Subject: Study of high-frequency electromagnetic radiation impact and Aires resonators influence on behavior, genetic and epigenetic processes in cells of CNS and peripheral organs (model organisms : rat (Rattus norvegicus) and honey bee (Apis mellifera L.)

Subject: 高頻電磁輻射影響與 Aires 共振器對中樞神經系統及周邊器官細胞之行為、遺傳與表觀遺傳過程之研究（模式生物：大鼠 Rattus norvegicus 與蜜蜂 Apis mellifera L.）

STAGE FOUR: Study of the effects of the limitation of an external magnetic field, a router electromagnetic radiation and Aires Defender Pro resonators on the behavior in an open field test of rat strains with different levels of nervous system excitability

第四階段：研究外加磁場受限、無線路由器電磁輻射與 Aires Defender Pro 共振器對神經系統興奮性不同之大鼠品系於開放場測試中行為的影響

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高等神經活動遺傳學

Figure 1: REPORT **圖 1：報告**
UNDER THE AGREEMENT OF SCIENTIFIC COOPERATION

在科學合作協議之下

WITH AIRES HUMAN GENOME RESEARCH FOUNDATION

與 AIRES 人類基因組研究基金會

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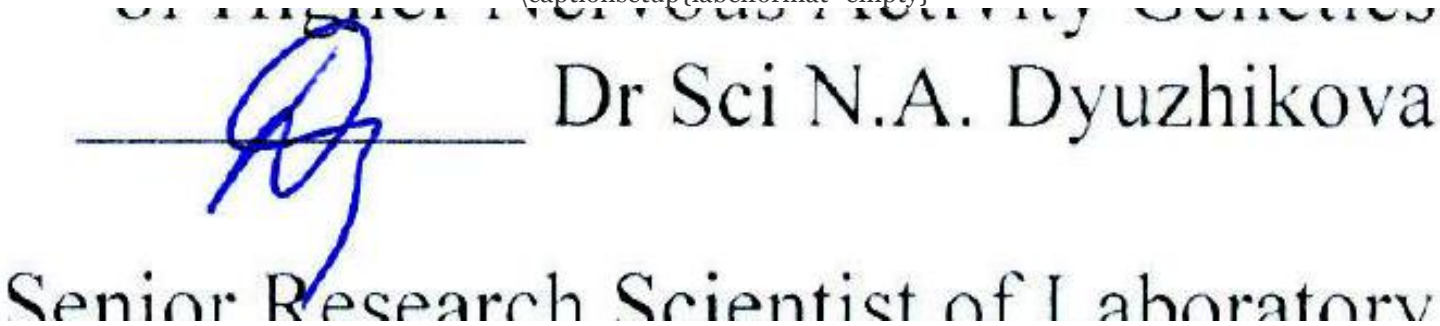

Figure 2: REPORT **圖 2：報告**
UNDER THE AGREEMENT OF SCIENTIFIC COOPERATION

在科学合作协议下

WITH AIRES HUMAN GENOME RESEARCH FOUNDATION

與 AIRES 人類基因研究基金會

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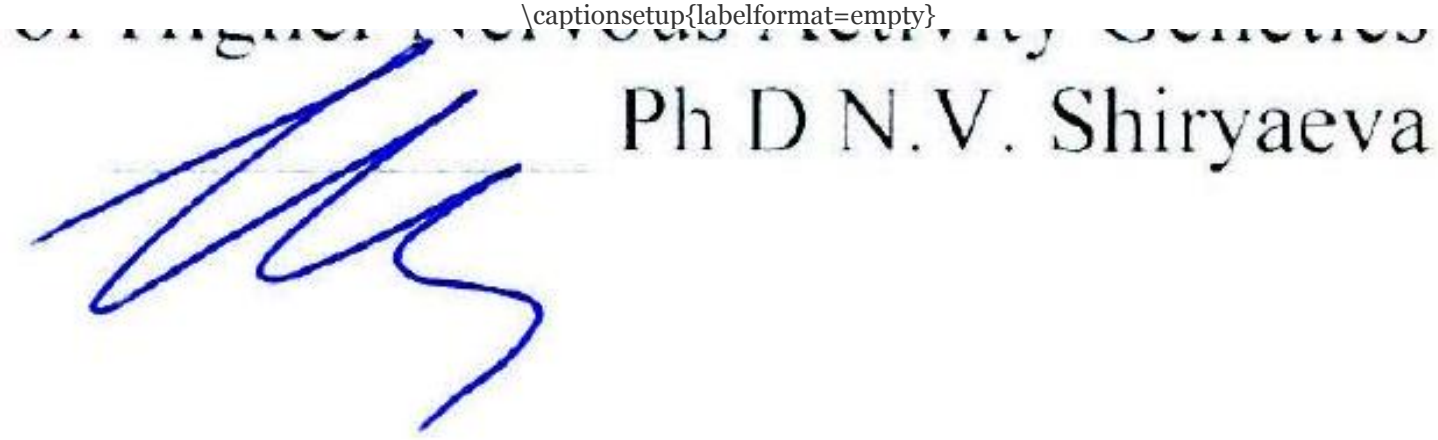


During the contractual work (stages 1-3), a Faraday cage (Aires) was used to limit external electromagnetic effects. To determine the exact values of the induction of the magnetic field outside and inside the experimental chambers, measurements were made using Fluxmaster magnetometers (StefanMayerInstruments, Dinslaken, Germany) ($1\mathrm{nT} - 200\mu\mathrm{T}$, resolution of 1 nT) and HB0302.1A (St. Petersburg, Russia) ($0.1\mu\mathrm{T} - 100\mu\mathrm{T}$, with resolution of $0.1\mu\mathrm{T}$). The measurements taken in different parts of the chamber and outside it are shown in Table 1 and indicate there are no differences between the magnetic component indices outside and inside the experimental chamber (without a router and with a router included in the network) (ANOVA Ftest $= 0.36; \mathrm{P} = 0.704$).

在合約工作期間（階段 1–3），使用法拉第籠（Aires）以限制外部電磁影響。為了測定實驗箱外部與內部磁場感應強度的精確數值，採用 Fluxmaster 磁力計（StefanMayerInstruments，Dinslaken，Germany）（ $1\mathrm{nT} - 200\mu\mathrm{T}$ ，解析度為 1 nT）及 HB0302.1A（聖彼得堡，Russia）（ $0.1\mu\mathrm{T} - 100\mu\mathrm{T}$ ，解析度為 $0.1\mu\mathrm{T}$ ）進行測量。於箱體不同部位及箱外所做之測量結果如表 1 所示，顯示實驗箱外部與內部（在網路中未含路由器與含路由器情況下）之磁性分量指標無差異（ANOVA F 檢定 $= 0.36; \mathrm{P} = 0.704$）。

Table 1: Table 1. Measurements of magnetic field induction ($\mu\mathrm{T}$) in different parts of the experimental chamber and outside it.

表 1：表 1. 實驗箱不同部位及箱外之磁場感應強度（ $\mu\mathrm{T}$ ）測量值。

\captionsetup{labelformat=empty}

Outside the chamber **箱外**	Inside the chamber **箱內**	Inside the chamber with the router turned on **箱內（路由器開啟）**
X ± m		
59.6 ± 18.1	55.9 ± 7.9	54.4 ± 7.8

Considering the results of the measurements, the decision was made to use as an experimental screening chamber covered with several layers of amorphous soft magnetic material, providing a measurable 40-fold decrease in the magnitude of the induction of the Earth's magnetic field inside the chamber (from $48\mu\mathrm{T}$ to $1.2\mu\mathrm{T}$). In recent years, the biological effects of weak magnetic fields and the Earth's magnetic field weakened by shielding using such equipment have been actively researched. The magnetic field induction inside and outside the chamber were measured by the domestic three-component magnetometer HB0302.1A ($0.1 - 100\mu\mathrm{T}$). It was important to assess the effect of the animals' exposure under conditions of a limited external magnetic field with clear parameters, primarily on motor activity, emotion, and other components of behavior in an "open field" test. And then we assess the effect of electromagnetic radiation (EMR) of a router and Aires Defender Pro resonators under the given conditions with known LMF values.

考量測量結果後，決定使用一個實驗篩選箱，其外層覆蓋多層非晶軟磁性材料，使箱內地磁場磁感應強度可被明顯削弱達約 40 倍（從 $48\mu\mathrm{T}$ 到 $1.2\mu\mathrm{T}$ ）。近年來，弱磁場以及以此類設備屏蔽而削弱的地磁場之生物效應成為積極研究的主題。箱內與箱外的磁場感應強度由國產三分量磁力計 HB0302.1A（ $0.1 - 100\mu\mathrm{T}$ ）測量。評估動物在具有明確參數的受限外加磁場條件下暴露的效應很重要，主要關注於在「開放場」測試中的運動活動、情緒及其他行為成分。隨後在已知 LMF 值的前提下，我們再評估路由器的電磁輻射（EMR）與 Aires Defender Pro 共振器在該條件下的影響。

The "open field" method was first proposed by Hall (Hall, 1934, 1936). It involved placing a rat in a brightly lit circle, and then observing characteristics of motor activity and emotionality (according to the defecation response, number of boluses). There are presently various modifications of this technique, depending on the tasks of the experiment. A "open field"

"開放場域（open field）"方法最早由 Hall 提出（Hall, 1934, 1936）。該方法將大鼠置於光線明亮的圓形場域內，然後觀察其運動活動與情緒性的特徵（依據排便反應、糞便顆數等）。目前根據實驗目的，該技術已有多種改良。一種"開放場域"

(circular) apparatus is designed to study the exploratory and emotional behavior of rodents under conditions of being transferred to a new environment; it allows a comprehensive assessment of natural controlled behavior: assessment of the level of emotion, motor activity (the horizontal is the number of crossed sectors, and the vertical is upright positions reflecting orienting and exploratory activity), and the severity of the anxiety-depressive component (activity in the central, most open and illuminated sector of the field, the number of twists and turns), fear level based on a freezing response, and stereotypical behavior (grooming). Assessing the behavior of rats in an "open field" apparatus is included in the list of tests for conducting preclinical studies of pharmacological substances and the establishing their neuroleptic, antidepressant, and

anxiolytic activity.

