令和４年度
北海道大学大学院理学院

自然史科学専攻
科学コミュニケーション講座

入　学　試　験
夏　期
（外　国　語）

問　　題

○ 問題は、２ページ目から６ページ目までです。
○ 解答用紙の１ページ目に受験番号と氏名を書いて下さい。
○ 英和辞典（ただし電子的な辞書を除く）を参照してもかまいません。

問題１．　次の英文は、Massimiano Bucchi and Brian Trench (2021) “Rethinking science communication as the social conversation around science”, Journal of Science Communication 20(03)の抜粋です。下線部の(A)と(B)を日本語に訳しなさい。

Two related usages of conversation are in play here: a mode of interactive communication that is set in contrast with dissemination or other hierarchical modes, and a concept that embraces all that is being said on a certain matter in society. Our inclusive definition of science communication not only validates activities such as science cafés and science comedy that are oriented to pleasure, but also recognises as part of the wider practice of science communication the ‘spontaneous’ use in popular culture of images and ideas from and related to science. Hozier, an Irish singer-songwriter with an international audience, picked up from a TED Talk by astrophysicist Katie Mack the notion that the expansion of the universe could be reversed. He named Mack in a line in his song, No Plan: “As Mack said, there will be darkness again”. This naming found its way into the Wikipedia entry for Mack, the pair met in 2019 after one of his concerts and tweeted excitedly about the encounter, and so the conversation has continued on Twitter and by other means, continually amplifying Mack’s thesis. In her book, *The end of everything (astrophysically speaking)* [2020], she returned the compliment to Hozier, by quoting him. Thus, we find science communication as conversation where there are no science communicators, self-designated or not.

Conversation also emphasises long-term continuity in science communication: conversazione (in the Italian form) was a widely used designation in the 19th century for public displays, demonstrations and explanations of current science mounted by scientific societies for the enlightenment and entertainment of their expanding publics. Further back in history, Robert Hooke’s *Micrographia* [1665], a book of sixty illustrations mostly drawn from observations at the microscope, was originally designed to include in the conversation King Charles II, who was expected to pay a visit to the Royal Society; his Majesty could obviously not be asked to sit together with the fellows and look into the microscope [Nicolson, 1956].

(A)A different kind of conversation over time can be seen in the trajectory of pictures of the dodo bird painted by the 17th-century Flemish painters Roelant and Jan Savery about the time when the last living exemplar was seen in Mauritius. Two centuries later, mathematician and writer Charles Dodgson (pseudonym, Lewis Carroll) introduced the bird as a character in *Alice's adventures in Wonderland* [1865]. He was likely inspired by a Savery image of a dodo that he had seen in Oxford in guiding his illustrator, John Tenniel. In the same period naturalist Richard Owen [1866] was figuring out how to reconstruct fossil remains of a dodo sent to him at the British Museum and used Roelant Savery's paintings as a source. Three years later, Owen acknowledged he had been misled by such paintings to represent the dodo as 'squat and overly obese', but by then the image of the clumsy and funny dodo had stuck. We see here an interesting conversation loop from images in art influencing science and literature and settling in popular culture.

A characteristic of conversation articulated in communication studies and philosophy is that it is unpredictable and open-ended; we are also adopting deliberately this characteristic. Franco-Moroccan philosopher Ali Benmakhlouf [2016] stresses this, drawing insights from *Alice's adventures in Wonderland*, which features many false starts and misunderstandings in conversations. (B)Ideas, information or images from and about science can spread widely, as one conversation opens another: in the process, the ideas, information and ideas inevitably acquire new meanings. This process does not always or only depart from and return to science, its actors and its institutions; it swirls in society somewhat independently, and with interruptions, and that is what we intend to capture with the preposition, *around*, in our definition of science communication as the social conversation around science.

