

# 英 語

90 分

## 注 意 事 項

1. 試験開始の合図までこの冊子を開かないこと。
2. 本問題冊子は 18 ページ、答案用紙は 2 ページである。
3. 各答案用紙の上の枠内には、受験番号を記入し、その右側の枠内には、受験番号の下 2 桁の数字を忘れずに記入すること。
4. 解答はすべて各答案用紙の所定の欄に記入すること。
5. 問題冊子および答案用紙は切りはなさないこと。
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試験問題は、つぎのページより始まります。

I 次の英文を読んで、以下の設問に答えよ。(80点)

Kaylee Byers crouches in a patch of urban blackberries early one morning this June to check a live trap in one of Vancouver's poorest areas, which is referred to by its postal code V6A. Her first catch of the day is near a large blue dumpster on "Block 5," in front of a 20-some-unit apartment complex above a thrift shop. Across the alley a building is going up; between the two is an overgrown paper- and wrapper-strewn lot. In the lot there are rats.

"Once we caught two in a single trap," she says, peering inside the cage. She finds a new rat there and makes a note of it on her clipboard; she'll be back for it, to take the animal to her nearby van, which is parked near (according to Google Maps) an "unfussy" traditional Ethiopian restaurant. Once inside the van, the rat will be put under anesthesia and will then be photographed, brushed for fleas, tested for disease, fixed with an ear tag, and released back into V6A within 45 minutes.

Byers is a PhD student under veterinary pathologist\*<sup>1</sup> Chelsea Himsworth, a University of British Columbia School of Population and Public Health assistant professor who has become a local science celebrity thanks to her Vancouver Rat Project. Himsworth started the project as a way to address health concerns over the city's exploding rat population — exploding anecdotally, that is, as no one has counted it.

Prior to Himsworth's work, in fact, the sum total knowledge of Canada's wild rats could be boiled down to a single study of 43 rats living in a landfill in nearby Richmond in 1984. So six years ago she stocked an old minivan with syringes, needles, and gloves and live-trapped more than 700 of V6A's rats to sample their DNA and learn about the bacteria they carried.

Her research has made her reconsider the age-old labeling of rats as invaders that need to be completely fought back. They may instead be just as much a part of our city as sidewalks and lampposts. We would all be better off

if, under most circumstances, we simply left them alone.

Rats thrive as a result of people. The great modern disruptions caused by urban development and human movement across the world have ferried them to new ecological niches. “Rats are real disturbance specialists,” says biologist Ken Aplin, who has studied the rodents and their diseases for decades. <sup>(2)</sup> “Very few wild animals have adapted so well to the human environment without active domestication.” Rats invade when ecosystems get disrupted. In terms of the bare necessities, “rats need only a place to build a burrow (usually open soil but sometimes within buildings or piles of material), access to fresh drinking water, and around 50 grams of moderately calorie-rich food each day,” according to Matthew Combs, a doctoral student at Fordham University who is studying the genetic history of rats in New York City. In a human-dominated landscape like New York or Vancouver, “It comes down to where rats have found a way to access resources, which often depends on how humans maintain their own environment.”

It’s not hard to understand why humans often think of the rat lifestyle as a parasitic response to our own. But that’s not entirely true. “I have to stop myself sometimes because I want to say that rats have adapted to our cities,” says Combs. The reality is that rats were perfectly positioned to take advantage of the disruptions caused by human settlement long before we arrived. They’ve been on Earth for millions of years, arriving long before modern humans evolved, about 200,000 years ago. Before cities were even a glimmer in our eye, rats <sup>(b)</sup> were learning to become the ultimate opportunists. “They were likely stealing some other species’ food before ours,” Combs says. Even in the still-remote mountain habitats of New Guinea, says Aplin, “you tend to find rats living in landslides or along creek systems where natural disturbance is going on.” Walk into a lush, primary, intact forest, “and they’re pretty rare.” It’s not that rats have become parasitic to human cities; it’s more correct to say they have become parasitic to the disturbance, waste, construction, and destruction that we humans

have long produced.

