Readings in Science

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最新科学と人の今を読む

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NAN'UN-DO

Readings in Science

by
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Unit 1　Babies learn to babble like birds learn to sing

Karen Ravn, 29 May 2013

Research challenges theory of innate vocal abilities[1]. Researchers have found similar patterns in the ways human babies and songbirds learn their vocalizations[2].

[Key Words & Phrases] psychology, language acquisition, learning pattern, innate sequencing theory, babies, songbirds, bubbling, singing, syllables, cross-species, etc.

[1] innate vocal abilities: 生まれつきの能力音声能力。innate は「生まれつきの」,「生得の」「先天的な」を意味し, learned「生後学習された」に対する概念。　[2] vocalization: 発声

Babies learn to babble[3] before they learn to talk, at first simply repeating individual syllables (as in ba-ba-ba), and later stringing[4] various syllables together (as in ba-da-goo). Songbirds exhibit[5] similar patterns during song-learning, and the capacity for this sort of syllable sequencing[6] is widely believed to be innate, and to emerge full-blown[7] — a theory that is challenged by a paper published on *Nature*'s website today[8]. A study of three species — zebra finches[9], Bengalese finches[10] and humans — reports that none of the trio has it that easy. Their young all have to learn how to string syllables together slowly, pair by pair.

"We discovered a previously unsuspected[11] stage in human vocal development," says first author Dina Lipkind, a psychologist now at Hunter College in New York.

The researchers began by training young zebra finches (*Taeniopygia guttata*) to sing a song in which three syllables represented by the letters A, B and C came in the order ABC–ABC. They then trained the birds to sing a second song in which the same syllables were strung together in a different order, ACB–ACB.

Eight out of seventeen birds managed to learn the second song, but they did not do so in one fell swoop[12]. They learned it as a series of syllable pairs, first, say, learning to go from A to C, then from

C to B and finally from B to A. Forthermore, they didn't do it overnight, as the innate-sequencing theory predicts. Instead, on average, they learned the first pair in about ten days, the second in four days, and the third in two days.

The researchers found evidence of similar learning patterns in untrained Bengalese finches (*Lonchura striata domestica*). For instance, in this bird's songs, some syllable pairs are reversible[13] — sometimes syllable A comes before syllable B and vice versa. Again, the innate-sequencing theory predicts that young birds should acquire[14] both orders at the same time, but they do not. When the scientists tracked the development of seven such pairs, they found that the birds acquired the two orders an average of about 18 days apart.

Babble on

Perhaps most surprisingly, the study found evidence that human babies follow a similar learning pattern. When the researchers analysed databases of vocal recordings from nine infants, they found that their well-known babbling progression — from repeating the same syllable to stringing different syllables together — did not happen quickly, but occurred gradually, over a period of 20–30 weeks.

"The study provides beautiful evidence of stepwise[15] transitions in songbirds, as well as analyses that are suggestive of[16] the same phenomenon in human infants," says Michael Frank, a language-acquisition[17] researcher at Stanford University in California. But he cautions that the hypothesis for babies should be tested experimentally.

Michael Goldstein, a psychologist who heads a bird and baby lab at Cornell University in Ithaca, New York, questions whether the learning patterns exhibited by the finches can even be generalized across the species' tuneful[18] relatives. "There's no such thing as a generic[19] songbird," he says. He also points out that the study used only small sample sizes.

Goldstein is also heartened by the study's cross-species[20] comparisons. "A lot of people talk about the parallels[21] between birds and babies," he says, "but very few actually study them. It's good that they've done this."

