JAMAME Journal of Advanced Mathematics and Mathematics Education
2023, VOL. 06, NO. 3, 11-23

The Data Delivering Algebraic Arcs (DADA-ARCS) of Corpus Callosum Like as Brachistochrone Curve in Brain: A New Thorem

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Abstract

Background: Corpus callosum provides the flow of information between the two cerebral hemispheres. Algebraic analysis of corpus calosum curve has not been adequately studied. According to the Pythagorean theorem, the shortest path joining the ends of the two right sides of a right triangle is the hypotenuse. However, the shortest time path for a particle is the brachistochrone curve. In this study, brachicytokrone like architectures of corpus callosum and food catching time of rats were examined.

Methods: 15 male rats were included in this study. Animals divided into three groups according to o determine food catching time (FCT/msec) in average time (GI; n=5), above (GII; n=5) and below (GIII, n=5) of average. It was confirmed by algebraic methods that the microhistoanatomical structures of the corpus callosum resembled the brachystochron curves. The **Da**ta **D**elivering **A**lgebraic **A**rcs were named DADA-ARCS because of the initials of the words in the title. The area between the DADA arches and the brachystochrone curves (DADA-ARC/BSC) and the FCT were analyzed with the t test.

Results: Average FCT of GI was 223±17 msec; for GII was 276±39 ms, and for GIII was 189±15 msec. Average B-CCS values (mm2) were: 1.023±0.289 in GI; 1.798±0.401 in GII and 0.711±0.152 in GIII. Statistical results were: $p<0.005$ in GI/GII; $p<0.0001$ in GII/GIII and $p<0.00001$ in GI/GIII.

Conclusions: Since the arcs of the corpus callosum resemble the brachiocytokrone curve, the interhemispheric signals reached the target in a shorter time, and the food capture time was found to be shorter in these subjects.

Key words: Corpus callosum, DADA-ARCS, capture tim

1. Introduction

The corpus callosum connects the two hemispheres anatomically and physiologically and have important roles on decision-making process and knowledge transportations between two hemispheres (Peruzzo D, Med Image Comput Comput Assist Interv. 2014). The integration of information across the corpus callosum is dependent on its structural integrity and functionality (Berretz G, Behav Brain Res. 2022). Corpus callosum abnormalities have adverse effects on decision-making process (Caiazzo G, J Neurol. 2014). Billions of neural networks consisting of trillions of nanometeric and femtometric mini neurocomputers must operate with maximum time and energy savings. Otherwise, the brain will never be enough for the biochemical energy it will have to use. Even if it is enough, the brain will burn with the heat energy that will be released. In order for the inputs and outputs to be processed by trillions of circuits to be concluded with a common decision, these circuits must work fast and simultaneously. In order for the speed of thought, which is the most important software of the brain, which we can call RAM power, to be at the ideal and maximum level, the hardware of the brain must be in a state to manage these principles. Brain circuits, which are neuroelectrodynamically a signal generator, emitter and collector, have to use signal flow time sparingly. According to Euclidean theory, the shortest line between two points or between the ends of two overlapping line segments is a line segment. However, since the brain is a dynamic and global structure, these theories lose their validity in the universe of neural circuits. In our opinion; he corpus callosum, which is a curved space in a continuous vibration state, which connects the brain hemispheres anatomically and functionally, should also be examined with the laws of non-oclidian geometry and quantum physics. According to the geometry of curved spaces and quantum physics laws using non-Euclidean methods; the brain also needs the shortest-time path in terms of physics-time geometry. According to current science, this path is the cycloid or cytochrone curve described by Bernouli, Galileo and Huygens (Kamath SG, Phys Rev A Gen Phys. 1987). The brachistochrone is the shortest-time curve for the shortest travel time (Sun P, Sci Rep. 2022). In this study, we examined the relationship between the time of finding food and the geometric structures of the corpus callosum in rabbits; Interestingly, we found that the corpus callosum structure was curved parallel to the cycloid in fast decision makers. We transformed the area between the corpus callosum curve and the cycloid curve as the capture time difference in those with a long capture time. With this area, the food catching times of the rabbits were found to be statistically significant. In the future, I predict that our theory will be confirmed by newly invented devices.

