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A Neurophysical Hypothesis on the Role of the Intensity of the Electromagnetic Field Generated by the Cerebral Hemispheres in the Determination of Laterality, in Line with Einstein's Unified Field Theory

Einstein'ın Birleşik Alan Teorisi Doğrultusunda, Lateralitenin Belirlenmesinde Serebral Hemisferler Tarafından Oluşturulan Elektromanyetik Alanın Yoğunluğunun Rolü Üzerine Nörofiziksel Bir Hipotez

Mustafa Can Guler[1], Mehmet Kürşat Karadağ[2], Mehmet Dumlu Aydın[2]

[1]Department of Physiology, Medical Faculty, Atatürk University, Erzurum, Turkey
[2]Department of Neurosurgery, Medical Faculty, Atatürk University, Erzurum, Turkey

Abstract

Aim: Traditional models of cerebral laterality, focusing primarily on anatomical and functional asymmetries, fall short of explaining the underlying physical dynamics. This study pioneers a novel perspective by hypothesizing that the intensity of the electromagnetic field generated by the cerebral hemispheres plays a crucial role in determining laterality. Inspired by Einstein's unified field theory, we explore this hypothesis through an interdisciplinary approach that merges principles of physics with neurophysiology.

Material and Method: Our research employed an innovative experimental design involving three groups of male Wistar albino rats categorized based on handedness: right-handed, left-handed, and ambidextrous. We utilized electroencephalography (EEG) to measure the electromagnetic field intensity of the cerebral hemispheres, analyzing the data through a lens that combines traditional neuroscientific methods with concepts adapted from field theory.

Results: The findings reveal a significant correlation between the intensity of the electromagnetic field in the dominant hemisphere and handedness, with dominant hemispheres displaying higher field intensities. Notably, ambidextrous rats exhibited no significant difference in field intensity between hemispheres, underscoring the potential influence of electromagnetic fields on hemispheric dominance.

Conclusion: This study's implications suggest a radical rethinking of how cerebral functions might be influenced by electromagnetic phenomena. The integration of Einstein's unified field theory into the study of cerebral laterality opens new pathways for research. Our findings advocate for a broader, more integrated understanding of brain functionality, highlighting the need for further interdisciplinary research in this nascent field.

Keywords: Laterality, hemisphere, electroencephalography, electromagnetic field

Öz

Amaç: Öncelikle anatomik ve fonksiyonel asimetrilere odaklanan geleneksel serebral lateralite modelleri, altta yatan fiziksel dinamikleri açıklamakta yetersiz kalmaktadır. Bu çalışma, serebral hemisferler tarafından üretilen elektromanyetik alanın yoğunluğunun lateralitenin belirlenmesinde çok önemli bir rol oynadığını varsayarak yeni bir bakış açısına öncülük etmektedir. Einstein'ın birleşik alan teorisinden esinlenerek, bu hipotezi fizik prensiplerini nörofizyoloji ile birleştiren disiplinler arası bir yaklaşımla araştırıyoruz.

Gereç ve Yöntem: Araştırmamızda, sağ elini kullanan, sol elini kullanan ve iki elini de kullanabilen olmak üzere üç grup erkek Wistar albino sıçanı içeren yenilikçi bir deneysel tasarım kullanılmıştır. Serebral hemisferlerin elektromanyetik alan yoğunluğunu ölçmek için elektroensefalografi (EEG) kullandık ve verileri geleneksel sinirbilimsel yöntemleri alan teorisinden uyarlanan kavramlarla birleştiren bir mercek aracılığıyla analiz ettik.

Bulgular: Bulgular, baskın hemisferdeki elektromanyetik alan yoğunluğu ile el kullanımı arasında anlamlı bir korelasyon olduğunu ve baskın hemisferlerin daha yüksek alan yoğunluğu sergilediğini ortaya koymaktadır. Özellikle, iki elini de kullanabilen sıçanlar, hemisferler arasındaki alan yoğunluğunda önemli bir fark sergilememiş ve elektromanyetik alanların hemisferik baskınlık üzerindeki potansiyel etkisinin altını çizmiştir.