（環形）裝置旨在研究嗤齒動物在被轉移到新環境時的探索與情緒行為；它允許對自然受控行為進行全面評估：情緒水平的評估、運動活動（水平為穿越區段的次數，垂直為豎立姿勢，反映定向與探索活動）、焦慮-抑鬱成分的嚴重性（在最中央、最開放且照明最強的區段的活動、轉身與回轉的次數）、以僵直反應為基礎的恐懼程度，以及刻板行為（梳理）。在「開放場」裝置中評估大鼠行為被列入進行藥理物質臨床前研究及確定其抗精神病、抗抑鬱與抗焦慮活性的一系列測試中。

The nervous system is extremely sensitive to the influence of EMR. The effect of a magnetic field and EMR on the nervous system is characterized by changed behavior, conditioned reflexes, and physiological processes. The body's reaction to these effects largely depends on the initial functional state of the nervous system. Accordingly, it seemed important to use a special rat model with hereditary differences in nervous system excitability, a line with low excitability (high excitability threshold - HT) and a line with high excitability (low excitability threshold - LT).

神經系統對電磁輻射的影響極為敏感。磁場和電磁輻射對神經系統的作用表現為行為、條件反射和生理過程的改變。機體對這些作用的反應在很大程度上取決於神經系統的初始功能狀態。因此，使用具有遺傳性神經系統興奮性差異的特殊大鼠模型顯得十分重要，一支為低興奮性（高興奮閾值 - HT），另一支為高興奮性（低興奮閾值 - LT）。

Purpose and objectives of the fourth stage:

第四階段的目的與目標：

investigation of the effect of shielding the external magnetic field of a cylindrical chamber and unshielded counterpart;

研究圓柱形腔體屏蔽外部磁場與未屏蔽對照的影響；

investigation of the influence of EMR while a standard Wi-Fi router is operating;

研究在標準 Wi-Fi 路由器運作時電磁輻射的影響；

investigation of the influence of Aires Defender Pro resonators under the action of the EMR of a standard Wi-Fi router on behavior in an "open field" test of two HT and LT male rat lines

Material and methods

The work was carried out on male rats of the HT and LT lines at the age of 5 months. The rats were bred at the Genetic Laboratory of Higher Nervous Activity. The males were kept in groups of 6 specimens in standard cells on a standard diet.

To create the conditions of a weakened external magnetic field, we used a screening chamber made of non-magnetic material (cardboard) and covered with several layers of amorphous soft magnetic material (AMAG-172), which provided a 40 -fold decrease in the magnitude of the induction of the Earth's magnetic field inside the chamber (from 48μ T to 1.2 μT) . The imitation chamber was made of cardboard, had no shielding, and was covered with black polyethylene. Both chambers were cylinders with a diameter of 60 cm and a length of 140 cm, closed at one end and open from the other, so that a cage with rats can easily be placed in the chamber.

黑色聚乙烯。兩個艙室皆為直徑 60 公分、長 140 公分的圓柱體，一端封閉、另一端開放，便於將裝有大鼠的籠子放入艙室中。

We used a Wi-Fi router (LinkSys E1200-EE/RU wireless router) with the following technical specifications: wireless carrier frequency: 2.4 GHz , number and type of antennas: 2 internal antennas, gain of the standard antenna(s), dBi : 4dBi.

我們使用一台無線路由器（LinkSys E1200-EE/RU wireless router），其技術規格如下：無線載波頻率：2.4 GHz，天線數量與類型：2 支內建天線，標準天線增益： dBi : 4dBi **。**

The Aires Defender Pro fractal-matrix resonator-converters (special ring diffraction gratings) used in the experiments are a universal Fourier filter. To evaluate the resonators' influence on the damaging effect of the router's EMR, 6 resonators were used, as in the previous experiments on rats. They were placed in the middle of each edge of the cage with the animals (on the outside).

實驗中使用的 Aires Defender Pro 分形矩陣諧振轉換器（特殊環形繞射光柵）為一種通用的傅立葉濾波器。為評估諧振器對路由器電磁輻射損害效應的影響，使用了 6 個諧振器，與先前對大鼠的實驗相同。它們被放置在動物籠子四邊中點的位置（籠子外側）。

To study the influence of the limitation of the external magnetic field, the influence of the EMR of the router and resonator-converters, the “home” cage with animals was placed in the shielding chamber either without additional influences (LMF group) or with a router located on a tray in the center of the cage’s lid (LMF+Router groups), and the router and resonators (LMF+Router+Resonators groups). The experimental groups were exposed for 12 hours (10:00 PM to 10:00 AM). The control groups were groups of rats placed in the imitation chamber at the same time, without the router (WLMF groups), with a router (WLMF+Router groups), with a router and resonators (WLMF+Router+Resonators groups). The animals’ behavior in the “open field” test was assessed one hour after the end of the animals’ exposure in the chambers.

為研究外部磁場受限、路由器電磁輻射及共振器-轉換器之影響，「家用」籠內的動物被置於屏蔽室中，條件為沒有額外影響（LMF 組），或籠蓋中央托盤放置路由器（LMF+Router 組），以及放置路由器與共振器（LMF+Router+Resonators 組）。實驗組於每次暴露 12 小時（晚間 10:00 至翌日早上 10:00）。對照組則是在相同時間置於模擬室內的鼠群，沒有路由器（WLMF 組）、有路由器（WLMF+Router 組）、以及有路由器與共振器（WLMF+Router+Resonators 組）。动物在「開放場」測試中的行為於暴露結束一小時後評估。

The animals kept in the vivarium and not exposed to the effects served as the naive control (“Control 1”).

在動物房飼養且未受任何影響的動物作為天真對照（“Control 1”）。

The “open field” apparatus used was a circle with a diameter of 160 cm , bounded by a border that was 35 cm high. The floor of the circle was divided into 20 cm squares. Above the center of the floor at a height of 60 cm a 500 W lamp was suspended with a mirror reflector, providing illumination at the floor level from 2000 lx in the center to 1500 lx at the edges. The apparatus was placed in a darkened room. During the test, a rat was placed in the central square of the circle and its behavior was monitored for 5 minutes. After each animal was tested, the floor was wiped with $35-40\%$ alcohol solution and then a dry napkin. The following behavior parameters were recorded:

所使用的「開放場」裝置為一個直徑 160 公分的圓形，四周以 35 公分高的邊緣圍起。圓形地面被劃分為 20 公分見方的格子。地面中心上方 60 公分處懸吊一盞 500 瓦的燈具並配有鏡面反射器，地面照度由中心的 2000 勒克斯降至邊緣的 1500 勒克斯。裝置置於昏暗的房間內。測試期間，將大鼠置於圓形的中央格子，並監測其行為 5 分鐘。每隻動物測試結束後，地面以 $35-40\%$ 酒精溶液擦拭，然後以乾布擦拭。記錄下列行為參數：

Latency of the first movement (s)

首次移動潛伏期（秒）

Horizontal motor activity (number of intersected squares)

水平運動活動（穿越格子的次數）

Vertical motor activity (raising up on the hind legs, number of upright positions)

垂直運動活動（後腿立起，直立姿勢的次數）

Emotionality (number of boluses)

情緒反應（排糞次數）

Grooming (number of acts)

梳理（行為次數）

Freezing (number of acts)

僵直（行為次數）

Turns to the left (number of acts)

向左轉（行為次數）

Turns to the right (number of acts)

向右轉（次數）

Twists (number of acts) **扭轉（次數）**

Statistical processing 統計處理

To present the results in tables, we calculated mean values with the error of the mean and median. The medians are shown in all the figures. The accuracy of the differences between the variants was determined using the Mann-Whitney test, as well as ANOVA using Statgraphics Centurion XV11 and Statistica 6.0.

為了以表格呈現結果，我們計算了平均值與平均數誤差以及中位數。所有圖表均顯示中位數。變異之間差異的顯著性以 Mann-Whitney 檢定以及使用 Statgraphics Centurion XV11 和 Statistica 6.0 進行的變異數分析（ANOVA）來確定。

Results and discussion 結果與討論

Analyzing the behavior of the naive animals in the “open field” test made it possible to identify interlinear differences in the level of vertical motor activity (Fig. 3) and acts of freezing (Fig. 6). The number of upright positions is higher, and the number of acts of freezing is lower for highly excitable rats of the LT line compared with the low-excitable HT line. This is associated with genetically determined features of the rats’ excitability and reflects the linear characteristics of elements of innate behavior. It should be noted that the rats of these lines behave differently depending on the level of excitability of their nervous systems, and their behavior has different strategies. This is confirmed by the data we have obtained.

分析在「開放場」測試中對初次接受測試之動物行為的觀察，使我們能識別出不同系別在垂直運動活動水平（圖 3）及凍結行為次數（圖 6）上的差異。與低興奮性的 HT 系列相比，LT 系列高度興奮的老鼠呈現較多的直立姿勢次數，且凍結行為次數較少。此現象與老鼠興奮性之遺傳決定特性有關，反映出先天行為元素之系列性特徵。值得注意的是，這些系別的老鼠會依其神經系統興奮性程度展現不同的行為，並採取不同的行為策略。我們所獲得的數據證實了這一點。

It was found that exposing the animals in the chambers for 12 hours, regardless of additional experimental conditions, affects the behavior of the studied rat lines in different ways and leads to a change in the various elements of behavior in one and the other line compared to the naive control: for the HT line - fewer acts of freezing (Fig. 6) and a larger number of turns (Fig. 7); for the LT line - shorter latency of the first movement (Fig. 1), less emotionality (Fig. 4), and more acts of grooming (Fig. 5). This data indicates that the animals’ very presence in the closed space of the cylinders affects their subsequent reactions in the “open field” apparatus and the characteristics of these reactions depend on the animals’ genotype.

