Managing brain-hype: Understanding and discriminating overemphasized brain-based allegations

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Abstract. Research about our brain's function is today essential for the assessment of the human species and for our self-comprehension. However, since the neuroscientific turn took place in several areas of research such as psychology, philosophy, and AI, the consequential interdisciplinarity this event created gave birth to an important phenomenon that is still in place today: neuro-hype or brain-hype. As a matter of fact, we are increasingly overstimulated by brain-based observations, research, and alleged discoveries. But, how much of this hype around our brains is justified? This is an essential question if we aim to assess and understand neuroscientific research today. Therefore, in this work, we analyze this phenomenon and its outcomes by investigating different topics ranging from newspaper titles to the relationship between brains and research. In addition to that, we discuss several theories such as neuroessentialism that have made an attempt to explain and understand this phenomenon, which has important ethical implications concerning both scientists and society in its entirety.

Key words: brain-hype, neuro-hype, neurorealism, neuroessentialism, brain-based allegations

Introduction

Brain-hype is a well-known communication phenomenon. By this term, we refer to the exaggerated or unsubstantiated claims and expectations surrounding the field of neuroscience. It is a term that we use to describe situations where the potential of neuroscientific research and its applications are overhyped, leading to unrealistic expectations or misleading interpretations of the findings. This has to do with a broad class of neuroscientific claims that outmatch extensively the available evidence or even its correctness (1). Such a phenomenon can be detected both in academic texts and journalistic texts, and it comes from the conscious or unconscious action of hyping up scientific claims. As it has been reported (2) hyping up scientific claims is not a peculiarity of the neurosciences.

Magnifying scientific findings in the biomedical field is, unfortunately, a rather popular phenomenon in science communication that raises serious bioethical questions. For instance, we can observe, within scientific writing lots of examples concerning other kinds of "hypes": oncology hype, cardiology hype, nutritional hype, and many more (3).

Therefore, our topic of discussion, *brain-hype*, is just a small subset of this larger issue.

Why brainhype

Contemporary literature revolving around this particular topic (4) has defined this issue as *neurohype*, however for pragmatic reasons that we will see shortly we believe that brainhype would be not only a better term for it but more importantly a clearer one for the public.

The term "neurohype" is more commonly used and recognized in the scientific community and literature (5) to describe the exaggerated claims and expectations surrounding neuroscience. It specifically focuses on the field of neuroscience and the associated hype or misconceptions that can arise from it.

On the other hand, the term "brainhype" is not as widely used or recognized. It is a less specific term that encompasses the broader realm of exaggerated claims and expectations related to the capabilities and potential of the human brain. While it can overlap with neurohype, brainhype can extend beyond just the field of neuroscience to include various areas where the brain is a central focus, as we will shortly see.

While the term "brainhype" can be used to describe exaggerated claims related to the brain, the term "neurohype" could be seen as only describing the specific context of exaggerated claims within neuroscience. Therefore, even though "neurohype" remains the most commonly used, we sustain that brainhype brings the public the clarity it needs to understand and spot the phenomenon.

a. First of all, in using this term, we imply the current centrality of brainhood and its identification as personhood (6), then the term brain would be better suited for explaining this phenomenon than the suffix -neuro;
b. The second reason why we prefer such a denomination is linked to the place and role that the neurosciences have in today's society. Today the neurosciences and their related research are not confined to the neuro-disciplines, but they are intended in a broader sense than before. In this context, we are referring to disciplines that are not traditionally -neuro disciplines but have extended their interests to the neurosciences and cognitive sciences in recent times. Such disciplines comprehend philosophy, linguistics, AI, engineering, logic, mathematics, and computation: using the term indicating the organ with which these disciplines are concerned, in their sub-categories is a way to extend the phenomenon (and its relative accountability) to the whole range of scientific research that is concerned with brains.
c. Lastly, since this phenomenon is, as we will see in the present work, so widespread using a simpler and more direct term such as *brain*, would give more understandability and accessibility to that part of the public that is not directly concerned with the neurosciences, but is still a part of the brainhype equation by often being the addressee of products and information concerning this phenomenon.

Situating and defining the issue

Advancements in the medical field are copious nowadays, just consider endocrinology with AI wearable devices that calculate glucose levels in the blood (7), or wearable insulin deliverers (8). In cardiology, we have engineered heart valves (9) and miniature ventricular assist devices (10). And in epidemiology and biotech faster and faster vaccine creation and distribution (11), oncology with immunotherapy (12), and liquid biopsy techniques (13). In the neurosciences, we can observe slower revolutionary breaks in research, and we still have not acquired a great deal of information about our brains yet. So, as you can see, scientific hype seems to be, within the neurosciences, even less justifiable concerning other fields, or is it?

Even if research in the neurosciences has fewer results and is somewhat slower than in other medical fields, these times are truly exciting for the discipline. In fact, we are, now, in a very liminal situation where it seems that a real and concrete turn will be finally possible (14) a turn that will tell us more about our brains. It is like we have most of the pieces of a puzzle, and we just need to assemble it. This will be possible also thanks to fMRI technologies (15). Consequently, we are seeing, and we will see in the future, an increase in brain-hype in several contexts, including the academic one.

