From: Rick
To: IELTS Prep Group
*Subj: IELTS **Reading** lesson 4-18-2018*

Lesson Objective
The student shall be able to use "power words" as part of their oral vocabulary, read and comprehend both social and business language and demonstrate effective oral communication skills

Section One

Vocabulary
Match the correct word in column A with the definition in column B, then use in a sample sentence
Evaluation Criteria: Ability to understand definitions of English vocabulary

Column A	Column B
VOCABULARY	**DEFINITION**
1. **TIME-TRAVEL** (noun)	**A.** The science that deals with matter, energy, motion, and force.
2. **PHYSICS** (noun)	**B.** a test, trial, or tentative procedure; an act or operation for the purpose of discovering something unknown or of testing a principle, supposition, etc.
3. **EXPERIMENTS** (noun)	**C.** a strong likelihood or chance of something
4. **QUANTUM** (noun)	**D.** a representation, usually on a smaller scale, of a device, structure, etc.
5. **SPECULATION** (noun)	**E.** A statement or proposition that seems self-contradictory or absurd but in reality expresses a possible truth. a person or thing exhibiting apparently contradictory characteristics
6. **PARADOX** (noun)	**F.** The smallest quantity of radiant energy, equal to Planck's constant times the frequency of the associated radiation. The fundamental unit of a quantized physical magnitude, as angular momentum.
7. **MODEL** (noun)	**G.** To pass or move over, along, or through.
8. **PROBABILITY** (noun)	**H.** the contemplation or consideration of some subject
9. **TRAVERSE** (verb)	**I.** Hypothetical transport through time into the past or the future.

Section Two

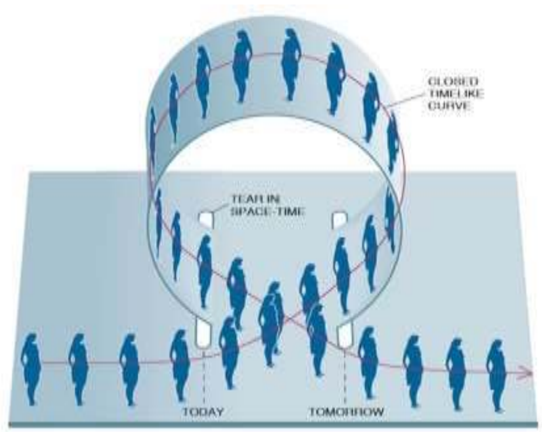
Reading Comprehension and Pronunciation skills.

Evaluation Criteria: Ability to effectively read and comprehend written English in a social or business environment.

ARTICLE A

Time Travel Simulation Resolves "Grandfather Paradox"

Source



1. On June 28, 2009, the world-famous physicist Stephen Hawking threw a party at the University of Cambridge, complete with balloons, hors d'oeuvres and iced champagne. Everyone was invited but no one showed up. Hawking had expected as much, because he only sent out invitations after his party had concluded. It was, he said, "a welcome reception for future time travelers," a tongue-in-cheek experiment to reinforce his 1992 conjecture that travel into the past is effectively impossible.

But Hawking may be on the wrong side of history. Recent experiments offer tentative support for time travel's feasibility—at least from a mathematical perspective. The study cuts to the core of our understanding of the universe, and the resolution of the possibility of time travel, far from being a topic worthy only of science fiction, would have profound implications for fundamental physics as well as for practical applications such as quantum cryptography and computing.

2. Closed time like curves
The source of time travel speculation lies in the fact that our best physical theories seem to contain no prohibitions on traveling backward through time. The feat should be possible based on Einstein's theory of general relativity, which describes gravity as the warping of spacetime by energy and matter. An extremely powerful gravitational field, such as that produced by a spinning black hole, could in principle profoundly warp the fabric of existence so that spacetime bends back on itself. This would create a "closed time like curve," or CTC, a loop that could be traversed to travel back in time.

Hawking and many other physicists find CTCs abhorrent, because any macroscopic object traveling through one would inevitably create paradoxes where cause and effect break down. In a model proposed by the theorist David Deutsch in 1991, however, the paradoxes created by CTCs could be avoided at the quantum scale because of the behavior of fundamental particles, which follow only the fuzzy rules of probability rather than strict determinism. "It's intriguing that you've got general relativity predicting these paradoxes, but then you consider them in quantum mechanical terms and the paradoxes go away," says University of Queensland physicist Tim Ralph. "It makes you wonder whether this is important in terms of formulating a theory that unifies general relativity with quantum mechanics."