研究发现，將動物置於密閉箱內 12 小時，不論是否有其他實驗處置，都會以不同方式影響受試大鼠系的行為，並導致兩系相較於未處理對照組在各行為要素上出現變化：對於 HT 系—冷凍行為次數減少（圖 6）且轉向次數增加（圖 7）；對於 LT 系—首次移動延遲縮短（圖 1）、情緒性降低（圖 4），以及梳理行為次數增加（圖 5）。這些資料顯示，動物僅僅因為置身於圓筒的封閉空間，就會影響其在「開放場」裝置中的後續反應，而這些反應特性的差異取決於動物的基因型。

The experimental results made it possible to establish that the attenuation factor from the screening of the external magnetic field (LMF) affects only highly excitable rats of the LT line. The LMF’s influence was an increase in the number of acts of freezing (Fig. 6), which indicate a possible increase in the fear response in the new environment, as well as more left and right turns (Figs. 7 and 8), which indicates an increase in the animals’ anxiety (chaotic movements) (compared to the corresponding WLMF groups and naive controls).

實驗結果顯示，外部磁場屏蔽所造成的衰減因子（LMF）僅影響高度興奮性的 LT 系大鼠。LMF 的影響表現為凝視（freezing）次數增加（圖 6），這暗示在新環境中恐懼反應可能升高；同時左轉與右轉次數也增加（圖 7 與圖 8），顯示動物焦慮程度上升（行動變得較為混亂）（相較於相應的 WLMF 組與原始對照組）。

The radiation of the router under conditions of an external magnetic field weakened by the shielding, and without it, also affects only certain elements of behavior in the “open field” test, which differ in highly excitable and low-excitable rats. For the HT line under the influence of the router, an increase in the number of right turns was observed (Fig. 8), whereas for the LT line, there was an increase in the number of acts of freezing (Fig. 6) and twisting (Fig. 9) in comparison with the LMF and WLFM groups, respectively, and the naive control.

在外部磁場被屏蔽衰減或未被衰減的條件下，路由器的輻射也僅影響「開放場」測試中某些行為元素，而這些影響在高興奮性與低興奮性大鼠間有所不同。對 HT 系而言，受路由器影響時右轉次數增加（圖 8）；而對 LT 系，則在與 LMF、WLMF 組及原始對照比較時，凝視行為（圖 6）和扭動行為（圖 9）次數增加。

However, the router’s influence in the conditions of LMF leads to a selective decrease in the emotionality in rats of the HT line (Fig. 4) and in the horizontal motor activity in rats of the LT line (Fig. 2). These are the most significant elements of

normal behavior associated with different levels of hereditary nervous system excitability in the animals.

然而，在低磁場（LMF）條件下，無線路由器的影響導致高興奮性（HT）系老鼠的情緒性選擇性下降（圖 4），而在低興奮性（LT）系老鼠則出現水平運動活性下降（圖 2）。這些是與動物遺傳性神經系統興奮性不同水平相關之正常行為中最顯著的要素。

The action of the Aires resonators was tested on only one HT line. Under the conditions of the shielding chamber, the resonators resulted in a decrease in the number of right turns (Fig. 8) in comparison with the action of the router. That is, the resonators influenced precisely the trait that changed (increased) under the influence of the router.

Aires 共振器的作用僅在一個 HT 系進行測試。在屏蔽室條件下，與路由器的作用相比，共振器導致右轉次數減少（圖 8）。也就是說，共振器影響的正是路由器作用下發生改變（增加）的那一行為特徵。

Under the conditions of the imitation chamber, the resonators amid the influence of the router caused a sharp increase in horizontal motor (exploratory) activity (Fig. 2), acts of grooming (Fig. 5), and reduced freezing (Fig. 6). However, the number of twists under the influence of the router and resonators increased regardless of the type of chamber (Fig. 9).

在模擬室條件下，共振器在路由器影響之中引起水平運動（探索）活動的劇增（圖 2）、梳理行為次數增加（圖 5），以及僵直行為減少（圖 6）。然而，不論室型如何，在路由器與共振器共同作用下，扭轉次數皆有所增加（圖 9）。

Thus, our results allow us to infer that the resonators have a selective positive effect, provided that the external magnetic field is limited to only one component of the behavior, i.e. the number of right turns, but not left turns. This may be due to lateralization of the to receive and respond to EMR. However, it is still difficult to establish specific patterns.

因此，我们的結果使我們推斷，當外部磁場僅限於行為的單一成分時——即右轉次數，而非左轉次數——共振器會產生選擇性的正向影響。這可能與接收與應對電磁輻射的側化有關。然而，要確立具體的模式仍然困難。

Without a weakening of the external magnetic field, the resonators influenced other behavioral components and increased motor activity and grooming, while decreasing fear in the animals, which can generally be considered the animals' adaptive responses to the new conditions. Regardless of the operating conditions of the external magnetic field, the resonators caused an increase in acts of twisting.

在外部磁場未被削弱的情況下，共振器影響了其他行為成分，並增加了運動活動與梳理行為，同時降低了動物的恐懼感，這通常可被視為動物對新環境條件的適應性反應。無論外部磁場的工作條件為何，共振器都會導致扭轉行為次數增加。

Thus, given the combination of two EMR factors (the router and the resonators), elements of the animals' general motor and exploratory activity were strengthened and the fear response, which can also be observed after stressful influences, was suppressed.

因此，當兩種電磁輻射因子（路由器與共振器）結合時，動物的一般運動及探索活動成分被強化，而恐懼反應則被抑制，這種情形也可在壓力影響後觀察到。

The increased grooming may have two biological meanings. On the one hand, grooming is classified as a comfort behavior, which is confirmed by the well-known increase in the number of acts of grooming as an animal becomes accustomed to the environment, accompanied by a decrease in indicators of stressful behavior. On the other hand, in rodents grooming, a behavioral marker of stress, also becomes more active under the influence of stress. Next, it seems

增加的梳理行為可能有兩種生物學意涵。一方面，梳理被歸類為安慰行為，這一點可由眾所周知的現象得到印證：動物隨著對環境的熟悉而梳理行為次數增加，同時壓力行為的指標減少。另一方面，在嚙齒類動物中，梳理也是壓力的行為標記，於是在壓力影響下也會變得更為活躍。接下來，似乎

important to use correlation analysis to determine the relationship between the behavioral elements under investigation.

重要的是要使用相關分析來確定所研究行為要素之間的關係。

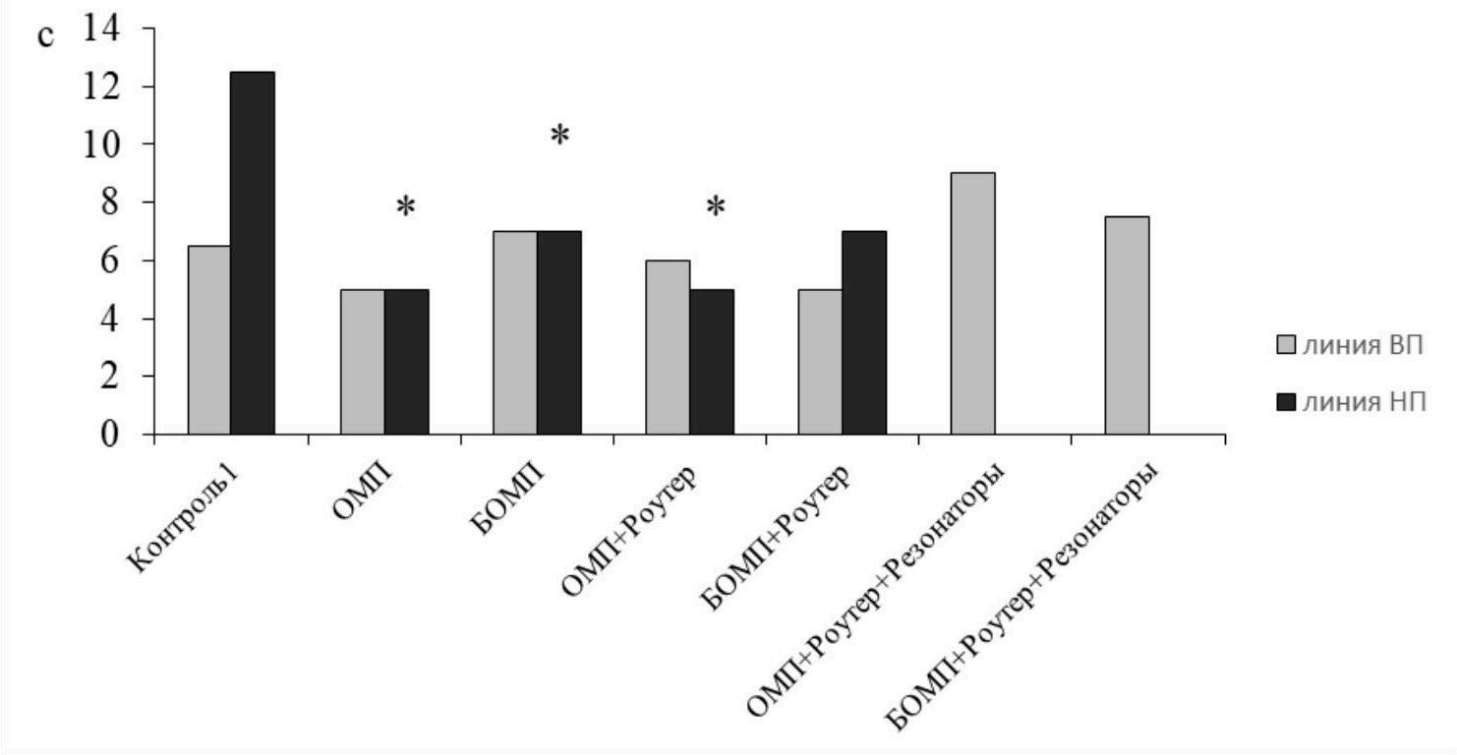
In general, our experiments indicate that all of the studied factors influence different components of rat behavior in the "open field" test. The nature of the reaction to exposure in cylinders, to the weakening of the external magnetic field, and to the router's EMR depends on the animals' hereditary nervous system excitability and affects various components of

behavior.