Which brings into question the constant human quest to disrupt rats and their habitats. As much as rats thrive in disrupted environments, Byers says, they've managed to create very stable colonies within them. Rats live in tight-knit family groups that are confined to single city blocks and that rarely interact. The Rat Project hypothesized that when a rat is removed from its family by pest control, its family might flee its single-block territory, spreading diseases that are usually effectively quarantined to that family. In other words, the current pest control approach of killing one rat per concerned homeowner call could be backfiring, and spreading disease rather than preventing it.

The diseases that rats might be spreading aren't just their own. Himsworth likes to say that Vancouver's rats are like sponges. Their garbage-based diets allow them to absorb a diverse collection of bacteria that live throughout their city, in human waste and in our homes. "So it's not like the presence of harmful bacteria is characteristic of the rats themselves," she says. They get that bacteria from their environment, and when they move, they take these place-specific pathogens with them.

When "stranger" rats come into contact, Byers says, territorial battles ensue. "They urinate out of fear and they draw blood," she says — perfect for expelling and acquiring even more bacteria. It's during these territorial brawls, Byers and her colleagues believe, that bacteria can converge, mix, and create new diseases. "The rat gut acts as a mixing bowl," says Himsworth, where bacteria that would otherwise never interact can swap genes and form new types of pathogens.

One example is a strain of methicillin-resistant *Staphylococcus aureus*<sup>\*2</sup>, or MRSA, that Himsworth found in V6A's rats. It included a piece of genetic material from a very closely related superbug called methicillin-resistant *Staphylococcus pseudintermedius*<sup>\*3</sup>, or MRSP, which is often only associated with domestic animals like pet dogs. It seems that rats pick up human MRSA from

the sewers or the streets and canine MRSP from our yards, then mix them in their guts. These new human-rat bugs could then potentially spread back to people via the rats' droppings and saliva.

In V6A it's hard not to notice the litter around us. Garbage has bubbled out from under the lids of trashcans, and a pile of empty syringes surrounds a parking-lot trap. Walking across this landscape of debris, cracked concrete, and weeds, Byers stops at another trap, which is set on what she has named "Block J." She and two student assistants are heading the project's second phase, which involves tracking the real-time movement of rats, using ear tags. Once these trees are mapped, she will begin to euthanize individual rats and see how their family responds. Part of her PhD work is to understand how human-caused disruptions, pest control in particular, affect how rats move throughout V6A. The hypothesis is that the disruption will send communities scurrying for new ground. With nearly 100 cages to check today, Byers moves hastily to a trap on Block 8. No rat here, but this one did catch a skunk.

A significant finding from the project's original phase, Byers tells me, is that not every rat in V6A carried the same disease. Rat families are generally confined to a single city block, and while one block might be wholly infected with a given bacteria, adjacent blocks were often completely disease-free. "Disease risk doesn't really relate to the number of rats you're exposed to as much as it does to which family you interact with," says Robbin Lindsay, a researcher at Canada's National Microbiology Lab who assisted the Vancouver Rat Project in screening for disease. If those family units are scattered, diseases could potentially spread and multiply—something Byers is hoping to figure out through her PhD work.

If that's true, a city's rat policy should include doing the unthinkable: intentionally leave them where they are. "It might be better to maintain local rat populations that already have some sort of equilibrium with the people who live there," says Aplin. Many of the diseases that we share with rats are already

part of a human disease cycle established over centuries, he says. Seen this way, rats are irrepressible — “a force of nature, a fact of our lives.” Rather than focusing on killing them, we need to try to keep their populations stable and in place — and that includes managing rat immigrants.

An established rat society in a neighborhood makes it a much less viable destination for other rats, for example those entering through ports. Exotic rats can be more of a threat than those adapted to the region because each rat community evolves with its own suite of unique pathogens, which it shares with the other vertebrates in its ecosystem. New rats mean new diseases. The big question now, Aplin says, is “what happens when these different pathogens come together? This is something that I’m just starting to think about now. If the local rat population is suppressed, if you’re actively getting rid of it, then you’re also actively opening up niches for these foreign rats to enter.”