[3] babble: 喃語を言う，バブバブ言う　[4] string together: ～を一列につなぎ合わせる　cf. 名詞 = ヒモ，一列，過去形・過去分詞形 = strung　[5] exhibit: 示す　[6] sequencing: シーケンス，順序に並べること　cf. sequence: 順番に並べる　[7] full-blown: 完全に成熟した，満開の　[8] See Lipkind, D. et al. Nature http://dx.doi.org/10.1038/nature12173 (2013).　[9] zebra finches: キンカチョウ　[10] Bengalese finches: ジュウシマツ　[11] unsuspected: 思いも寄らない，気がつかなかった　[12] in one fell swoop: 突然 = all at once　cf. fell: 鋭い，急な；swoop　掴む事　[13] reversible: 逆にできる，裏にできる　[14] acquire: 習得する　cf. acquire language = 言語を習得する，名詞 = acquisition　[15] stepwise: ステップ的には　cf. –wise を名詞につけると「～的には」という副詞になる。money + -wise (money-wise) = 金銭的には　[16] suggestive of: ～を示唆する　[17] language-acquisition: 言語習得　[18] tuneful: 音楽的な　[19] generic: 総称の，一般的な cf. a generic songbird: ソングバードと総称できる（一般化できる）もの，generic drugs = 会社名を特定せずに売られる薬　[20] cross-species: 異種間　[21] parallel: 類似

Exercise 1 Answer the following questions.

[1] According to the article, which one of the following statements is correct?

(1) Babies first repeat syllables and then string them together.
(2) Babies repeat syllables before they babble.
(3) They string syllables together before they babble.

[2] According to the article, which one of the following statements is wrong?

(1) Babies already know at birth how to string syllables together.
(2) The innate theory of sequencing syllables is wrong.
(3) Zebra finches and Bengalese finches must learn how to sequence syllables.

[3] Fill in the following blank space with the most appropriate expression. "Some scholars believe that language is _____, not learned after birth."

(1) innate (2) challenged (3) strung

[4] How did Lipkind and her colleagues train young zebra finches?

(1) The birds first learned to sing a song with three syllables in a certain order, and then another song with the same syllables in a different order.
(2) The bird learned to sing the two different songs with six different syllables in the same order.
(3) The birds learned to sing two different versions of the ABC song by changing the order of the three letters.

[5] How did the young zebra finches learn the two songs used in Lipkind's experiment?

(1) They had to spend much time and effort to learn the second song as a series of syllable pairs.
(2) They spent much less time and effort than Lipkind had thought to learn both songs as a series of syllable pairs.
(3) They learned the second song quite easily by separating all syllables into pairs, as the innate-sequencing theory predicts.

[6] Fill in the following blank. "If sequencing syllables is _____, the birds did not have to spend so much time and effort to learn a song in which the same syllables were put together in a different order."

(1) innate (2) not innate (3) on average

[7] Which one of the following statements does not reflect Lipkind and her colleagues' finding on untrained Bengalese finches?

(1) The birds learned two syllables A and B at the same time.
(2) The birds learned either syllable A first and then syllable B or syllable B first and then syllable A, not both at the same time.
(3) The birds spent a lot of time to acquire the two orders, which disproves the innate-sequencing theory.

[8] Which one of the following statements is closest to the piece of evidence Lipkind claims to reject the innate-sequencing theory?

(1) With human babies' babbling, progression from repeating the same syllables to stringing different syllables together takes over 20 days.
(2) Human babies' well-known babbling progression follows a pattern similar to songbirds' but happens very quickly.
(3) Human babies repeat the same syllables well over a period of 20-30 weeks before stringing them together.

[9] Michael Frank:

(1) thinks that Lipkind needs more experiments in order to apply the evidence of stepwise transition in songbirds to human babies' babbling.
(2) agrees that the evidence of the stepwise transitions in songbirds can be applied to human babbling.
(3) rejects both Lipkind's evidence of stepwise transition in songbirds, and her evidence of the same phenomenon in human infants.

[10] Michael Goldstein:

(1) casts doubt on Lipkind's study because it generalizes finches' learning pattern across other species', and the samples used were too limited.
(2) questions whether the species' tuneful relatives can be generalized as generic songbirds.
(3) points out that Lipkind's study has proved that there is no such thing as a generic songbird.

[11] Goldstein, however ...