2. Materials Methods

15 Male rats with a bodyweight of 367±0.78g were used in that study. Animals were fed with standard laboratory chow and water. To determine of food catching time, the food reaching test

was applied. Each rat was placed in a stainless steel cage and followed two weeks to apply food reaching tests every day. The ceiling hole 40 cm above the floor and the rat could reach to food with either front paw. A carrot was conveniently placed in the hole in with pellet food four times a day daily. Food catching time of each rat's with the right or the left paw reaching scores were noted. The process was repeated for each rat 100 times. without making any distinction between right-handedness and left-handedness, the time taken by the calves to catch food was taken as a basis. At the end of the experiment, the subjects were sacrified by intracardiac injection of formalin under general anesthesia.

2.1. Histological analysis

Their brains were removed intact and fixed with 10% formalin. Sections taken from the parietal conus perpendicular to the basal brain plane were embedded in paraffin blocks to see the busiest part of the corpus callosum. Sections of five microns taken were stained with hematoxylene eosin and examined with a light microscope. Results were compared statistically using by Mann Witney U test.

It was confirmed by algebraic methods that the microhistoanatomical structures of the corpus callosum resembled the brachystochron curves. The **Da**ta **D**elivering **A**lgebraic **A**rcs were named DADA-ARCS because of the initials of the words in the title. The area between the DADA arches and the brachystochrone curves (DADA-ARC/BSC) were estimated by algebraic methods. Arcs representing the degrees of curvature of the corpus callosum were drawn in the computer environment. Next, a brachystochrone curve selected from the literature was placed transparently over the corpus callosum. The areas between the corpus callosum's own arc and the brachistochrone curve were counted using the grid-square method. Findings and calculation methods of the article are given in picture captions.

2.2 Numerical values

Average FCT of GI was 223±17 msec; for GII was 276±39 ms, and for GIII was 189±15 msec. Average B-CCS values (mm2) were: 1.023±0.289 in GI; 1.798±0.401 in GII and 0.711±0.152 in GIII. Statistical results were: $p<0.005$ in GI/GII; $p<0.0001$ in GII/GIII and $p<0.00001$ in GI/GIII.

2.2.1. Discussion

It has always been a matter of curiosity how the nervous system takes measures to ensure the most efficient and economical transport of the signal flow rate between the two circuits in the nervous system. According to Euclidean theory, the shortest line between two points in a plane is a line

segment. However, it is impossible to find an Euclidean plane, since the universe is spinning. Thus, in such spaces, the shortest distance between ii points can be any type of regular or irregular arc. For example, according to the Pythagorean theorem, one of the foundations of mathematics; The shortest distance joining the right side ends of a right triangle in a plane is the hypotenuse. However, when you plan to make a path between the two ends of a right triangle in the vertical plane and go down, the shortest path in terms of physical time is not the hypotenuse, but the brachistochrone (Cycloid) curve drawn between these two ends. The cycloid is the quickest curve and also has the property of isochronism by which Huygens improved on Galileo's pendulum (Kamath SG, Phys Rev A Gen Phys. 1987).

2.2.2 Historical Perspective

When Johann Bernoulli is on the verge of 30, a question comes to his mind. Question: "What kind of slide should a person on a high tower use to get down to the ground as soon as possible"? is in the form. And it publishes it as an award-winning question in a major journal. After long and ingenious calculations, Bernoulli found that the fastest slide should be in the form of a cycloid curve. Galileo asked himself this problem before: "There must be an arc close to a circle"! found an answer. Indeed, years before Bernouli, Galileo studied this curve most extensively and named it cycloid. Another person who has done permanent work on the cycloid is Blaise Pascal. So what is a cycloid? If you mark a fixed point on a circle and roll it on a flat table, the vertical path that point follows in the vertical plane becomes a cycloid curve. Christiaan Huygens also posed another interesting problem with the cycloid curve in 1659. If we drop a ball from the edge of a bowl and watch it roll in the bowl, we will see that with each rolling, the height reached by the ball decreases and the duration of each oscillation is different from each other. The question was: What should the shape of the bowl be so that even if the ball slows down, the duration of each oscillation is the same? This problem is called the Tautochrone Problem, the Synchronicity Problem. Huygens solved this problem and showed that the solution would be a cycloid curve.

