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REVIEW ARTICLE

DOI: https://doi.org/10.31577/ansr.2026.68.2.1

Impact of Climate Change on Cognition

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Submitted: 2026-08-08 Accepted: 2026-10-08 Published online: 2026-11-11

Key words: **change; cognition; neuropsychology; systematic review; stress; psychology**

Act Nerv Super Rediviva 2026; **68**(2): 51–57 **PII:** 68022601 © 2026 Act Nerv Super Rediviva

Abstract

OBJECTIVES: Climate change refers to alterations in climate patterns primarily caused by human activity, with potential consequences for both physical and mental health. The aim of this study was to conduct a systematic review so as to analyze the impact of climate change on cognition.

METHODS: Following PRISMA guidelines, a systematic search was conducted in databases such as Web of Science, Scopus, PubMed, and Google Scholar using terms related to climate change and cognition. A total of 194 articles were initially identified. After removing duplicates and applying inclusion/exclusion criteria, 51 empirical studies involving human subjects, published between 2015 and 2025, were selected for analysis.

RESULTS: The findings suggest that climate change negatively impacts cognitive functions, including perception, attention, memory, adaptability, and decision-making. Mediating factors such as anxiety, depression, and thermal stress were frequently reported. Vulnerable populations include elderly adults, individuals with neurocognitive disorders, and those under intense academic or work-related pressure.

CONCLUSION: Climate change acts as a chronic stressor that may impair brain regions such as the hippocampus, cerebellum, and prefrontal cortex, contributing to cognitive decline. These results highlight the importance of incorporating neuropsychology into interdisciplinary responses to climate change, as well as promoting cognitive health through prevention, research, and policy action.

Introduction

Climate change refers to a modification in the climate that, directly or indirectly, is caused by human activity, altering the composition of the global atmosphere and adding to the natural variability of the climate observed over comparable time periods (United Nations 1992; IPCC 2023). Climate change encompasses a wide range of phenomena, such as pollution, high temperatures, air quality issues, and natural disasters (Herrán 2012). Regarding the levels of greenhouse gases since 1750, the unequivocal cause of climate change appears to be human activity. In 2019, the concentration of carbon dioxide (CO2) was the highest in at least two million years. These emissions were linked to fossil fuel combustion and industrial processes, with an annual increase of 1.3% between 2010 and 2019. That same year, approximately 79% of greenhouse gas emissions came from the energy, industrial, and transportation sectors, while the remaining 22% came from agriculture and forestry. As a result, by 2019, about 35% of the population lived in countries emitting more than nine tons of CO_2 per capita (United Nations 1992; IPCC 2023).

With regard to high temperatures, there has been a faster increase since the 1970s than in any of the previous 50 years (United Nations 1992; IPCC 2023). In particular, from 2001 to 2020, the world was approximately 1.1°C warmer than between 1850 and 1900, registering an average temperature of 1.09°C on land and 0.88°C in oceans between 2011 and 2020.

A particularly concerning factor for many governments is that between 3.3 and 3.6 billion people living in Africa, Southeast Asia, Central and South America inhabit contexts highly vulnerable to climate change. This is due to climate change acting as a multiplier of meteorological threats such as hurricanes, heatwaves, frost, floods, droughts, and landslides (United Nations 1992; IPCC 2023; UNHCR 2023), becoming a precursor to socio-economic issues such as food insecurity, lack of access to drinking water, damage to infrastructure, poor educational and labor conditions, loss of livelihoods, resource conflicts, poverty, and displacement (UNHCR 2023). These environmental changes and their impact on living beings negatively and significantly affect the composition, resilience, or productivity of ecosystems, becoming not only an economic but also a cognitive challenge (Reiss *et al.* 2021).

Therefore, climate change should be a phenomenon of interest to neuropsychology if we consider the conceptualization of cognition as a set of mental abilities that allow us to acquire, process, store, and use information. These capabilities include perception, attention, memory, language, thought, and reasoning. Cognition is not a singular function but a set of interrelated processes that allow individuals to understand and act in the world. It varies among individuals and can develop over a lifetime through experience, education, and intellectual stimulation (Portellano 2005; Sternberg 2012; Neisser 1967).

Some systematic reviews have shown that climate change affects cognition. However, they have done so using only four (Kidd *et al.* 2023), three (Crane *et al.* 2022), two (Wade & Griffiths 2022), or even just one database (Yeganeh *et al.* 2018). This suggests that further research could be conducted using other studies published in databases that are not addressed in these systematic reviews. An analysis of the impact of climate change on cognition enables fields like neuropsychology to propose strategies for cognitive damage prevention, scientific dissemination, and well-being promotion (IPCC 2023). This underlines the need for neuropsychology to engage in interdisciplinary work that influences legislative, academic, and governmental actions highlighting the implications of climate change on human well-being. In light of the above, the following research question was proposed: What is the impact of climate change on cognition?