(1) finds Lipkind's research very significant because it examines similarities among different species.
(2) is heartened by talk about parallels between birds and babies.
(3) says that it's good that babies and birds actually have those parallels.

[12] Which one of the following statements best reflects the article's conclusion on Lipkind's research?

(1) More experiments on both human infants and birds are necessary to prove her findings.
(2) Based on many false assumptions, her research does not prove anything at all.
(3) Cross-species comparisons shouldn't be used because they are still unproven.

Exercise 2 Choose the correct word or expression to best complete each sentence.

[1] Babies _____, but may be trying to say something.

(1) babble (2) acquire (3) swoop

[2] Whether or not language is an _____ ability is a difficult question.

(1) innate (2) analyzed (3) exhibited

[3] She spent her school days without knowing her _____ talent for music.

(1) unsuspected (2) overnight (3) reversible

[4] Researchers tried to _____ pieces of information.

(1) string together (2)caution (3)occur

[5] I got all my Christmas shopping done _____.

(1) in one fell swoop (2) experimentally (3) pair by pair

[6] Education _____, information communication technology (ICT) has brought much change.

(1) –wise (2) parallel (3) patterns

[7] I seem to have _____ two copies of this book by mistake.

(1) acquired (2) generalized (3) heartened

[8] Greetings are a _____ behavior among all animals.

(1) cross-species (2) on average (3) caution

[9] His manner was _____ of an ancient warlord.

(1) suggestive (2) untrained (3) similar

[10] The new engines had a _____ problem with their fans.

(1) generic (2)tuneful (3) full-blown

Exercise 3 Further research

[1] Expand and update the research mentioned in this article.

(1) Read one of the related stories listed below.

(2) Try to find and skim one or two related stories in the latest *Nature News & Comment (http://www.nature.com/news/)* or other literature.

[Related stories]

(1) Babies' brains may be tuned to language before birth
(http://www.nature.com/news/babies-brains-may-be-tuned-to-language-before-birth-1.12489)

(2) Why tongue twisters are hard to say
(http://www.nature.com/news/why-tongue-twisters-are-hard-to-say-1.12471)

(3) Finches learn even when practice isn't perfect
(http://www.nature.com/news/finches-learn-even-when-practice-isn-t-perfect-1.10675)

[2] What do you think of the research? Write a short essay in English.
(200 words)

Exercise 4 Practice English math terms.

Learn how to pronounce each of the following terms used in graphs, charts and figures.（グラフ、チャート、図等の読み方）

[1] bar graph ／ bar chart（棒グラフ）

[2] line graph（折れ線グラフ）

[3] pie chart ／ circle chart（円グラフ）

[4] bar graph（帯グラフ）

[5] distribution（分布図）

[6] histgram（柱状グラフ）

[7] title（表題）

[8] item（項目）

[9] row（行）

[10] column（列）

[11] cell(s)（セル）

[12] unit（単位）

[13] segment(s)（円グラフの各部分）

[14] bar（棒グラフの棒）

[15] straight line（直線）————

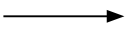
[16] curve（曲線） 

[17] solid line（実線）————

[18] broken line（破線）－ － － －

[19] dotted line（点線）••••••••••••

[20] undulating line（波線）

[21] fluctuating line（変動線） 

[22] origin（原点）

[23] x-axis（X 軸）

[24] y-axis（Y 軸）

[25] The horizontal/first axis（横軸）

[26] The vertical/second axis（縦軸）

Unit 2　It's not just Fukushima: Mass disaster evacuations challenge planners — [1]

David Biello, 05 March 2012

The Fukushima evacuation zone raises the issue of what would happen during an evacuation[1] in heavily populated US metropolises during a nuclear meltdown. More than 180 million people live within 50 miles of a nuclear power plant in the US — the radius[2] the US suggested (residents) be evacuated during the nuclear crisis at Fukushima Daiichi.

Being twice as long as most other essays compiled in this textbook, this essay was cut half to be covered in Unit 2 and Unit 3.

[Key Words & phrases] nuclear accident, disasters, physics, medicine, evacuation, policy, society/community, living, etc.

