In support to my hypothesis that exogeneous factors, like geomagnetic and cosmogenic factors, had and have a crucial role in human neurogenesis.

In asked Google AI Search to answer my question about why my hypothesis is not supported by the mainstream science?

The Google answer was as it follows:

"*Scientists have not connected geomagnetic events, solar cycles, supernovae, C14 production, reactive oxygen species (ROS), and neurogenesis in the way you describe because several links in this chain of causality are not scientifically demonstrated and are considered speculative. The overall hypothesis lacks robust evidence and contains significant gaps in our understanding of how these phenomena would interact at a biological level*."

"*While it is true that cosmic rays influence the production of C14 in the upper atmosphere, and certain events can cause temporary spikes, there is no evidence that these fluctuations directly lead to meaningful changes in cellular ROS production. A significant increase in radiation-induced ROS requires far higher doses that what would be received from cosmic ray activity, which has a negligible direct effect on biological tissue at ground level. The human body does not incorporate atmospheric C14 quickly enough for small, year-long spikes to register as a significant increase in internal radiation. Any C14 produced diffuses throughout the global carbon cycle, a process that takes decades to centuries*."
"*The body has evolved robust mechanisms to manage normal oxidative stress, and a small, temporary rise in atmospheric C14 would not override these systems.*"

"*The idea that a simple "increase in ROS" causes a "pulse of neurogenesis" oversimplifies a complex biological process. A true "pulse" of neurogenesis would require a specific, localized, and carefully controlled release of ROS within the neural stem cell niche, not a vague, global increase in C14. Neurogenesis itself transiently generates oxidative stress, but this is an effect, not necessarily a cause of the process*."

"*No studies have directly connected external cosmic events to the precise, internal cellular changes in ROS needed to trigger neurogenesis.*"

"*The hypothesis relies on linking several distinct fields of research with very different scales of time and magnitude, and the connections between the fields is speculative. However, the magnitude of these C14 changes is far too small to influence biology via radiation. The connection from atmospheric C14 fluctuations to a biologically meaningful increase in ROS has not been demonstrated and is physically improbable.*"

"*Simply observing that cosmic events occur, C14 changes, ROS exists, and neurogenesis happens is not evidence of a causal relationship. For a connection to be scientifically accepted, each stage must be rigorously tested and the mechanism clearly identified. The current evidence does not support a causal chain between these phenomena.*"

I am an independent researcher in multidisciplinary domain. Because I am not embedded in any specific institution, but I am affiliated to the AAAS, my scope and role is to review scientific literature, to find those patterns which are common in several fields, and when a hypothesis about the correlation developed by those patterns emerges, I would try to find if a causality can be demonstrated. I think that every multidisciplinary scientist proceeds in a similar manner.

For my research uploaded on academia.edu, when some of my papers show high attractiveness among the academia.edu readers, then, I collect them as chapters and I self-publish as books.
However, my research reached a peak, connecting and relating my hypothesis to what will happen in our near or immediate future. I just uploaded on academia.edu two papers about the "premises of an Information Society." In all these connections to such type of near future the Artificial Intelligence and Digitalization play the fundamental role.

I give to the AI tentative a high appreciation, and I suggested in my work some applications, where the social implications must be highly elevated.

Therefore, when I addressed Google AI Search the question about how my hypothesis is viewed by current research, the Google AI answer was only a mainstream adjusted view, where the multidisciplinary issue in itself was expressed as "*the hypothesis relies on linking several distinct fields of research with very different scales of time and magnitude,*" where the answer in itself negates the very scope of multidisciplinary research.

I decided to search further the same topics expressed in my hypothesis on the same Google AI, but I addressed every aspect embedded into it in a separate manner, and I found that, in fact, Google has strong arguments, which are offered online to validate my hypothesis.

I will show those arguments by continuing to quote Google AI Search.

Regarding the influence of cosmic ray activity, previously Google said: "*While it is true that cosmic rays influence the production of C14 in the upper atmosphere, and certain events can cause temporary spikes…*".