總體而言，我們的實驗顯示，在「開放場」測試中，所有研究的因素都會影響大鼠行為的不同構成要素。對於圓筒內的暴露、外部磁場的減弱以及路由器電磁輻射的反應性質，取決於動物遺傳性神經系統興奮性，並會影響行為的各種成分。

The action of the Aires Defender Pro resonators changed the behavior of low-excitable rats of the HT line and caused their activity to increase when placed in a new environment. Specific behavioral components of the animals' reaction to the action of Aires resonators were also identified, indicating their selective positive influence on specific elements of behavior.

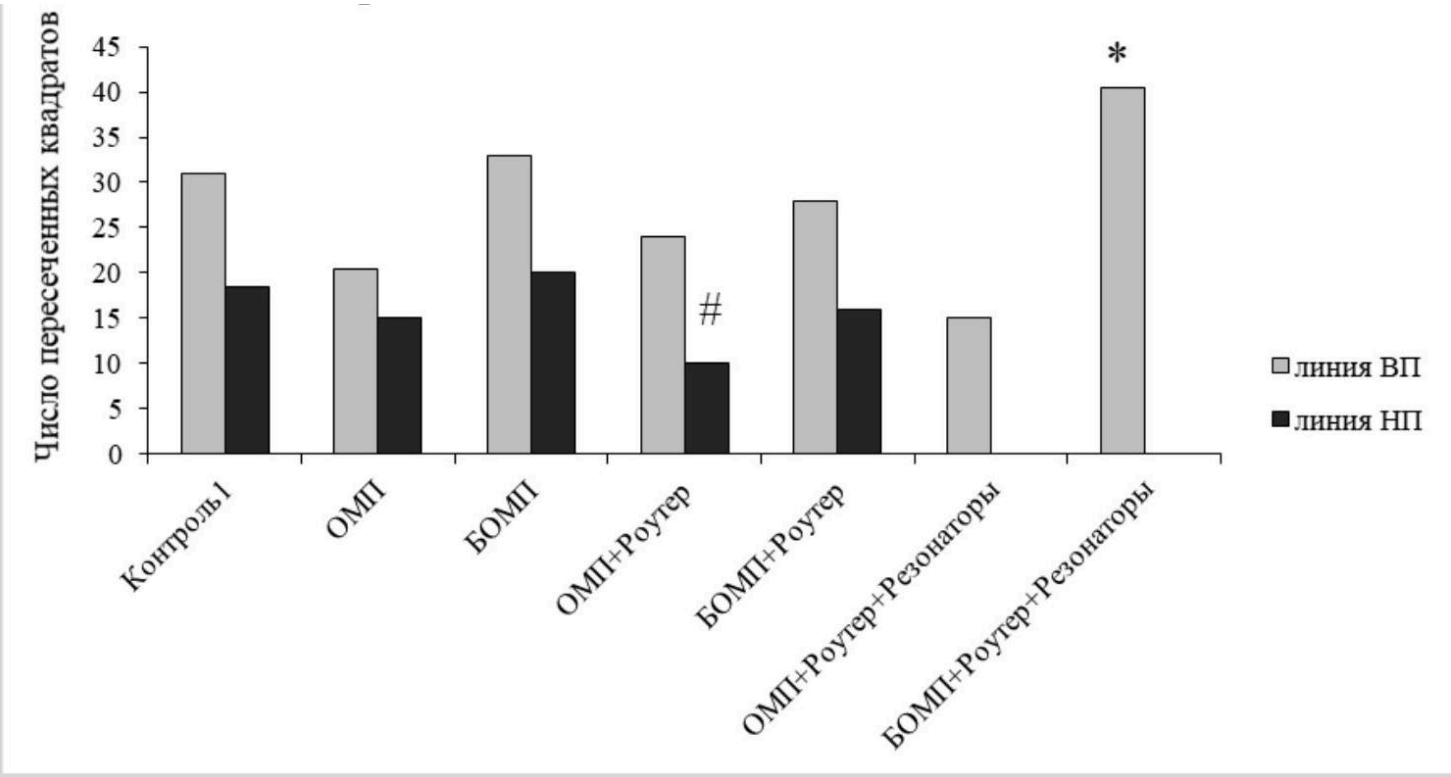
Aires Defender Pro 谐振器的作用改變了 HT 系列低興奮性大鼠的行為，並在置於新環境時使其活動量增加。也辨識出動物對 Aires 谐振器作用的特定行為成分，顯示其對行為特定要素具有選擇性的正向影響。



Russian 俄文	English 英文
Латентный период 潛伏期	Latency 潛伏期
с	s
Контроль1 對照 1	Control 1
ОМП	LMF
БОМП	WLMF
ОМП+Роутер ОМП+路由器	LMF+Router LMF+路由器
БОМП+Роутер БОМП+路由器	WLMF+Router WLMF+路由器
ОМП+Роутер+Резонаторы ОМП+路由器+共振器	LMF+Router+Resonators LMF+路由器+共振器
БОМП+Роутер+Резонаторы БОМП+路由器+共振器	WLMF+Router+Resonators WLMF+路由器+諧振器
линия ВП	HT line
линия НП	LT line LT 血統

Fig. 1 Latency of reactions in the "open field" test of male rats of the HT and LT lines Key: *- The differences with Control 1 (naive) of the LT line are significant ($P < 0.05$).

圖 1 使用"開放場"測試測得 HT 與 LT 兩系成年雄性大鼠反應潛伏期。註：*- 與 LT 系對照組 1（未處理）之差異具有顯著性（$P < 0.05$）。



Russian 俄文	English 英文
Горизонтальная двигательная активность **横向運動活動**	Horizontal motor activity **横向運動活動**
Число пересеченных квадратов **穿越方格數**	Number of intersected squares **穿越方格數**
Контроль1 **控制 1**	Control 1
ОМП	LMF
БОМП	WLMF
ОМП+Роутер **ОМП+路由器**	LMF+Router **LMF+路由器**
БОМП+Роутер **БОМП+路由器**	WLMF+Router **WLMF+路由器**
ОМП+Роутер+Резонаторы **ОМП+路由器+共振器**	LMF+Router+Resonators
БОМП+Роутер+Резонаторы **БОМП+路由器+共振器**	WLMF+Router+Resonators
линия ВП **高興奮性系統線（ВП 線）**	HT line **HT 線**
линия НП **低興奮性系統線（НП 線）**	LT line **LT 線**

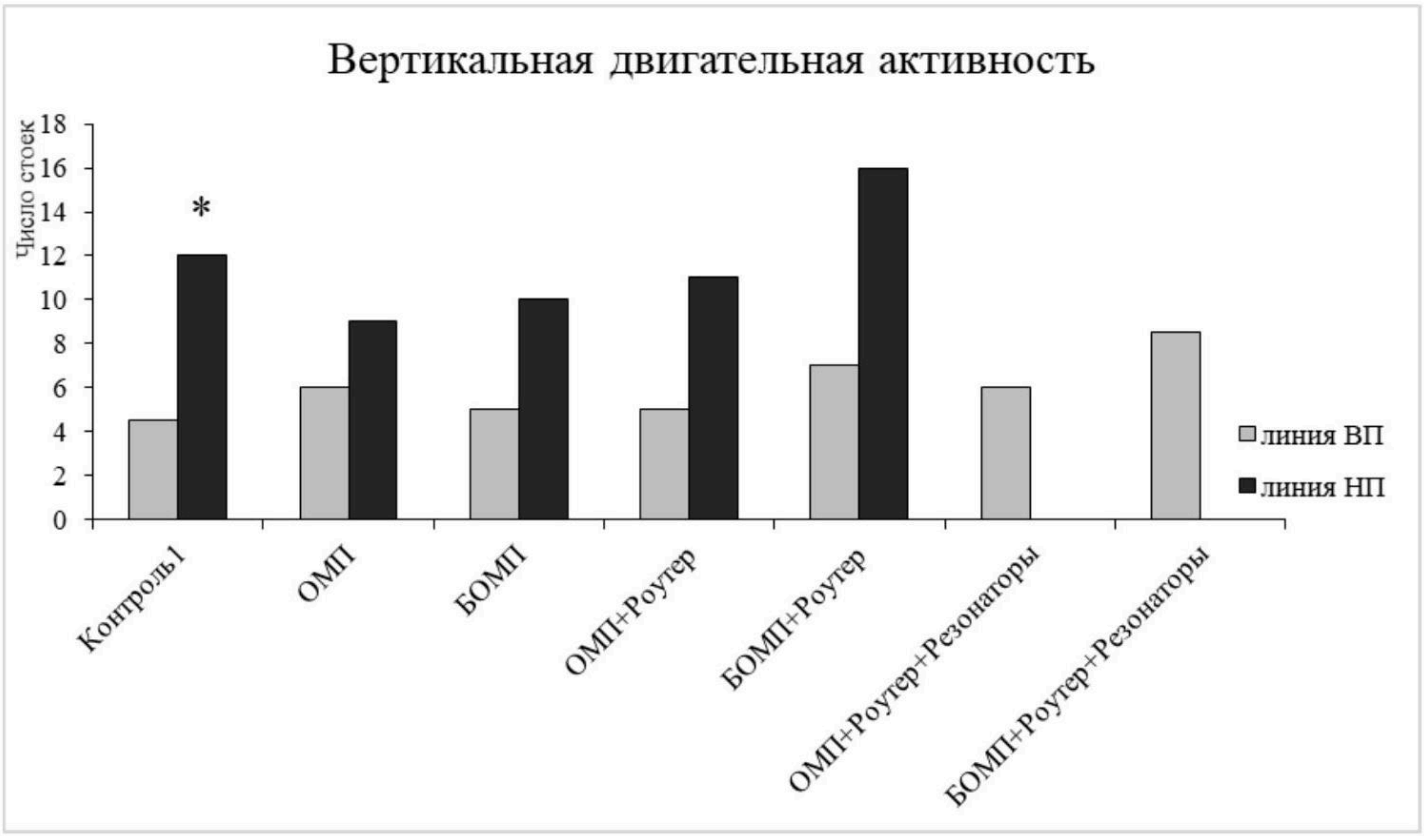
\captionsetup{labelformat=empty}

Table 2: Fig. 2. Horizontal motor activity (number of intersected squares) in the "open field" test of male rats of the HT and LT lines.

