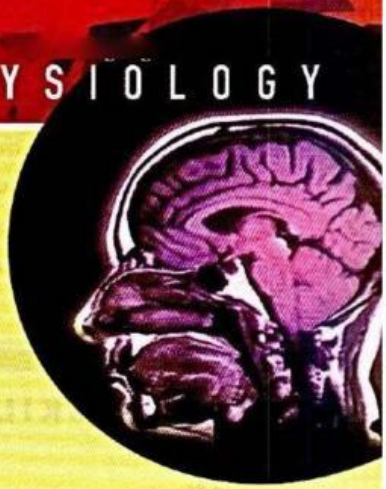
UNIT 1

Mapping the Human Brain



In this unit, you will

- read how scientists of the past tried to learn about the human brain.
- read how modern technology helped scientists learn about the human brain.
- increase your understanding of target academic words for this unit.

READING SKILL Previewing

Self-Assessment

Think about how well you know each target word, and check (✓) the appropriate column. I have...

TARGET WORDS	never seen the word before	seen the word but am not sure what it means	seen the word and understand what it means	used the word, but am not sure if correctly	used the word confidently in *either* speaking *or* writing	used the word confidently in *both* speaking *and* writing
AWL analyze						
average						
behavior						
complex						
AWL create						
AWL function						
link						
locate						
possible						
wonder						

AWL Academic Word List
Oxford 3000™ keywords

Outside the Reading What do you know about physiology? Watch the video on the student website to find out more.

READING 1

Before You Read

In small groups or with the whole class, discuss the following questions.

1. What are some words that describe a person's personality or behavior?
2. Do you ever wonder why certain people behave as they do?
3. Is it possible for a person to change his or her personality?

READING SKILL Previewing

LEARN

Previewing a book or article means scanning it to get a general idea of what it will be about. It allows you to recall what you already know about a topic and what you can expect to learn. Most good readers spend a few minutes previewing before they begin to read academic texts.

APPLY

Work with a partner. Preview Reading 1 by answering these questions.

1. Read the title. Why would anyone need a map of the brain?
2. Look at the words just under the heading "Read" (on this page). Where did the information in the article come from?
3. Do you think this article will be about past or present time? Why?
4. Look at the pictures and the words under them. What information do they give you about the topic?
5. What do you expect to learn from this article?

Read

The information in this article is from a popular science magazine. Use your dictionary to find the meaning of words that you do not know.

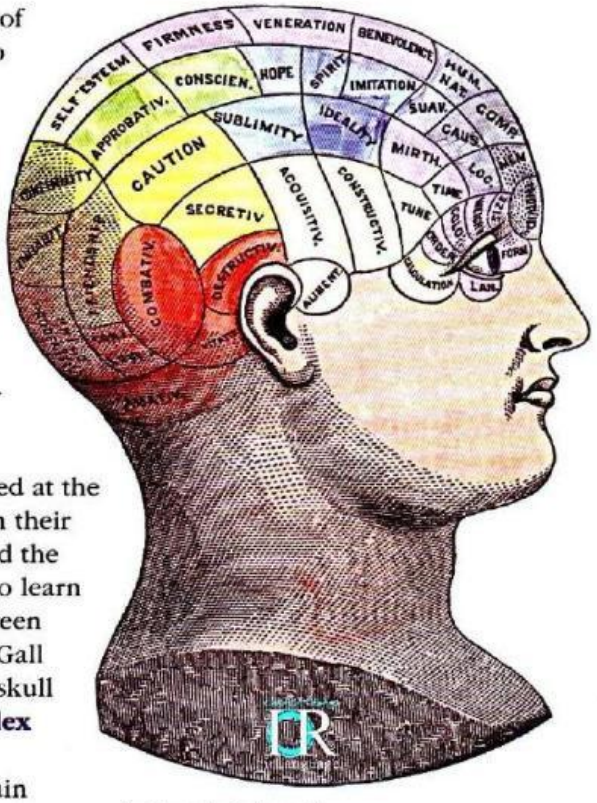
An Early Brain Map

Throughout history, human **behavior** seemed **impossible** to understand. Teachers **wondered** why some students were good at math but other students were not. People **wondered** why one neighbor was friendly but another was unfriendly. Parents **wondered** why one child **behaved** and another caused trouble. In the early 19th century, a German doctor thought he could answer these **complex** questions. His name was Franz Joseph Gall.

