Android Science

- IN THIS LESSON YOU WILL LEARN HOW TO SKIM A TEXT BY READING HEADINGS, ABOUT DEVELOPING HUMANOID ROBOTS, AND HOW TO USE APPOSITIVES.

Before You Read

I *Answer the following questions.*

1. What else do you know about robots, besides what you read in the previous lesson?
2. If you designed a robotic toy, what types of functions would you include? Give other details of your dream robotic toy.
3. How much can a robot resemble a human being in terms of emotions?

II *Reading Skills and Strategies—Skimming a Text by Reading Headings*

In the previous lesson, you learned how to skim thesis statements and topic sentences in the reading. In this lesson, you are going to learn to skim a reading by using the headings.
You will often see headings (or subtitles) in English articles. By skimming and following these you can easily get the overall idea or organization of the article, which helps you when you want to read in more detail later.

Skim the article and find the headings. Write down the headings in this article and the main ideas of each heading. The first two headings have been written down for you. Please complete the chart below.

Heading	Main Idea
Humanoids and Androids at the 2005 World Exposition	
Ishiguro and His Approach to Creating Androids	
_____	

Reading

Android Science

Hiroshi Ishiguro makes perhaps the most humanlike robots around—not particularly to serve as societal helpers but to tell us something about ourselves

Tim Hornyak

Humanoids and Androids at the 2005 World Exposition

At the 2005 World Exposition in Japan's Aichi **prefecture**, robots from laboratories throughout the country were on display. The **humanoids** came in all shapes and sizes: they moved on wheels, walked on two legs, looked like lovable little dolls or fantastic mechanical warriors. All, however, were instantly recognizable as artificial creations. Except one: it had moist lips,
5   **glossy** hair and vivid eyes that blinked slowly. Seated on a stool with hands folded primly on its lap, it wore a bright pink **blazer** and gray **slacks**. For a **mesmerizing** few seconds from several meters away, Repliee Q1 was virtually indistinguishable from an ordinary woman in her 30s. In fact, it was a copy of one.

To many people, Repliee is more than a humanoid robot-it is an honest-to-goodness android,
10   so lifelike that it seems like a real person. Japan boasts the most advanced humanoid robots in the world, represented by Honda's Asimo and other bipedal machines. They are expected to eventually pitch in as the workforce shrinks **amid** the **dwindling** and aging population. But why build a robot with **pigmented** **silicone** skin, smooth gestures and even makeup? To Repliee's creator, Hiroshi Ishiguro, the answer is simple: "Android science."

15   ### Ishiguro and His Approaches in Creating Androids
Director of Osaka University's Intelligent Robotics Laboratory, Ishiguro has a high **furrowed** brow beneath a shock of inky hair and **riveting** eyes that seem on the verge of **emitting** laser beams. Besides the **justification** for making robots anthropomorphic and bipedal so they can work in human environments with architectural features such as stairs, Ishiguro believes that
20   people respond better to very humanlike robots. Androids can thus **elicit** the most natural communication. "Appearance is very important to have better interpersonal relationships with a robot," says the 42-year-old Ishiguro. "Robots are information media, especially humanoid robots. Their main role in our future is to interact naturally with people."

To emulate human looks and behavior successfully, Ishiguro **yokes** robotics with cognitive
25   science. In turn, cognitive science research can use the robot as a test bed to study human

perception, communication and other faculties. This novel cross-**fertilization** is what Ishiguro describes as android science. In a 2005 paper, he and his collaborators explained it thus: "To make the android humanlike, we must investigate human activity from the standpoint of [cognitive science, behavioral science and neuroscience], and to evaluate human activity, we

30   need to **implement** processes that support it in the android."

One key strategy in Ishiguro's approach is to model robots on real people. He began research four years ago with his then four-year-old daughter, casting a **rudimentary** android from her body, but its few actuator **mechanisms** resulted in jerky, unnatural motion. With Tokyo-based robotics maker Kokoro Company, Ishiguro built Repliee also by "copying" a real person—

35   NHK TV newscaster Ayako Fujii--with shape-memory silicone rubber and **plaster** molds. **Polyurethane** and a five-millimeter-thick silicone skin, soft and specially colored, cover a metal skeleton. Given clothing, a **wig** and lipstick, it is a near mirror image of Fujii.