3. Experimenting with a curve
Recently Ralph and his PhD student Martin Ringbauer led a team that experimentally simulated Deutsch's model of CTCs for the very first time, testing and confirming many aspects of the two-decades-old theory. Their findings are published in Nature Communications. Much of their simulation revolved around investigating how Deutsch's model deals with the “grandfather paradox,” a hypothetical scenario in which someone uses a CTC to travel back through time to murder her own grandfather, thus preventing her own later birth. (Scientific American is part of Nature Publishing Group.)

Deutsch's quantum solution to the grandfather paradox works something like this:

Instead of a human being traversing a CTC to kill her ancestor, imagine that a fundamental particle goes back in time to flip a switch on the particle-generating machine that created it. If the particle flips the switch, the machine emits a particle—the particle—back into the CTC; if the switch isn't flipped, the machine emits nothing. In this scenario there is no a priori deterministic certainty to the particle's emission, only a distribution of probabilities. Deutsch's insight was to postulate self-consistency in the quantum realm, to insist that any particle entering one end of a CTC must emerge at the other end with identical properties.

4. Therefore, a particle emitted by the machine with a probability of one half would enter the CTC and come out the other end to flip the switch with a probability of one half, imbuing itself at birth with a probability of one half of going back to flip the switch. If the particle were a person, she would be born with a one-half probability of killing her grandfather, giving her grandfather a one-half probability of escaping death at her hands—good enough in probabilistic terms to close the causative loop and escape the paradox. Strange though it may be, this solution is in keeping with the known laws of quantum mechanics.
In their new simulation Ralph, Ringbauer and their colleagues studied Deutsch's model using interactions between pairs of polarized photons within a quantum system that they argue is mathematically equivalent to a single photon traversing a CTC. "We encode their polarization so that the second one acts as kind of a past incarnation of the first,” Ringbauer says. So instead of sending a person through a time loop, they created a stunt double of the person and ran him through a time-loop simulator to see if the doppelganger emerging from a CTC exactly resembled the original person as he was in that moment in the past.

5. By measuring the polarization states of the second photon after its interaction with the first, across multiple trials the team successfully demonstrated Deutsch's self-consistency in action. "The state we got at our output, the second photon at the simulated exit of the CTC, was the same as that of our input, the first encoded photon at the CTC entrance," Ralph says. "Of course, we're not really sending anything back in time but [the simulation] allows us to study weird evolutions normally not allowed in quantum mechanics."

Those "weird evolutions" enabled by a CTC, Ringbauer notes, would have remarkable practical applications, such as breaking quantum-based cryptography through the cloning of the quantum states of fundamental particles. "If you can clone quantum states,” he says, “you can violate the Heisenberg uncertainty principle,” which comes in handy in quantum cryptography because the principle forbids simultaneously accurate measurements of certain kinds of paired variables, such as position and momentum. "But if you clone that system, you can measure one quantity in the first and the other quantity in the second, allowing you to decrypt an encoded message."

6. "In the presence of CTCs, quantum mechanics allows one to perform very powerful information-processing tasks, much more than we believe classical or even normal quantum computers could do," says Todd Brun, a physicist at the University of Southern California who was not involved with the team's experiment. "If the Deutsch model is correct, then this experiment faithfully simulates what could be done with an actual CTC. But this experiment cannot test the Deutsch model itself; that could only be done with access to an actual CTC."

Alternative reasoning
Deutsch's model isn't the only one around, however. In 2009 Seth Lloyd, a theorist at Massachusetts Institute of Technology, proposed an alternative, less radical model of CTCs that resolves the grandfather paradox using quantum teleportation and a technique called post-selection, rather than Deutsch's quantum self-consistency. With Canadian collaborators, Lloyd went on to perform successful laboratory simulations of his model in 2011. "Deutsch's theory has a weird effect of destroying correlations," Lloyd says. "That is, a time traveler who emerges from a Deutschian CTC enters a universe that has nothing to do with the one she exited in the future. By contrast, post-selected CTCs preserve correlations, so that the time traveler returns to the same universe that she remembers in the past."

7. This property of Lloyd's model would make CTCs much less powerful for information processing, although still far superior to what computers could achieve in typical regions of spacetime. "The classes of problems our CTCs could help solve are roughly equivalent to finding needles in haystacks," Lloyd says. "But a computer in a Deutschian CTC could solve why haystacks exist in the first place."

Lloyd, though, readily admits the speculative nature of CTCs. "I have no idea which model is really right. Probably both of them are wrong," he says. Of course, he adds, the other possibility is that Hawking is correct, "that CTCs simply don't and cannot exist." Time-travel party planners should save the champagne for themselves—their hoped-for future guests seem unlikely to arrive.

