PROFESSOR LAYTON AND MENTAL GYMNASTICS

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Introduction

In our daily life, there are actions we subconsciously perform countless times, such as getting dressed and going to work. We do not need to focus on them because they are part of our procedural memory, responsible for the acquisition of skills. However, both in our professional and our personal lives, we face certain unusual problems which, given the circumstances, are hard to fathom. Thus, we are forced to use our puzzle solving skills. The effectiveness of the latter depends mostly on how often (and how hard) we train them.

The technological progress of our time resulted, firstly, in the possibility of designing puzzles that are more complex than those we find in newspapers, and secondly, in an increase in the use of portable devices such as tablets and iPhones.

The object of study of this essay is the development of intellectual skills which results from solving puzzles, specifically those in the "Professor Layton" series, available on the Nintendo DS/3DS, Android and iOS. Each game in the series contains about 150 puzzles (besides the downloadable ones) designed by psychologist Akira Tago and his team.

In the first chapter, I shall endeavour to explain what a puzzle is. In the second

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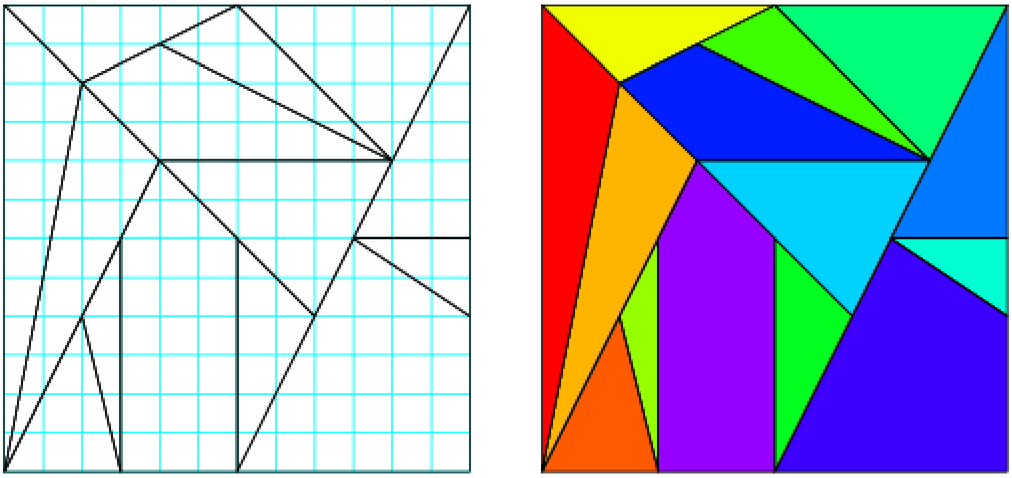
1 BIO-NOTE: João Jorge Capelo Sottomayor Spínola Fernandes has a BA in Portuguese and English Studies (2015) awarded by FCSH, and is currently finishing his Master's Degree in English and North-American Literature and Culture at the same institution. His master's thesis concerns the Victorian perception regarding Simon de Montfort's political and judicial legacy. He also took a course in Oral Communication Techniques in 2016. He is interested in various academic subjects such as Law, Sociology, Psychology and History, and has written several essays in college pertaining to each of them. The present essay combines the field of Neuroscience and the author's hobby of puzzle solving.

chapter, I shall identify every intellectual skill that can be improved by solving "Professor Layton" puzzles. Finally, I shall analyse a group of puzzles in terms of how the brain processes the information required to solve them.

Chapter I- What is a Puzzle?

According to the Merriam-Webster Dictionary, a <u>puzzle</u> is "a question, problem or contrivance designed for testing ingenuity". The first recorded use of the term dates back to 1582 (as a verb) and to 1599 (as a noun).

The oldest puzzle we know of is the <u>Ostomachion</u>, which means "bone-fight". It is part of a mathematical treatise attributed to Archimedes and consists of a geometrical puzzle composed of 14 irregular shapes.



<u>Example of an Ostomachion</u>

Theoretically, the object of the puzzle may have been to fit the pieces in a box or build other, more complex shapes.

1.1 J. Hudson Ballard and E.H. Lindley's Definitions of "Puzzle"

In his monograph, Ballard (1915: p. 6) defines a puzzle as: a) a situation with a difficult and unknown solution; b) a situation with an assuredly possible solution; and c) a situation entirely controlled by the person who's solving the problem. Additionally, Ballard writes that puzzles may be classified as a) bi-dimensional or tri-dimensional; b) according to the number of correct moves necessary to solve them; c) according to their flexibility (i. e. how many pieces of the puzzle one is allowed to interact with); d) according to the number of possible solutions; and e) according to the intellectual skills necessary to solve them.

E. H. Lindley (cited in Ballard, 1915: p. 6), on the other hand, divided puzzles into the following groups: a) language (riddles, charades, etc.); b) mechanical, which require perceptiveness and are solved through a certain trick; c) physical puzzles, which require some knowledge of Physics; and d) mathematical puzzles, which require arithmetic operations.

After asking 500 school children and 300 adults to solve a puzzle, Lindley (cited in Ballard: p. 12) found out that there were essentially three methods of solving a puzzle: a) trial and error;[2] b) the conceptual method, which consists of investigating and analysing the puzzle thoroughly; c) the perceptual method, which is a mixture of the two aforementioned methods. It consists of trial and error, albeit with a vague idea of what the solution is and how to find it.

Our intellectual skills can only be improved through the use of the perceptual or the conceptual method.

1.2. Ruger's Investigation

In the beginning of the twentieth century, Doctor Ruger conducted an

2 Most of Lindley's test subjects (to wit, nearly all the children and most of the adults) used this method.

experiment whose goal was to show how cerebral processes work when we solve puzzles. He asked a series of questions to his test subjects right after giving each of them a puzzle to solve. (*Ibidem*, p. 13)

Ruger (cited in Ballard, p. 15) writes that his test subjects often solved their puzzles through trial and error (which was the most obvious method). However, according to Ballard (*Ibidem*, p. 16), Ruger disregarded the emotional state of the people he tested (indeed, they were often ashamed of failing in front of someone who already knew the right solution to the puzzle, namely Ruger himself). Moreover, the test subjects were inexperienced at solving puzzles. These factors ultimately compromised the validity of the results of the experiment. A further problem consists of the fact that Ruger asked his subjects to take notes of how they solved their puzzles, which prevented them from fully focusing on the puzzle.