Appearance, though, is only part of human likeness. To achieve smooth upper-body movement in Repliee, Ishiguro equipped it with 42 small, quiet air **servo actuators**. Because a fridge-

40   size external air compressor powers the actuators, locomotion was sacrificed. Similarly, Ishiguro off-loaded most of the android's control elements and sensors. Floor sensors track human movement, video cameras detect faces and gestures, and microphones pick up speech. The result is a surprisingly good. "I was developed for the purpose of research into natural human-robot communication," Repliee says in velvety prerecorded Japanese, raising its arm in

45   instantaneous response to a touch picked up by its **piezoelectric** skin sensors.

The Uncanny Valley

Humanlike robots run the risk of compromising people's comfort zones. Says Ishiguro collaborator Takashi Minato: "Because the android's appearance is very similar to that of a human, any subtle differences in motion and responses will make it seem strange." This

50   negative emotional reaction is known as the "uncanny valley," first described in 1970 by Japanese roboticist Masahiro Mori. Repliee, though, is so lifelike that it has overcome the creepiness factor, partly because of the natural way it moves. [1]

In a land where Sony Aibo robot dogs are treated like family, it is not surprising that the engineering students who work on Repliee daily have developed a special protectiveness

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[1]*One of Ishiguro's android-science experiments demonstrates the importance of movement. He had subjects identify the color of a cloth behind a curtain after it had been pulled back for two seconds. Unknown to participants, Repliee was also behind the curtain, either motionless or exhibiting prelearned "micro movements" that people unconsciously make. When the android was static, 70 percent of the subjects realized that they had seen a robot. But when Repliee moved slightly, only 30 percent realized it was an android.*

55 towards it. Gaze-direction experiments suggest that nonengineers can unconsciously accept androids on a social level, too. In these studies, subjects pausing to consider a thought looked away during conversations with both people and Repliee, leading Ishiguro and his associates to consider that the breaking of eye contact can be a measure of an android's human likeness. They see this as key to eliminating psychological barriers to robots playing everyday roles in

60 society. (Less sophisticated androids are already at work in Japan: Saya, a robot with fewer sensors and limited movement that was developed by Hiroshi Kobayashi of Tokyo University of Science, has been a receptionist in the university's lobby for years.)

"An android is a kind of **ultimate** experimental **apparatus** and test bed," states Ishiguro collaborator Karl MacDorman, who has been examining possible links between the **uncanny**

65 **valley** and fear of death. "We need more of them." Although Ishiguro's **automatons** may even evolve to bipedalism, perhaps ironically, he is sure that androids will never be able to pass for human. There will be no need, say, for the elaborate Blade Runner-type "**empathy** tests." "Two seconds or 10 seconds of confusion is possible, but a whole day is not," Ishiguro remarks. "It's impossible to have the perfect android."

70 Still, he wants his next android, a male, to be as authentic as possible. The model? Himself. Ishiguro thinks having a robot clone could ease his busy schedule: he could **dispatch** it to classes and meetings and then teleconference through it. "My question has always been, Why are we living, and what is human?" he says. An Ishiguro made of **circuitry** and silicone might soon be answering his own questions.

75 Posted in *Scientific American*, June 2006, issue #52

MORE ABOUT ISHIGURO

Although Ishiguro grew up as a typical robot-model-building Japanese boy near Kyoto, he was more interested in philosophical questions about life. Mild colorblindness forced him to abandon his aspirations of a career as an oil painter, and he was drawn to computer and robot vision instead. He built a guide robot for the blind as an undergraduate at the University of Yamanashi, and elements of his later humanoid Robovie went into the design of Mitsubishi Heavy Industries' new household communications robot, Wakamaru. A fan of the android character Data from the Star Trek **franchise**, he sees robots as the ideal vehicle to understand more about ourselves.

After You Read

Answer the following questions.

1. Where did the 2005 World Exposition take place?
2. What does Repliee look like, according to the article?
3. According to paragraph 3, why is appearance important for robots?
4. According to the article, what are the reasons for creating robots that are anthropomorphic and bipedal?
5. In order to emulate human looks and behavior successfully, what did Ishiguro do?
6. What disadvantages did an earlier android that Ishiguro had designed have?
7. What did Ishiguro do to achieve smooth upper-body movement in Repliee?
8. Why would androids cause discomfort to humans? (You may state the reasons provided in the article, as well as state your own ideas.)
9. What is the "uncanny valley"? Who proposed it and when?
10. What do Ishiguro and his associates see as a key to eliminating psychological barriers to robots playing everyday roles in society?