In Vancouver, this is a fact of life. “One important thing we do have right over there,” says Byers, motioning with her left hand, “is Canada’s largest shipping port.” Vancouver sits on Vancouver Harbor, which houses the great Port of Vancouver. In one of Himsworth’s earlier studies, she found mites\*<sup>4</sup> on the ears of rats that live by the port and compared them to rats that take up residence around V6A. Port rats had malformed ears full of a strange breed of mite previously unknown to Canada — “an exotic species that’s found in Asia,” Himsworth says, which happens to be where Vancouver gets the majority of its imports. These foreign ear mites were not found on rats from any other block.

“So I think Aplin’s theory has a lot of merit,” Himsworth says. “It seems that the established rat population at the port acts as a buffer.” ダニが V6A 地区全体に拡散するのを防いだきたのは、まさにこれではないかと彼女は考える。<sup>(4)</sup>

Disruption, of course, doesn’t come from just ports and pest control. It is part and parcel of modern civilization. Vancouver’s population is growing steadily (by about 30,000 residents each year), bringing housing development, demolition, and more garbage. Even our love of birds can be a problem. Two years ago, for



example, rats invaded a playground and community garden in East Vancouver, a bit outside of V6A. Several media sites reported on the visitors, which were evidently drawn in by birdseed dropped by a single individual. The area soon became known as “Rat Park.” The City of Vancouver urged the garden’s coordinator to put up signage asking people to avoid feeding the birds and to pick up their overripe vegetables. An exterminator was hired as well — adding more disruption still.

Himsworth hopes the new science will sway Vancouver’s existing policy on rats, which, she stresses, is currently “essentially non-existent.” This bothers her a lot. “I know that Vancouver Coastal Health essentially has the standpoint that, ‘Well, we don’t see the disease in people so we don’t worry about it,’ ” she says of the region’s publicly funded health-care authority. Homeowners with rat infestations can ring 311\*<sup>5</sup>, Canada’s 411, to report an infestation, but that’s not a preventative response. “Rats are pests, and we don’t spend health-care dollars to track pests,” said Media Officer Anna Marie D’Angelo of Vancouver Coastal Health. It was a message echoed by Issues Management Communications Coordinator Jag Sandhu of the City of Vancouver: “The City of Vancouver does not track the rat population.” To Himsworth, this is shortsighted. “They’re not taking the rat disease risk seriously because they haven’t seen it in humans yet — but that’s not where diseases start.” She also believes the issue is in part one of social justice. Rats typically affect poor areas, like V6A, that have little political clout.

Back inside one of Byers’s traps in V6A, needlelike nails are lightly scraping on the metal. “It’s a black rat,” Byers tells me — the famed carrier of the Black Death. Byers says she isn’t concerned about bubonic plague, which in North America is mainly carried by prairie dogs. But there were 13 rat-driven bubonic plague outbreaks in seven countries between 2009 and 2013. And there are plenty of new diseases cooking.

- \*1 veterinary pathologist 獣医病理医
- \*2 methicillin-resistant *Staphylococcus aureus* メチシリン耐性黄色ブドウ球菌
- \*3 *Staphylococcus pseudintermedius* 犬の皮膚や粘膜の常在菌叢を構成するブドウ球菌種
- \*4 mites ダニ
- \*5 311 カナダで、緊急性の高くない事件やトラブルを通報する時の電話番号

[Adapted from Becca Cudmore, “The Case for Leaving City Rats Alone,” in Hope Jahren, ed., *The Best American Science and Nature Writing 2017*. New York: Houghton Mifflin Harcourt, 2017: 59-64.]

