in mental health science. Rolland Griffiths and Stephen Ross, at the **NYU*** Langone Center of Excellence on Addiction, for example, gave psilocybin to 80 patients with life-threatening cancer in Baltimore and New York City. More than three-quarters reported significant relief from depression and anxiety related to their fear of dying. These improvements remained even six months after the treatment and were related to the amplification of spontaneous fluctuations. Ross told *Scientific American*, “It is simply unprecedented in psychiatry that a single dose of a medicine produces these kinds of dramatic and enduring results.”

Spontaneous fluctuations are a tool we should not underestimate. More Americans have died from COVID-19 than in World War II, and the numbers are likely to double before the end. Millions more are grieving the loss of their loved ones. Many COVID-19 “long-haulers” are also dealing with mental health issues related to the lasting effects of the disease. We need safe and reliable mental health solutions, and ^(L) [the toolbox / out / left / no / should be / of / tool]. Getting plenty of REM sleep and dreams uninhibited by alcohol, **ibuprofen***, and **cannabis*** can help, as can decriminalizing psilocybin, as several cities are doing, to make therapies more accessible. Even looking at natural **fractals***, like trees and plants, can contribute to flux therapy. Having a good theory about how spontaneous fluctuations work is the key to finding more treatments.

As the fear of illness and death (M) the minds of many, the advances in this line of work offer some measure of comfort. They might just help us survive the COVID-19 aftermath.

(Thomas Nail, February 17, 2021, *Nautilus Magazine*, extracted and slightly modified.)

***Notes:**

serotonin: a chemical substance that carries messages from nerve cells to other nerve cells or muscles

psychedelics: a drug that will create psychedelic or hallucinatory condition

psilocybin: a hallucinogenic alkaloid found in a certain type of mushroom, such as a magic mushroom

functional magnetic resonance imaging: fMRI, a method to visualize brain activities

the beta, gamma, infraslow, theta: kinds of brain waves, so named according to the wavelength

syncopated: shortened

an eddy: a circular movement of water

a metastable state: chemically unstable state in the absence of certain conditions that would induce stability, but not prone to spontaneous transformation

NYU: New York University, a private university located in New York City

ibuprofen: a drug used to reduce pain and inflammation

cannabis: a drug made from the dried leaves and flowers which gives the user a feeling of being relaxed

a fractal: a curve or pattern that includes a smaller curve or pattern which has exactly the same shape

(1) Select the meaning which is most likely to correspond to (A) The challenges in the context of this article. Write the letter of the meaning you have selected.

- (a) unconditional objections
- (b) problems that can be ignored
- (c) strong protests to demonstrate
- (d) confrontations to be tackled
- (e) difficult tasks to accomplish
- (f) threats facing you

(2) Fill in the parentheses (B), (F), and (M) with the most appropriate word from the list below. Change the word form if necessary.

consume

estimate

discuss

base

count

address

hypothesize

request

gather

(3) The following questions are about (C), (D), and (L).

(a) Put the words in the square brackets of (C), (D), and (L) into the correct order.

(b) Select the meaning which is most likely to correspond to the underlined (L). Write the number of the sentence you have selected.

- ① You should return all instruments after using them.
- ② Try whatever you can think of and do.
- ③ Remove everything from the bed in order to have a good sleep.
- ④ You must not use all the tools in the box.
- ⑤ Just try to take people to the hospital by all means.

(4) The following passage describes the main points of the fourth paragraph starting with (E)Spontaneous brain fluctuations. Fill in each blank from (a) to (h) with a word or a group of words from the list below. Change the word form if necessary. Each item can be used only once.

It is (a) that although REM sleep and dreaming can improve (b) mental states, the sleeping and dreaming states are (c) with by antidepressants and even by sleeping pills. REM sleep is one of the (d) states of the brain, where (e). This activity is described as (f). Antidepressants work to (g) (f), and then, people experience what is called (h).

emotional numbness	rest	positive
cut off	water rolls into a ditch	our mind wanders
interfere	negative	spontaneous brain fluctuations
reduce	ideal	increase
neurons are still firing	a primary side effect	ironic
a vital role		

(5) Change (G)know and (H)know into the most appropriate form.

(6) Select the meaning which is most likely to correspond to the underlined (I) Researchers chalked the phenomenon up to “random background noise”. Write the letter of the sentence you have selected.

- (a) Researchers denied the idea of “random background noise.”
- (b) Researchers were impressed with “random background noise.”
- (c) Researchers ascribed the phenomenon to “random background noise.”
- (d) Researchers were able to enhance the phenomenon.
- (e) Researchers measured “random background noise.”
- (f) Researchers improved the phenomenon to make “random background noise.”

(7) With regard to (J) a paradigm shift, what paradigm shift does the author suggest? Complete each sentence by filling in the underlined parts.

Neuroscientists used to consider _____.
However, now the cognitive fluctuations _____
and are viewed as _____. The fluctuations are amplified,
and _____.

(8) What is (K) the flux theory? Explain it in about 60 words. Include all of the following words and phrases and underline them on your writing. You must NOT change the word forms.

antidepressants

in contrast

new ways of

flow

spontaneous brain fluctuations

disrupt

depressive thoughts

2

Read the article below and answer the questions. The words with an asterisk * are defined in the Notes section.

In 1956, Rita Colwell was walking with her fiancé across the campus of Purdue University when she spotted Henry Koffler, an eminent biologist. She had just earned a **bachelor's*** in bacteriology at the university, and she told the renowned professor that she planned to postpone medical school and secure a **graduate fellowship*** at Purdue while she waited for her partner to finish his **master's*** in chemistry. She recalls the late Dr. Koffler's response as swift and chilling: "We don't waste fellowships on women," he told her, adding, "[A]."