General objective

To conduct a systematic review in order to analyze the impact of climate change on cognition.

Specific objectives

1) Identify the main authors researching the impact of climate change on cognition, as well as the countries where these studies are conducted and the year of publication.
2) Analyze the variables traditionally associated with cognition referenced in key studies on the impact of climate change.
3) Examine the variables that may influence cognition as referenced in the principal studies on the impact of climate change.

Material and methods

This systematic review was conducted following the PRISMA guidelines (Moher *et al.* 2009; Urrutia & Bonfill 2013) to ensure proper execution of systematic reviews (Figure 1). The process is described in the following phases:

Initial Search

The initial searches were conducted in September 2024 using the terms 'Climate change' and 'Cognition' in the databases Web of Science, Scielo, Scopus, PubMed, and Google Scholar. Later, the search was expanded using combinations of the terms 'Ambient air pollution', 'Heat wave', 'Psychological problems', 'Climatic change', 'Hot weather', 'Heat extremes', 'mental health', 'neuropsychological adaptations', 'climate change', and 'cognition', using Boolean operators AND and OR as appropriate.

The combination of terms that produced the highest number of results was (Cognition) AND (Climatic change) AND (Climate change) AND (neuropsychology adaptation), each yielding 30 articles in Google Scholar. Another combination, (Climate change) AND (condition), yielded 20 results in Scopus.

Subsequently, inclusion and exclusion criteria were applied to proceed with article selection. A total of 194 articles were initially identified based on their titles, of which 116 were excluded due to duplication. The remaining 78 abstracts were reviewed, and inclusion and exclusion criteria were applied (Figure 1).

Inclusion Criteria

- Empirical studies only (excluding single case studies, or manuals).
- Publications between 2015 and 2025, inclusive.

Exclusion Criteria

- Studies involving non-human subjects.

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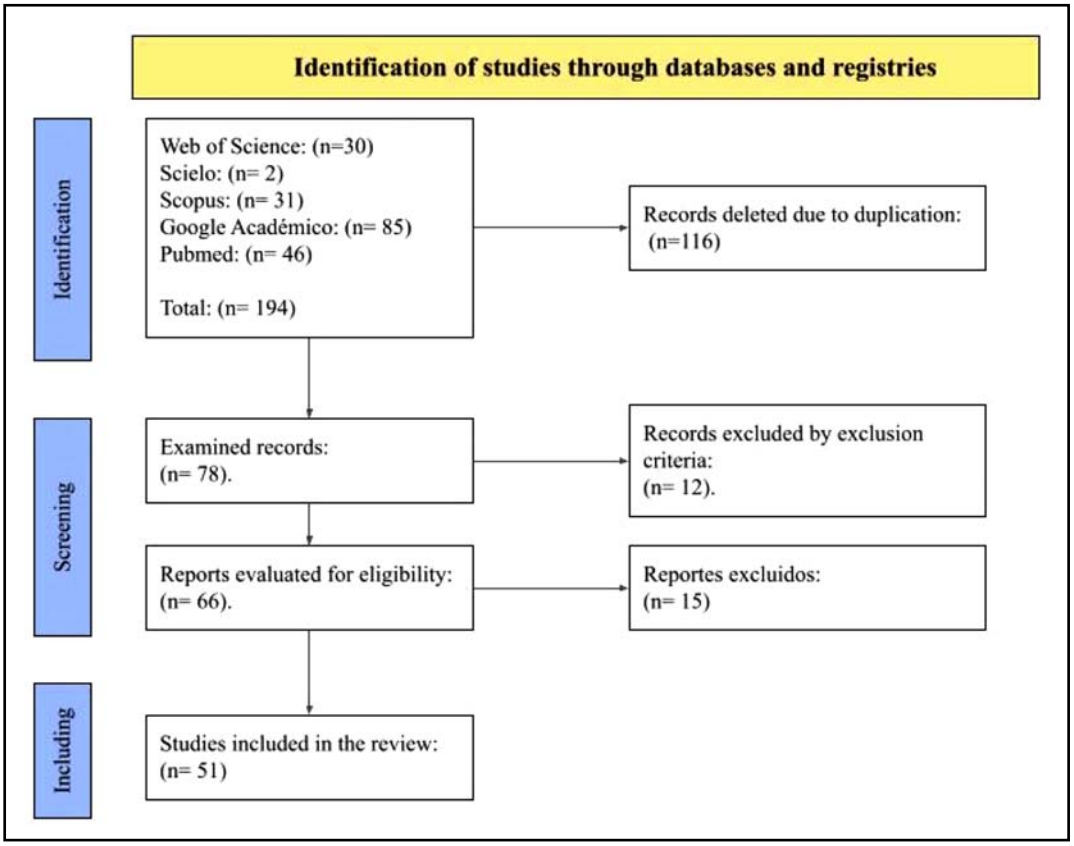


Fig. 1. PRISMA Flow Diagram in Four Phases (Moher *et al.* 2009; Urrutia & Bonfill 2013).