Sonuç: Bu çalışmanın sonuçları serebral fonksiyonların elektromanyetik olaylardan nasıl etkilenebileceğine dair radikal bir yeniden düşünme önermektedir. Einstein'ın birleşik alan teorisinin serebral lateralite çalışmasına entegrasyonu, araştırmalar için yeni yollar açmaktadır. Bulgularımız, beyin işlevselliğinin daha geniş, daha entegre bir şekilde anlaşılmasını savunmakta ve bu yeni gelişen alanda daha fazla disiplinlerarası araştırmaya duyulan ihtiyacı vurgulamaktadır.

Anahtar Kelimeler: Lateralite, hemisfer, elektroensefalografi, elektromanyetik alan

Corresponding *(İletişim)*: Mustafa Can Güler, Department of Physiology, Medical Faculty of Ataturk University, Erzurum, Turkey
Mehmet Dumlu Aydın, Department of Neurosurgery, Medical Faculty, Atatürk University, Erzurum, Turkey
E-mail *(E-posta)*: mcanguler@yahoo.com, nmda11@hotmail.com
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INTRODUCTION

The human brain, an electrical and biochemical organ, naturally generates electromagnetic fields through the activities of its neurons. Neurons communicate via synaptic transmissions, electrical impulses that propagate through neural circuits.[1] This electrical activity generates localized electromagnetic fields, detectable through methods such as electroencephalography (EEG).[2]

The proposition that the intensity of these electromagnetic fields plays a role in determining cerebral laterality is inspired by the unified field theory's foundational concept: the interrelation of forces within a unified framework.[3] In the context of our hypothesis, we extrapolate this concept to suggest that just as the unified field theory seeks to describe different forces within a single framework, the electromagnetic fields generated by cerebral activity could be integral to the brain's functional organization, specifically in the determination of hemispheric dominance.

An electromagnetic field is produced by moving electric charges.[4] It propagates at the speed of moving electric-loaded particles and interacts with charges and currents. The magnetic field creates the electric field by moving charged particles or currents. These two fields can be viewed as a combination of electric and magnetic fields.[5] Unified field theory is usually considered a combination of electric and magnetic fields for a single physical field.[6] According to unified field theory, electric and magnetic fields can generate each other, transform into each other, and affect each other in the surrounding electric and magnetic fields.[7]

The corpus callosum connects the two hemispheres anatomically and physiologically and plays a vital role in the decision-making process and knowledge transportation between the two hemispheres.[8] Information integration across the corpus callosum depends on its structural integrity and functionality.[9] It is a bridge that carries sensory-motor impulses and regulates lateralized behaviors.[10] Corpus callosum abnormalities have adverse effects on the decision-making process.[11] Various studies examined the relationship between corpus callosum size and hand preference.[12-14]

The exploration of cerebral laterality has predominantly been constrained within the boundaries of neuroanatomy and psychology, largely overlooking the profound potential of physical sciences to unravel the mysteries of the brain.[15] The unified field theory, a cornerstone of theoretical physics proposed by Einstein,[3] offers a tantalizing framework for reimagining the principles underlying cerebral functions. Existing literature on cerebral laterality has primarily focused on structural, genetic, and functional aspects, often neglecting the electromagnetic properties intrinsic to neural operations.[16]

In our opinion, although both hemispheres seem to vibrate simultaneously, due to the structural differences of the hemispheres, the hemispheric circulation, and the phase difference in the hemispheric electrodynamic activities, the electromagnetic fields produced by the hemispheres also differ. As a result, the formed electromagnetic waves can interact symmetrically, asymmetrically, or even oppositely to create a combination field of varying intensities. Most likely, the corpus callosum rebalances the static, dynamic, or kinetic storms between the two hemispheres, which is beneficial for the brain.

At the core of this hypothesis is the proposition that the brain's electromagnetic fields, generated by the electrical activity of neurons, could be fundamentally influenced by principles akin to those of the unified field theory. Neurons communicate through electrical impulses, creating localized electromagnetic fields detectable by techniques such as EEG. This neural activity, and consequently the electromagnetic fields it generates, can be conceptualized as being influenced by the same principles that govern the interaction of electromagnetic and gravitational fields in the unified field theory.