Vocabulary Comprehension

ESP Vocabulary

This vocabulary is commonly used in the field of information technology.

silicone	*n*	a material based on silicon and oxygen that has a variety of useful properties, such as electrical insulation, thermal stability, flexibility, low chemical reactivity and low toxicity. It is often used as a sealant or coating
plaster	*n*	a thick liquid that is spread onto walls and ceilings and then forms a smooth, hard surface
polyurethane	*n*	a groups of plastics that can be rigid or flexible, foams or solid materials. They have a wide variety of uses, such in mattresses, as floor coatings and for packaging
servo	*n*	servo is a device that uses feedback to correct the performance of a mechanism

actuator	n	a mechanical device for controlling a system.
piezoelectric	adj	if a material, such as crystals, ceramics or bone, is piezoelectric, it means that when stress is applied to it then electric potential is produced
automaton	n	a machine, such as a robot, that can operate independently of humans
uncanny valley	n	a theory in robotics: when robots become more like humans there will be a point when hurnan reaction will dip down to negative and then come back up to positive on a graph
circuitry	n	circuitry is the collection of small wires that an electric current flows through in

General Vocabulary

This vocabulary is used for general purposes.

justification	n	a reason why something is correct and morally right
perception	n	a particular way of understanding or thinking about something
implement	v	to put something such as an idea, plan, system, or law into practice
mechanism	n	a method or process for getting something done within a system or organization
ultimate	adj	the final or maximum outcome of an event or activity
prefecture	n	one of the districts into which some countries are divided
humanoid	n	a creature or robot that looks like a human
glossy	adj	shiny in an attractive way
blazer	n	a type of light jacket that is often worn as part of a uniform, for example by schoolchildren or members of a sports club
yoke	v	if people, animals, or things are yoked, or are yoked together, they are connected or joined
slacks	n	another word for pants, similar, but slightly less formal, than the kind that are worn with a suit jacket
mesmerizing	adj	so attractive or interesting that you do not notice or pay attention to anything else around you

amid	*prep*	in the middle of; during
dwindling	*adj*	used to describe the state of becoming gradually less or smaller over a period of time until almost nothing remains
pigmented	*adj*	something that contains or resembles a natural substance that gives color to something, such as paint, skin, or hair
furrowed	*adj*	covered with deep lines
riveting	*adj*	extremely interesting or exciting
emit	*v*	to send something out into the air, especially gas, light, or heat
elicit	*v*	to make someone react in the way that you want
franchise	*n*	a formal agreement for someone to sell a company's products or services in a particular place, in exchange for a payment or part of the profits
fertilization	*n*	the process of fertilizing an egg or a female animal or plant
rudimentary	*adj*	basic, and not detailed or developed
wig	*n*	artificial hair that you wear on your head
apparatus	*n*	the machines, tools, and equipment needed for doing something, especially something technical or scientific
empathy	*n*	the ability to understand how someone feels because you can imagine what it is like to be them
dispatch	*v*	to send someone or something somewhere

Exercise

Fill in the blanks with the most appropriate words from the list below. Pay attention to capitalization and tense and make any necessary changes.

implement	justification	ultimate
perception	riveting	furrowed
elicit	mesmerizing	emit

1. Sam has a _____ brow, which is the most distinctive feature of his face.

2. The story is excellent, _____ stuff.

3. The public's _____ of him is slowly changing.

4. Claire has _____ eyes, which makes her more intense.

5. The question _____ a positive response from 60% of voters.

6. The report states that motorcycles _____ a lot of exhaust fumes and are inefficient with regard to fuel.

7. Attempts to _____ change have met with strong opposition.

8. The incident affected the _____ outcome of the war.

9. There can be no _____ for such rude behavior.

Language Focus

Collocation

*As discussed in the reading, scientists nowadays are able to build robots which have nearly the same appearance as a human. Many **adjectives** are used in this lesson to modify human features such as eyes, lips, skin, hair, and gesture. The table below shows that these four nouns share the same collocation pattern: **Adjective + Noun**. Pay careful attention to the adjectives which frequently follow these nouns.*

Adjective+ Noun

Adjective	Noun	Example
moist pouting warm	lips	Except one: it had **moist lips, glossy hair** and **vivid eyes** that blinked slowly. (Line 4)
glossy inky fine	hair	Director of Osaka University's Intelligent Robotics Laboratory, Ishiguro has a high furrowed brow beneath a shock of **inky hair** and **riveting eyes** that seem on the verge of emitting laser beams. (Line 16)
vivid riveting sparkling	eyes	

pigmented delicate pale	skin	But why build a robot with **pigmented silicone skin**, **smooth gestures** and even makeup? (Line 13)
smooth dramatic symbolic	gesture	

Note: **The alternative adjectives** that collocate with the **targeted nouns** you see above are selected from **JTW** based on their high frequency.