[1] evacuation: 避難，cf. evacuate: 避難する　[2] radius: 半径，半径範囲

On March 11, 2011, Japan suffered a massive[3] earthquake and subsequent[4] tsunami that destroyed roads, bridges, and buildings; killed nearly 16,000 people; and critically[5] disabled three reactors[6] at the Fukushima Daiichi nuclear power plant. By March 12, the U.S. Nuclear Regulatory Commission (NRC)[7] was already considering urging[8] Americans within 50 miles of the stricken nuclear reactors to evacuate, given[9] an explosion in Unit 1[10] that destroyed the reactor building and exposed[11] spent[12] nuclear fuel and other radioactive materials[13] into the air.

"If this happened in the U.S., we would go out to 50 miles," said Bill Borchardt, NRC executive director for operations[14] on March 17, according to transcripts[15] of the days following the catastrophe[16]; "That would be our evacuation recommendation[17]."

In fact, in the U.S., more than four million Americans live within 10 miles of the 63 of nuclear power plant sites with at least one operating[18] reactor, according to data compiled[19] by the NRC based on the 2000 census.[20] That number swells[21] when the radius extends outward to[22] 50 miles, to affect[23] more than 180 million Americans, and includes major metropolitan areas such as New York City, Philadelphia, San Diego and even West Palm Beach, Fla[24].

In the wake of[25] the meltdowns in Japan, and subsequent evacuations, could all these people in the U.S. be evacuated or take some form of protective action in time[26] in similar circumstances?

Planning for the worst

Nuclear power plants are surrounded by two "emergency planning zones[27]" developed out of accident analyses conducted[28] in the 1960s and 1970s: a roughly 10-mile radius around the plant that must anticipate[29] being exposed to[30] a radioactive plume[31], and a roughly 50-mile radius around the plant that must prepare for possibly being exposed to radioactive particles[32] that drop out of a plume. "Neither[33] are zones that are fixed, and that is the absolute boundary[34]," explains the NRC's Patricia Milligan, the senior technology advisor for preparedness and response in the Office of Nuclear Security and Incident Response[35]. "We don't expect that nuclear power plant operators would stop taking action because it's at 10.5 miles. The plans are built so that 10 miles provides a reasonable basis, and if you need to expand[36], you could."

That is exactly what happened in the case of Fukushima. Just hours after[37] the tsunami on March 11, the Japanese government ordered an evacuation of those living within three kilometers of the stricken[38] nuclear reactors, and suggested those living within 10 kilometers stay indoors with the windows closed. As the situation progressively[39] worsened and radiation hot spots were discovered farther afield[40], the Japanese government expanded the evacuation order.

The goal in the zones prescribed[41] by U.S. regulations is to avoid any radiation doses[42] that exceed[43] the U.S. Environmental Protection Agency's "protective action guidelines"[44] for exposure[45] to a plume of radioactive material being released from a nuclear power plant. The U.S. rules note that evacuation, or sometimes getting indoors "should normally be initiated[46] at one rem[47]," or 10 millisieverts[48]. (A rem is a dosage unit[49] of x-ray and gamma-ray radiation exposure.) Workers within a nuclear power plant can receive doses of up to 50 millisieverts per year. It takes immediate[50] exposure to as much as two sieverts[51] of radiation to cause sickness straightaway[52].

As bad as it's gotten

Rulemaking is based on the best available data. So what has been learned from previous close calls[53] from nuclear and nonnuclear incidents alike? On March 28, 1979, the nuclear power plant at Three Mile Island in Pennsylvania[54] suffered a partial meltdown that led to the release of radioactive materials. In the fog of confusion[55] that surrounded the event, Pennsylvania government officials advised children and pregnant women within a five-mile radius of the facility to leave. That radius of evacuation ultimately[56] extended some 20-miles around the plant, although the majority of local residents did not evacuate. Those who stayed were urged to remain indoors, and farmers were urged to shelter their animals and feed them stored food.