After reviewing the abstracts and applying the inclusion/exclusion criteria, 12 articles were excluded: four because they were not empirical studies and eight because they focused on non-human subjects. A further fifteen articles were eliminated after full-text review, as their results or conclusions did not reference cognition or how it was affected by climate change. Ultimately, 51 articles were selected for the systematic review (Figure 1). All indicated a certain impact of climate change on cognition based on the conceptualization of these variables (United Nations 1992; IPCC 2023; Neisser 1967; Portellano 2005; UNHCR 2023). The selected articles were published in English and Spanish.

Results

According to Figure 1, after reviewing 194 studies across various databases, 51 were included in the final analysis. The selection process excluded 116 studies due to duplication, twelve for not meeting the inclusion criteria, and fifteen due to lack of relevance.

Figure 2 shows that the four countries with the most publications are the United Kingdom (twelve articles), the United States (eight), China (six), and Canada (three).

In Figure 3, the stacked bar chart illustrates the years with the most publications and highlights the only author (Thompson, C.) who conducted two studies on this topic, both in 2024, representing 20% of that year's articles. Other publications each year were by different authors, each of whom contributed only one study.

Figure 4 illustrates that the most commonly affected traditional cognitive variable was cognitive impairment (six articles), followed by adaptability (three articles), and then dementia, perception, and decision-making (two articles each).

From Figure 5, it can be seen that the most frequently cited variable potentially influencing cognition was anxiety (4 articles), followed by thermal stress and depression (two articles each).

Discussion

The results of this study indicate that climate change affects cognition in both basic and higher-level processes. Specifically, basic functions such as perception, attention, and memory are frequently mentioned, while among higher-level processes the most impacted are adaptability, decision-making, working memory, systematic thinking, and information processing (Portellano 2005; Taylor & Workman 2021; Wilson 1999).

Some of the reviewed studies, for example, associate high temperatures with decreased impulse inhibition, promoting impulsive and aggressive behavior (Breda *et al.* 2023). Cognitive impairment due to climate change is likely explained by its role as a high-level stressor that generates extreme and unstable living