Corpus Tutorial: Just the Word (JTW)

In this section, you are going to review JTW (http://86.188.143.199/JustTheWord/) corpus search introduced in the previous lesson to find out how the nouns stated in the collocation table above are utilized.

1. Go to **JTW** corpus at http://86.188.143.199/JustTheWord/.

2. Type the noun **lips** in the key word box. Then click **SHOW COMBINATIONS**.

3. Click on the collocation pattern **ADJ N*** on the right side of the page and find **pouting lip**.

4. Click on **pouting lip** to see how it is utilized in the sentences.

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  She had the same smouldering eyes and pouting lips, the same tiny waist and big swelling
 placing them provocatively between her pouting lips, she sucked.
 g Hollywood films with vast drawings of pouting female lips, it was all he could do to stop
 y, inviting him unknowingly to kiss her pouting lips.
 well-rounded girl with yellow hair and pouting lips.
                The floppy fringes and pouting lips of the respective lead singers are anc
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Exercise

*Use **JTW** and repeat steps 2-4 to find how collocations below are utilized. Then write a complete sentence for each collocation.*

1. symbolic gesture

   _____

2. sparkling eyes

   _____

3. fine hair

   _____

Language Spot—Appositives

In the previous lesson, you learned about relative clauses. In this lesson, you are going to learn about appositives.

In English writing, relative clauses can be reduced to noun phrases, which are called *appositives*. Like a relative clause, an appositive can be used to modify, or further explain the noun that it precedes.

Look at the following example:

To Repliee's creator, **Hiroshi Ishiguro**, the answer is simple: "Android science."

In this example, the appositive, Hiroshi Ishiguro is enclosed between commas. You may also enclose the appositive between long dashes.

To Repliee's creator—**Hiroshi Ishiguro**—the answer is simple: "Android science."

To *Repliee's creator*, *Hiroshi Ishiguro*, the answer is simple: "Android science."

To *Repliee's creator*, *(who is) Hiroshi Ishiguro*, the answer is simple: "Android science."

Look at another example from this lesson:

Director of Osaka University's Intelligent Robotics Laboratory, Ishiguro has a high furrowed brow beneath a shock* of inky hair and riveting eyes that seem on the verge of emitting laser beams.

*thick, heavy mass

Exercise

1. *Go back and read the article. Find all of the appositives and underline them. Check your answers with your partner.*

2. *Practice writing sentences containing appositives. Create sentences that include the words in this lesson as well as appositives and are somewhat related to the topic of this lesson.*

3. *Go online and find an article entitled "Scientists Send Robots to Charm School." It can be retrieved at the following location: http://www.scientificamerican.com/article.cfm?id=scientists-send-robots-to-charm-school. Read the article and identify and underline the appositives.*

Tasks

I Work in groups. Suppose you are a member of the SOCIOBOTICS team, developing a "social robot," at Osaka University's Intelligent Robotics Laboratory. Now, it's time to show your final product to all the staff members. Draw your robot and present it to the class. Use at least five *appositives* and the words introduced in this lesson in your presentation. You can use *appositives* as much as possible when you present. Use "providing explanations" as the speaking strategy. (Remember: Since this is a "social robot," don't forget to give it some human qualities so that it can interact easily with people.)

Useful Phrases/Vocabulary

MIREA, <u>**the name of our robot**</u>, is interactive and can do complex tasks.

            └──• **appositive**

Shawn, <u>**the robot we have designed**</u>, is an interactive robot with emotions.

appositive •───┘

II In this lesson, an android called *Repliee Q1* was introduced. According to the reading passage, *Repliee Q1* could gesture, blink, and speak like a real woman.

Look at the video of another robot prototype, Repliee Q2, as she interacts with visitors, and waves for the camera. (video website: http://news.nationalgeographic.com/ news/2006/03/0331_060331_robot_video.html)

As you read in this article, the uncanny valley hypothesis states that when robots and other facsimiles of humans look and act almost but not exactly like actual people, it causes a response of revulsion among human observers. The "valley" in question is a dip in the proposed graph of the positivity of human reaction as a function of a robot's lifelikeness.

After you look at the photos and videos above, what do you feel about the robots that look very much like humans? Please share your thoughts with your classmates.

Useful Phrases/Vocabulary

Starter sentences

❏ I think the robots that look exactly the same as humans, are _____

(*strange/mysterious/any other adjectives to describe the robots or what you feel*) because…

❏ In my opinion, the robots, which resemble humans a great deal, are _____

_____(*strange/mysterious/any other adjectives to describe the robots or*

what you feel) in that…