A NEW THEORY

Dr. Gall believed that the brain was the source of human **behavior**. He thought it was **possible** to understand human **behavior** if we understood how the brain **functioned**. He believed that each area of the brain was **linked** to a certain **behavior**, such as bravery. Furthermore, Dr. Gall **wondered** if the **functions** of the brain **created** bumps on a person's skull (the skull is the bone around a person's head). If so, a doctor could learn about a person's **behavior** by **analyzing** these bumps. He could **analyze** the location and size of the bumps on the skull. The bumps would tell the doctor about the person's **behavior**.

Dr. Gall began to test this idea. First he looked at the heads of many people. He **located** the bumps on their skulls. He measured these bumps. Then he asked the people questions about themselves. He wanted to learn about their **behavior**. He looked for a **link** between people's bumps and their **behavior**. Finally, Dr. Gall thought he could **link** every bump on a human skull to a certain brain **function**. He **created** a **complex** map of an **average** human head. The map had 27 areas. He labeled each of the areas with a brain **function**. Some of these **functions** were friendship, music, numbers, a love of children, bravery, humor, and memory. Dr. Gall named this mapping of the human skull "phrenology."



A phrenology "map"

THE GROWTH OF PHRENOLOGY

Phrenology **created** great interest around the world. Some people thought Dr. Gall's ideas were **wonderful**. They thought his phrenology map was a scientific way to understand human **behavior**. In fact, some people learned how to read head bumps. They became phrenologists. Customers went to them to have their head bumps **analyzed**. They asked the phrenologists for advice about their lives.

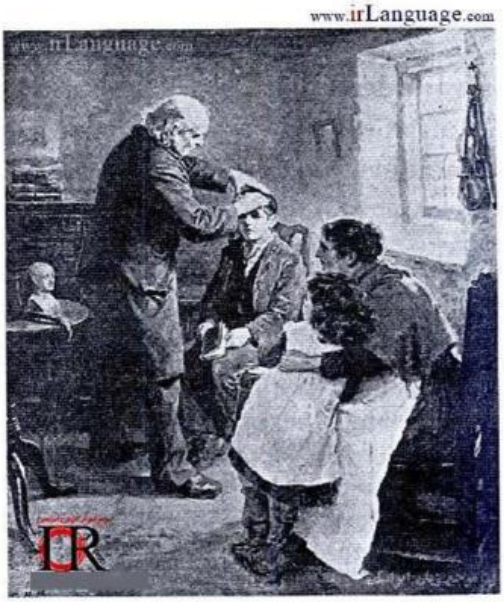
PHRENOLOGY'S CRITICS

In contrast, other people made jokes about phrenology and head bumps. They laughed at Dr. Gall and his ideas. They did not think phrenology was scientific. They said it was **impossible** to know a person's personality by **analyzing** head bumps.

In the early 20th century, the study of human **behavior** became important to scientists. They learned that head bumps could not explain how people behaved. They looked for other explanations. Soon everyone agreed that phrenology was not a science after all. It was only one man's attempt to understand human **behavior**. ■

Phre-nol′o-gy (-nŏl′ə-jē), *n.* **1.** Science of the special functions of the several parts of the brain, or of the supposed connection between the faculties of the mind and organs of the brain. **2.** Physiological hypothesis that mental faculties, and traits of character, are shown on the surface of the head or skull; crainiology. — **Phre-nol′o-gist,** *n.* — **Phre-nol´o-log′ic** (fren´o-lojik), **Phren´o-log′ic-al,** *a.*

An early definition of phrenology



A phrenologist analyzing head bumps.

Reading Comprehension

Mark each sentence as *T* (True) or *F* (False) according to Reading 1.

T 1. Dr. Gall believed that the brain was the source of human behavior.