Now asking differently the same question, the Google response is: "*Yes, a low dose of ionizing radiation, such as 0.17 mGY, can potentially boost mitochondrial activity. Mitohormesis (that causes short-term burst of ROS) describes how a low-dose radiation triggers an adaptive response that ultimately strengthens the cell's defenses and boost mitochondrial function.*" This view contradicts previous Google AI view that showed that human body does not incorporate C14. Wikipedia says: "*Since many sources of human food are ultimately derived from terrestrial plants, the relative concentration of C14 in human body is nearly identical to the relative concentration in the atmosphere*." (the human body incorporates C14 directly from plants, herbivores and carnivores which eat herbivores, because the plants first incorporate directly C14 through photosynthesis). Also, Google shows that high doses of ionizing radiation will damage the mitochondria and the DNA.

A study of Li-Chung Wei, Yiu-Xiu Ding, Yong-Hong Liu, Li Duan, Ya Bai, Mei Shi, and Liang-Wei Chen, titled *Low-Dose radiation stimulates Wnt/beta catenin signaling, neural stem proliferation, and neurogenesis in the mouse hippocampus in vitro and vivo*, published in Journal of Radiation Research in January 2012 indicates:

"Wnt/beta catenin signaling is critical in the control of proliferation and differentiation rate of neural stem cells or progenitors in the hippocampus." They used low-dose radiation in the range of 0.3 Gy that increased proliferation and neuronal differentiation of neural stem cells. Also, the study found that the subjects during Morris-water maze test showed behavioral improvement of animal learning in the low-dose radiation group.

Another study led by Norio Takahashi, Munechika Misumi, and Hideko Murakami, titled *Association between low dose of ionizing radiation administrated acutely or chronically, and time to onset of stroke in a rat model*, was published online 2020 Aug 4.

The authors found that the rats acutely irradiated with doses with cumulative dose between 0 and 1.9 Gy (at a rate of 0.05 or 0.1 Gy/day) indicated a threshold around 0.1 Gy. Bellow the threshold, but chronically exposed, no significant increase in stroke symptoms was observed. The risk of stroke clearly appeared at high doses.

When mice were exposed to low doses but for 20-30 generations, the results show a host of biopositive effects, like increased litter size and number, increased viability, and faster growth rate. The mice were exposed to 4.3 mGy/day for three weeks. In another experiment a mice colony was exposed for 21 generations to a 28.8 mGy dose at 1.2 mGy/hour. The

lowest dose used was 31 mGY, representing a radiation exposure of 4 mCi, which produced an absorption of 0.4 mGy/hour. Here should be noted that the dose of 4 mCi is double compared to C14 dose recorded in 1950. In sum, an increase of 2 mCi in the radiation has produced a significant biopositive effect in animal experiments.

Another study of Feng Ru Tang, Weng Keong Loke, Boo Cheong Khoo, titled *Low-dose or low-dose-rate ionizing radiation-induced bioeffects in animal models*, published in the Journal of radiation Research on 2016, Dec 27; 58(2):165-182 (doi: 10.1093/jrr/rrw120) showed that acute or chronic low-dose ionizing radiation ((LDIR) (100 mSv) or the low-dose-rate ionizing radiation (LDRIR) (6 mSv/hr.) induced genetic and epigenetic changes on bionegative and biopositive effects. The authors found that bionegative and biopositive effects depend on many individual factors, like metabolism, body energy consumption, and many other elements. My hypothesis assumed that several known extinctions of Late Quaternary can be attributed to bionegative effects. I postulated that Neanderthals also became affected by mental alterations, which caused their relatively rapid extinction. Maybe other hominin species encountered similar outcomes.

The Late Quaternary extinctions correspond to two phases: the first phase, developed between 45 ka and 35 ka, is the epoch of a weak geomagnetic field and high C14 isotopes concentration; the second phase of extinction, developed between 15 ka and 1o ka, corresponds to Gothenburg geomagnetic excursion that was overlapped by several other cosmogenic events and by the Younger Dryas cold episode.

This review study is important because it refers to low-dose radiation with values of 6 mSv to 20 mSv. All these types of irradiation have a biological effect, infirming the Google AI Search that stated that some radiation is too small to have an effect on biota.

There have been estimated that the atmospheric radiocarbon (C14 isotopes) fluctuated due to a chain of solar minima, between 1500 AD to 1850 AD by 2%.

There is estimated (Nydal-1968) that the residence time in the stratosphere to the troposphere is 2.0 years. The transfer between Earth's hemispheres take one year. The C14 atmospheric residence before transferring to the biosphere and aquatics is four years. The residence on the ocean's surface is seven years, and the transfer to the depth is 24 years.