I-1. 下線部(1)を日本語に訳せ。

I-2. 下線部(2)はネズミが何を得意とすることを指しているか。30字以内の日本語で説明せよ。(句読点も文字数に含める。)

I-3. 下線部(3)を日本語に訳せ。

I-4. 下線部(4)を英語に訳せ。

I-5. 下線部(a)から(c)について、それぞれの意味にもっとも近いものをAからEの中から選び、記号で答えよ。

(a) “could be boiled down to”

- A. could amount to
- B. could be affirmed by
- C. could be overturned by
- D. could elaborate on
- E. could merge with

(b) “Before cities were even a glimmer in our eye”

- A. When cities were constructed of mud and bricks
- B. When cities were less brightly illuminated at night
- C. When cities were not yet imagined or built
- D. When cities were places that people did not feel proud of
- E. When cities were unpleasant places to live in

(c) “usually effectively quarantined to that family”

- A. commonly well-monitored outside that family
- B. normally exclusively targeted at that family
- C. often utterly fatal to that family
- D. ordinarily well-contained within that family
- E. typically completely harmless to that family

I-6. 以下の(1)から(3)の答としてもっとも適切なものをAからEの中から選び、記号で答えよ。

(1) Choose the reason that Himsworth is concerned about MRSA, a kind of bacteria.

- A. MRSA demonstrates that harmful bacteria can be created within the bodies of and spread by rats.
- B. MRSA demonstrates that harmful bacteria can be deadly to humans as there are no effective medications to cure a person infected by them.
- C. MRSA demonstrates that harmful bacteria can be transmitted straight from household pets such as dogs to the humans they live with.
- D. MRSA demonstrates that harmful bacteria can evolve into new strains within infected human hosts.
- E. MRSA demonstrates that harmful bacteria can kill animals that humans cherish, such as their pet dogs, along with animals that they dislike, such as rats.

(2) Look at the word “trees” marked with double underlining on page 4. Choose the best description of what the word “trees” refers to in the article.

- A. An architectural sketch of burrows in which families of rats live in a particular neighborhood.
- B. A diagram of the pathways certain rats travel over the course of a set period of time.
- C. A flowchart depicting the routes along which diseases spread across the city among animals and humans.
- D. A genetic map showing multiple generations and branches of families among the rat population in an area.
- E. A geographical survey of forested sections within the city of Vancouver.

- (3) Choose the statement that Himsworth would most likely agree with.
- A. The government of Vancouver has encouraged citizens to participate in community debates and policy formation on matters that affect everyone.
  - B. The government of Vancouver has exhibited disagreement among various departments on crucial topics such as control of the rat population.
  - C. The government of Vancouver should maintain the characteristics of local communities with different socioeconomic backgrounds.
  - D. The government of Vancouver would be more concerned about rats if they infested the neighborhoods that have influence on public policy in the city.
  - E. The government of Vancouver would be underfunded if they supported scientific research on subjects such as the rats that inhabit the city.

I-7. 次の1から10の文から、本文の内容に一致するものを3つ選び、番号で答えよ。

1. Himsworth is well-known to the citizens of Vancouver for her research on rats and diseases in the city.
2. Before the launch of the Vancouver Rat Project, there were only a few minor research studies conducted on rats in that city.
3. Historically speaking, the number of rats dramatically increased after human beings began constructing and living in urban environments.
4. Rat families generally fear going out of their territory for a while after a family member is killed.
5. Rats do not engage in fights with unfamiliar rats unless humans drive them out of their residential areas.
6. The Rat Project scientists purposefully leave used experimental syringes out in places where they set up rat traps.
7. Even if humans do not directly touch the rats that live near them, they can catch diseases from them.
8. An experimental procedure of the Vancouver Rat Project was to identify the illnesses and the mites that rats carry in different areas of the city.
9. Vancouver City officials believe urban development is beneficial for creating rat-free urban spaces for the human population.
10. People in East Vancouver were blamed for feeding birds and growing vegetables in their neighborhood as this was believed to have attracted rats to their local park.

II 次の英文を読んで、以下の設問に答えよ。(70点)

We are at our cutest as infants. We're most helpless then, too. But every infant has a help button: Cry, and most likely any adult within earshot will rush over to hold and soothe them with a gentle song.

Other primate species, including chimpanzees and macaques, also cradle and carry their fussy young. But human caregivers do something extra. "We added the singing," says psychologist Sandra Trehub, professor emeritus at University of Toronto Mississauga.