3. Selections From The Application Areas Of The Brachistochrone Curve

Quantum brachistochrone is the shortest path for quanta (Koike T. Philos Trans A Math Phys Eng Sci. 2022). The brachistochrone is the shortest-time curve is the path connecting two points that enables the shortest travel time (Sun P, Sci Rep. 2022). Classical mechanics mentioned brachistochrone to formulation of dynamics and electrodynamics problems (Pinheiro MJ. Heliyon. 2017). Quantum echanics plays an important role in modern science and technology by generalizing a recent method for solving quantum brachistochrone equations (Geng J, Phys Rev Lett. 2016). Carnot cycle related to entropy concept derived from brachistochrone formula (Zhao T, Entropy (Basel). 2018). Dropping objects represent simple harmonic motion according to environmental gravitation laws (Pesnell WD. Am J Phys. 2016). Markovian dynamics to pursue the fastest convergence to the stationary state. The brachistochrone method is applied to the continuous-time master equation for finite-size systems (Takahashi K, Phys Rev E. 2016).

The quantum brachistochrone equation is required for potential to provide accurate time-optimal protocols for a wide range of quantum control problems (Wang X, Phys Rev Lett. 2015). The excitonic optimal energy transfer in photosynthetic systems is modulated by quantum brachistochrone parameters (Thilagam A. J Chem Phys. 2012). The quantum mechanical brachistochrone systems regulate higher-dimensional Hilbert space dynamism (Günther U, Phys Rev Lett. 2008) and quantum computing (Bender CM, Phys Rev Lett. 2007). Biopolymer folding pathways is regulated by brachistochrone parameters (Fernández A, Biophys Chem. 1998).
Inspired by these laws of mathematics and physics, we hoped it would be useful to analyze whether the degree of curvature of the corpu callosum plays a role in rapid decision making. With the help of animal experiments, we investigated whether there is a relationship between the degree of practicality and the spring feature of the corpus callosum, which has a major role in the joint decision-making of bryn by carrying signals between the two hemispheres.

3.1. Corpus Callosum

Corpus callosum have important roles on decision-making process and knowledge transportations between two hemispheres (Peruzzo D, Med Image Comput Comput Assist Interv. 2014). The corpus callosum has an important role in determining lateralityand (Sacco S, Dev Psychobiol. 2006). Functional hemispheric asymmetries emerge as the left and the right hemisphere are dominant for different aspects of task processing. However, the hemispheres do not work independent of each other but share information through the corpus callosum. The integration of information across the corpus callosum is dependent on its structural integrity and functionality (Berretz G, Behav Brain Res. 2022). Functional lateralisation of brain functions is distributed along four functional axes: symbolic communication, perception/action, emotion, and decision-making. This latter result suggests that during evolution, brain size expansion led to functional lateralisation to avoid excessive conduction delays between the hemispheres (Karolis VR, Nat Commun. 2019). Corpus callosum abnormalities have adverse effects on decision-making process (Caiazzo G, J Neurol. 2014). Corpus callosum agenesies lead to decision-making compromise and potential negative social consequences (Ferreira Furtado LM, Cureus. 2022). Individuals with agenesis of the corpus callosum can have intelligence within the normal range, but nevertheless have deficiencies in decision-making and complex novel problem-solving (Brown WS, Arch Clin Neuropsychol. 2012). Reaction time increases with callosal agenesia owned patients (Anstey KJ, Neuropsychologia. 2007). When we apply the same laws to the brain, we encounter the fact that the arcs of the corpus callosum, which are the main parts of the brain in thinking and decision-making mechanisms, and the corpus callosum (CC), which connects the two cerebral hemispheres, are also cycloid.
With the method of my own design, I observed that the curvatures of the corpus callosum which determine the speed of thought with their cycloid curves, are equivalent to each other in order to embody the working speed of the brain and therefore the mind. And I named these springs DADA ARCS so that they can be named easily in the literature, taking the first letters of the first four words, which are largely hidden by chance in the title of the article I wrote in English. The laws

of mathematics and physics must be independent of each other. The laws of time and space are independent of each other. These data on the corpus callosum have been partially confirmed by radiological analysis (). (Acer N, Brain Res. 2010). In the future, I predict that our theory will be confirmed by newly invented devices.

3.1.1. Limitation: This study does not inculde electrophysiological data.

3.1.2. Conclusion: Nature's understanding of economy, saving principles and designs are magnificent. It is a magnificent design that the corpus callosum is designed similar to the plan cycloid in terms of physical time, so that the decisions taken by the two halves of the brain, which consists of two separate processing hemispheres, reach each other as soon as possible.