___ 2. He thought it was possible to understand behavior by measuring the human brain.

___ 3. He wondered if people would laugh at his ideas.

___ 4. He looked for a link between the size of a person's head and his behavior.

___ 5. Dr. Gall created a complex map of an average human head.

___ 6. The map showed the location of 27 brain functions.

___ 7. Customers went to phrenologists to have their head bumps analyzed.

Vocabulary Activities STEP I: Word Level

A. **Work with a partner. Use the words below to complete the story. Use the words in parentheses (...) as clues.**

analyze	behavior	created	linked	possible
average	complex	functions	located	wondered

In the early 19th century, phrenology (1) created (started) great interest among (2) _____ (typical) men and women. They visited phrenologists because they (3) _____ (wanted to know) about their talents and characters. Parents often asked a phrenologist to predict a child's future. Men and women in Europe used phrenology to help them choose among several (4) _____ (maybe suitable) marriage partners. Companies used phrenology to check the (5) _____ (way of acting) of people applying for jobs. The process was long and (6) _____ (made up of several steps) First phrenologists moved their hands over the skull of a customer. When they (7) _____ (found) a bump or dent, they would look at a phrenology map to see which personality trait was (8) _____ (connected) to that area. Finally, they would (9) _____ (look at details of) all the findings and discuss each of the 27 brain (10) _____ (special uses) with the customer. Some customers were pleased and others were disappointed by what the phrenologists told them.

A *function* (noun) is the purpose or special duty of a person or thing.

*The nurse's main **function** is identify the nature of a medical problem.*

*The **function** of a lamp is to provide light.*

To function (verb) means "to work correctly" or "to be in action."

*My computer isn't **functioning** well.*

*My brain **functions** best after I've had a cup of coffee.*

(See Oxford American Dictionary for learners of English, p. 297)

B. **With a partner, match the body part on the left with its *function*. Take turns creating sentences with the words. Read them out loud.**

1. the heart — 1 a. to pump blood through the body

*The **function** of the heart is to pump blood through the body.*

2. the eyes — ___ b. to smell
3. the stomach — ___ c. to chew
4. the ears — ___ d. to digest food
5. the nose — ___ e. to see
6. the teeth — ___ f. to hear

Possible refers to something that has not yet happened. Something is *possible* if it could happen or if it could be done. Something is *impossible* if could not happen or it could not be done. These words are often used with *it is* in sentences such as those below.

*It is **possible** that I will visit my family next week.*

*It is **impossible** for me to go this week.*

(See Oxford American Dictionary for learners of English, p. 542)

CORPUS

C. **With a partner, decide which of these behaviors are possible. Write P if the behavior is possible and I if behavior is impossible.**

___ 1. The day a baby girl is born, she says, "Hello, Mother."
___ 2. A child cries when his cookie falls on the floor.
___ 3. A woman has not seen her sister for 20 years.
___ 4. A man takes cooking lessons.
___ 5. A boy teaches his horse to speak Japanese.
___ 6. A woman eats only foods that begin with the letter *A*.

Discuss why some of these behaviors are impossible.

The adjective *average* refers to something that is usual or typical.

*The **average** person must work hard to be successful.*

*Friends are important to the **average** teenager.*

The noun *average* is a mathematical term. An *average* is obtained by adding several figures then dividing the sum by the number of figures. *Average* is also the verb form.

*The **average** of 1, 3, and 14 is 6. (1 + 3 + 14 = 18 ÷ 3 = 6)*

*Most students **average** about six hours of sleep a night.*

(See Oxford American Dictionary for learners of English, p. 46)

CORPUS

D. ***Average*** **is used to describe things that are typical or usual. Work with a partner. Put an A in front of things that an average office worker does every day. Take turns making sentences with the items marked A.**

*The **average** office worker wakes up early every day.*

A wakes up early	___ flies in an airplane to work
___ eats lunch with a celebrity	___ eats dinner with family members
___ watches television at night	___ buys a new car
___ sits at a desk	___ talks to people at work

The adjective *complex* refers to something that is made up of several connected parts or steps and may be difficult to understand. The opposite of *complex* is *simple*.

*A foreign language has **complex** grammar rules that you must learn.*

*A subway is a **complex** system of train tracks underneath a city.*

(Oxford American Dictionary for learners of English, p. 145)

CORPUS

E. **Work with a partner. Look at the two lists below. Each item on the left is *simple*. It has few parts and is easy to use. The one opposite on the right is *complex*. Take turns making sentences about the pairs.**

1. a kite	an airplane
2. a child's picture book	a university textbook
3. a wagon	an automobile
4. counting	averaging ten numbers
5. a family dinner	a wedding feast

*A kite is simple, but an airplane is **complex**.*

Vocabulary Activities STEP II: Sentence Level

To analyze something means "to examine it carefully in order to understand or explain it."