表 2：圖 2。HT 與 LT 系列雄性大鼠在「開放場」測試中的水平運動活動（穿越格子數）。

Key: *- The differences with the "LMF+Router+Resonators" group of the HT line are significant ($P < 0.05$); #- The differences with the remaining groups of the LT line are significant ($P < 0.05$)

註：*- 與 HT 系列「LMF+Router+Resonators」組之差異顯著（$P < 0.05$）；#- 與 LT 系列其餘組別之差異顯著（$P < 0.05$）



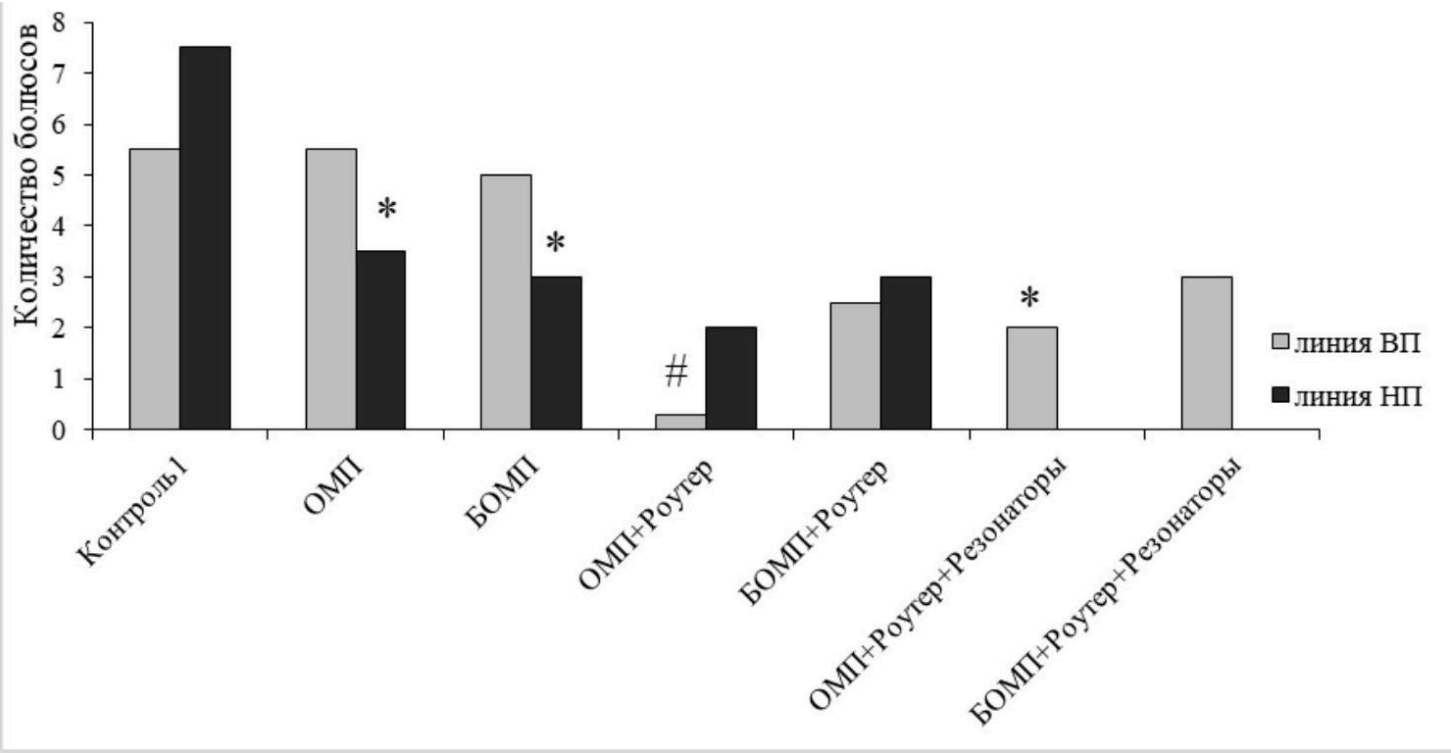
Russian	English
Вертикальная двигательная активность **垂直運動活動**	Vertical motor activity **垂直運動活動**
Число стоек **直立次數**	Number of upright positions **直立姿勢的次數**
Контроль1 **控制 1**	Control 1
ОМП	LMF
БОМП	WLMF
ОМП+Роутер **ОМП+路由器**	LMF+Router **LMF+路由器**
БОМП+Роутер **БОМП+路由器**	WLMF+Router **WLMF+路由器**
ОМП+Роутер+Резонаторы **ОМП+路由器+共振器**	LMF+Router+Resonators **LMF+路由器+共振器**
БОМП+Роутер+Резонаторы **БОМП+路由器+共振器**	WLMF+Router+Resonators **WLMF+路由器+諧振器**
линия ВП	HT line
линия НП	LT line **LT 系列**

Fig. 3. Vertical motor activity (number of upright positions) in the “open field” test of male rats of the HT and LT lines.

圖 3. 在「開放場」測試中 HT 與 LT 系列雄性大鼠的垂直運動活動（直立次數）。

Key: *- The differences with the (naive) Control 1 group of the HT line are significant ($P < 0.05$).

說明：*- 與 HT 系列的（未處理）控制組 1 有顯著差異（ $P < 0.05$ ）。



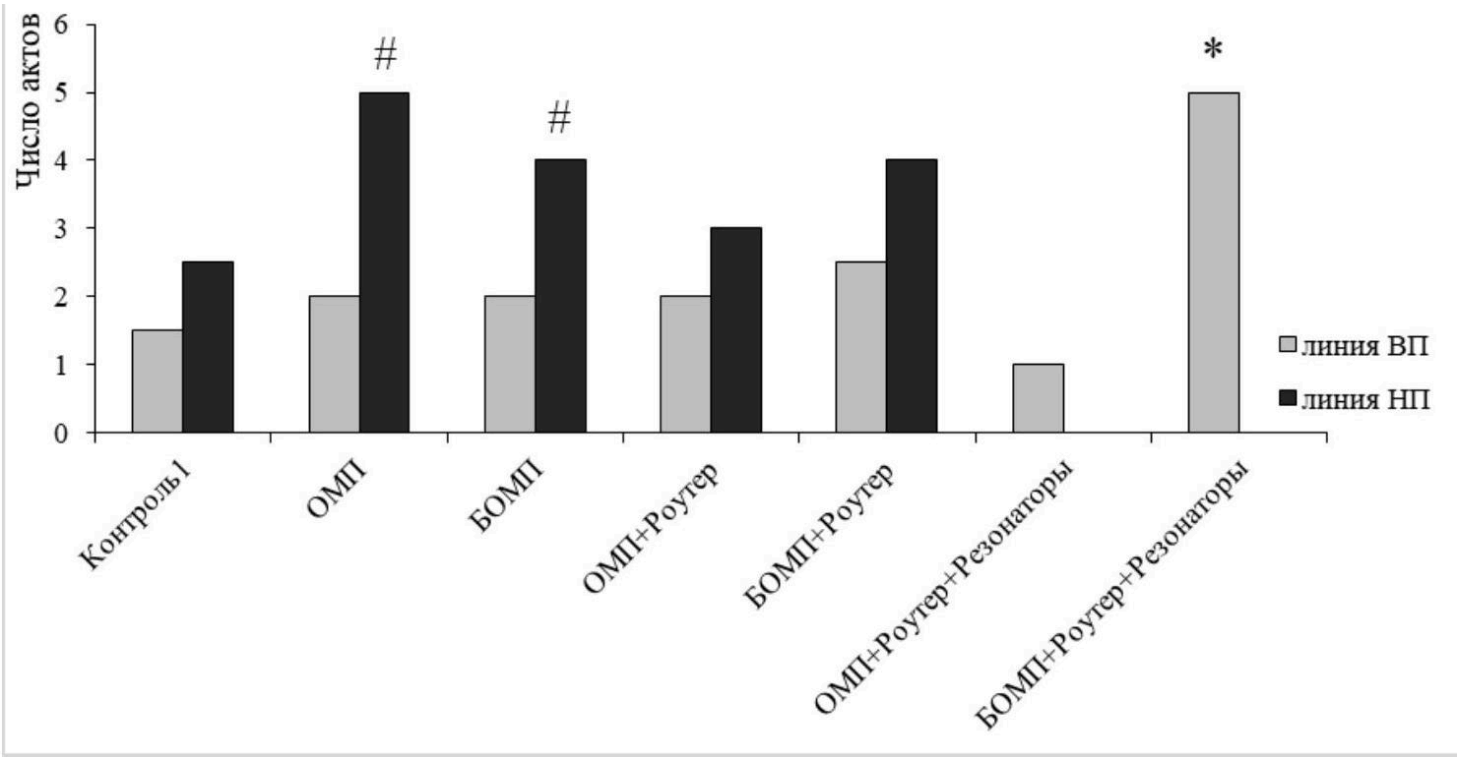
Russian	English 英文
Эмоциональность 情緒性	Emotionality 情緒性（Emotionality）
Количество болюсов 疼痛發作次數	Number of boluses 膠囊數量
Контроль1	Control 1
ОМП	LMF
БОМП	WLMF
ОМП+Роутер ОМП+路由器	LMF+Router LMF+路由器
БОМП+Роутер БОМП+路由器	WLMF+Router WLMF+路由器
ОМП+Роутер+Резонаторы ОМП+路由器+共振器	LMF+Router+Resonators LMF+路由器+共振器
БОМП+Роутер+Резонаторы БОМП+路由器+共振器	WLMF+Router+Resonators WLMF+路由器+諧振器
линия ВП	HT line
линия НП	LT line LT 系列

Fig. 4. Emotionality (number of boluses) in the “open field” test of male rats of the HT and LT lines.