In the context of cerebral laterality, this theoretical integration suggests that the dominance of one hemisphere could be attributed, in part, to variations in the intensity of electromagnetic fields generated within the brain. These variations may influence the functional organization and specialization of the hemispheres, affecting cognitive and motor processes that are lateralized, such as handedness.

The application of unified field theory principles to understand brain electromagnetic fields opens new vistas for interpreting brain function and dysfunction. For example, asymmetries in electromagnetic field intensity between hemispheres could underlie the lateralization of certain cognitive functions or predispositions to neurological conditions. This perspective could lead to novel diagnostic approaches, where imbalances in electromagnetic field intensities are used as biomarkers for early detection of cerebral laterality disorders or neurodegenerative diseases.

MATERIAL AND METHOD

Fifteen male Wistar albino rats weighing 250±50 gr were used. Animals were fed with standard laboratory chow and water. The research methodology and necessary authorizations underwent a thorough examination and received approval from the Committee on Animal Experiment Ethics (Date: 29.04.2024, Decision No: 97) at the Medical Faculty of Ataturk University in Turkey. Both the care of the animals involved in the study and the execution of the experimental procedures adhered strictly to the standards and regulations provided by this ethics committee. There are paw preference tests for different species, such as mice, rats, cats, and dogs, for various topics in the literature.[17-20] We applied a food reaching test to determine the paw preference and food catching time. The rats were placed in steel cages with two holes, separated by 1 cm (**Figure 1**). The openings are proper for using forearms to reach food but small for a snout. Since the paw preference stabilized in five days,[21] we regularly observed the animals for six days and used the fifth-day results for the handedness assessment in line with the literature.[21,22] We obtained five right-pawed (GI; n=5), five left-pawed (GII; n=5), and five mixed-pawed (GIII, n=5).

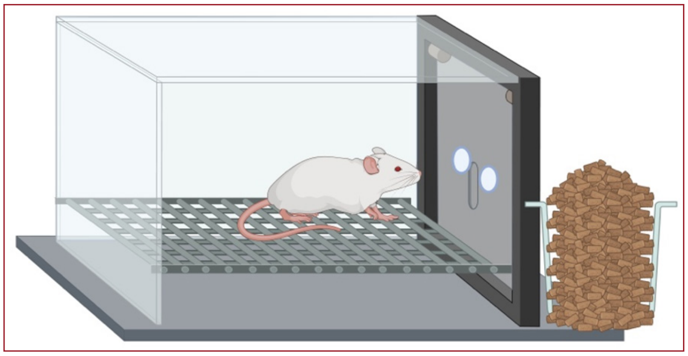

Figure 1. Experimental rat placed in steel a cage with two holes separated with 1 cm. Rat can eat food by reaching out through hole(s) (Created with BioRender.com).

Without making any distinction between right-handedness and left-handedness, the time taken by the rats to catch food was taken as a basis. EEG was taken under general anesthesia using conventional methods (MP 100 A-CE (Bıopac Systems, USA). At the end of the experiment, the subjects were sacrificed the animals with high-dose anesthesia.

The total length (L) of the five-second EEG wave path taken by the load (number of neurons: n/mm3) in the unit volume of the brain; the total area under these EEG waves (F) is the force exerted by this charge, and the product of these two parameters is considered as the work (W) done by the unit volume of the load. The total work done in five milliseconds is calculated by W=L.F. The W values were compared among groups with the t-test.

Histological Analysis

In our study, we meticulously prepared brain tissues by fixing them in 10% formalin, embedding them in paraffin, and sectioning at five microns to closely examine the corpus callosum. This region was chosen for its critical role in hemispheric communication and its potential relevance to our investigation of electromagnetic field intensity and cerebral laterality. Hematoxylin and Eosin (H&E) staining was employed to highlight the structural integrity and cellular density of the corpus callosum, offering a clear contrast between neural components and the surrounding matrix.