Finally, it should be noted that Ruger kept a record of wrong answers to the puzzles and false moves (i.e. unnecessary steps to solve the puzzle). However, Ruger never refers to this record, which means that he probably could not see the scientific relevance of the aforementioned mistakes. (*Ibidem*, p. 20)

Chapter II- The Effects of Puzzle Solving on the Human Mind

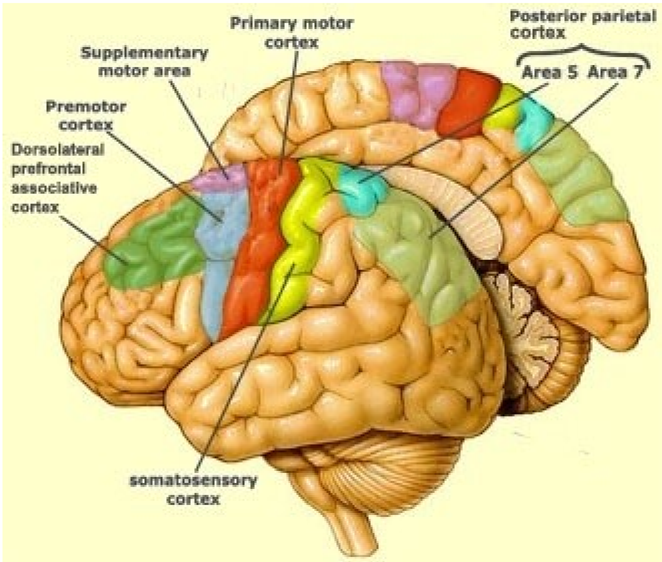
In this chapter, I shall identify all the mental skills we train by solving the puzzles from the "Professor Layton" series, as well as which cerebral processes activate them. These data were provided mostly by experiments conducted with MRI (Magnetic Resonance Imaging) technology. The latter shows which parts of the brain are activated during a certain activity through the detection of changes in the blood flow. Currently, we don't know exactly how certain intellectual skills fully work. However, I shall not refer to unconfirmed or untested theories and speculations in this chapter.

Some puzzles require the use of more than one skill. These will be identified in the next chapter.

2.1. The General Mental Processes: Motor Skills

Whenever we solve puzzles, we inevitably use our motor skills. The latter

endeavour to accomplish tasks that have certain goals. In order to get them to work, several areas of the brain are activated: the parietal cortex (which registers the physical aspects of the puzzle), the supplementary motor area (which plans the physical answers to the puzzle), the cingulate cortex (which provides solutions) and the cerebellum (which programs all the steps we take to solve the puzzle). (Restak, 2013: pp. 439-440)

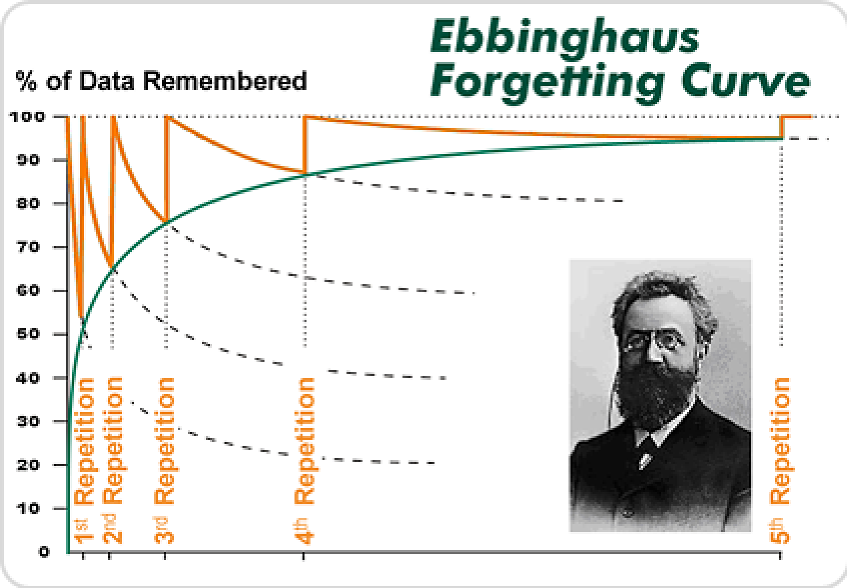


Areas of the Brain Responsible for the Motor Skills (highlighted in colours)

2.2. Memory

The first laws of memorization were developed by Hermann Ebbinghaus.

Firstly, according to what Ebbinghaus calls the learning curve, the time required to memorise a list of unknown syllables increases as the number of syllables increases as well.



Ebbinghaus Forgetting Curve

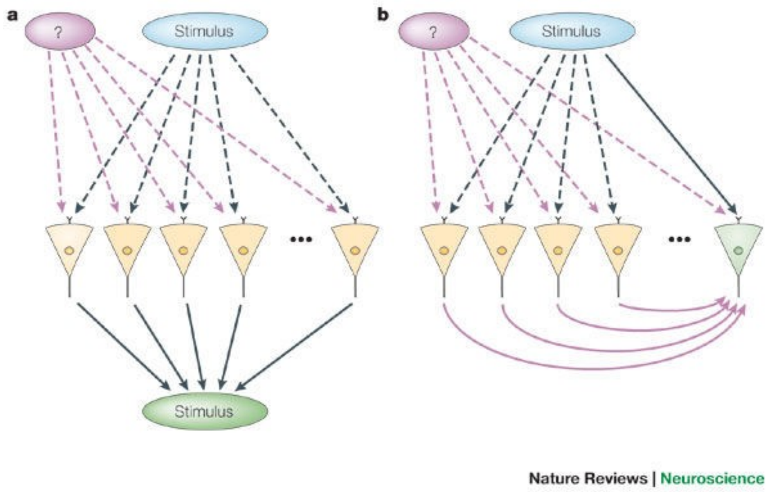
Secondly, memorizing known words takes one tenth of the time required to memorize unknown words.

Thirdly, constant exercises of medium difficulty improve your memory better than punctual sessions of very hard memory exercises.

Finally, practising what we learn improves our mental ability to store data. (*Ibidem*, p. 171)

On a cerebral level, we store data through the formation of neuronal circuits, also called "cell assemblies". These connections are strengthened every time a memory is retrieved.

This enables the acquisition of knowledge and abilities. (*Ibidem*, p.176)

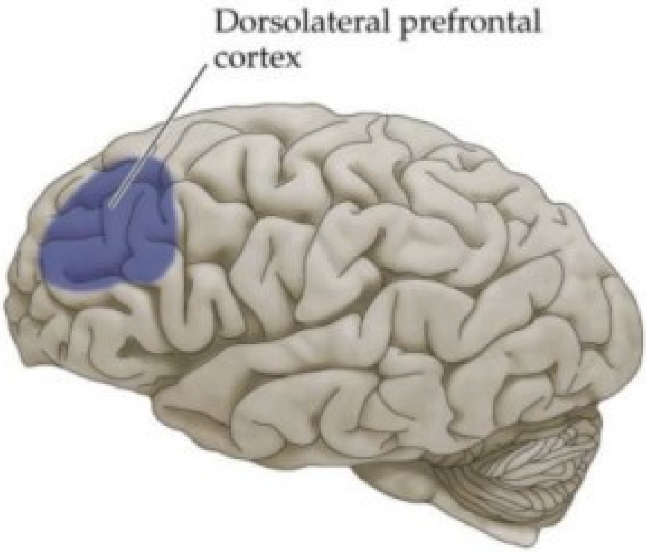


Cell Assembly Organization

2.2.1 Work Memory

Our work memory is flexible and can be improved through frequent training. Observing a certain object for longer will raise the odds that we will remember it later.