Paul A. LaViolette estimated in 2011 that a giant cycle of solar flares occurred in phase around 12,973 BP, 12,837 BP and 12,639 BP, or for approximately 300 years, making the radiocarbon concentration rise by 50%.

However, the mentioned events (geomagnetic and cosmogenic) have been recorded as an increase of the C14 atmospheric concentration that can vary from 0.5-5% to 100%.

"The rate of disintegration of potassium (K) 40 and C14 in the normal adult body are comparable. The K-40 gives about 0.17 mSv/year and C14 gives 0.012 mSv/year internal dose."

Average annual dose for a person on Earth from natural sources is 3 mSv, while the C14 disintegration is 0.012 mSv/year. If the recorded atmospheric concentration is over the baseline, it means it is over 3 mSv and can reach as much as doubling that is 6 mSv, like in the case of the peak reached in 1962 during the Atomic Bomb atmospheric experiments. From this value of 6 mSv occurs the aforementioned rate of disintegration of 0.012 mSv/year

A Typical PET/CT scan is about 25 mSv that is 0.025 Gy.

Any amount of ionizing radiation carries a small risk of long-term effects. No level of radiation, including the low-level, can be considered risk-free.

I can postulate that multi-annual accumulation of C14 isotopes may play a role in influencing the neurogenesis. The atmospheric residence time is four (4) years before it occurs the full dilution in various sinks. Does occur an accumulation of radiocarbon in these four years or any other time period when the cosmogenic rays penetrate the Earth's atmosphere?

However, in the case of the atmospheric Atomic Bomb experiments the peak of 80-100% over the 1950 baseline was reached in 1962, when the atmospheric experiments became banned, while 30 year later (in 1992) the concentration was still 20% over the baseline. But returning to 1950 baseline level occurred only in 2020.

Let's analyze how much C14 can be accumulated in one hundred years of higher than baseline atmospheric concentration of C14 isotopes? Based on C14 disintegration factor, in 100 years the atmosphere can accumulate as much as 6 mSv/year that is 600 mSv from which the disintegration amounts to 1.2 mSv.

In the case of 1,000 years of atmospheric accumulation, disregarding the C14 dispersion in various natural sinks that remain poorly documented, the total can be 6,000 mSv (or 0.6 Gy that is higher that the thresholds value of 0.17 Gy and 0.3 Gy established during animal experiments) but from which it must be deducted, at least in part, a disintegration value of 12 mSv or more.

The lowering of the intensity of the geomagnetic field is active during the entire duration of the geomagnetic and cosmogenic events, meaning that the galactic rays continue to penetrate the Earth's atmosphere directly proportional to the variation in the geomagnetic shield strength.

If the accumulation assumption is valid, then, one can find some thresholds of accumulated radiation, where each level has a particular influence in the process of neurogenesis.

My hypothesis is associated with several assumptions I made about the distinct effect produced by such a variety of levels. I assumed that higher effects would have been generated by the geomagnetic excursions, which are regularly more than 1,000 years long.

In my assumption, I attributed to such long excursions the capacity to influence the energetic consumption of the human brain, causing changes in the balance between nonlinear and linear mental processing.

Shorter excursions, in the range of 100 years, along with solar minima, which show an average length of 60-100 years, would have a smaller effect, like that of an increased mental quantification of the qualitative values.

Another new quote from Google AI: "*Traces of C14 can influence mitochondrial development and function, primary through the effects of low-level ionizing radiation. When C14 is incorporated into organic molecules, such as DNA and proteins, its decay can have a direct biological impact. In response to radiation damage, cells activate a DNA damage response, increasing in mtDNA copy numbers as a compensatory mechanism*."

"*The effect of C-14 radiation on mitochondria can influence a cell's overall developmental trajectory, especially for stem cells where metabolic state is key to differentiation*."

Up to this point, Google AI Search provides enough information to draw a connection between low-doses of ionizing radiation generated by C14 atmospheric concentration and the exogeneous effect caused by the increases in ROS generation that stimulates mitochondria production.