Statistical Analysis

Statistical analysis was integral to our examination of histological differences between the groups. Using the Mann-Whitney U test, we compared the neuronal density and structural features within the corpus callosum of right-handed, left-handed, and ambidextrous rats. This non-parametric test was chosen for its suitability in analyzing small, non-normally distributed samples, typical of histological studies.[23]

RESULTS

As seen in **Figure 2A**, an electric field is formed by the magnetic fields rotating in opposite directions at the edges of a metal disc spun in a U magnet and by the effect of the magnetic field created. This translates into the composite area represented in **Figure 2B**. When the brain is examined with the same laws, it is seen that these laws are also valid in the brain (**Figure 2C**). Because of the corpus callosum U magnet, falx fixed plate. However, the rotating disk has been replaced by the relatively vibrating brain. While the "n" electrically charged neurons (Qn) in a unit volume in the cerebral cortex vibrate and form their fields at different field strengths (yellow-red circles) on the left (LMF) and right (RMF), the combined area of the two hemispheres (UMF) is formed through the corpus callosum.

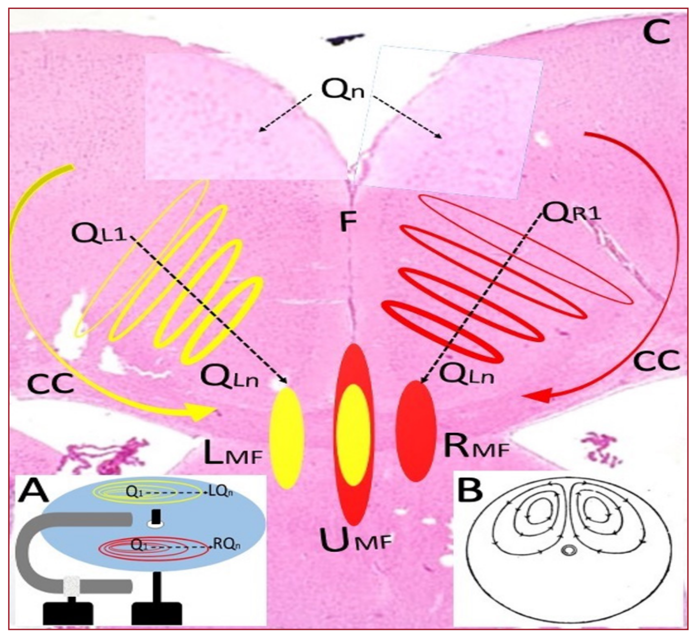

Figure 2. A) An electric field is formed by the magnetic fields rotating in opposite directions with each other, B) The magnetic field is translated into the composite area, C) The corpus callosum (CC) U magnet, falx fixed plate. The n electrically charged neurons (Qn) in a unit volume in the cerebral cortex vibrate and form their fields at different field strengths (yellow-red circles) on the left (LMF) and right (RMF): the combined area of the two hemispheres (UMF) is formed through the CC.

The five-millisecond alpha sequence of electroencephalography waves (f(x)) created by the action potential (red curve) formed by a neuronal discharge, magnetic fields (red circles) formed by the vibration resultant of these, and electromagnetic pulsations of the brain in a two-dimensional plane is observed in **Figure 3**. We determined the area between the points where the deepest of these alpha waves intersect the x-axis and five consecutive alpha waves as the representative intensity of the unit combined area of the hemispheres. By calling the smallest unit f, we considered the field strength as its multiples. Here, f(x) is the wave function, l is the wavelength, and F is the area it occupies. The total area intensity (W) is the distance (L) multiplied by the force (F). So: W=L.F

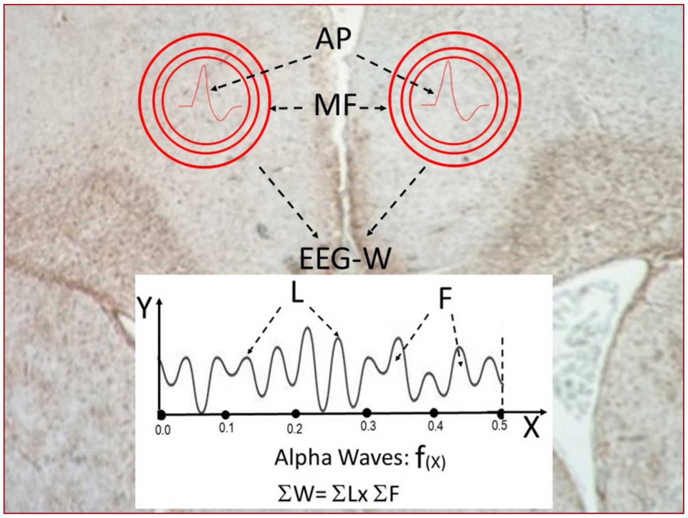

Figure 3. The five-millisecond alpha sequence of electroencephalographic waves (f(x)) generated by the action potential (red curve) produced by a neuronal discharge, the magnetic fields (red circles) produced by the resulting oscillations, and the electromagnetic pulsations of the brain are observed in a two-dimensional plane. Here, f(x) is the wave function, L is the wavelength, and F is the area it occupies. The total area intensity (W) is the distance (L) multiplied by the force (F).