3.1.3. Future Insight: This is how nanoneurochips will likely be designed in the future.

4. Figures & Legends

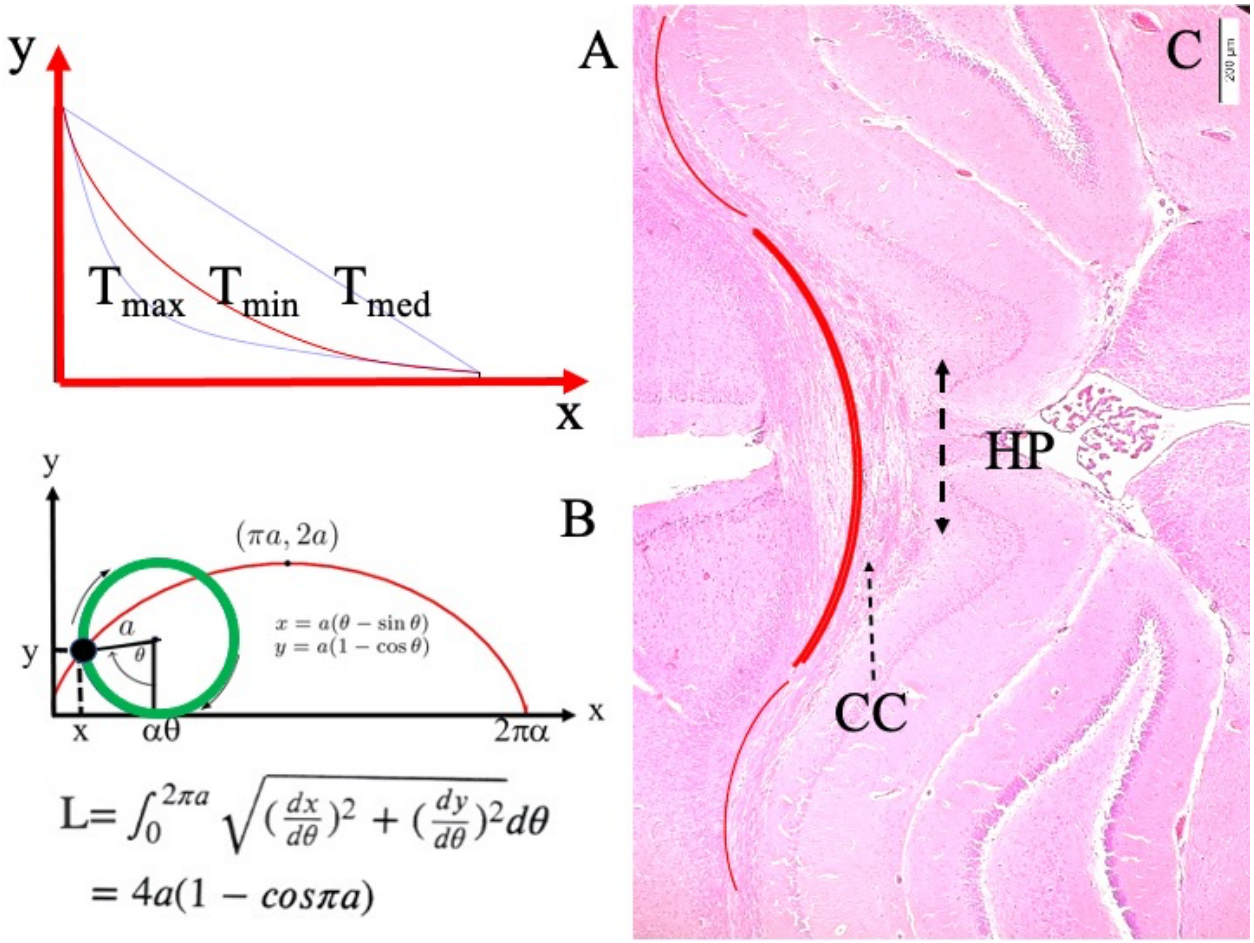

Figure 1

The cycloid is the most economical path to follow in free rolling downhill or in the movement of particles in the quantum world. In the right triangle in the figüre (A), although the shortest path between the ends of the right sides is the hypotenuse (TMD: Medium Time), the shortest path for a moving particle is the cycloid curve in the middle (TMİN: Minimum Time). In terms of time, the hypotenuse is in the second place and the left most parabola is in the third place (TMAX). Any point i on a circle draws a cycloid curve when the circle is rolled. The formation, shape and descriptive trigonometric equations of the curve are given in figure B. The arc of the corpus callosum (CC), which connects the cerebral hemispheres consisting of two hemispheres, also resembles a cycloid. Considering the functions of the corpus callosum (CC/in figüre C), it is likely that the callosal mimer was designed so that the signals between the two hemispheres reach their destination as soon as possible and the brain takes decisions at the most optimal time. In addition to the corpus callosum, note the same arcs in the adjacent hippocampus (HP) (LM, H&, x4/C).