Now a celebrated scientist herself, Dr. Colwell, 85, tells this story in her new publication of her life, "A Lab of One's Own: One Woman's Personal Journey Through Sexism in Science." She is a former director of the National Science Foundation (NSF), a distinguished professor at the University of Maryland and Johns Hopkins University, and the source of a breakthrough in the study of cholera. She hopes that by revealing her personal battles with sexism, she will inspire other women to push forward in the field. "[B]," she explains over the phone from **Halifax, Nova Scotia***, during a visit with one of her daughters. "Science is still male-dominated, and a good deal of persistence is still required."

The landscape for women in science has clearly changed for the better since Dr. Colwell began her career. She writes that the surge of female college graduates in the 1950s and 1960s spurred an "unprecedented" wave of sexual discrimination by men who suddenly feared for their jobs. These days, it is no longer OK to fire a woman if she decides to marry or to push a pregnant colleague to get an abortion to save her career. It is now illegal for American universities to have separate career tracks for men and women, and explicitly sexist comments are rarer. The NSF's ADVANCE program, which Dr. Colwell launched to improve the status of women in the sciences, has helped promote thousands of women to full professors around the country. Both of Dr. Colwell's **alma maters*** — Purdue and the University of Washington, where she earned her **Ph.D.*** in aquatic microbiology — have had female presidents, and women now make up more than half of all medical-school students, according to the Association of American Medical Colleges.

Yet Dr. Colwell laments that more progress hasn't been made. "[C]," she says. A 2018 report by the National Academies of Sciences, Engineering and Medicine found that harassment remains common and often pushes talented women out of the field. Female researchers with similar credentials as their male colleagues often wait longer for grants from the National Institutes of Health and usually get less money, Dr. Colwell notes in the book.

“Women still have to do more work than men to get accepted,” she says. “You have to publish more extensively, and only in the best journals. I don’t think that’s changed.”

Over the years, Dr. Colwell has been passed over for promotions and told that she shouldn’t worry her “pretty little head” over one thing or another. Even now, she notices men dismissing her ideas or talking over her in meetings. Yet her experiences with discrimination yielded a silver lining. Dr. Colwell’s struggle to pursue her interests in the face of reluctant professors and bureaucratic dead ends meant that she created what she calls “a patchwork education.” Her search for willing mentors led her to study chemistry, English literature, bacteriology, medicine, genetics and oceanography. It is usually poor form for scientists to switch so readily among subjects. [D].

She now thinks that her hybrid education gave her the tools for her big breakthrough on cholera. Her training in microbiology, oceanography and genetics helped her discover that cholera can never be eradicated because it exists naturally and is spread by copepod, a tiny **crustacean*** found in both freshwater and saltwater habitats.

Yet it took decades for her insight to enter the mainstream. Dr. Colwell suggests that the delay was in part because cholera was seen as a medical problem, yet she approached it as a marine scientist, not as a physician. “The idea that cholera exists in the natural environment was tough to take for some of the old guard,” Dr. Colwell says. She suspects the fact that she is a woman did not help. “Now that my findings are in textbooks, I don’t have to defend them so energetically.” She has also found ways to predict future cholera outbreaks and reduce infection rates.

* * *

Dr. Colwell’s book includes tips for how women can navigate implicit bias and get ahead. Although she is keen for more female scientists to pursue their goals with confidence, she also notes that many of her accomplishments came with diplomacy. As the first female head of the NSF, from 1998 to 2004, her comments at meetings were often ignored, but she learned that if she waited for a man to restate her proposal, and if others then described the idea as “brilliant,” she could move the plan forward. “[E],” she writes. “If you’re concerned about immediate praise, you risk achieving nothing.” She remains grateful that her husband of 62 years, who died three years ago, never felt threatened by her success. “He said, ‘Look, you’re doing what you like to do and I’m doing what I like to do. What could be better?’”

Like many scientists, Dr. Colwell is an optimist. She is proud of her two daughters, both of whom have followed her into the sciences: One is a botanist, the other a molecular

geneticist. But she predicts that the field will be more welcoming to future generations. “[F]” to girls who are born now, she marvels. For the female scientists of tomorrow, “most of the impediments will have faded away.”

(Emily Bobrow, August 14, 2020, *The Wall Street Journal*, truncated and slightly modified)

***Notes:**

bachelor's: a bachelor's degree, which is the first university degree

a graduate fellowship: the state of being a member of an academic organization who pursues a research-based graduate degree

master's: a master's program to obtain a secondary university degree after finishing a bachelor's program

Halifax, Nova Scotia: Nova Scotia is an eastern province of Canada, and Halifax is its capital.

alma maters: the schools, colleges or universities that one graduated from

Ph.D.: the highest degree awarded to a person whose thesis has been approved by a committee of professors in a graduate school

crustacean: any creature with a soft body that is divided into sections and has a hard outer shell, such as crabs, lobsters, and shrimps

(1) Select the most appropriate sentence for each blank from [A] to [F] from the list below. Write the letter corresponding to the sentence on the answer sheet.

- (a) I wrote the book because I realized the problems I faced weren't unique to me or because of some flaw I had
- (b) You don't get the credit in that moment, but you will when the job gets done
- (c) The experience, however, inspired Dr. Colwell to use a more interdisciplinary approach to solve complex scientific and medical problems
- (d) The only degree you're going to get is in the maternity ward of a hospital
- (e) The world is open
- (f) There are still plenty of ways to discourage women from pursuing scientific careers

(2) Write an English essay of about 250 words in response to both of the following questions (a) and (b) below. If you need to cite what is written in the article, use single quotation marks (' ') to indicate the parts you have cited.

(a) What do you think about Dr. Colwell's life-long battles with sexism?

(b) What is your view of inequality between males and females in Japan or in the world?

Do you see any problem?