The brain area responsible for the work memory is the dorsolateral prefrontal cortex, the most anterior portion of the frontal lobes. (*Ibidem*, pp. 116-117)



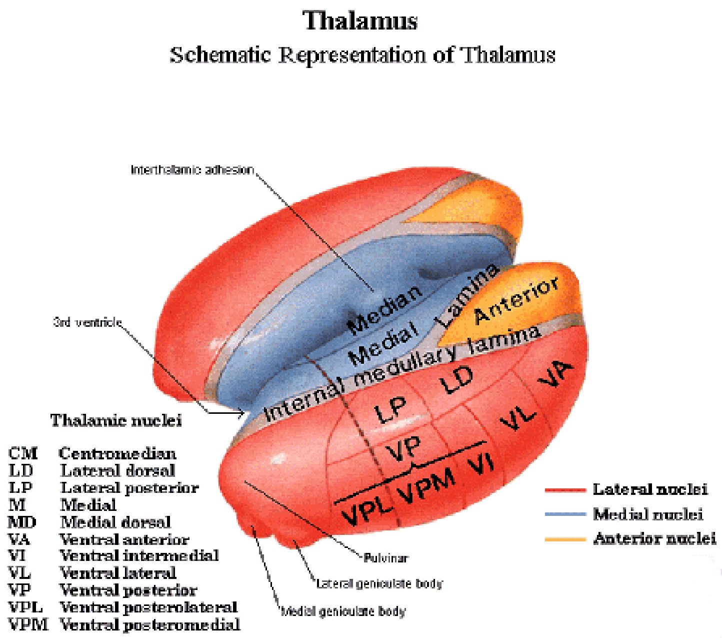
Dorsolateral Prefrontal Cortex

When we try to remember something, the dorsolateral prefrontal cortex is activated, making an image of the object in question. This also allows us to focus on the object and recognize it once we find it.

According to psychologist Paul Verhaeghen (cited in Restak, 2013: p. 129), we can focus on a maximum of four groups of objects simultaneously. However, the number of individual objects we can remember can be anything from 7 to 80.

2.2.2 Procedural Memory

Procedural memory consists of automatic abilities and associations. A typical example would be our first language, which we speak fluently. This information is codified in the hippocampus, which is located in the temporal lobe that connects the fornix (arch) to the mammillary bodies and the dorsal thalamus. If any of these structures is damaged, the individual will suffer serious memory losses. (*Ibidem*: pp. 157, 159)



Thalamus

This ability allows us to solve puzzles faster, provided we do the latter often.

2.3 Visual Perception

Visual perception is the result of the activation of individual cells located in the primary visual cortex. (*Ibidem*, p. 276)

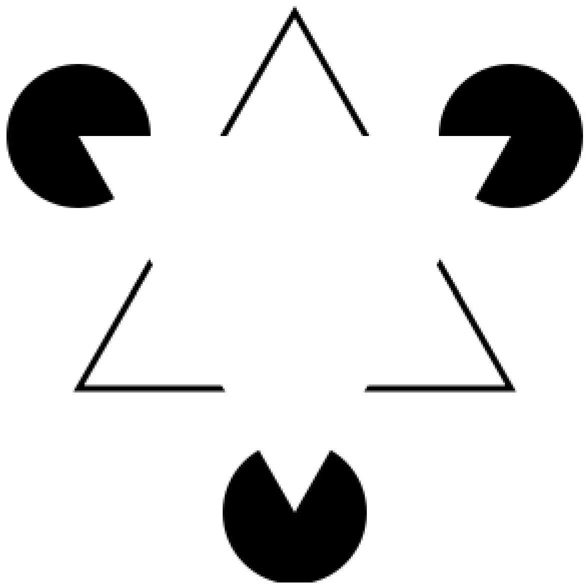
2.3.1 Illusions

Our visual cortex tends to compensate for processed information that it

considers incomplete or erroneous. These compensations, which often distort reality and fool us, are called illusions.

When we observe an image that resembles a vase, for example, we activate our association cortex. The latter stores the knowledge we need to identify objects. Incidentally, in order to know what a vase is, for example, we must have some experience observing them.

On the other hand, illusory contours are the result of the perception of edges and lines when there is no change of colour in an image. The Kanizsa triangle, for example, shows what appears to be a white triangle whose edges are evoked by the mouths of 3 "pacmen". (*Ibidem*, p. 277)



Kanizsa Triangle Example

While vision often dominates the other senses, the latter may also perceive illusions.

2.3.2. Pattern Recognition

The observation of patterns consists of two cerebral processes.

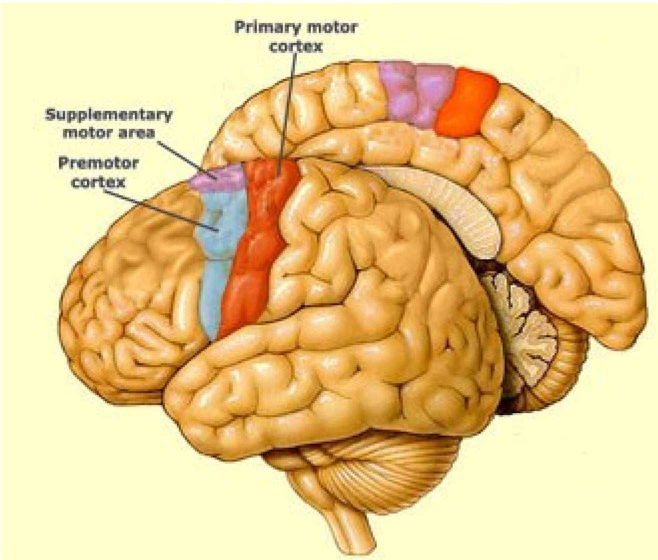
The first results from the connection of the occipital lobe to the parietal lobe. The latter occupies itself with knowing where things are.

The second connection is from the occipital lobe to the temporal lobe, which finds out what things are. (*Ibidem*, p. 287)

2.3.3 Spatial Thinking and the Challenge of Mental Rotation

While visual thinking concerns itself with bi-dimensional and flat images, spatial thought registers tri-dimensional images. Schools and teachers do not normally encourage practising this ability; they tend to focus a lot more on language and mathematical skills. Consequently, few are the people who can rotate an object in their minds without any difficulties. This is, however, a must for architects, who have to create tri-dimensional mental images of buildings, and for surgeons, who have to think about every side of an organ. (*Ibidem*, p. 331)

The brain areas responsible for spatial thought are the parietal lobe and particularly the SMA (Supplementary Motor Area). (*Ibidem*, p. 334)



Supplementary Motor Area (highlighted in purple)