In the end, despite the partial meltdown and release of radioactive material, numerous studies have found limited or no health effects. But the worst accident in U.S. commercial nuclear power history did point out flaws[57] in evacuation planning. "Three Mile Island was a very enlightening[58] accident in terms of[59] how an accident progresses," Milligan notes.

First and foremost[60], it became clear that nuclear accidents to date, including Fukushima, are slow-moving affairs. In the case of Fukushima, there were at least 14 hours between the loss of electricity to power[61] the pumps keeping cooling water on the nuclear fuel, and a melt down. In nonnuclear emergencies, such as the release of toxic gases[62], only minutes may pass before catastrophe[63] hits. "When there are conditions immediately dangerous to life and health, you don't have hours, you have significantly[64] less time than that to get people out of the way of chlorine gas or a wildfire," Milligan says. Nuclear accidents also tend to affect a much smaller area than, for example, a major hurricane like Katrina[65] that covered a swath[66] of territory 400 miles wide, and caused approximately[67] two million people to evacuate Alabama, Louisiana and Mississippi coastal areas. "Evacuations can occur very effectively and very quickly in this country," Milligan adds. (To be continued in Unit 3.)

[3] massive: 巨大な [4] subsequent: 引き継いでくる [5] critically: 危機的に，深刻に，重篤に [6] reactor: 原子炉 [7] Nuclear Regulatory Commission (NRC): 原子力規制委員会 [8] urging~ to: urge ~ to, ～することを強いる [9] given: ～を仮定すると，～があるとすれば [10] Unit 1: 第一原子炉 [11] exposed: 露出した，野ざらしの [12] spent: 使用済みの [13] radioactive materials: 放射線物質 [14] http://www.nrc.gov/reading-rm/doc-collections/cfr/part001/part001-0032.html [15] transcript: 記録，調査書 [16] catastrophe: 災害 [17] evacuation recommendation: 避難勧告 [18] operating: 稼働中の，cf. operate: 稼働する [19] compiled: 編纂された，cf. compile: 編纂する [20] census: 調査 [21] swell: 膨らむ [22] extend outward to: 外側に～まで延長する，cf. to: ～まで [23] to affect: その結果影響を与える，cf. affect: 影響を与える，to affect: 結果的用法の不定詞 [24] West Palm Beach, Fla: フロリダ州海岸沿いの観光都市，cf. Fla: Florida [25] in the wake of: ～をうけて [26] in time: 間に合うように cf. protective action in time: 間に合う防護行動 [27] emergency planning zones: NRC が定める原発事故緊急非難区域，http://www.nrc.gov/about-nrc/emerg-preparedness/about-emerg-preparedness/planning-zones.html [28] conducted: 実施された，cf. conduct: 実施する [29] anticipate: 見込む，期待する [30] be exposed to: ～にさらされる，cf. expose A to B: A を B にさらす [31] radioactive plume: 放射性プリューム，放射能雲，cf. plume: 雲，ガス状の物 [32] particles: 分子，粒子 [33] neither: ここでは Neither a roughly 10-mile radius (around the plant) nor a roughly 50-mile radius の意味 [34] the absolute boundary: 絶対的境界線 [35] The Office of Nuclear Security and Incident Response: US NRC 内で原子力施設の安全に関する技術的事案の評価を司る部署。http://www.nrc.gov/about-nrc/organization/nsirfuncdesc.html [36] expand: 広げる [37] just hours after: まさに～の何時間後 [38] stricken: 打撃を受けた [39] progressively: 刻々と [40] farther afield: さらに遠くで [41] prescribed: 規定された [42] radiation doses: 放射線量 [43] exceed: 越える [44] http://www.epa.gov/rpdweb00/docs/er/pag-manual-interim-public-comment-4-2-2013.pdf [45] exposure: 被爆，cf. expose の名詞形 [46] initiated: 開始された，cf. initiate: 始める，開始する [47] rem: レム，cf. 1 レムは 1.07185 レントゲン [48] millisieverts: ミリシーベルト [49] a dosage unit: 計量単位 [50] immediate: 瞬間的な [51] sievert: シーベルト [52] straightaway: 直ちに [53] close call: 危機一髪 [54] Three Mile Island: 1979 年 3 月 28 日アメリカ東部スリーマイル島原子力発電所事故。 [55] confusion: 戸惑，困惑，cf. confuse: 戸惑わせる，困惑させる [56] ultimately: 最終的に，結局 [57] flaw: 欠陥 [58] enlightening: 啓発的な [59] in terms of: ～と言う意味で [60] foremost: 真っ先に [61] power: ～に動力を与える [62] toxic gases: 有毒ガス [63] catastrophe: 天災，災害 [64] significantly: かなり，大きく [65] Katrina: 2008 年 5 月アメリカを襲った最大級のハリケーン・カトリーナ。 [66] swath = area [67] approximately: 大方，約