For these reasons, it is important to clarify better what we mean when we refer to brainhype and why it is a pressing topic to address.

The human brain and its functions are incredibly complex, and neuroscience is a rapidly evolving field that seeks to understand the brain's structure and function. However, due to the complexity of the brain and the limitations of current scientific understanding, there is often a gap between what is known and what is claimed or perceived.

Brainhype can manifest in various ways. For example, media reports may sensationalize neuroscientific studies, leading to exaggerated claims about

the implications for understanding human behavior, cognition, or mental disorders. Additionally, some commercial products or services may capitalize on the allure of neuroscience, making unsupported claims about their effectiveness in enhancing cognitive abilities or improving mental health. Therefore, it seems mandatory to approach neuroscientific claims with a critical mindset and to rely on scientific consensus and rigorous evidence. While neuroscience holds great promise for advancing our understanding of the brain and its disorders, separating legitimate scientific advancements from the hype is crucial to ensure the accurate dissemination of information.

But what are the reasons why this phenomenon happens in the first place? We have spotted three different points:

1. Simplistic interpretations: brainhype often arises when complex neuroscientific findings are oversimplified or misinterpreted. The brain is an intricate organ, and its functions are not easily reducible to simplistic explanations. However, as we will see in this work in popular media, complex concepts may be simplified to catchy headlines or sound bites, which can lead to misunderstandings or exaggerated claims about the significance of the research.
2. Exaggerated implications: Neuroscientific research findings are sometimes extrapolated beyond their actual scope. For example, a study may find a correlation between a certain neurobiological brain activity pattern and a specific behavior (16), but that does not necessarily mean there is a causal relationship or that the findings can be applied universally. However, these findings can be misconstrued as definitive explanations or predictions about human behavior or cognitive abilities, leading to unwarranted hype.
3. Commercial exploitation: The allure of neuroscience and the belief in brain-based interventions have led to the development of numerous commercial products and services claiming to enhance cognitive abilities or mental health (17). These products may use neuroscientific jargon or references to brain imaging techniques to lend credibility to their claims. However, the scientific evidence supporting the effectiveness of many of these products is often limited or lacking, resulting in misleading or exaggerated marketing claims (18).
4. Publication bias: brainhype can also be fueled by publication bias, where positive or extraordinary results are more likely to be published and highlighted, while null or negative results are often overlooked (19). This can create an inflated perception of the effectiveness or significance of certain interventions or findings in the field of neuroscience.

It is important to approach neuroscientific claims with skepticism and to consider the broader context of the research, including replication studies, scientific consensus, and critical evaluation by experts in the field. By doing so, we can separate the legitimate advancements from the exaggerated or misleading claims, promoting a more accurate understanding of the capabilities and limitations of neuroscience.

Of course, this phenomenon - both in an academic and in a social setting - poses an undeniable threat to the credibility of neuroscience in the public eye. Without explicit guidance, both laypersons and academics (without being formally trained in neurosciences) can easily fall prey to dubious proclamations that endanger everyone, one good example of that is neurologisms.

Neurologisms

Neurologisms are neologisms born to give a strong and defining neurological take on disciplines and life aspects that are not traditionally linked to the neurosciences. For example: neuroadvertising; neurowine; neuroarchaeology; neuroarchitecture; neurobotany (information processing and communication in plants); neurocapitalism; neurocinema; neurocosmetics; neuroconsulting; neurofashion; neurogastronomy, and many more (20)

Perhaps we can all agree on the fact that some neurologisms are confusing. But are they just confusing? In reality, *neurologisms* can be ethically dangerous because they mislead the public towards something that should have proven scientific evidence at its roots, but sometimes is just a product of marketing and capitalism. Therefore, they create some expectations that

will not (and cannot) be met, by actively tricking consumers and users (21).

Over-trusting the neurosciences

Educating the public on neuroimaging techniques and technologies has been the core of the RRI (responsible research and innovation) project (22), which had the aim to mitigate brainhype. Within this project, there has been an inquiry on Dutch press highlighting how the reported data was usually intended in a positive connotation and progress, and unfortunately, a proper expression of limitations was rarely present.

The authors of this study have explored how the current reporting methods have the tendency to enable brain hype rather than ease it. This is why this inquiry is utterly important to us, especially if one considers that technology is far from being neutral and having a neutral impact on our lives and neurosciences and that it is likely going to improve increasingly fast in the next decade.

In line with this last work, we have also consulted an original analysis (23) that confirms our first suspicion: neuroscience in the media is reported in a generally overly optimistic way, without giving too many details on the actual research studies, as if the public should not be interested in the technical details of science and these should not be something worth explaining to people. This, in our opinion, highlights a huge problem of justice where the general public is deprived of the opportunity to having explained in a clear and accessible way how neuroscientific studies work and their limitations.

The negative outcome of all this has, again, something to do with providing the public with suggestions of brain-related activities or capabilities that are actually impossible to achieve, as highlighted by the example below.