2.4 Critical Thinking

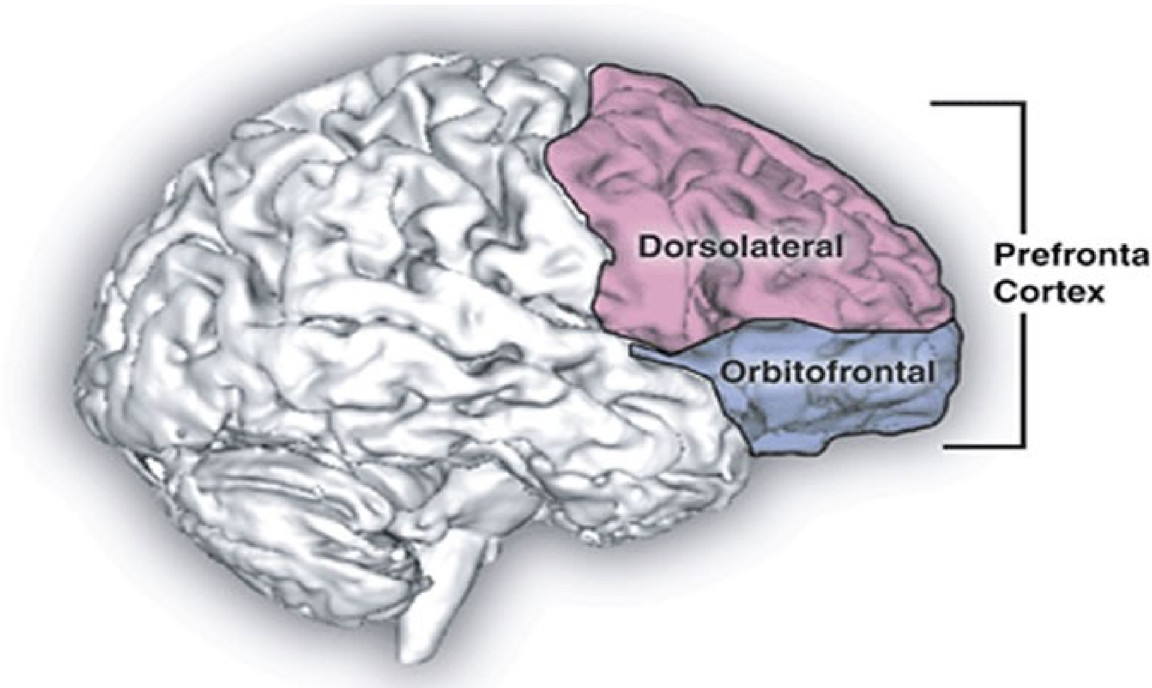
Most of the "Professor Layton" puzzles require a careful analysis of the instructions and even the accompanying picture. These explain to us how the puzzles work and often provide important clues. However, it is up to us to decide what is useful and what is irrelevant.

Sometimes, solving a puzzle requires a special "trick" (i. e. something that is not referred to in the instructions and that we must find out for ourselves). On the other hand, we are sometimes fooled by what we read on the instructions or what we observe in the pictures (though, naturally, this is all intentional). Ultimately, we can rely only on our critical thinking skills and take everything else with a grain of salt.

2.5 The Cognitive Process

2.5.1. Logic

The areas of the brain that are activated by logical thinking vary with the object of the latter. Whenever we think about inconclusive topics or situations, we use the right prefrontal cortex. Conversely, when our reasoning is valid and conclusive, we use our left prefrontal cortex. (*Ibidem*, p. 590)



Prefrontal Cortex

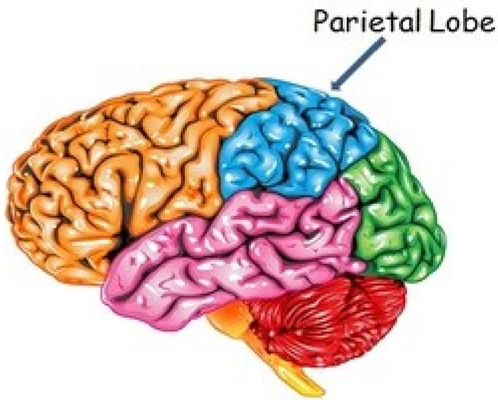
The first known work regarding logic was the *Organon,* written by Aristotle. The most important notion included in this work is that of the "deduction" (*sullogismos*). According to the Greek philosopher, a deduction consists of speech

(*logos*), which, when we suppose certain things (premises or *protasis*), leads us to certain results (conclusion or *sumperasma*). In practice, our logical reasoning consists more frequently of simplified versions of the categorical, conditional and disjunctive syllogisms. We do not tend to consider whether or not our arguments obey the logical rules set by Aristotle.

2.5.2 Arithmetic

As is the case of many other intellectual skills, we still don't know how the cerebral mechanism responsible for arithmetic works.

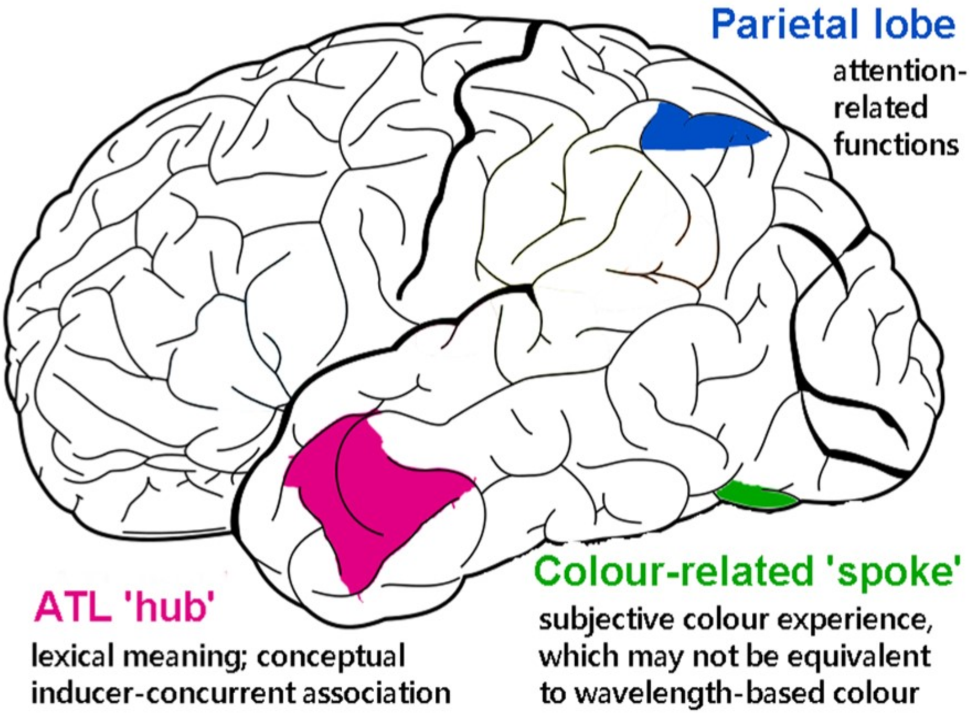
Since we learn how to perform basic arithmetical operations, these are stored in our long-term memory banks, very close to our language centre. This enables us to perform them quickly and with ease. Conversely, complex operations require the use of our parietal lobes and our work memory.



The Parietal Lobe (highlighted in blue)

2.5.3 Creativity

Creativity is used whenever we encounter irregular situations and have to use the "tricks" referred to in subchapter 2.4. When we find these, we are using the anterior temporal lobes.



Anterior Temporal Lobes (Highlighted in Magenta)

We will see in the next chapter that creativity is necessary when the key to a certain puzzle seems impossible to find. On the other hand, when the most obvious way to reach the solution is not very practical, we must come up with an easier method (the arithmetical puzzles illustrated in 3.2.2 prove this point).

Chapter III- Analysis of a Series of "Professor Layton" Puzzles

3.1 Methodology

The following analyses were performed considering the data present in the previous chapters and my own experience at solving puzzles.

In order to avoid the obstacles encountered by Ruger, the author of this monograph solved and analysed the puzzles alone, without any test subjects. This is because the goal of this investigation was to record the intellectual process of solving puzzles in optimum conditions and without any pressure or the fear of failure. Furthermore, no hints were ever used, as this would compromise the aforementioned process.

Finally, I have included the instructions and pictures of every puzzle, along with their solution and analysis.