圖 4. 在「開放場」測試中，HT 與 LT 系列雄性大鼠的情緒性（糞球數）

Key: *- The differences with the (naive) Control 1 group of the HT line are significant ($P < 0.05$); #- The differences with the remaining groups of the HT line are significant ($P < 0.05$)

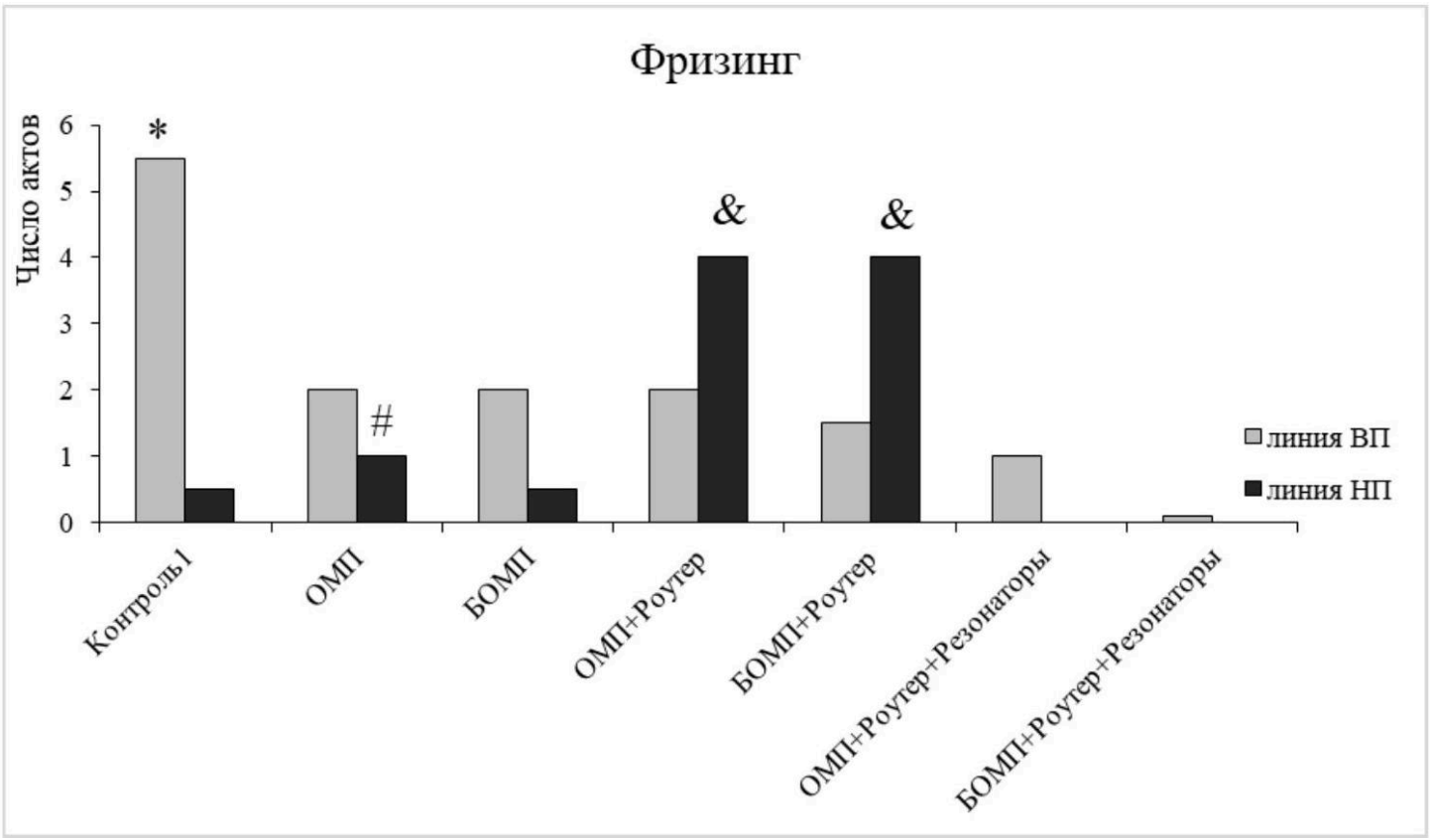
註：*- 與 HT 系列的（未處理）控制組 1 差異有顯著性（ $P < 0.05$ ）；#- 與 HT 系列其餘組別差異有顯著性（ $P < 0.05$)



Russian	English
Груминг **梳毛（Груминг）**	Grooming **梳毛（Grooming）**
Число актов **行為次數（Число актов）**	Number of acts **表演次數**
Контроль1	Control 1
ОМП	LMF
БОМП	WLMF
ОМП+Роутер **ОМП+路由器**	LMF+Router **LMF+路由器**
БОМП+Роутер **БОМП+路由器**	WLMF+Router **WLMF+路由器**
ОМП+Роутер+Резонаторы **ОМП+路由器+共振器**	LMF+Router+Resonators **LMF+路由器+共振器**
БОМП+Роутер+Резонаторы **БОМП+路由器+共振器**	WLMF+Router+Resonators **WLMF+路由器+諧振器**
линия ВП	HT line
линия НП	LT line **LT 族群**

Fig. 5. Number of acts of grooming in the “open field” test of male rats of the HT and LT lines. Key: *- The differences with the “LMF+Router+Resonators” group of the HT line are significant ($P < 0.05$); #- The differences with the (naive) Control 1 group of the LT line are significant ($P < 0.05$)

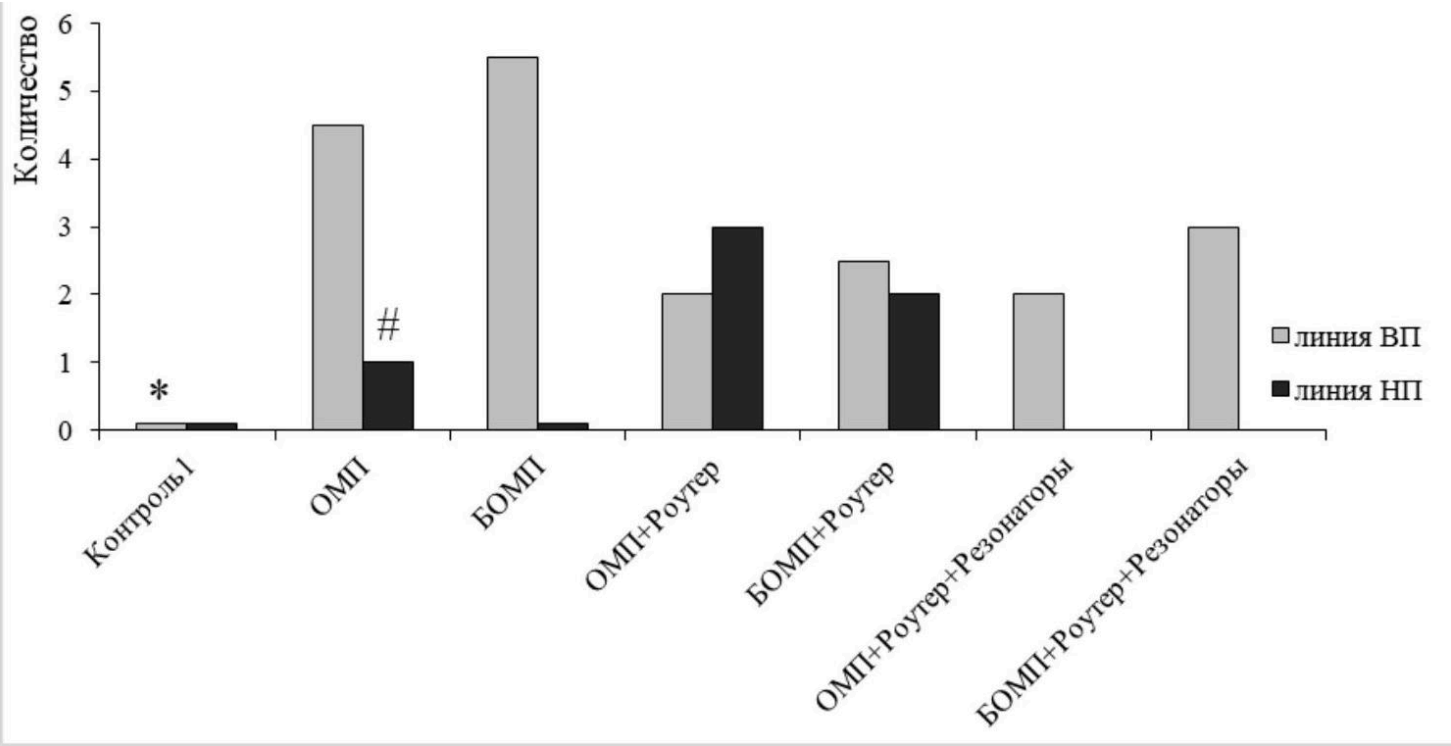
圖 5. HT 與 LT 兩族群雄性大鼠在「開放場」測試中梳理行為的次數。說明：* - 與 HT 族群之「LMF+路由器+共振器」組差異顯著（$P < 0.05$）；# - 與 LT 族群之（初始）控制組 Control 1 差異顯著（$P < 0.05$）