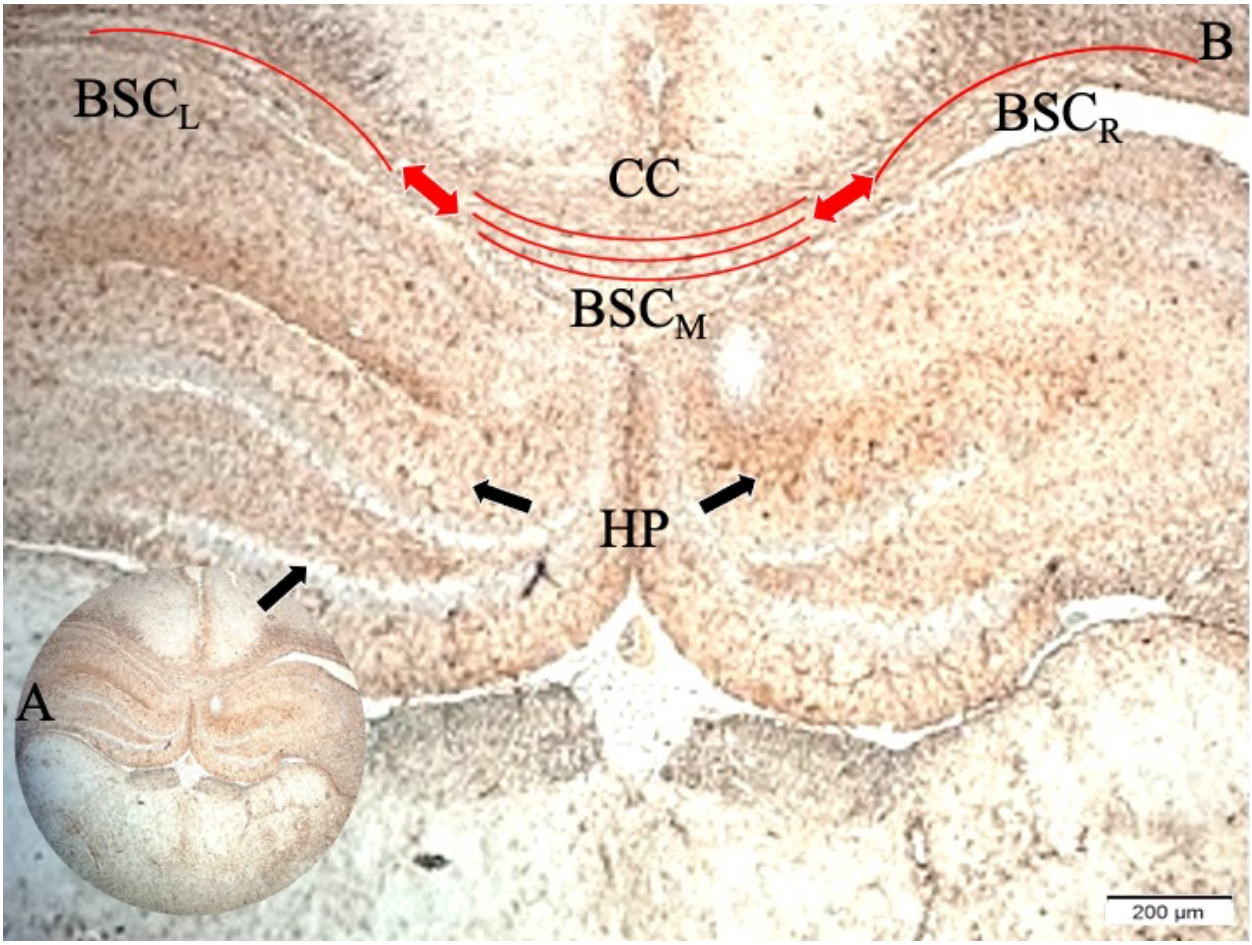

Figure 2

Histoanatomical pathways between corpus callosum and brain hemispheres are observed in figur A. In Figure B; The combined state (BSCM) of fibers from the right (BSCR) and left (BSCL) brain hemispheres is seen. According to us, this structural feature of the corpus callosum ensures that neurotransmitters and signals in the relevant axons reach the target as soon as possible. The presence of cycloid-like arcs in the hippocampus (HP), which is the memory area, is necessary for rapid recall (LM, GFAP, x4).