*Students **analyzed** the results of the experiment.*

*A doctor **analyzed** the patient's problems.*

An *analysis* is a careful examination of the parts or details of something.

*The doctor wrote an **analysis** of the patient's problems.*

An *analyst* is a person who analyzes something.

*Our city hired an **analyst** to determine if a new school was needed.*

(See Oxford American Dictionary for learners of English, p. 24)

CORPUS

F. **Rewrite these sentences using the form of *analyze* in parentheses.**

1. A scientist made a study of climate changes in Europe. (analyzed)
   *A scientist **analyzed** climate changes in Europe.*
2. A salesman examined the December sales report. (analysis)
3. A technician failed to understand the computer's problems. (analyze)
4. A teacher spent the day examining students' test scores. (analyzing)
5. An airline hired someone to study passenger service. (analyst)

To *locate* something is to find its exact position, often after the position was unknown.

*I forgot where I parked my car, but I finally **located** it.*

The passive verb form is used to describe where something is.

*Beijing is **located** in China.*

The verb *to locate* something also means "to put or build something in a particular place."

*The university will **locate** the new library on top of the hill.*

A *location* is a place or position.

*The police reported the **location** of the fire.*

(See Oxford American Dictionary for learners of English, p. 423)

CORPUS

G. **Imagine that you are the owner of a beautiful new hotel in another country. A newspaper reporter is asking you questions about it. Answer the questions with the words in parentheses. Then compare answers with other students.**

1. Do you have a picture of your hotel? (locate)
   *Yes, I can **locate** a picture on my computer.*
2. Where is your hotel? (be located)
3. Why did you choose that place? (location)
4. A painting was stolen from your hotel. Where did the police find it? (located)
5. On what floor will your office be? (be located)
6. Where will you build your next hotel? (locate)

READING 2

Before You Read

In small groups or with the whole class, discuss the following questions.

1. What is a map? Why do people need maps?
2. How can scientists study the brains of people?
3. Here are some expressions about the brain. What do you think they mean? "He sure is a brain." "Use your brain." "Some people are brainless."

READING SKILL Previewing

APPLY

With a partner, preview Reading 2 by answering these questions.

1. Look at the title of the article. Do you think the article is about the past, present, or future?
2. Look at the pictures in the reading. How are they different from the pictures in Reading 1?
3. How would you expect brain mapping today to be different from Dr. Gall's brain mapping?

Read

This article is from a science website. Use your dictionary to find the meaning of words you do not know.

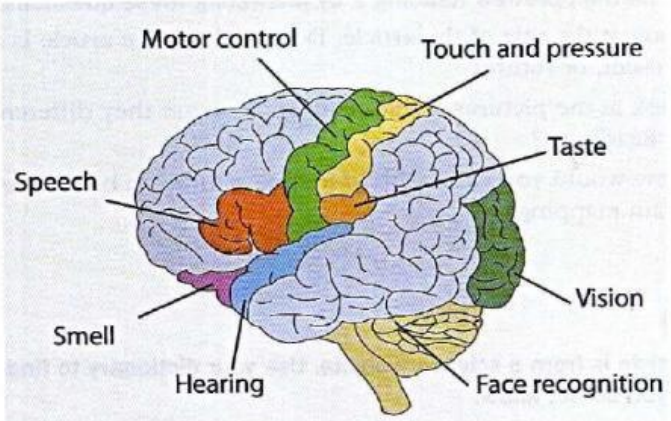
BRAIN MAPPING TODAY

In the early 20th century, scientists studied the brain. They studied parts of the brain. They studied how the brain controls human **behavior**. They **wondered** if there was a **link** between the parts of the brain and human **behavior**. They **wondered** if all brains were the same. Scientists had many questions about the brain. However, they could not look inside a living brain. Scientists needed other ways to find the answers. New technology—computers—helped scientists study the brain.

An **average** human brain has 100 billion cells. The brain is very **complex**. It has many parts. These parts have many different **functions**. Before computers, people did not know how to describe these parts and **functions**. But computers made it **possible**. Computers and electronic scanning[1] machines helped people see how a living brain **functions**. Scanning machines take pictures of the inside of the brain. The pictures appear on a computer screen. Scientists can then see the pictures. They can **analyze** the pictures.