3.2. Analysed Puzzles

3.2.1. Memory

Puzzle: Battle of Wits

Battle of Wits (3DS Upper Screen)

Instructions: In this puzzle, you have to memorise the order of a knight's attacks and repeat it by choosing the corresponding drawings.

Solution: The first knight performs 4 attacks. The second and the third perform six. However, the third knight disappears before the sixth attack. The attack the knight performed after disappearing is logically the only one we did not see.

Battle of Wits (3DS Lower Screen)

Analysis: Generally, memory puzzles consist of remembering colours or bi-dimensional objects. This particular puzzle, however, forces us to mentally visualise attacks in three dimensions. Moreover, we have to match them to bi-dimensional drawings, which is, on the whole, a somewhat complicated process.

It should be noted that there are essentially two ways we can memorise: by language (i.e. mentally repeating the names of what we want to remember, such as "red, blue, green") or by making a mental image of what we want to remember. However, here we have to memorise a sequence of attacks whose names we don't know. Therefore, we have no choice but to mentally visualise them.

3.2.2. Arithmetics

Puzzle: The Window Pain

Window Pain (Initial Screen)

Instructions: "I was carefully cleaning up the fragments of this broken window with my three friends. I picked up the first three pieces. My friends followed in turn, each picking up three more pieces than whoever went before them. In the end, there were still three fragments on the floor. How many pieces of glass were there to begin with?"

Solution: The sum of all the pieces equals 33.

Window Pain (Finished Puzzle)

Analysis: The more arithmetical operations one has to perform, the harder it will be for their parietal lobes to organise and solve them. Now, most people would try to do the math in their heads, which, in this case, is hard to do. Thus, we have to use our creativity in order to find an easier way. The latter consists in writing down the information given by the puzzle in numbers: 3+(3X2)+(3X3)+(3X4)+3=33. Each operation written between round brackets corresponds to one of the "friends".

Puzzle: Ride Rotation

Ride Rotation (Initial Screen)

Instructions: A girl tries a spinning teacup ride, beloved at amusement parks across the world. There are four saucers on the ride's base and four cups on each saucer. The base, saucers and cups each take 20 seconds to make one complete clockwise rotation. If the girl in the picture is facing east now, which way will she be facing after the cup has spun for 15 seconds?

Solution: One complete rotation of 20 seconds is 360 degrees. However, 15 seconds is only long enough for ¾, in other words, 270 degrees. We thus have to sum all three rotations (taken by the base, the saucer and the coup), which totals 810 degrees. Since two full rotations are 720 degrees, we are left with 90 degrees (¼ of the rotation) to reach 810. As the rotation is clockwise, the girl will be facing South.

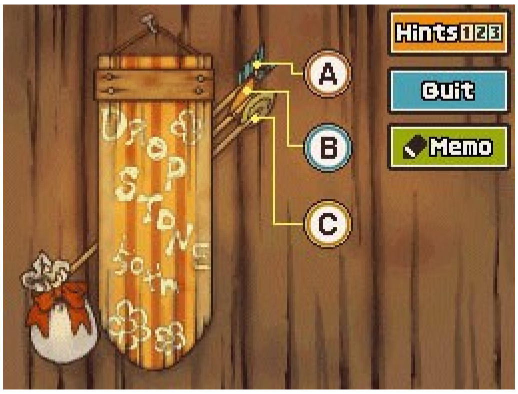
Ride Rotation (Finished Puzzle)

Analysis: While it appears that we require an extensive knowledge of maths and geometry to solve this puzzle, the latter is actually solvable by a few basic operations. However, the intimidating nature of this puzzle is intentional. We assume only a genius would be able to figure out the answer, which discourages us "laymen" almost immediately.

We should always be aware that there is a practical solution to every (well-designed) puzzle. Otherwise, our reasoning will be much poorer and we'll be tempted to give up. Self-confidence is an important trait to have when solving a puzzle.

3.2.3 Illusions

Puzzle: The Winning Arrow



The Winning Arrow (Initial Screen)

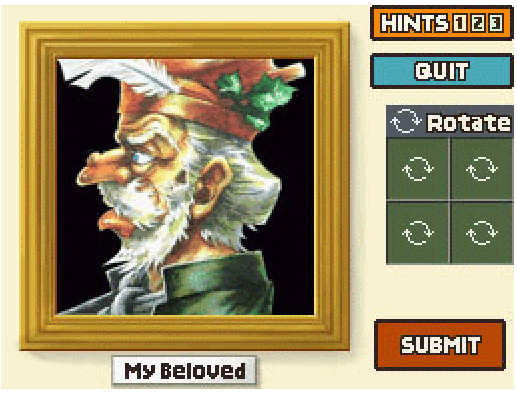
Instructions: A bag of candy dangles from one of three arrows attached to the wall. Assuming that all three arrows are perfectly straight, which arrow - A, B, or C - is connected to the candy?

Solution: B.


The Winning Arrow (Finished Puzzle)

Analysis: This puzzle offers an example of the Poggendorff illusion. We would tend to choose arrow C because, theoretically, our perception of concealed acute angles in diagonal lines is poor. Curiously, the illusion doesn't manifest itself when the lines are horizontal or vertical.

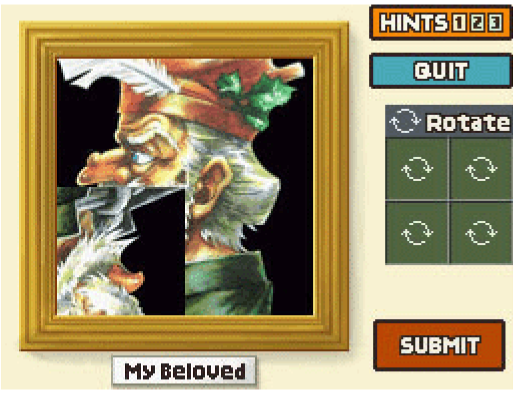
Puzzle: My Beloved



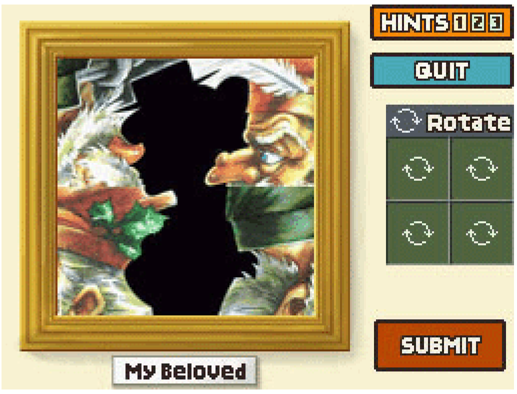
My Beloved (Initial Painting)

Instructions: A work from a famous artist was recently discovered. The painting is a self-portrait of the painter in his later years and is entitled "My Beloved". Assuming the artist wasn't a huge narcissist and referring to himself, his beloved should appear in the painting somewhere. Can you find his beloved?

Solution: By rotating the image, we can change the position of the man's face, along with the black background. When we combine the latter in the centre of the painting, we obtain the silhouette of the man's "beloved".



My Beloved (Rotation)



My Beloved (Rotation)

Analysis: This puzzle was inspired by an image developed by the psychologist Edgar Rubin called "Rubin's Vase". The latter displays the white silhouette of a vase. However, the black background can be perceived as two identical faces looking at each other. In order to perceive these shapes, we have to use our association cortex, along with our experience at observing vases and faces.