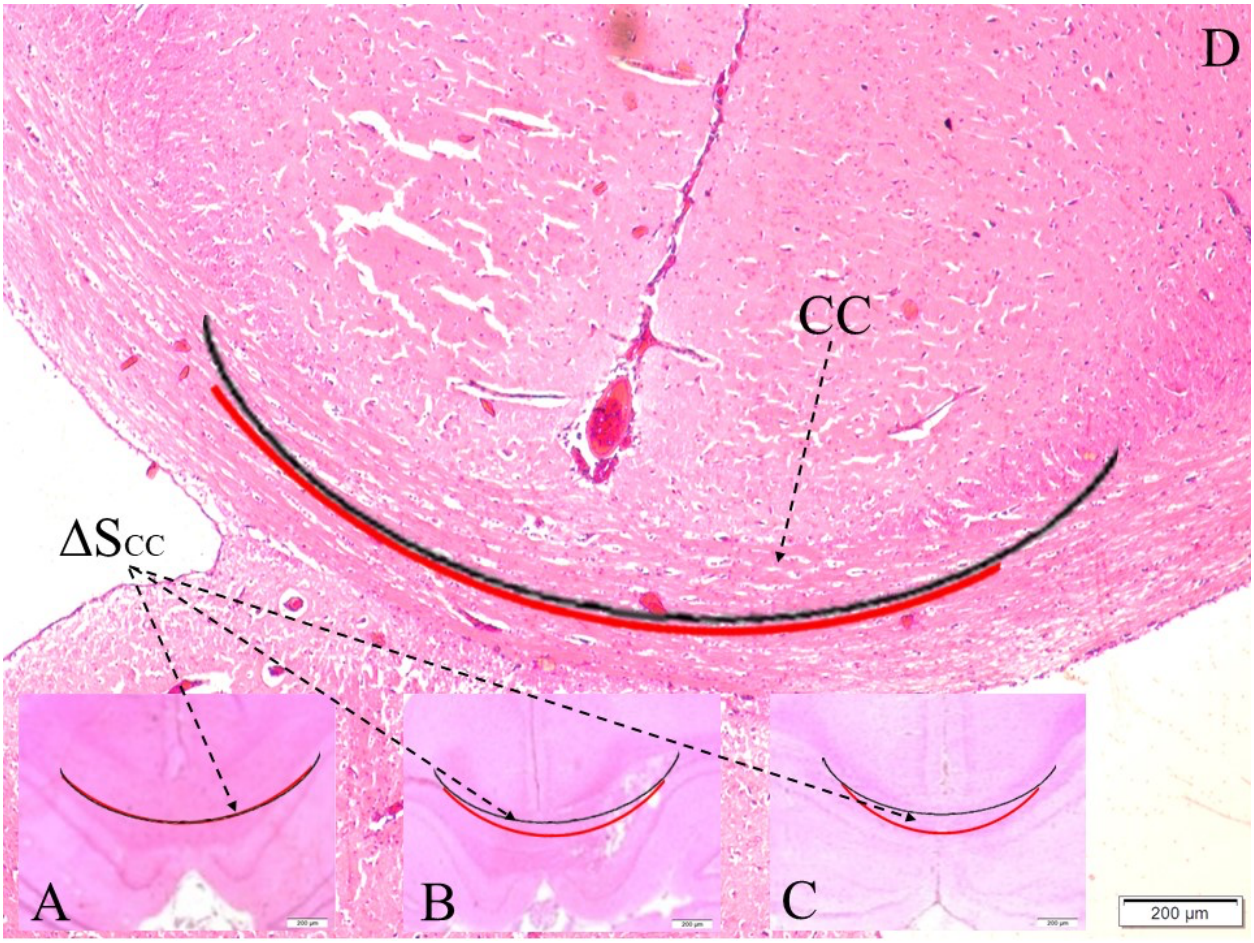

Figure-3

The differences in the histoanatomical pathways between the corpus callosum and brain hemispheres are observed in the groups. In Figure A, overlapping cycloid and corpus callosum curves of the subjects who found their food in the shortest time; in figure B, slightly discrete corpus callosum and cycloid curves of subjects who found their food in slightly above-average time; Figure C shows very discrete corpus callosum and cycloid curves of the subjects who were able to find their food in the longest time. In our opinion, the area between the arc of the corpus callosum and the cycloid curve corresponds to the decision-making time in time. In the article, this area

value (SSC) and the time to find food were compared. This finding interestingly supported our theory (LM, H&E, x4).