ARTICLE B

Time Travel: Theories, Paradoxes & Possibilities

Source

1. Time travel — moving between different points in time — has been a popular topic for science fiction for decades. Franchises ranging from "Doctor Who" to "Star Trek" to "Back to the Future" have seen humans get in a vehicle of some sort and arrive in the past or future, ready to take on new adventures.

The reality, however, is more muddled. Not all scientists believe that time travel is possible. Some even say that an attempt would be fatal to any human who chooses to undertake it.

2. Understanding time
What is time? While most people think of time as a constant, physicist Albert Einstein showed that time is an illusion; it is relative — it can vary for different observers depending on your speed through space. To Einstein, time is the "fourth dimension." Space is described as a three-dimensional arena, which provides a traveler with coordinates — such as length, width and height —showing location. Time provides another coordinate — direction — although conventionally, it only moves forward. (Conversely, a new theory asserts that time is "real.")

3. Einstein's theory of special relativity says that time slows down or speeds up depending on how fast you move relative to something else. Approaching the speed of light, a person inside a spaceship would age much slower than his twin at home. Also, under Einstein's theory of general relativity, gravity can bend time.

Picture a four-dimensional fabric called space-time. When anything that has mass sits on that piece of fabric, it causes a dimple or a bending of space-time. The bending of space-time causes objects to move on a curved path and that curvature of space is what we know as gravity.

4. Both the general and special relativity theories have been proven with GPS satellite technology that has very accurate timepieces on board. The effects of gravity, as well as the satellites' increased speed above the Earth relative to observers on the ground, make the unadjusted clocks gain 38 microseconds a day. (Engineers make calibrations to account for the difference.)

In a sense, this effect, called time dilation, means astronauts are time travelers, as they return to Earth very, very slightly younger than their identical twins that remain on the planet.

5. Through the wormhole
General relativity also provides scenarios that could allow travelers to go back in time, according to NASA. The equations, however, might be difficult to physically achieve.

One possibility could be to go faster than light, which travels at 186,282 miles per second (299,792 kilometers per second) in a vacuum. Einstein's equations, though, show that an object at the speed of light would have both infinite mass and a length of 0. This appears to be physically impossible, although some scientists have extended his equations and said it might be done.

A linked possibility, NASA stated, would be to create "wormholes" between points in space-time. While Einstein's equations provide for them, they would collapse very quickly and would only be suitable for very small particles. Also, scientists haven't actually observed these wormholes yet. Also, the technology needed to create a wormhole is far beyond anything we have today.

6. Alternate time travel theories
While Einstein's theories appear to make time travel difficult, some groups have proposed alternate solutions to jump back and forth in time.

Infinite cylinder
Astronomer Frank Tipler proposed a mechanism (sometimes known as a Tipler Cylinder) where one would take matter that is 10 times the sun's mass, then roll it into very long but very dense cylinder.

After spinning this up a few billion revolutions per minute, a spaceship nearby — following a very precise spiral around this cylinder — could get itself on a "closed, time-like curve", according to the Anderson Institute. There are limitations with this method, however, including the fact that the cylinder needs to be infinitely long for this to work.

7. Black holes
Another possibility would be to move a ship rapidly around a black hole, or to artificially create that condition with a huge, rotating structure.
"Around and around they'd go, experiencing just half the time of everyone far away from the black hole. The ship and its crew would be traveling through time," physicist Stephen Hawking wrote in the Daily Mail in 2010.

"Imagine they circled the black hole for five of their years. Ten years would pass elsewhere. When they got home, everyone on Earth would have aged five years more than they had."

However, he added, the crew would need to travel around the speed of light for this to work. Physicist Amos Iron at the Technion-Israel Institute of Technology in Haifa, Israel pointed out another limitation if one used a machine: it might fall apart before being able to rotate that quickly.

8. Cosmic strings
Another theory for potential time travelers involves something called cosmic strings — narrow tubes of energy stretched across the entire length of the ever-expanding universe. These thin regions, left over from the early cosmos, are predicted to contain huge amounts of mass and therefore could warp the space-time around them.

Cosmic strings are either infinite or they're in loops, with no ends, scientists say. The approach of two such strings parallel to each other would bend space-time so vigorously and in such a particular configuration that might make time travel possible, in theory.

9. Time machines

It is generally understood that traveling forward or back in time would require a device — a time machine — to take you there. Time machine research often involves bending space-time so far that time lines turn back on themselves to form a loop, technically known as a "closed time-like curve."