MRI SCANNING

One kind of scanning is MRI. These letters stand for Magnetic Resonance Imaging. MRI uses magnetic forces and radio waves. MRI **creates** computer images, or pictures, of the brain. The process is simple. A person lies on a table. An MRI machine scans his or her head. A computer that is **linked** to the scanner **creates** images. These images show the parts of the brain and their **locations**.



FMRI SCANNING

A **functional** MRI, called an fMRI, works the same way. However, it **creates** images of brain **functions**. For example, an fMRI scan is made while a person is doing an activity. The person can be listening to music or smelling different foods. When the person is doing these things, some areas of the brain are active. The computer images show which areas are active. When an area of the brain is active, more blood flows there. The scan shows this. Then scientists can see which parts of the brain control the different **functions**. For instance, scientists can see which parts control hearing or smell.

Scientists wanted to know what the **average** human brain looked like. They tried to use MRI and fMRI images to **create** a map of the **average** brain. However, brains are

[1] One meaning of the word *scan* is to read something quickly. Another meaning is to use a machine to produce a picture of the inside of a person's body on a computer screen.

very different. Scientists decided to collect many examples of brains. They thought this was the best way to show the parts of an **average** brain. First they scanned the brains of hundreds of people. They scanned brains of people from all over the world. Then computers **analyzed** the images from the scans. The computers collected measurements of the brain parts. Finally, computers **averaged** the measurements and **created** brain maps.

One map shows the parts of an **average** brain. Other maps show the **locations** of brain **functions**. Memory and speech are two of these **functions**. Special maps show brain images from different kinds of people. For example, there are images from sick and healthy people, male and female people, young and old people.

Doctors around the world can examine these maps online. They can compare these images with brain scans from their own patients. These online maps also help doctors who operate on brains. The doctors can see the exact **location** of important brain parts before they operate.

Brain mapping is a **wonder** of modern technology. It allows scientists to examine living human brains and answer questions about human **behavior**. ■

A doctor studies a brain scan.

Reading Comprehension

Mark each sentence as *T* (True) or *F* (False) according to Reading 2.

___ 1. Scientists used to wonder where the human brain was located.
___ 2. Brain mapping was not possible before computers were invented.
___ 3. Brain functions can be scanned by fMRI machines.
___ 4. All human brains are average.
___ 5. Computers analyze the images created from brain scans.
___ 6. A computer that is linked to the scanner creates images.
___ 7. fMRI scans can change human behavior.
___ 8. MRI scans create computer images of complex brain parts.

Vocabulary Activities STEP I: Word Level

A. **Use the words below to complete the story. Use the words in parentheses as clues.**

analyzes	behavior	complex	impossible	location
average	create	functions	links	wondered

Ken was a ten-year-old boy who couldn't read. His teacher said he was intelligent, but his classroom (1) _____ (way of acting) was a problem. His parents (2) _____ (wanted to know) what was wrong. A doctor suggested that Ken have an fMRI scan. The brain scan was made while Ken was trying to read a book. Afterward, the doctor looked at the scan of the left half of Ken's brain. This is the (3) _____ (place) of most language (4) _____ (activities). Three separate areas are related to the (5) _____ (made of many parts) task of reading. The first focuses on the sounds of words. The second area (6) _____ (examines details of) parts of words and (7) _____ (connects) sounds to printed letters. The third area links letters to words, and links words to ideas. In (8) _____ (typical) brains, all three areas work together. But Ken's scan showed brain activity only in the first area. There were no connections to the other two areas. This made it (9) _____ (not able to happen) for Ken's brain to use the functions of other two areas. The doctor realized that Ken had dyslexia. About 20% of children have this reading disorder. There is no cure, but reading experts can (10) _____ (make) special lessons to help these children become better readers. Ken began the lessons right away and is already a better reader.

B. **Think about Reading 1 and Reading 2. Work with a partner. Write P if the idea is only in the reading about phrenology, M if the idea is only in the reading about brain mapping, and B if the idea is in both readings.**

___ located brain functions
___ analyzed bumps
___ used computers
___ used fMRI
___ created maps
___ people laughed
___ collected information from many people
___ wondered about behavior

Phrenology	fMRI examination
Done for curiosity of customer	Done as a medical procedure
Examines outside of head	Looks inside the brain
Not scientific	Scientific
Tries to explain behavior	Identifies affected brain areas

A *link* is a person or thing that connects two people or things. *To link* two people or things is to suggest a connection between them. The verb is often used in the passive.