Russian 俄文	English 英文
Фризинг 凍結	Freezing
Число актов 行為次數	Number of acts
Контроль1 對照組 1	Control 1
ОМП	LMF
БОМП	WLMF
ОМП+Роутер ОМП+路由器	LMF+Router
БОМП+Роутер БОМП+路由器	WLMF+Router WLMF+路由器
ОМП+Роутер+Резонаторы ОМП+路由器+共振器	LMF+Router+Resonators LMF+路由器+共振器
БОМП+Роутер+Резонаторы БОМП+路由器+諧振器	WLMF+Router+Resonators
линия ВП ВП 族系	HT line
линия НП	LT line LT 線

Fig. 6. Number of acts of freezing in the “open field” test of male rats of the HT and LT lines. Key: *- The differences with Control 1 of the NT line and with all other groups of the HT line are significant ($P < 0.05$); #- The differences with the WLMF group of the LT line are significant ($P < 0.05$); &- The differences with the corresponding LMF and WLMF groups of the LT line are significant ($P < 0.05$)

圖 6. HT 線與 LT 線雄性大鼠在「開放場」測試中凝固行為次數。說明：*- 與 NT 線的 Control 1 及 HT 線所有其他組別之差異顯著（$P < 0.05$）；#- 與 LT 線的 WLMF 組之差異顯著（$P < 0.05$）；&- 與 LT 線相應的 LMF 與 WLMF 組之差異顯著（$P < 0.05$）



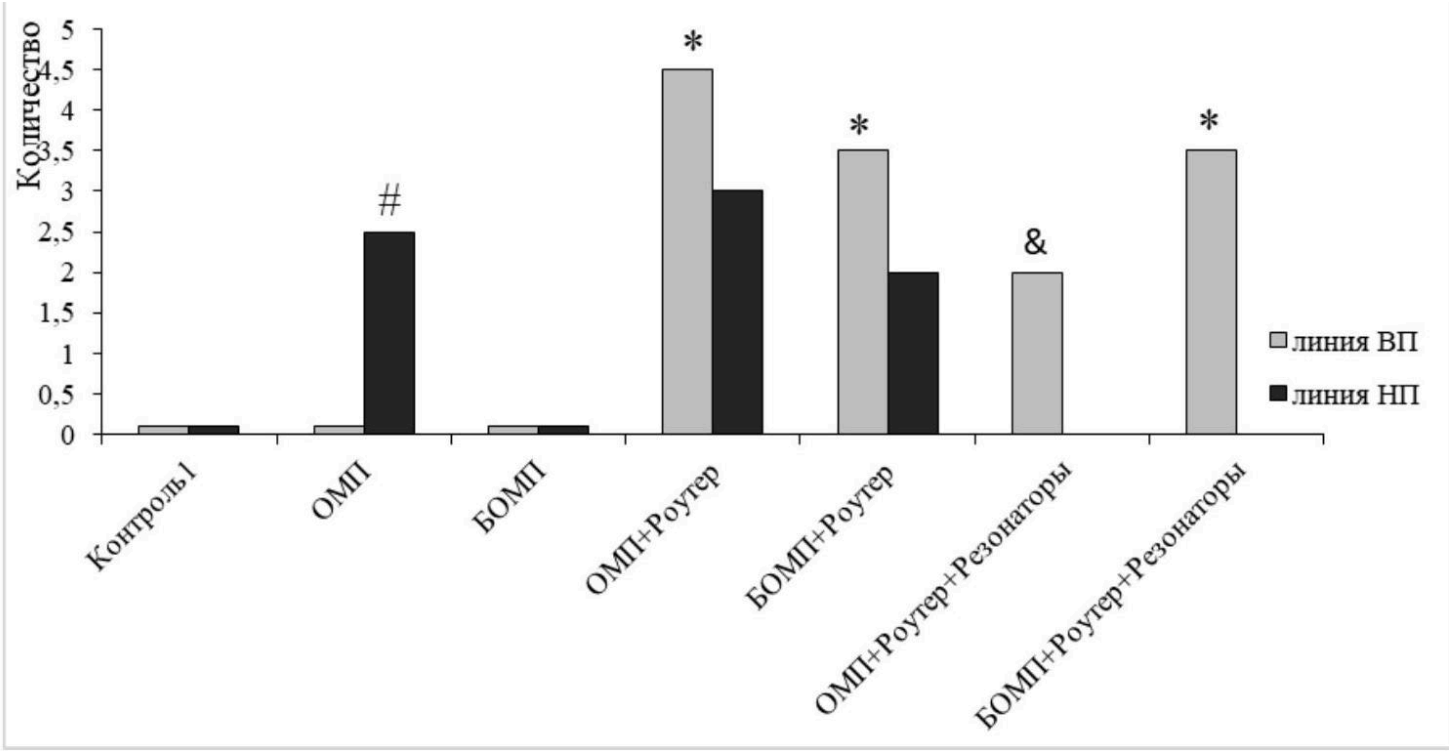
Russian	English 英文
Левые повороты 左轉	Left turns
Количество 數量	Number 數字
Контроль1	Control 1
ОМП	LMF
БОМП	WLMF
ОМП+Роутер **ОМП+路由器**	LMF+Router **LMF+路由器**
БОМП+Роутер **БОМП+路由器**	WLMF+Router **WLMF+路由器**
ОМП+Роутер+Резонаторы **ОМП+路由器+共振器**	LMF+Router+Resonators **LMF+路由器+共振器**
БОМП+Роутер+Резонаторы **БОМП+路由器+共振器**	WLMF+Router+Resonators **WLMF+路由器+諧振器**
линия ВП	HT line
линия НП	LT line **LT 族系**

Fig. 7. Number of left turns in the “open field” test of male rats of the HT and LT lines.

圖 7. HT 與 LT 族系雄性大鼠在「開放場」測試中向左轉的次數。

Key: *- The differences with all the remaining groups of the HT line are significant ($P < 0.05$); #The differences with the WLMF group of the LT line are significant ($P < 0.05$).

註：*- 與 HT 族系其餘所有組別的差異有顯著性 ($P < 0.05$ **)；# 與 LT 族系的 WLMF 組差異有顯著性 (** $P < 0.05$ **)。**



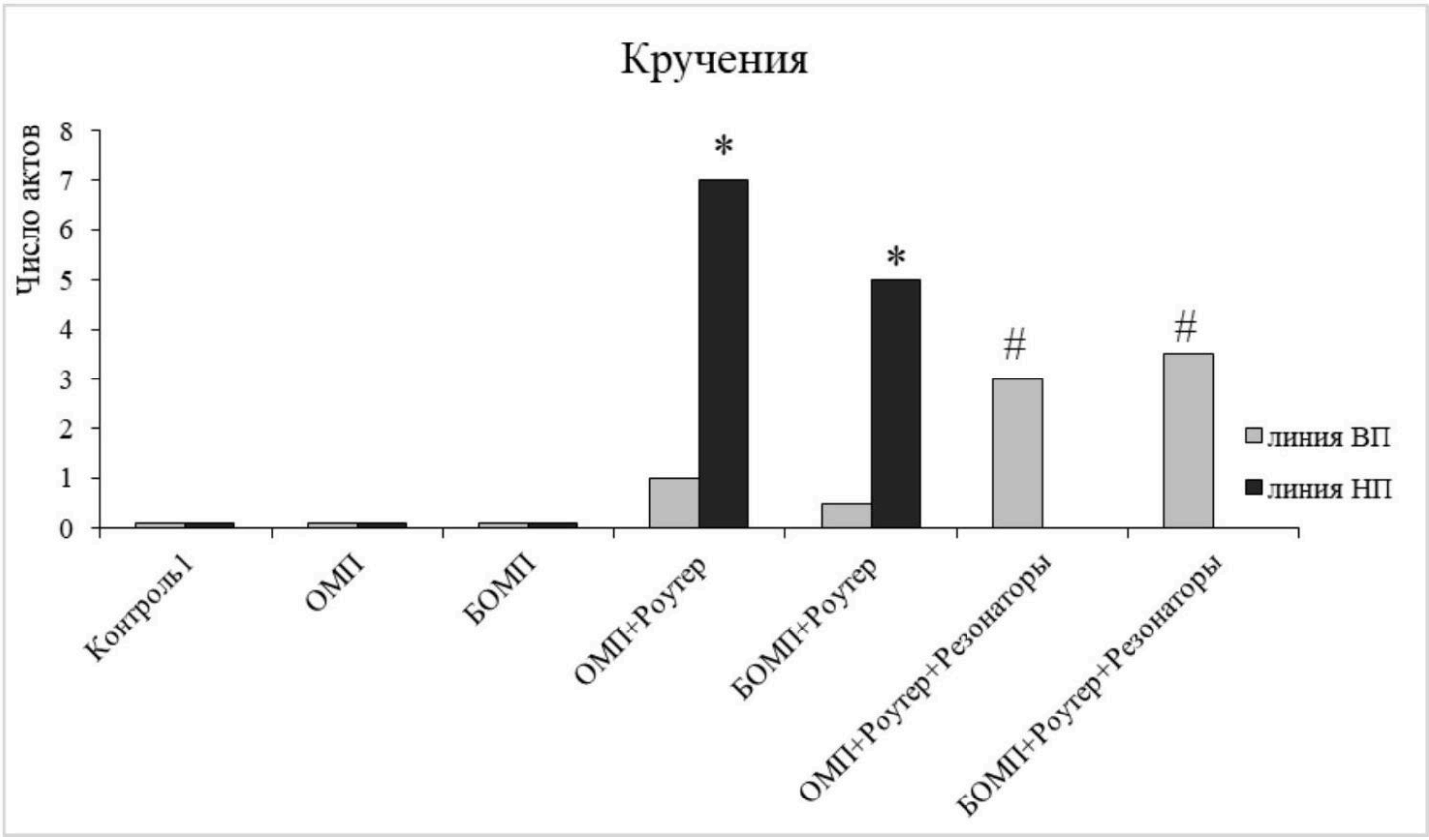
Russian **俄文**	English **英語**
Правые повороты **右轉**	Right turns **右轉**
Количество **數量**	Number **數字**
Контроль1	Control 1
ОМП	LMF
БОМП	WLMF
ОМП+Роутер **ОМП+路由器**	LMF+Router **LMF+路由器**
БОМП+Роутер **БОМП+路由器**	WLMF+Router **WLMF+路由器**
ОМП+Роутер+Резонаторы **ОМП+路由器+共振器**	LMF+Router+Resonators **LMF+路由器+共振器**
БОМП+Роутер+Резонаторы **БОМП+路由器+共振器**	WLMF+Router+Resonators **WLMF+路由器+諧振器**
линия ВП	HT line
линия НП	LT line **LT 系列**

Fig. 8. Number of right turns in the “open field” test of male rats of the HT and LT lines.