As far as this puzzle is concerned, it should be noted that we do not tend to focus on the apparently irrelevant background as much as we do on the colourful and well defined face. This is because the latter is much easier to recognise. Thus, whoever doesn't know about Rubin's vase and its particularities would probably have a hard time solving this puzzle, not knowing what to expect.

3.2.4 Logic

Puzzle: Trial by Tennis

Trial by Tennis (Initial Board)

Instructions: Six ladies have just finished playing a tennis tournament round-robin style (each one played all the others once). The results are still in the process of being drawn up on the board here, but you know only two of the matches ran out of time and ended in draws. Much to her surprise, E managed to win a match despite being a tennis rookie. Can you work out whom she defeated?

Solution: We immediately know that E did not beat B, as B was never defeated. From what we can read on the board, we know that both games that ended in draws were played by C (one against A and the other against B). Ergo, A lost only against B, tied with C and defeated D, E and F.

Knowing that D lost against A and B, we can deduce that D defeated C, E and F.C tied against A and B, and lost against D. Therefore, his two victories could only have been against E and F. By a process of elimination, the only person who could have lost against E is F.

Trial by Tennis (Finished Board)

Analysis: This puzzle was probably inspired by the "zebra puzzle", which was created, allegedly, by Einstein himself when he was young.[3] Essentially, we have to make our deductions based on what the puzzle tells us.

The logical process necessary to solve this puzzle consists of testing a series of hypotheses ("if X, then Y; if Y, then Z", etc.). Now, this puzzle in particular follows a clear and linear line of thought, which forces us not to lose focus until we have our final answer. If our train of thought is lost, it may be necessary to start from the beginning, as we will start to doubt our conclusions. Thus, we can't afford to let our left pre-frontal cortex rest until we find the answer, which constitutes a good mental exercise in and of itself.

Puzzle: The Cake Gobbler

The Cake Gobbler

Instructions: "Hey! Somebody ate my piece of cake! I was saving that for later"! A: "I didn't eat it"! B: "Neither A nor D ate it". C: "I didn't eat it, either"! D: "C is telling the truth". Somebody isn't telling the truth. That person is the cake gobbler. Who is it? !

Solution: If A were lying, B would be too. Ergo, neither is the cake gobbler. If C were lying, so would D be. Thus, they did not eat the cake either. The only statement that doesn't match any of the others is that of the owner of the cake himself. Ironically, he is the cake gobbler.

3 We now know that Einstein couldn't have created the puzzle, since a cigarette brand mentioned on the original zebra puzzle didn't exist when the physicist was young.

Analysis: The logical key to this puzzle is the fact that only one person is lying. However, there is a trick: we tend to assume that the cake gobbler has to be either A, B, C or D. Therefore, we can only rely on our critical thinking skills and not on what we assume to be absolutely true by default.

In some puzzles of this kind, the person who is lying is not necessarily the culprit we are looking for. This is yet another trick designed to fool us.

3.2.5. Visual Perception

Puzzle: Funny Shapes

Funny Shapes (Initial Screen)

Instructions: Five shapes are drawn on the chalkboard below. One of them is not quite right. Which one?

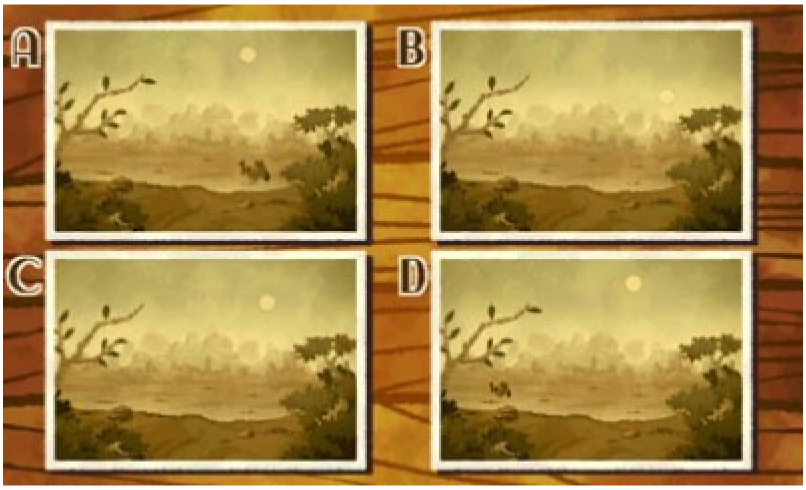
Solution: If we look closely, we will find that all the shapes drawn are composed of a certain number (the first shape is composed of threes, the second of fives, the third of sevens, etc.). This is what they have in common. However, there is something else: the shape of threes is composed of three threes, the one of fives is composed of five fives, etc. The shape that doesn't belong is the one composed of sixes, because it has only five sixes.

Funny Shapes (Finished Puzzle)

Analysis: This puzzle is arguably inspired by the ***Gestalt*** effect. The latter consists in the idea that the whole is other than the sum of the parts. Indeed, at first glance, these shapes have nothing in common. They are simply irregular drawings and not made of several numbers put together. However, according to the puzzle, only one of them isn't "quite right". Thus, we deduce that they must have something in common. By using the association cortex and our experience at observing Arabic numbers, we can separate mentally the parts of each shape.

Finally, in order to find the actual solution, we have to count every single number in every shape, which is done by another mental separation.

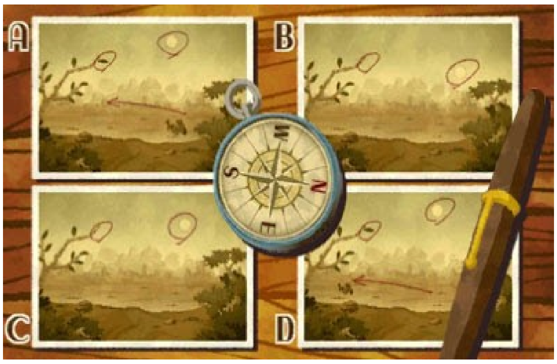
Puzzle: Faded Photos



Faded Photos (Initial Screen)

Instructions: Four dusty photos are kept in a battered old box of keepsakes. They're faded and hard to make out, but they all show the same place and seem to have been taken within a short space of time. In photo A, you can see a horse-drawn carriage traveling across the frame. Can you tell in which direction the carriage was headed?

Solution: Since we can see the Sun in these photos, we have a natural clue as to where the carriage is headed. Knowing that the Sun is setting and that it is to the right of the carriage, we deduce that the latter is heading South.



Faded Photos (Finished Puzzle)

Analysis: This puzzle requires the use of no less than three skills: perception, logic (respectively, the visual cortex and the prefrontal cortex), and critical thinking.

Considering that the photos were taken within a short space of time, we can deduce if the Sun is either rising or setting. In order to figure out which, we have to notice the tree branch whose only leaf can be seen in A and D (when the carriage is passing by), but not in B and C (because it fell). Therefore, the photos show the sunset.

Puzzle: Mysterious Memo

Mysterious Memo (Initial Screen)

Instructions: When you returned to you apartment, you discovered a strange piece of paper next to your calculator. Your roommate must have been trying to tell you something before he left. The note says "101 X 5". What could

this mysterious memo mean?