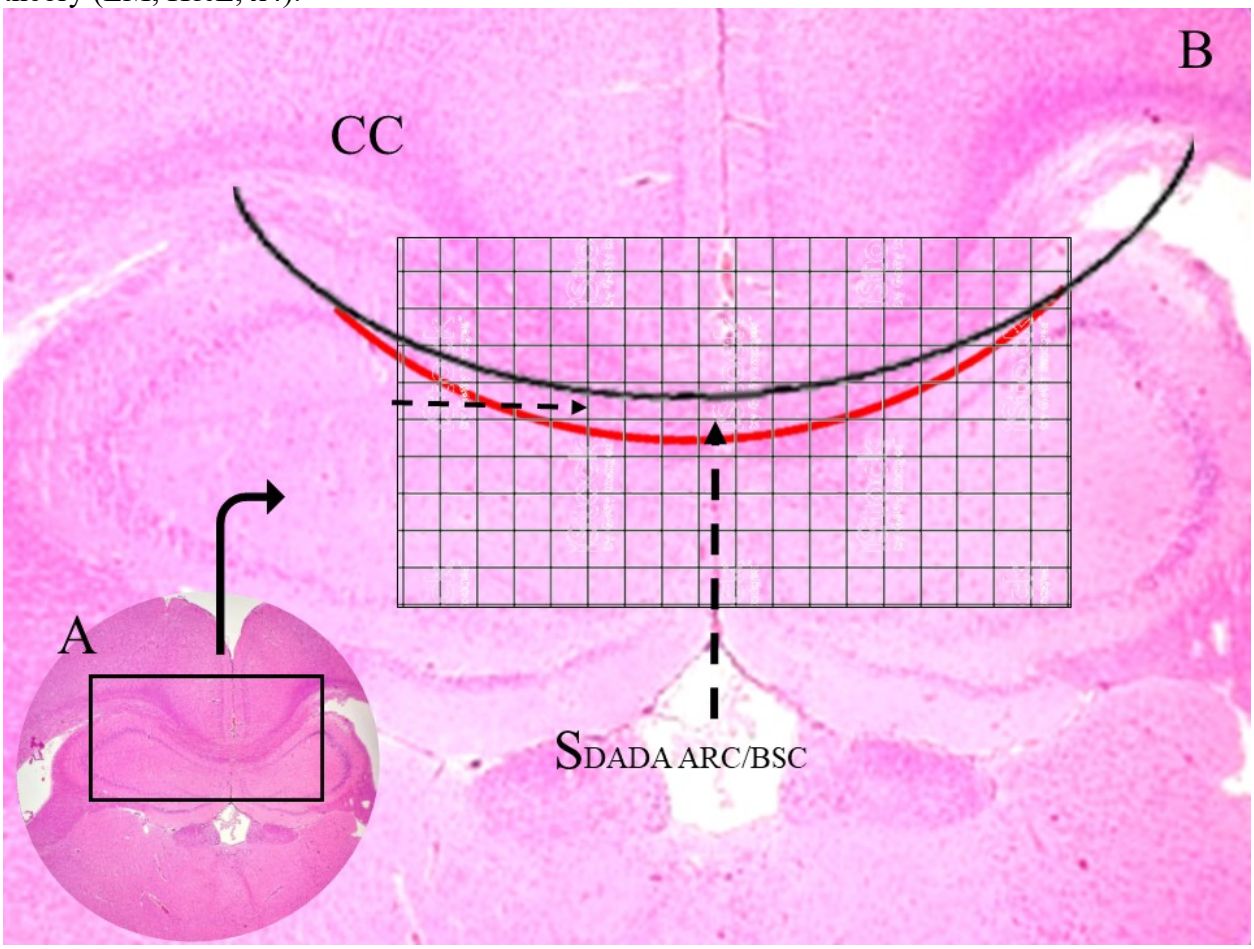

Figure-4

The method of estimating the area between the curve representing the corpus callosum and the cycloid curve (BCCS) with a transparent square scale is followed.

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