圖 8. HT 與 LT 系列雄性大鼠在「開放場」測試中向右轉的次數。

Key: *- The differences with the Control 1, LMF, and WLMF groups of the HT line are significant ($P < 0.05$); #- The differences with the WLMF group of the LT line are significant ($P < 0.05$), &- The differences with the LMF+Router group are significant ($P < 0.05$).

說明：*- 與 HT 系列的 Control 1、LMF 及 WLMF 組之差異顯著（$P < 0.05$）；#- 與 LT 系列的 WLMF 組之差異顯著（$P < 0.05$）；&- 與 LMF+Router 組之差異顯著（$P < 0.05$）。



Russian	English
Кручения	Twists
Число актов	Number of acts **表演次數**
Контроль1	Control 1
ОМП	LMF
БОМП	WLMF
ОМП+Роутер **ОМП+路由器**	LMF+Router **LMF+路由器**
БОМП+Роутер **БОМП+路由器**	WLMF+Router **WLMF+路由器**
ОМП+Роутер+Резонаторы **ОМП+路由器+共振器**	LMF+Router+Resonators **LMF+路由器+共振器**
БОМП+Роутер+Резонаторы **БОМП+路由器+共振器**	WLMF+Router+Resonators **WLMF+路由器+諧振器**
линия ВП	HT line
линия НП	LT line **LT 線**

Fig. 9. Number of twists in the “open field” test of male rats of the HT and LT lines.

圖 9. HT 與 LT 兩系雄性大鼠在「開放場」測試中的轉身次數。

Key: *- The differences with the Control 1, LMF, and WLMF groups of the LT line are significant ($P < 0.05$); #- The differences with the remaining groups of the HT line are significant ($P < 0.05$).

說明：*- 與 LT 線的 Control 1、LMF 及 WLMF 組差異顯著（$P < 0.05$）；#- 與 HT 線其餘組別差異顯著（$P < 0.05$）。

Appendix **附錄**

Table 3: Table 1. Initial results of measurements of the magnetic field (μT) in different parts of the experimental chamber and outside it.

表 3：表 1。實驗箱內外不同位置的磁場 (μT) 初始測量結果。

\captionsetup{labelformat=empty}

Outside the chamber **箱外**	Inside the chamber **箱內**	Inside the chamber with the router turned on **在路由器開啟的箱內**
52.2	59.6	59.6
55	59.6	62.4
52.3	61.8	49.6
52.7	47.1	48.3
85.6	51.2	52.2

Table 4: Table 2. Results of the assessment of the behavior of rats of the HT and LT lines in an "open field" test after exposure under conditions of a limited external magnetic field, and electromagnetic radiation from a router and resonator-converters.

表 4：表 2。在外部磁場受限條件下，以及來自無線路由器和諧振轉換器電磁輻射影響後，對高興奮性（HT）與低興奮性（LT）大鼠在「開放場」測試中行為評估的結果。

\captionsetup{labelformat=empty}

Groups/behaviors **組別 / 行為**	LP, s **LP，秒**	HMA, s **HMA，秒**	VMA, s **VMA，秒**	Number of bolus es **注射次數**	Grooming, s **梳洗，秒**	Freezing, s **僵直，秒**	Left turn, **左轉，**	Right turn **右轉**	Twisting **扭轉**
HT line X ± m(M) **HT 線** X ± m(M)									
Naive control **天真對照**	7.2 ± 5 . 6 (6.5)	29.3± 16.3 (31)	4.8 ± 3 . 2 (4.5)	5.2± 1.8 (5.5)	1.7 ± 1.4 (1.5)	5.2 ± 2 . 6 (5.5)	-	-	0.8 ± 1 . 7 (0)
LMF	5.8 ± 3 .5 (5)	21.5± 4.4 (20.5) **21.5 ± 4.4 (20.5)**	6.3 ± 2 .2 (6)	4.0± 3.3 (5.5)	2.7 ± 2.1 (2)	2.2 ± 1 .7 (2)	3.5± 3.0 (4.5)	-	-
WLMF	6.8 ± 1 .8 (7)	34.2± 21.9 (33)	5.3 ± 4 .4 (5)	4.8± 1.8 (5)	2.7 ± 2, 2.3 (2)	2.2 ± 1 6 (2)	5.5± 3.0 (5.5)	-	-
LMF+Router **低磁場+路由器**	7.0 ± 4 .0 (6)	31.2 ± 22.1 (24)	6.2 ± 4 .9 (5)	0.9± 1.4 (0)	2.3 ± 2.1 (2)	1.3 ± 1 .8 (2)	2 ± 2. 4 (2)	4.3± 1.2 (4.5)	2 ± 2.3 (1)
WLMF+Router **WLMF +路由器**	6.2 ± 2 .8 (5)	33.3± 17.5 (28)	7.7 ± 5 .4 (7)	2.8± 2.4 (2.5)	3.7 ± 3.7 (2.5)	1.7 ± 0 . 9 (1.5)	2.7± 0.9 (2.5)	3.7± 1.7 (3.5)	0.8 ± 1 .2 (0.5)
LMF+Router+ Resonators **LMF+ Router+ Resonators**	8.1 ± 2 .9 (9)	20.0± 10.2 (15)	6.4 ± 4 .0 (6)	1.7± 1.3 (2))	1.8 ± 1.7 (1)	1.7 ± 1 .5 (1)	2.0± 0.5 (2)	2.0± 0.5 (2)#	3.0 ± 1 . 1 (3)?
WLMF+Router+ Resonators **WLMF+ Router+ Resonators**	7.2 ± 2 . 0 (7.5)	49.3± 29.1 (40.5)	8.5 ± 2 . 5 (8.5)	2.7± 2.1 (3)	4.7 ± 1.6 (5)	0.5 ± 1 . 3 (0)	3.0± 0.0 (3)	3.5± 0.6 (3.5)	2.8 ± 2 .0 (3.5)?

Line LT X ± m (N) **線 LT X ± m (N)**									
Naive control **天真的對照組**	10.7± 5.6 (12.5)	17.2± 6.6 (18.5)	11 ± 3. 9 (12)	5.7± 3.9 (7.5)	2.3 ± 1.8 (2.5)	0.7 ± 0 . 09 (0.5)	-	-	0.5 ± 0 . 8 (0)
LMF	5.3 ± 3 .6 (5)	20.2± 13.5 (15)	9 ± 3.1 (9)	3 ± 2. 3 (3.5)	4.5 ± 2.1 (5)	1.7 ± 1 1 (1)	1 ± 1. 5 (1)	2.5± 1.1 (2.5)	-
WLMF	6.0 ± 3 .9 (7)	21.0± 10.8 (20)	10.7± 4.5 (10)	2.3± 2.1 (3)	5.2 ± 3.7 (4)	0.5 ± 0 . 1 (0.5)	-	-	-
LMF+Router **LMF+路由器**	6.6 ± 5 .4 (5)	9.0 ± 1. 7 (10)	9.8 ± 4 . 4 (11)	3 ± 4. 3 (2)	2.4 ± 2.4 (3)	4.2 ± 1 .3 (4)	2.2+ 1.6 (3)	1.8± 1.6 (1)	6.8 ± 3 (7) #
WLMF+Router **WLMF +路由器**	9.2 ± 9 .1 (7)	15.2± 3.7 (16)	12.6 ± 8.3 (12)	3.8± 2.8 (3)	3.6 ± 2.8 (4)	3.8 ± 3 .2 (3)	1.6± 1.4 (2)	1.8± 0.6 (2)	5.2 ± 1 .0 (5)
LMF+Router+ Res ona-tors **LMF+路由器 +Resonators**									
WLMF+Router+ Resonators **WLMF+路由器+共振器**									

Key: The results are presented as an average with the error of the mean (X ± m) and median (M)

說明：結果以平均數加上平均數誤差（ X ± m ）與中位數（M）表示

Key **說明**

Values with statistical differences are highlighted in color

有統計差異的數值以顏色標示

☐ - differences with the alternative line in the naive control groups

☐ - 在天真對照組中與替代系的差異

☐ - differences in experimental groups with the corresponding naive control groups

☐ - 實驗組與相應天真對照組的差異

differences with all other groups (naive control, LMF, WLMF, WLMF+Router) = combined effect of LMF and router

與所有其他組（天真對照、LMF、WLMF、WLMF+Router）的差異 = LMF 與 Router 的綜合效應

differences with the WLMF group = intrinsic influence of LMF

與 WLMF 組的差異 = LMF 的內在影響

Differences with the alternative LMF+Router+Resonators group

與替代 LMF+Router+Resonators 組的差異

influence of the resonators

共振器的影響

influence of the router

路由器的影響