To accomplish this, time machines often are thought to need an exotic form of matter with so-called "negative energy density." Such exotic matter has bizarre properties, including moving in the opposite direction of normal matter when pushed. Such matter could theoretically exist, but if it did, it might be present only in quantities too small for the construction of a time machine.

However, time-travel research suggests time machines are possible without exotic matter. The work begins with a doughnut-shaped hole enveloped within a sphere of normal matter. Inside this doughnut-shaped vacuum, space-time could get bent upon itself using focused gravitational fields to form a closed time-like curve. To go back in time, a traveler would race around inside the doughnut, going further back into the past with each lap. This theory has a number of obstacles, however. The gravitational fields required to make such a closed time-like curve would have to be very strong and manipulating them would have to be very precise.

10. Grandfather paradox

Besides the physics problems, time travel may also come with some unique situations. A classic example is the grandfather paradox, in which a time traveler goes back and kills his parents or his grandfather — the major plot line in the "Terminator" movies — or otherwise interferes in their relationship — think "Back to the Future" — so that he is never born or his life is forever altered.

If that were to happen, some physicists say, you would be not be born in one parallel universe but still born in another. Others say that the photons that make up light prefer self-consistency in timelines, which would interfere with your evil, suicidal plan.
Some scientists disagree with the options mentioned above and say time travel is impossible no matter what your method. The faster-than-light one in particular drew derision from American Museum of Natural History astrophysicist Charles Lu.

That "simply, mathematically, doesn't work," he said in a past interview with sister site Live Science.
Also, humans may not be able to withstand time travel at all. Traveling nearly the speed of light would only take a centrifuge, but that would be lethal, said Jeff Tollaksen, a professor of physics at Chapman University, in 2012.
Using gravity would also be deadly. To experience time dilation, one could stand on a neutron star, but the forces a person would experience would rip you apart first.

11. Time travel in fiction

Two 2015 articles by Space.com described different ways in which time travel works in fiction, and the best time-travel machines ever. Some methods used in fiction include:

One-way travel to the future: The traveler leaves home, but the people he or she left behind might age or be dead by the time the traveler returns. Examples: "Interstellar" (2014), "Ikarie XB-1" (1963)
Time travel by moving through higher dimensions: In "Interstellar" (2014), there are "tesseracts" available in which astronauts can travel because the vessel represents time as a dimension of space. A similar concept is expressed in Madeleine L'Engle's "A Wrinkle In Time" (2018, based on the book series that started in 1963), where time is folded by means of a tesseract. The book, however, uses supernatural beings to make the travel possible.

Travelling the space-time vortex: The famous "Doctor Who" (1963-present) TARDIS ("Time And Relative Dimension In Space") uses an extra-dimensional vortex to go through time, while the travelers inside feel time passing normally.

12. Instantaneous time jumping: Examples include "The Girl Who Leapt Through Time" (2006), the DeLorean from "Back To The Future" (1985), and the Mr. Peabody's WABAC machine from "The Rocky and Bullwinkle Show" (1959-64).
Time travelling while standing still: Both the "Time Machine" (1895 book) and Hermione Granger's Time-Turner from "Harry Potter" keep the traveler still while they move through time.

Slow time travel: In "Primer" (2004), a traveler stays in a box while time traveling. For each minute they want to go back in time, they need to stay in the box for a minute. If they want to go back a day in time, they have to stay there for 24 hours.

13. Traveling faster than light: In "Superman: The Movie" (1979), Superman flies faster than light to go back in time and rescue Lois Lane before she is killed. The concept was also used in the 1980 novel "Timescape" by Gregory Benford, in which the protagonist sends (hypothetical) faster-than-light tachyon particles back to Earth in 1962 to warn of disaster. In several "Star Trek" episodes and movies, the Enterprise travels through time by going faster than light. In the comic book and TV series "The Flash," the super-speedster uses a cosmic treadmill to travel through time.

Difficult methods to categorize: There's a rocket sled in "Timecop" (1994) that pops in and out of view when it's being used, which has led to much speculation about what's going on. There's also the Time Displacement Equipment in "The Terminator" movie series, which shows off how to fight a war in four dimensions (including time).

14. So, is time travel possible?
While time travel does not appear possible — at least, possible in the sense that the humans would survive it — with the physics that we use today, the field is constantly changing. Advances in quantum theories could perhaps provide some understanding of how to overcome time travel paradoxes.

One possibility, although it would not necessarily lead to time travel, is solving the mystery of how certain particles can communicate instantaneously with each other faster than the speed of light.
In the meantime, however, interested time travelers can at least experience it vicariously through movies, television and books.