Exercise 1 Answer the following questions.

[1] What were heavily damaged at Fukushima Daiichi nuclear plant by the earthquake and the tsunami on March 11, 2011?

(1) Its bridges. (2) Its three reactors. (3) Its roads.

[2] By March 12, 2011, the U.S. NRC made a decision to direct Americans living within 50 miles from the reactors to evacuate ...

(1) if an explosion in Unit 1 happened to destroy the reactor building.
(2) before an explosion in Unit 1 destroyed the reactor building.
(3) as soon as the tsunami struck the nuclear power plant.

[3] NRC executive director for operation must have transcribed all the happenings and decisions made after

(1) the catastrophe. (2) evacuation. (3) Unit 1.

[4] How many sites of nuclear power plants in the US have at least one operating reactor in 2000?

(1) About 50. (2) About 10. (3) About 60.

[5] What is the author's worry if the meltdowns occurred in the US?

(1) There will be 4 million to 180 million Americans who must evacuate, depending on the radius, ranging from 10 miles to 50 miles from the reactors.
(2) There are 63 nuclear plants near major metropolitan areas such as New York City, Philadelphia, San Diego and West Palm Beach.
(3) Unlike people in Japan, 180 million people near the nuclear plants, may not be willing to evacuate in time in the wake of similar meltdowns.

[6] What is meant by "Neither are zones that are fixed and that is the absolute boundary"?

(1) There are no plans that provide a reasonable basis for a roughly 10 mile-radius, so that you could expand it up to 50 miles.
(2) It is impossible to draw a clear line between areas that are affected by radioactive plumes or particles and those that are not affected by them.
(3) Neither a roughly 10-mile radius around the plant nor a roughly 50-mile radius around it is sufficient for preparedness.

[7] What is the goal in the zones prescribed by U.S. regulations?

(1) To protect U.S. citizens from exposure to radiation doses higher than the protective action guidelines.
(2) To either evacuate people or direct them to stay indoors in order to avoid any radiation doses.
(3) To protect workers within a nuclear plants from receiving radiation doses of 50 millsieverts per year, which instantly causes sickness.

[8] On what is rulemaking for "protective action guidelines" ?

(1) It should be based on the best available data learned strictly from nuclear incidents.
(2) It should be based on both previous nuclear and nonnuclear incidents.
(3) The data learned from the meltdown at Three Mile Island should be omitted since it was only a partial meltdown.

[9] Choose a statement <u>not</u> mentioned in the article concerning the nuclear incident at Three Mile Island.

(1) Pennsylvania government officials recommended that children and pregnant women within a five-mile radius of the plant should leave.
(2) Either no or highly limited health effects have been reported despite the fact that most local residents remained home.
(3) As soon as the radius of evacuation extended 20-miles, the majority not all, of local residents evacuated.

[10] What could be a flaw in the evacuation planning pointed out by the nuclear plant accident at Three Mile Island?