Solution: 101 X (times) 5= 505. The number 505 can be read as SOS.

Mysterious Memo (Finished Puzzle)

Analysis: It should be noted that there are many ways one can associate numbers with letters. We can identify letters by their order in the alphabet (A=1, G=7, etc.), by their place on the keys of a cell phone (2=ABC, 8=TUV, etc.) or even by Roman numerals (V=5, L=50, etc.). For this reason, it is not easy to decipher connections between numbers and letters in puzzles. Since we see a calculator, it is logical to assume the solution is to be found not in the operation itself but in its result. Finally, using the association cortex, we match the number 505 to SOS.

3.2.6 Mental Rotation

Puzzle: Stamp Stumper

Stamp Stumper (Initial Screen)

Instructions: This stamp is adorned with a blazing Sun motif. Can you picture how the design will look after you plonk the stamp down onto a piece of paper?

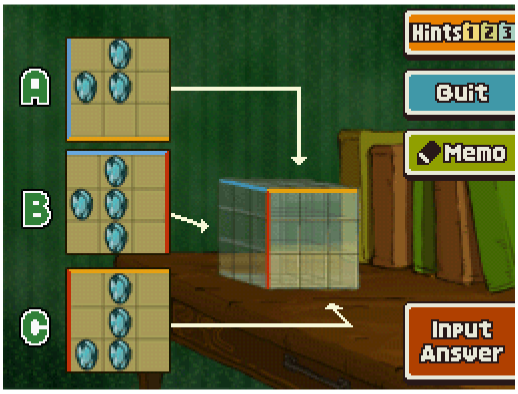
Solution: When we use a stamp on a flat surface such as a table, we obtain a mirrored depiction of the motif. Consequently, it can be neither A nor B. As far as C and D are concerned, we have to mentally rotate the stamp to verify that image C cannot be obtained. Thus, we are left with D.

Stamp Stumper (Finished Puzzle)

Analysis: This puzzle requires us to not only mentally rotate the drawings, but also to find certain differences between the drawings and the stamp motif. Thus, we use the visual cortex and the Supplementary Motor Area.

The puzzle may trick us into thinking the right drawing depicted an exact reproduction of the motif when the latter is turned upwards.

Puzzle: Glass Boxes

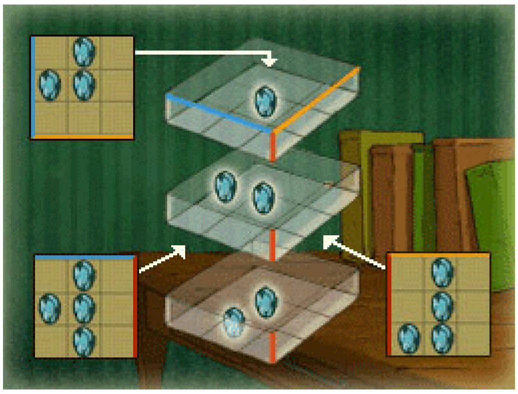


Glass Boxes (Initial Screen)

Instructions: Twenty-seven glass boxes have been stacked together to form a cube. Some of the glass boxes have a gemstone inside. Image A shows a view of

the cube from above, B shows a view from the side and C shows a view from the front. How many of the boxes contain gems?

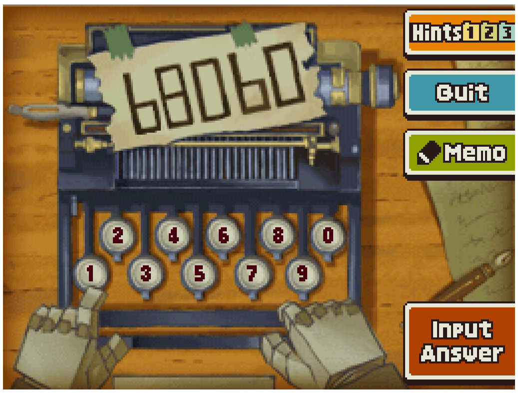
Solution: 5 gems. Image C shows 4 of the stones, which we can seen from the side. Image B shows the only gem we can't see from the front, since it is behind the gem shown in the middle of image C.



Glass Boxes (Finished Puzzle)

Analysis: If we saw these images bi-dimensionally, we would count a total of 11 gems. Consequently, we need to bear in mind that some of the stones shown in one image may be the same as those shown in different angles. It is hard for our brains to repeatedly compare different sides of a tri-dimensional object.

3.2.7 Creativity
Puzzle: Typing Numbers



Typing Numbers (Initial Screen)

Instructions: This typewriter has only number keys. Pressing a single key

types out that number immediately, but pressing subsequent keys takes an extra second for each key further along the keyboard from the previous key. For example, pressing 1 then 2 takes one second. Pressing 1 then 3 takes two seconds. What is the shortest time possible (in seconds) it will take to type "68060" as shown on the paper?

Solution: If we press the keys that we see on the paper, we would take 12 seconds. This is how the puzzle tricks us. However, if we turn the paper upside down, we get "09089", which we type in only 5 seconds.

Typing Numbers (Finished Puzzle)

Analysis: Anyone who has solved puzzles similar to this can instantly evoke the memory that a six turned upside down is a 9. In other words, they use their procedural memory. After that, they need only to count the seconds.

However, if you have never solved a puzzle like this, you have to use your anterior temporal lobes (for creativity) and your prefrontal cortex (for logic).

Puzzle: Seven Coins

Seven Coins (Initial Screen)

Instructions: Seven gold coins make up a circle. Moving only one coin, arrange them so there are an equal number of heads-up coins as there are tails-up coins.

Solution: We have 5 heads and two tails, so simply flipping a coin does not work. Consequently, besides flipping a coin, we need to place it on top of another head. Thus, we have 3 heads and three tails.

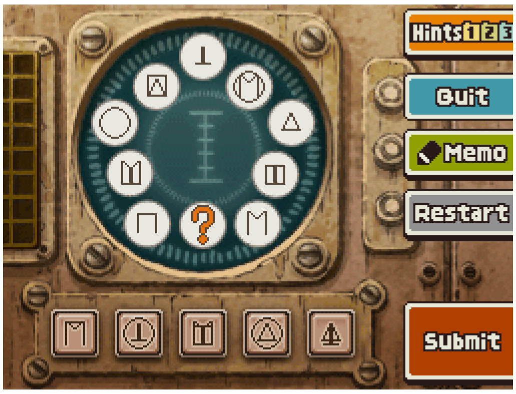

Seven Coins (Finished Puzzle)

Analysis: The game allows us to move the coin. Therefore, it stands to reason that that is part of the solution. However, in real life, most people would think that the only possible interaction performed with the coin would be to flip it. For this reason, it would be much harder for them to find the solution.

This is a good example of how, when we solve a puzzle, appearances often deceive us, both visually and perceptively.

3.2.8. Pattern Recognition

Puzzle: Switchboard Cipher



Switchboard Cipher (Initial Screen)

Instructions: This switchboard has an emergency-shutdown feature. Apparently, all you have to do is press the button marked with the symbol that should appear in place of the question mark. The symbols are arranged according to a certain rule. So, which button is it?

Solution: The most complex images result from combining two other symbols, both of them three symbols apart from each other. For example, the circled M is a mix of both the solitary M and the circle. Thus, the missing symbol is the circled triangle (a result of the triangle and the circle 3 symbols away).