"A.I. Is Getting Better at Mind-Reading" (24)

These issues that we have discussed during the course of our analysis can be related to two important phenomena that have been described some time ago: Neuroessentialism (25) and Neurorealism (23).

Neuroessentialism can be summed up as being a strong drive to consider brains as having human-like properties and attributing such properties to the organ rather than to human beings. This concept explains clearly a widespread phenomenon, especially in journalism and the press. The next examples are all titles of published articles that clearly show this tendency:

"Why it is awesome that your brain can experience awe" (26)

"The brain loves a challenge. Here's why" (27)

"How the brain perceives time" (28)

The problem with these headlines is clear: they assume the idea that brains can do things, when, in fact, such things are performed by people having brains, not by the organs themselves.

The other concept we find interesting in the context of brain-hype is neurorealism. Such a word means the rooted belief that information that comes from the brain holds greater authenticity and validity compared to non-brain-based information (29). Consequently, once we become aware that something originates "in the brain", we instinctively tend to associate truthfulness with this newly acquired knowledge, occasionally leading to the formation of inaccurate beliefs. The next examples, which are again titles of published articles, evidently show this aspect.

Examples:

"Brain Imaging Shows What Happens When We Question Fake News" (30)

"Is Hysteria real? Brain Imaging says yes" (New York Times, 2006; from (31))

These headlines inaccurately suggest that brain images are necessary for illustrating various concepts. In the first scenario, it is apparent that fMRI displays multiple brain processes occurring simultaneously, making it incapable of capturing the precise "questioning fake news" process. Conversely, hysteria, regardless of what brain imaging indicates, is hardly a tangible reality. The issue with brain hype lies in its tendency to create a mistaken implication and foster the false belief that our brains define our entire identity, even though we are more than just our brains.

Brainhood vs personhood

It has been suggested (32) that the main reason for brain-hype to is the modern tendency to substitute the concept of personhood with the one of brainhood, i.e., stating that we are brains first, and people secondarily. Obviously, this tendency has not been always a flagship of the human way to see themselves as human beings, on the contrary, we have seen different kinds of auto-descriptions during our time on earth, and the most evident two are Aristotelian Functionalism and Cartesian Dualism. However, with the advent of the modern era and the development of new medical techniques, it became clearer and clearer that brains had a major role in our lives, even more than what they actually have: this is commonly referred to as neuro-turn (33). The origin of the neuro-turn (34) can be naturally drawn from neuro-reductionist phenomena that attribute to our mind the sole role of being an external aspect of our brain, implying that all mental states are unequivocally brain states (35). However, advancing statements like this imply ignoring the role of the environment and even of our basic biology, hormones for instance have a great deal of power over our behavior (36). Considering this it has been suggested (35) that the brain should be understood as an interconnected organ that both influences and is influenced by the mind, playing a crucial role in facilitating the interaction between the embodied individual and the surrounding world. Unfortunately, today these less-radical views are losing their influence in the philosophical and biomedical landscapes of the debates about neurological criteria, an idea that is understood as neurocritique (37), implying the intellectual action of inquiring into the brain that has -as a consequence- an inquiry into the self. This inquiry into brain phenomena has been considered extremely reductionist (38), by seeing the self as a mere brain subject, and this means radically substituting the idea of personhood with the idea of brainhood.

But what is the origin of such a tendency? According to some (39), this tendency was born with the refinement of MRI techniques, when this happened brains were finally something we could somewhat see and gained more and more weight in the definition of our own existence.

Vidal (15) suggests that even if fMRI can only realistically represent the brain's morphology and drive some functions from it, neuroethics seems to have taken imaging for granted rather than analytically questioning it. Therefore, as we stated in our first argument, this seems to be a problem not just confined to the press and the general public but also involves academia in a deep way.

Who bears the responsibility?

As we have suggested in the entirety of this work, the issue of brain hype cannot be solely attributed to the press or capitalism; it is a collective responsibility that includes everyone, and academics and scientists are not exempt. As a matter of fact, it is important to note that when developing new psychological measures, especially in a scientific context, a specific requirement known as incremental validity should be fulfilled (40). Incremental validity refers to the capacity of an assessment technique to provide valuable predictive information that has not been already established by other measures. However, since most neuroimaging findings have yet to meet this criterion, the very idea of incremental validity poses a significant challenge, within this particular context. In simpler terms, most neuroimaging findings end up being redundant, offering no novel insights. Nevertheless, the tendency is to persist in publishing these redundant results and presenting them as something new, thereby contributing to the issue of brainhype (41– 42). However, if people working in academia, have ways to defend themselves against brain-hype the same cannot be said for the general public, i.e., for society. As a matter of fact, people do not always have the time or the means to multiply check some news or look for related scientific articles (if they are published open access). Therefore, we have a duty to the public to do better. The main issue to work on is: how can people trust scientists if they are part of this misleading brain-mania? And how can people trust journalists if they report the research in such a misleading way? A possible solution would be implementing bioethical training in science communication both for scientists and reporters in different ways but with the same goal: a trustworthy, accessible, and reliable kind of communication.

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