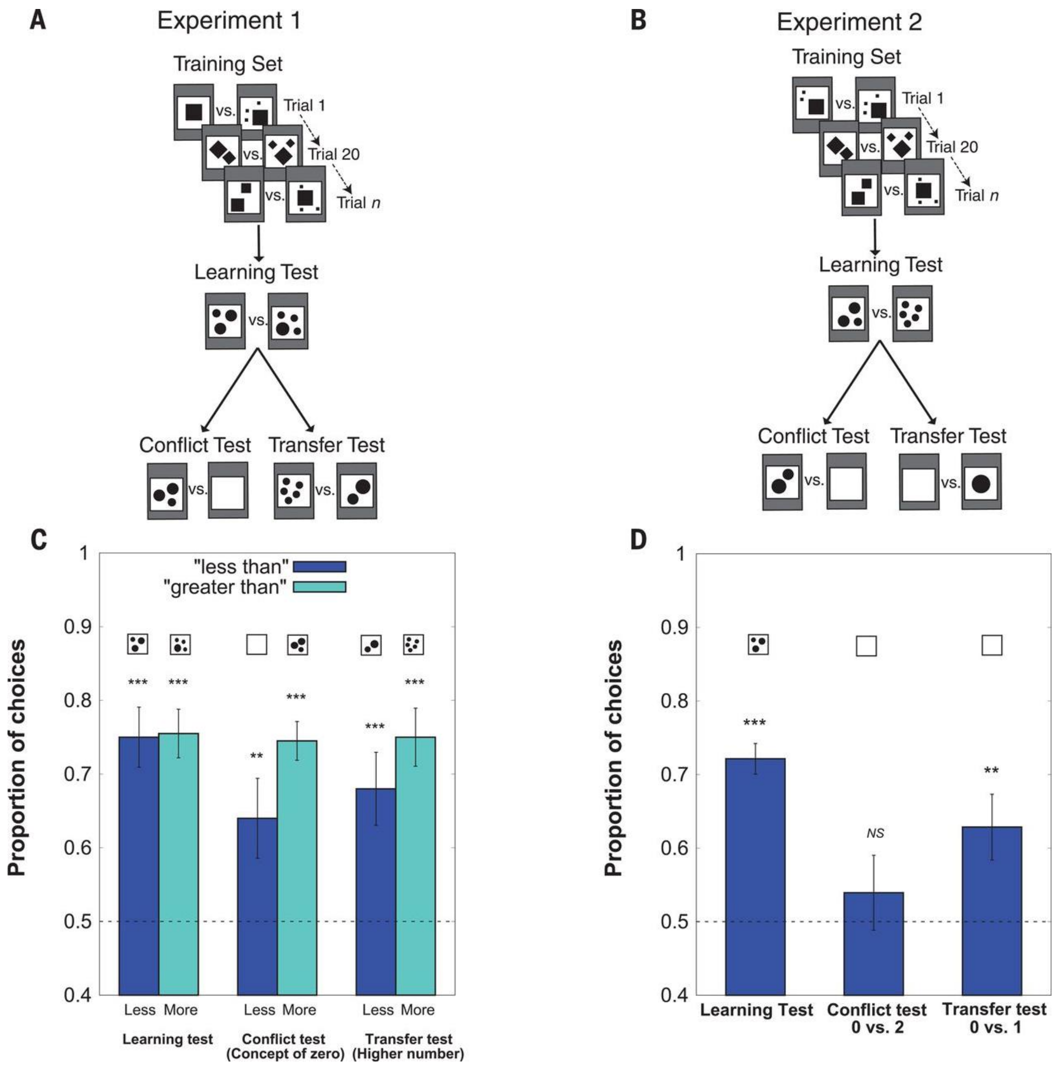
問題 2.　以下は、ミツバチの数概念に関する研究記事の一部です。これを読んで、あとの設問に答えなさい。

Honey bees have previously demonstrated the capacity to count and discriminate up to four objects in experiments that use classic conditioning techniques. Recent advancements in conditioning protocols reveal that bees can acquire rule-based relational concepts, thus enabling remarkable plasticity to acquire and apply seemingly advanced concepts such as size ordering. (A)<u>In this study, we tested the capacity of honey bees to extrapolate the acquired concepts of “greater than” and “less than,” as shown in primates, and thus formally demonstrate that an invertebrate can understand the concept of zero numerosity.</u>

We designed a set of experiments to test the extent to which honey bees may understand the concept of zero numerosity. (B)<u>In the first experiment,</u> we trained bees to understand the concepts of less than and greater than using appetitive-aversive differential conditioning. Bees were trained to the respective concepts using white square stimuli containing one to four black elements (**Fig. 1A**, fig. S1, and table S1). After reaching a criterion of ≥80% accuracy, bees demonstrated in nonreinforced tests that they had learned the concept of “numerically less” and “numerically greater” when presented with novel stimuli of one to four elements. Furthermore, bees were able to apply these concepts to determine that five elements were greater than two or three elements. Interestingly, bees demonstrated an understanding that zero numerosity lies at the lower end of the numerical continuum by choosing an “empty set” stimulus containing no elements if trained to less than (64.0 ± 5.4%; z score = 2.795, P = 0.005, n = 10; **Fig. 1C**) or by choosing unfamiliar stimuli containing elements if trained to greater than (74.5 ± 2.6%; z score = 6.609, P < 0.001, n = 10; **Fig. 1C**).
In the second experiment, we tested the extent to which bees may understand the quantitative concept of zero in comparison with other animals. (C)<u>As some animals find it challenging to differentiate between the numbers zero and one,</u>

we trained bees to less than using stimuli containing two to five elements and then tested their ability to differentiate between the unfamiliar numerosities of one and zero (**Fig. 1B**). After reaching a criterion of ≥80% accuracy, bees demonstrated the learned concept of numerically less when presented with the numbers two to five (73.8 ± 1.9%; z score = 10.18, $P < 0.001$). When presented with the unfamiliar numbers of one versus zero, bees chose the lower number of zero (63.0 ± 2.9%; z score = 4.23, $P < 0.001$; **Fig. 1D**), showing an understanding that an empty set is lower than one, which is challenging for some other animals.

(excerpt from, Howard, Scarlett R., et al. (2018) Numerical ordering of zero in honey bees, *Science*, vol. 360, Issue 6393, pp. 1124-1126.)



［設問］

(1)　下線部(A)を日本語に訳しなさい。

(2)　下線部(B)（第一の実験）の内容を日本語で要約しなさい。

(3)　下線部(C)を日本語に訳しなさい。