No one knows when parents first sang to infants, but the practice is ancient and universal. "There seems to be evidence of singing to infants throughout recorded history," says Trehub, who has studied musicality in infants and children for decades. All human cultures perform songs specifically for babies — so-called "infant-directed songs." Simpler, slower and repetitive, these lullabies seem to soothe distressed infants better than other song types.

But how — and why — did humans create infant-directed songs? In January, Harvard University evolutionary psychologist Max Krasnow and grad student Samuel Mehr published the first formal theory on the origins of lullabies in *Evolution and Human Behavior*. The songs, the researchers say, may have been the result of parents and infants clashing over a precious resource: parental attention.

"From a genetic perspective, parents and infants don't have the same interests," Krasnow says. "Infants want more of all resources than parents are willing to give."

In broad strokes, Krasnow and Mehr's new theory fleshes out the field's<sup>(1)</sup>general consensus about how lullabies may have originated. Shannon de l'Etoile, a professor of music therapy at the University of Miami's Frost School of Music, cites a theory that infant-directed songs evolved out of the need for "hands-free parenting."

“Think about the period when early humans became bipedal,” says de l’Etoile. “That coincided with the pelvis\*<sup>1</sup> narrowing, to allow walking upright, which limited the size of the infant at time of birth — all humans are born in a certain state of prematurity. We’re not like, say, horses, which are up and walking after a couple of minutes.”

Our inherent vulnerability as infants means human babies need an extended period of hands-on care, explains de l’Etoile, who studies infant-directed song but was not involved in Krasnow and Mehr’s research. She adds: “At the same time, the baby is growing at an exponential rate. 赤ん坊が、常に抱いて歩くには大きすぎるけれど、まだ世話が必要だという時がやってくる。<sup>(3)</sup> But the mom also needed to move around, to get water, prepare food.”

Singing allowed the mother, the traditional caregiver, to put the infant down while still reassuring the child.

“If the infant’s making a fuss, it could attract a predator,” says de l’Etoile. “A mother effective at using her voice to calm her infant would be more likely to survive — and the infant would be more likely to survive, too. Infant-directed song could be evidence of the very first music.”

While not contradicting this take on the origins of lullabies, Krasnow and Mehr propose a darker element to the evolution.

“The parent-infant relationship is not all cupcakes and sunshine,” says Mehr. “There is [ ① ].”

Krasnow and Mehr believe the tug of war between an infant seeking as much attention as possible and the caregiver dividing attention among other offspring and tasks crucial for survival may have set the stage for an evolutionary arms race.<sup>(a)</sup>

The competition begins simply enough: The infant makes a demand for attention, and the parent seeks to provide enough to satisfy the infant. But how does the parent express that attention hands-free, and how can the infant assess the quality of the attention received? Through vocalizations, according to



Krasnow and Mehr's theory.

A simple vocalization is easy to produce. But more complex vocalizations — such as singing — require memory, focus and skill, which could convey a higher quality to an infant. More demands for attention from the infant through crying might be answered with more complex vocalizations from the caregiver.

“Attention is invisible. You need an honest signal of its quality,” says Krasnow. “That’s where singing comes in. I can’t be singing to you while I’m running away from a predator, or while I’m just having a conversation with someone else. Even turning the head affects the quality of the voice. An infant can gauge where the parent’s attention is oriented. These are things that can’t be faked.”

And infants are very attentive to that particular signal, other researchers <sup>(b)</sup> have found. For example, over the past several years de l’Etoile has studied infants’ response to lullabies. In multiple studies, they were exposed to a range of stimuli, including either their mother or a stranger singing to them. In all cases, “all the infants were very attentive to all the singers. The infant-directed song was what was attracting attention,” says de l’Etoile.

Krasnow and Mehr stress that their research is theoretical. It lays out a possible route from general calls between individuals keeping in touch when out of sight, to specific, more complex vocalizations with infants, and eventually into lullabies. “Our theory on its own cannot predict that we are going to get a ‘Rock-a-Bye Baby,’” says Mehr, “but it points us in that direction.”

Not everyone is singing Mehr and Krasnow’s tune.