Switchboard Cipher (Finished Puzzle)

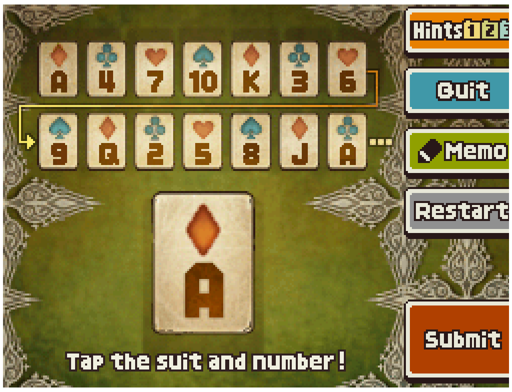
Analysis: We know from experience that the symbols consist of squares, triangles, circles and some irregular shapes. The goal is to find out what the shapes have in common in this context.

Now, unless we know a priori what we are looking for, we'll have a hard

time perceiving some symbols as combinations of others. Nevertheless, this puzzle could have been made more complicated if the symbols all had different sizes and/or were turned to the side. These small details would make it harder to find the common denominator.

In short, we can find the solution by mentally visualizing triangles (groups of three) whose "corners" are symbols associated with each other.

Puzzle: The 26th Card



The 26th Card (Initial Screen)

Instructions: You have a 52-card deck with no jokers. If the cards are all placed in a certain order that follows the pattern below, what will the number and suit of the 26th card be?

Solution: As far as the numbers are concerned, we perceive that each card is 3 numbers above the previous one. The cards whose value is above 10 are the jack, the queen, the king and the ace. On the other hand, the order of the suits is "diamonds, clubs, hearts, spades".

Since the ace is the 14th card, we know that the order repeats itself after the jack (13th card). Thus, the next ace is the 27th card, making the jack the 26th.

Taking into account that the first ace is that of diamonds and the second is that of clubs (following the general order of the suits), we can deduce that the third is that of hearts. This means that the card before that is one of clubs. Therefore, the 26th card is the jack of clubs.

The 26th Card (Finished Puzzle)

Analysis: Anyone who knows a priori the value of cards in poker will figure out the number sequence easily. Otherwise, it will be necessary to study the pattern in order to find out why 8, 9 and 10 are followed, respectively, by J, Q and K.

Theoretically, we could find the solution by simply counting the cards in our heads or by drawing them on paper. However, this is the least practical (but most obvious) method. Thus, we have to search for certain details in the pattern, which allow us to deduce the answer more easily.

3.2.9. Mechanical Puzzles

The most classical amongst the "Professor Layton" puzzles are the mechanical ones. These consist of tables whose pieces are movable (according to certain rules). Thus, solving them may take dozens of moves, even if we do not make any mistakes (though a secondary goal is to make as few moves as possible). Their main objective is generally simple in theory (i.e. getting a ball from one place to another). However, the obstacles we encounter (and even the movable pieces) make the puzzle much harder than expected.

Considering what we wrote in the previous paragraph, it would not be practical or useful to specify the solutions to the mechanical puzzles we will illustrate. However, we will provide the instructions to each example.

Analysis: There are two methods we can use in order to solve these puzzles:

The conceptual method consists of mentally visualizing every move we have to make until we reach the goal. Thus, we solve the puzzle with as few moves as possible. However, this is made complicated by the sheer number of necessary

moves we have to memorize.

The perceptual method consists of trial and error, but always keeping in mind the moves we haven't tried. These are the ones that often allow us to progress when we're stuck. This method may take longer than the other and requires a much greater number of moves. However, it can be deemed as safer and more effective in complex puzzles.

Examples:

Bunny-Hop Swap

Bunny-Hop Swap (Initial Screen)

Instructions: Here are some rather unusual rabbit toys. There are three rules: 1. The rabbits can only move by jumping horizontally, diagonally, or vertically over other rabbits. 2. They can jump over any number of rabbits at once. 3. A white rabbit will turn brown when jumped over, and vice versa. Can you make all the rabbits here turn brown, following the rules given above?

Bunny-Hop Swap (Finished Puzzle)

UFO SOS

UFO SOS (Initial Screen)

Instructions: "One day, I saw a spacecraft hanging motionless in the sky right above me. 'Must be engine trouble,' I thought. The solution was simple. All I had to do was move to the spacecraft's energy ball from the left to the right, and it was as good as new! Think you can do the same?"

UFO SOS (Finished Puzzle)

Emperor's Throne

Emperor's Throne (Initial Screen)

Instructions: Six penguins are standing on an iceberg- five small ones and their rather portly emperor. All penguins can move either horizontally or vertically, but once in motion they won't sop until they hit another penguin. If there is nothing in the way, they'll plunge straight into the sea! Can you help the emperor penguin get back to his rightful place in the centre of the iceberg?

Emperor's Throne (Finished Puzzle)

Conclusion

From the results of the analyses done in this study, it becomes clear that puzzle solving is essential if we wish to develop mental skills such as logic and imagination. Consequently, the scarcity of studies done on the subject is nothing short of regrettable. Indeed, the only monograph we found that deals with the mental processes involved in puzzle solving is Ruger's. Of course, Ruger did not have the data obtained recently by fMRI studies. Conducting more thorough investigations as to how people solve puzzles may reveal fully how certain cerebral processes work.

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RESUMO

Sempre que confrontamos um problema invulgar, somos forçados a ponderar uma solução, utilizando partes do nosso cérebro que (normalmente) não utilizamos no nosso dia-a-dia. Contudo, muito poucos estudos foram efectuados relativamente a como a resolução de puzzles pode beneficiar as nossas capacidades intelectuais. Por conseguinte, muitos não sabem como aperfeiçoar o seu pensamento crítico. O objectivo da presente monografia é analisar um certo grupo de puzzles que apareceu alguns anos atrás em videojogos destinados para as consolas portáteis: aqueles incluídos na série Professor Layton. Apesar de ser possível encontrar soluções directas em guias de estratégia, tentaremos no presente trabalho mostrar como processamos a informação necessária à resolução

de um puzzle, e como isto beneficia o cérebro. Com esta finalidade, foi resolvida uma série de puzzles e registado o processo cerebral, tendo em atenção o que se sabe actualmente da utilização das capacidades intelectuais.

Palavras-chave

Puzzles. Professor Layton. Capacidades intelectuais. Pensamento crítico.

ABSTRACT

Whenever we encounter an uncommon problem, we are forced to think of a solution using parts of our brain we do not normally train in our daily life. However, so far, very few papers have been written on how our intellectual abilities are improved by solving puzzles. The goal of this monograph is to analyse a group of puzzles included in the "Professor Layton" series. While strategy guides may provide direct, easy answers, I shall endeavour to show how people process mentally the information required to solve puzzles and how this benefits the brain. The genres of the aforementioned puzzles range from logic and arithmetic to mental rotation and pattern recognition.

Ultimately, I submit that puzzle solving is an extremely effective method of improving our intellectual abilities. Thus, its study may yet help neuroscientists progress in their investigation of mental processes.

Key-words

Puzzles. Professor Layton. Intellectual abilities. Critical thinking.

NOTA – As imagens que ilustram este artigo foram gentilmente cedidas pela autora.