(1) There was no definite evacuation planning that suited the progress and expansion of the Three Mile Island accident.
(2) Pennsylvania government officials did not give enough time for the residents to evacuate when they extended the radius of evacuation from 5 miles to 10 miles.
(3) Pennsylvania officials did not report how numerous studies had pointed out only limited or no health effects despite the partial meltdown and release of radioactive material.

[11] What did officials in the U.S. Environmental Protection Agency learn from the Three Mile Island accident?

(1) How enlightening the accident was.
(2) How an accident goes.
(3) How a partial meltdown progresses.

[12] Which one of the following statements is not mentioned in the article?

(1) Compared to an emergency such as a nuclear meltdown, you have much more time to evacuate.
(2) Little time is allowed for evacuation in the case of the release of toxic gases.
(3) The area to be evacuated for a hurricane is much wider than for a nuclear meltdown.

Exercise 2 Choose the correct word or expression to best complete each sentence.

[1] Fire department officials _____ the residents living nearby to quickly evacuate.

(1) exposed (2) urged (3) compiled

[2] _____ the fact that he's had six months to do this, he hasn't made much progress.

(1) given (2) straightaway (3) according to

[3] The _____ rocket fell somewhere near the launch site in the Pacific.

(1) transcribed (2) prescribed (3) spent

[4] The greater Tokyo area has extended _____ to more than 100 km.

(1) outward (2) approximately (3) afield

[5] Airport security was extra tight _____ yesterday's bomb attacks.

(1) in the wake of (2) as a result of (3) of course

[6] This medicine label says that one _____ should be taken three times a day.

(1) noble gas (2) dose (3) puff

[7] The _____ of this machine is well over 40cm.

(1) radius (2) plume (3) rem

[8] The ready _____ of guns in major cities in the USA escalates violence.

(1) flaw (2) confusion (3) availability

[9] A commercial airplane was hit by lightening. It was really a _____.

(1) catastrophe (2) reactor (3) close call

[10] Automobiles _____ by diesel fuel are coming back again.

(1) powered (2) initiated (3) enlightened

Exercise 3 Further research

[1] Expand and update the research mentioned in this article.

(1) Read one of the stories listed below, which focus on the Fukushima nuclear accident on March 11, 2011.

(2) Try to find and skim one or two related stories in the latest *Nature News & Comment* (*http://www.nature.com/news/*) or other literature. Find latest stories related to the massive earthquake, the tsunami, and the nuclear accident on March 11, 2011 in Japan.

[Related stories]

(1) Scientists report back from Fukushima exclusion zone
(http://www.nature.com/news/scientists-report-back-from-fukush ima-exclusion-zone-1.10106)

(2) Fukushima reaches cold shutdown
(http://www.nature.com/news/fukushima-reaches-cold-shutdown-1.9674)

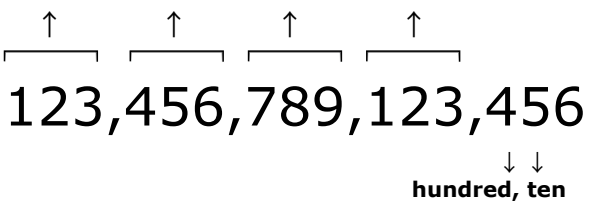
(3) Japan earthquake and nuclear crisis news special
(http://www.nature.com/news/specials/japanquake/index.html)

[2] What do you think of the research? Write a short essay in English.
(200 words)

Exercise 4 Practice English math terms.

Following the examples, write out each number.（**Large Numbers** 大きな数）

The numerical units → **trillion** **billion** **million** **thousand**



[Examples]

134,000 → How many thousands? → One hundred thirty-four thousand.

56,000,000 → How many millions? → Fifty-six million.

278,000,000 → How many millions? → Two hundred seventy-eight million

91,000,000,000 → How many billions? → Ninety-one billion.

22,543,897,150 → Twenty-two billion, five hundred forty-three million, eight hundred ninety-seven thousand, one hundred fifty.

[1] 351,438

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[2] 42,128,571

_____

[3] 6,321,987,405

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[4] 83,926,693,307

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[5] 10,008,034,110,013

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