Trehub doubts that the need to soothe infants pushed vocalizations to evolve <sup>(4)</sup> into lullabies. Humans use various means to calm infants: Rocking and carrying on their own, for example, can lull an infant to sleep. “Songs are not a unique solution for soothing infants,” Trehub says, which makes creating a solely evolutionary basis for them problematic.

For Krasnow and Mehr, the promise of their new paper is not the theory

itself — it's that they have developed a number of ways to test its validity. The team is already conducting studies with children and adults who have genetic conditions that may alter the normal response to hearing lullabies. They're also planning additional research with infants. These follow-up studies will test different aspects of their evolutionary theory for infant-directed song, potentially resolving not only its origins, but also the very roots of music in general.

“What we know so far is that parents singing to infants is [ ② ],” says Krasnow. “That’s a shock when you think of how different cultures can be. It suggests to us that there is something deeper and more functional going on.”

\*1 pelvis 骨盤

[Adapted from Yao-Hua Law, “Rock-a-Bye Baby’s Rocky Roots,” *Discover* (June 2017): 66-68.]

II-1. 下線部(1)を日本語に訳せ。人名はアルファベット表記のままでよい。

II-2. 下線部(2)のような状態が進化の上で生じたのはなぜか。その理由を本文にそって50字以内の日本語で説明せよ。(句読点も文字数に含める。)

II-3. 下線部(3)を英語に訳せ。

II-4. 下線部(4)を日本語に訳せ。人名はアルファベット表記のままでよい。

II-5. 文中の空欄 [ ① ], [ ② ] に入れるのもっとも適切なものをそれぞれ  
AからEの中から選び、記号で答えよ。

- ① A. a lot of conflict  
B. a tendency for self-sacrifice  
C. much room for evolution  
D. plenty of compassion  
E. scarcely any contradiction

- ② A. a declining trend  
B. a human universal  
C. a status-building endeavor  
D. a vicious circle  
E. an educational activity

II-6. 以下の(1)および(2)の答としてもっとも適切なものをAからEの中から選び、記号で答えよ。

- (1) Look at the underlined part (a). Which of the following does “an evolutionary arms race” refer to?
- A. competition among infants of the same growth stage for gaining the largest favor from adults
  - B. competition among groups of humans over bodily strength, a factor that determined which groups flourished and which perished
  - C. competition among parents, their younger and older offspring, in acquiring and developing vocalization skills
  - D. the idea that humans who could most efficiently distribute their attention among offspring while carrying out crucial tasks had the strongest chance of survival
  - E. the idea that parents and their infant offspring competed to increase chances of individual survival, according to their contrasting interests or needs
- (2) Look at the underlined part (b). According to the text, which of the following is true about the statement, “infants are very attentive to that particular signal”?
- A. A range of stimuli created by parents could influence how infants will respond to future infant-directed songs.
  - B. An infant senses the extent of the caregiver’s attention to herself or himself from the vocalization.
  - C. If a caregiver is producing complex sounds, it is enough to soothe the infant regardless of to whom it is directed.
  - D. Infants can distinguish between their mother’s voice and a stranger’s voice in the quality of their lullabies.
  - E. Simple vocalization signals a high level of focus on the infant, which allows the parent to engage in different tasks.

II-7. 次の1から8の文から、本文の内容に一致するものを2つ選び、番号で答えよ。

1. In times of trouble, parents console themselves as well as their children through song and music.
2. Infant-directed song did not raise the probability of each generation's survival above the level of the preceding one.
3. Singing has been an important tool for adults in their tug of war with infant offspring over a precious resource.
4. Infants are highly selective in the ways that they respond to singing by their mothers as distinct from vocalization by other adults.
5. Krasnow and Mehr's theory has put an end to the debate about how human vocalizations evolved into lullabies.
6. Krasnow and Mehr continue to seek various means to verify their theory.
7. The research by Krasnow and Mehr has unexpected benefits for people with genetic conditions that affect their ability to respond to lullabies.
8. There is now broad agreement that infant-directed song is likely to have been the very first form of music making.