The initial Google AI response states that "*there is no evidence these fluctuations directly lead to meaningful changes in cellular ROS production, because the cosmic ray activity has a negligible direct effect on biological tissue at ground level.*"

"*Controlled ROS production is linked to key aspects of neuronal development. The beneficial effect of ROS on neurogenesis is observed with controlled ROS generation at low-to-moderate levels. A balance is crucial; while physiological levels of ROS support neurogenesis, excessive ROS production can lead to oxidative stress, and neuronal damage.*"

What is not defined yet is only the ranges of C14 atmospheric concentration, which will have such indirect effect on neurogenesis.

However, as the literature describes, the C14 atmospheric concentration level over the 1950 baseline have been as follows:

-from 54 ka to 38 ka they were 60-80% higher than the baseline

-the peak occurred 60-80 higher the baseline during the Laschamp geomagnetic excursion

-from 38 ka to 25 ka C14 was about 60-40% above baseline.

Here, in sum, from 43 to 25 ka, the C14 was 18,000 years over the baseline.

During Gothenburg (13-12 ka) excursion it was 10% over the baseline and almost similarly during the Solovki (7.5-4.5 ka) excursion. The Blake and post-Blake events lasted for over 5,000-6,500 years and contained three-four alleged temporary polarity change.

Thus, these were not "temporal spikes" but "long lasting continual spikes." The shortest geomagnetic excursion (Sterno-Etrussia) occurred 2,700 years ago, and its duration was around 100 years.

Atmospheric concentration is measured in parts per million (ppm). Increased number of C14 molecules in the atmosphere absorbs more outgoing infrared (thermal) radiation from the Earth's surface that is re-emitted in all directions. This phenomenon is called "radiative forcing" and is measured in watts per square meter. The baseline is about 2 w/square-meter.

However, the C14 isotopes effect (radiocarbon effect) during 1962 was estimated at 4 mCi that is equivalent to 31 mGy. This last value of 31 mGy was the lowest dose used on animal experiments by one of the studies, and the increase of 2 mCi over the natural baseline produced significant biopositive effects in all animal experiments.

These animal experiments are very important for my hypothesis, because they indicate that the scientists had in mind the idea to check on such atmospheric concentrations of radiocarbon, which sometimes double the natural baseline of radiative exposure.

In the meantime, there is no indication that radiocarbon doses less than those tested but higher than the baseline would have no influence on neurogenesis. On the contrary, one of the review study mentioned refers to irradiation values of 6 mSv to 20 mSv, which can be produced by C14 atmospheric concentrations a little bit higher than the baseline.

In sum, **my hypothesis still accurately stands as a significant approach intended to describe the biopositive and bionegative radiative influence of the geomagnetic and cosmogenic events on human neurogenesis, where the neurogenesis ultimately represents a fundamental factor within human evolution in at least the last 100,000 years**.

Having both biological effects as an exogeneous outcome of the C14 atmospheric concentration, at high and low irradiation levels, there is a confirmation that both levels have an effect on ROS production, mitochondrial development, and on pulses of neurogenesis.

In the end of this paper, I would like to refer to a Google AI Search answer that explains the energetic consumption of the newly formed neurons. Here," *the mitochondria activity regulates the neurogenesis by regulating the behavior of neural stem cells (NSCs), neural progenitors, and mature neurons*. *Neurogenesis involves a critical metabolic shift from glycolysis to oxidative phosphorylation (OXPHOS). Glycolysis is a less efficient but faster energy source. As neural stem cells (NSCs) become active and differentiate into NPCs, they increase OXPHOS activity, which generates the high levels of ATP needed for rapid proliferation. Now****, fully differentiated neurons are highly dependent on OXPHOS to meet their Immense energy demands***."

In the above paragraph Google AI indicates the **need for a large energy demand of the newly differentiated cells.** This explains why neurogenesis may have a crucial role in stimulating brain adaptations for changed energy consumption levels. As much as the neurogenesis production increases, such an increase is reflected in higher energy requirements, which will cause changes in neural energy consumption, altering the balance between nonlinear and linear processing. This situation may show a proportional relationship occurring between C14 atmospheric concentration and ROS and mitochondrial productions.

However, as it appears, when atmospheric C14 concentration is relatively small, the influence on ROS and mitochondrial production is small, too, and the overall effect is quite distinct. In this case, it may only produce less radical effects, like those described as an increase in mental quantification that is an increase in linear approaches, or it may cause a hybrid state of the mind by combining the processing of visual and acoustic signals inside the neural tracks.