*The Spanish language is a **link** between Mexico and Spain.*

*Some schools **link** reading and writing together in one class.*

*Reading computer screens for a long time **is linked** to headaches.*

(See Oxford American Dictionary for learners of English, p. 420)

C. **With a partner, match the items on the left that are linked with those on the right. Take turns making sentences with the information.**

1. reading ___ a. writing

*There is a **link** between reading and writing. Reading **is linked** to writing.*

2. exercise ___ b. disease
3. speeding ___ c. car accidents
4. education ___ d. winter
5. height ___ e. future earnings
6. rats ___ f. shoe size
7. snow ___ g. good health

Behavior is how a person or animal acts. It can refer to one-time actions or long-term habits.

*Mrs. Inoue was embarrassed by her daughter's **behavior** in the restaurant.*

*My uncle went to Africa to study the **behavior** of elephants.*

To behave means "to act in a certain way."

*Scientists have studied how people **behave** in emergencies.*

The adjective *behaved* always occurs with an adverb that describes how someone *behaved*. Usually the adverb describes something good or bad.

*Yuna was a **well-behaved** little girl.*

*A lot of the children we deal with are badly **behaved**.*

Parents often say to a child, "*Behave* yourself!" or ask, "Why can't you *behave*?"

(See Oxford American Dictionary for learners of English, p. 63)

D. Work with a partner. Match the behavior on the left with the description on the right. Then one person reads the behavior and the other responds with the matching description.

1. Jamal sat quietly through the concert.	1 a. He was well-behaved.
2. Jamal shared his ice cream with his sister.	___ b. His behavior was gentle.
3. Jamal thanked his grandmother for the present.	___ c. He behaved generously.
4. Jamal didn't say a word all day.	___ d. He behaved badly.
5. Jamal argued with his father.	___ e. He behaved politely.
6. Jamal held the baby on his lap.	___ f. His behavior was strange.

Vocabulary Activities STEP II: Sentence Level

To wonder something is to want to know something that you do not know. It can be used about past, present, or future events. It is usually expressed by *I wonder* followed by *whether* or *if*.

*I **wonder** if she received my email this morning.*

*I **wonder** whether the library will be open tomorrow.*

To wonder can also be used with *wh–* question words. Notice the subject-verb order after *wonder*.

*I **wonder** who won the game yesterday.*

*I **wonder** where my book is.*

*I **wonder** when we're eating dinner.*

As a noun, *wonder* expresses a feeling of surprise and admiration.

*We watched in **wonder** as the baby horse stood up.*

*The computer is a **wonder** of modern technology.*

The adjective *wonderful* means "very good."

*I had a **wonderful** time.*

*The movie was **wonderful**.*

No wonder... is a common expression that means "I'm not surprised that..."

*I haven't had breakfast yet. **No wonder** I'm so hungry.*

***No wonder** it's so warm in here. The air conditioner is off.*

(See Oxford American Dictionary for learners of English, p. 840)

CORPUS

E. **Here are some questions you might still have about brain mapping. In your notebook, write five sentences that include a form of *wonder*. Use these ideas, or add your own.**

1. Does anyone still believe in phrenology?

   *I **wonder** if anyone still believes in phrenology.*

2. What does "phrenology" mean?
3. Does the average doctor have an MRI scanner?
4. Is it possible to go online to see a brain map?
5. Who invented the MRI scanner?
6. Are animal brains as complex as human brains?
7. Can animal brain functions be analyzed with an fMRI?
8. How are men's and women's brains different?

Word Form Chart			
Noun	**Verb**	**Adjective**	**Adverb**
creator creation creativity	create	creative	creatively

To create something is to make something new or cause something new to happen.

*Artists **create** beautiful pictures for us to enjoy.*

*Cara's job is to advise employees about cultural issues that sometimes **create** problems.*

The person who makes something or causes something new to happen is the *creator* of the new thing. The new thing that the person created is a *creation*.

*Walt Disney was the **creator** of many familiar cartoon characters.*

*His **creations** are known all over the world.*

A person who has many new or unusual ideas is said to be *creative*. Someone who finds a new or unusual way to do something is said to be doing it *creatively*.

*Mother always found **creative** ways to use leftover foods.*

*She often mixed meats and vegetables **creatively** to make a delicious soup.*

(See Oxford American Dictionary for learners of English, pp. 172–173)

CORPUS