The distribution of W values according to the groups is shown in **Table 1**. W values of the dominant hemispheres of GI/GII were significantly higher than the non-dominant ones ($p<0.0005$). The differences between the dominant hemispheres of subjects in GI/GII were insignificant ($p<0.005$). In addition, the differences between the two hemispheres were insignificant in two-handed GIII ($p<0.005$). However, differences between two-handed GIII and GI/GII dominant hemispheres were significant ($p<0.0001$).

Table 1. The distribution of W values according to the groups

	GI	GII	GIII
W/Dominant Hemisphere	27±3	32±5	38±6
W/Non-Dominant Hemisphere	21±2	26±4	35±5
W/Equal Dominant	-	-	36±4

The relationship between the W values and neuron density of EEG-recorded parietal cortices was compared statistically. Although there was a significant relationship between neuron density and W values, these results were not included in the discussion to avoid prolonging the article.

DISCUSSION

This study introduces a groundbreaking hypothesis suggesting that the intensity of electromagnetic fields generated by cerebral hemispheres significantly influences hemispheric dominance and, consequently, cerebral laterality. Our findings provide empirical support for this hypothesis, demonstrating a notable correlation between electromagnetic field intensity in the dominant hemisphere and handedness in Wistar albino rats. The implications of these results extend beyond the scope of traditional neurophysiological and neuroanatomical considerations, potentially heralding a paradigm shift in our understanding of brain functionality.

According to Euclidean theory, the shortest line between two points or between the ends of two overlapping line segments is a line segment.[24] According to the geometry of curved spaces and quantum physics laws using non-Euclidean methods,[25] the brain also needs the shortest-time path in physics-time geometry. According to current science, this path is the cycloid or cytochrome curve described by Bernoulli, Galileo, and Huygens.[26] The brachistochrone is the shortest-time curve for the shortest travel time.[27]

Handedness or hand preference is a popular neuroscience subject and has been researched for a long time.[28] In the literature, the language-controlling hemisphere is described as the dominant hemisphere, and the left hemisphere officiates in most human individuals.[29] Half of left-handed and about all right-handed humans are left cerebral dominant.[30] However, the right hemisphere hypothesis refers to the superiority of the right cerebrum in emotional conditions contributing to emotional brain lateralization.[31] Besides, mice represent right-hemisphere hippocampus-dependent 5–7 Hz oscillations in case of observational fear.[32] The right central nucleus of the amygdala performs increased neuronal activity compared to the left one during an acute injury.[33] In some vertebrates, the left hemisphere is a part of routine activities, while the right hemisphere plays a crucial role in emergencies. Animals mostly use the left hemisphere (right side of their bodies) during routine feeding.[34] In the view of such information, left or right-handed and related laterality varies in numerous conditions. Therefore, we can suggest our experimental animals' dominant hemispheres in terms of their hand preference when reaching food.

The corpus callosum has a curious role in determining laterality.[35] Anatomical or functional hemispheric asymmetries emerge as the left and right hemispheres dominate different task-processing aspects.[9] This latter result suggests that during evolution, brain size expansion led to functional lateralization to avoid excessive conduction delays between the hemispheres.[36] Corpus callosum agenesia leads to decision-making compromise and potential negative social consequences.[37] Reaction time increases with callosal agenesia-owned patients.[38] These data on the corpus callosum have been partially confirmed by radiological analysis.[39]

In the regulation of intrahemispheric and interhemispheric electromagnetic field oscillations, the corpus callosum, which connects two hemispheres like two battery cables, may also equalize the capacitances of the hemispheres. According to our theory, this function of the corpus callosum protects the brain from electromagnetic storms. It determines laterality instantly or continuously by adjusting the current balance between the two hemispheres. In determining the laterality, the single hemispheres vary depending on the electromagnetic field intensity of the hemispheres, the number of neurons they contain, the pulsation frequency of the brain, and the regulatory role of the corpus callosum, and the combined field strength of the whole brain may play an important role.

