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Peer Review

Review of: "The Role of Carbon Dioxide in the Evolution of Intelligence: Solving the Dinosauroid Question"

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Ugo Bardi's article delivers a stimulating and interdisciplinary hypothesis: that low atmospheric CO_2 concentrations and high O_2/CO_2 ratios have been central to the development of highly encephalized species, especially hominins, over the past 50 million years. The paper eloquently connects geological shifts in atmospheric composition with the metabolic demands of large brains, arguing that efficient oxygenation and CO_2 removal played an evolutionary role in advanced cognition and encephalization.

Strengths:

- **Novelty and Systems Perspective:** Bardi's work stands out for its originality, merging atmospheric science, evolutionary biology, and physiology to shed new light on evolutionary puzzles and to relate planetary-scale factors to the specifics of brain metabolism.
- **Balanced Discussion:** The author considers multiple influences on brain evolution – not solely atmospheric composition, but also social, technological, and ecological feedback mechanisms – providing a well-rounded analysis.
- **Societal Relevance:** The article draws timely links to current anthropogenic trends, emphasizing that rising CO_2 levels could diminish human cognitive performance, with implications for present and future generations.

Critical Assessment: While the discussion is widely interdisciplinary, some aspects, like the treatment of fossorial species (mole rats) and their low encephalization quotient (EQ), potentially linked to low O_2/CO_2 ratios in burrows, invite closer examination. Although the metabolic rationale is sound, EQ in small mammals is mostly governed by body size and evolutionary lineage rather than exclusively by habitat oxygenation. Adaptation to fossorial life may coincide with lower EQ, yet causality remains debated.

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Furthermore, the article would be strengthened by discussing organisms from other oxygen-challenged habitats – such as high-altitude mammals and birds – which are not addressed but could provide crucial comparative insight.

Suggestions for Future Research:

- **Broader Taxonomic Comparisons:** Future studies should systematically compare fossorial and high-altitude species to clarify how atmospheric composition, body size, and lineage collectively influence EQ.
- **Experimental Studies:** Laboratory and field research on the long-term physiological and cognitive effects of ambient CO_2 and O_2 would help elucidate the underlying mechanisms.

Overall Evaluation: Bardi's paper is an intellectually stimulating and timely contribution that pushes the boundaries of evolutionary theory through a systems-oriented lens. Its innovative concepts and interdisciplinary approach warrant further exploration and empirical validation. I recommend publication of the article, with the caveat that its limitations are acknowledged and that it inspires broader research along the suggested lines.

Declarations

Potential competing interests: No potential competing interests to declare.