Cognition and behavior, fundamentally rooted in the complex interplay of neural circuits across both hemispheres, might also be subject to the modulatory effects of these electromagnetic fields. For instance, variations in field intensity could influence cognitive processes such as attention, memory, and language, which are known to be lateralized to some extent. This suggests a possible mechanism by which electromagnetic fields could subtly influence the efficiency or preference of one hemisphere over another for certain cognitive functions.

Moreover, the concept of brain behavior, particularly the lateralization of functions such as handedness, emotional processing, and decision-making, could be re-evaluated in light of our findings. The differential electromagnetic signatures of the hemispheres might provide a physical basis for understanding how certain behaviors or cognitive styles become dominant. This perspective could also inform our understanding of disorders characterized by atypical lateralization, offering new pathways for therapeutic intervention. In essence, by acknowledging the role of electromagnetic fields in the cerebral hemispheres, our study not only contributes to the nuanced understanding of cerebral laterality but also invites a re-examination of how we conceptualize brain function and organization.

Theoretical Implications for Cerebral Laterality

In bridging this concept with cerebral laterality, we propose the following theoretical implications:

Electromagnetic field intensity as a determinant of hemispheric dominance: The differential intensity of electromagnetic fields generated by each hemisphere could influence the dominance for certain cognitive and motor functions. This aligns with the unified field theory by suggesting that a fundamental physical property (field intensity) underlies diverse neurological phenomena (laterality).

Interhemispheric interaction and unified field dynamics: The corpus callosum, facilitating interhemispheric communication, may function analogously to a "field modulator" in the brain's unified field. It could regulate the interaction between the hemispheres' electromagnetic fields, ensuring balanced functionality and coherence in brain operations, akin to the theoretical role of unified fields in maintaining equilibrium among physical forces.

Empirical exploration of unified field theory concepts in neurology: By applying concepts from the unified field theory to neurophysiology, we not only explore a novel hypothesis for cerebral laterality but also provide a unique empirical framework to test aspects of unified field theory principles, specifically the interplay and balance of forces (fields) within a complex system (the brain).

Limitations and Future Insight

Despite the groundbreaking insights provided by our study, it is important to acknowledge its limitations and outline avenues for future research. One of the primary constraints is the reliance on an animal model to infer cerebral laterality and electromagnetic field implications in humans. While offering valuable preliminary data, the direct applicability of these findings to human neurophysiology requires further validation.

Additionally, the complexity of electromagnetic field measurements and their interpretation within the neural context presents challenges in standardization and replication of the study's methods. Future research should aim to refine these measurement techniques and explore their applicability across a broader spectrum of subjects, including human participants, to substantiate the universality of the observed phenomena.

Furthermore, investigating the interaction between electromagnetic fields and other neural attributes, such as synaptic plasticity and neurotransmitter levels, could provide a more comprehensive understanding of the mechanisms underpinning cerebral laterality. Ultimately, our study lays the groundwork for a novel interdisciplinary approach to exploring brain functionality, urging the scientific community to further investigate the electromagnetic dimension of neural processes and its implications for understanding and treating neurological conditions.

CONCLUSION

Incorporating a detailed explanation of the unified field theory's principles and their relation to electromagnetic fields in the brain provides a theoretical foundation for our hypothesis. It not only enriched the manuscript by bridging physics and neurophysiology but also invited readers into an interdisciplinary dialogue, potentially catalyzing future research that further explores these connections. By elucidating these concepts, we aimed to make the theoretical underpinnings accessible to readers across disciplines, fostering a deeper understanding of our hypothesis and its implications for cerebral laterality and beyond.

ETHICAL DECLARATIONS

Ethics Committee Approval: All animal applications, including surgical and medical procedures, were accepted by the Animal Experiments Local Ethics Committee, Atatürk University (Date: 29.04.2024, Decision No: 97).

Informed Consent: Not available.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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