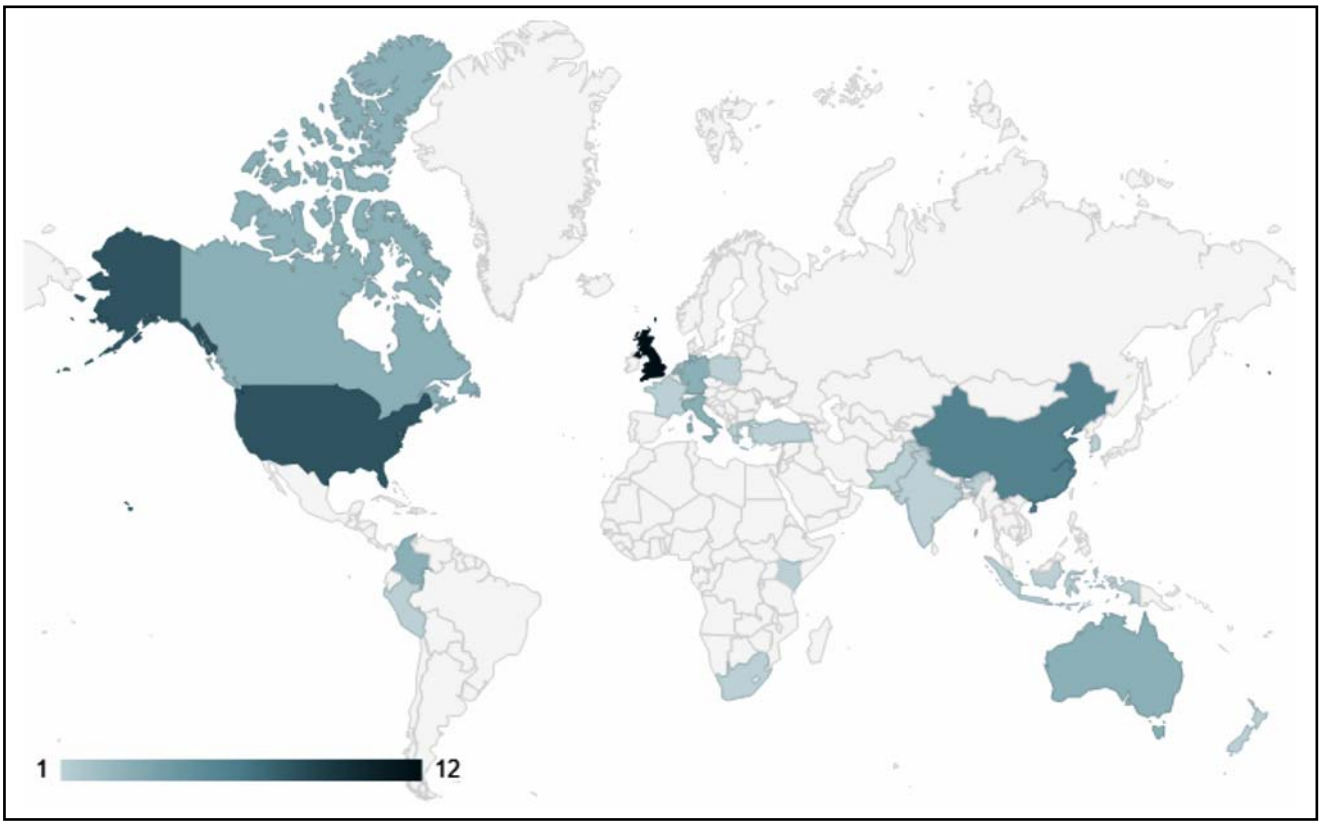


Fig. 2. Main Countries Conducting Research on the Impact of Climate Change on Cognition.
Note: The country with the darkest shade indicates the highest number of publications.

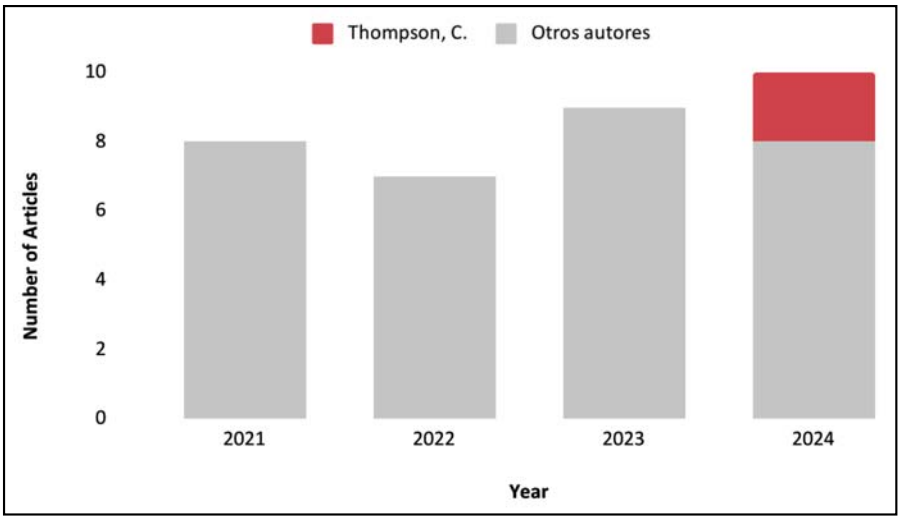


Fig. 3. Main Authors Investigating the Impact of Climate Change on Cognition and Most Productive Years.

conditions, altering individuals' relationships with their environment (Fernández *et al.* 1999).

This is consistent with studies concluding that stress may affect cognition or promote related conditions such as anxiety and depression, which in turn harm social, family, work, and academic relationships (Cano-Vindel 1997).

Cognitive implications partly reflect neurological changes caused by stress, which in excess can damage brain structures like the hippocampus (associated with memory and orientation), the cerebellum (linked to procedural memory, attention, language, and learning), and the prefrontal cortex (involved in adaptability), all of which appear vulnerable to stress (McEwen 2007; Lupien *et al.* 2009; Tirapu-Ustárroz *et al.* 2011; Arnsten 2023; Sandi 2013).

This suggests a vicious cycle: the environment demands rapid adaptation to stressful conditions while simultaneously reducing the individual's capacity to adapt. Some articles introduce terms like "climate anxiety" (Martin 2024). and "eco-anxiety" (Yin *et al.* 2024) to describe difficulties adapting to changing

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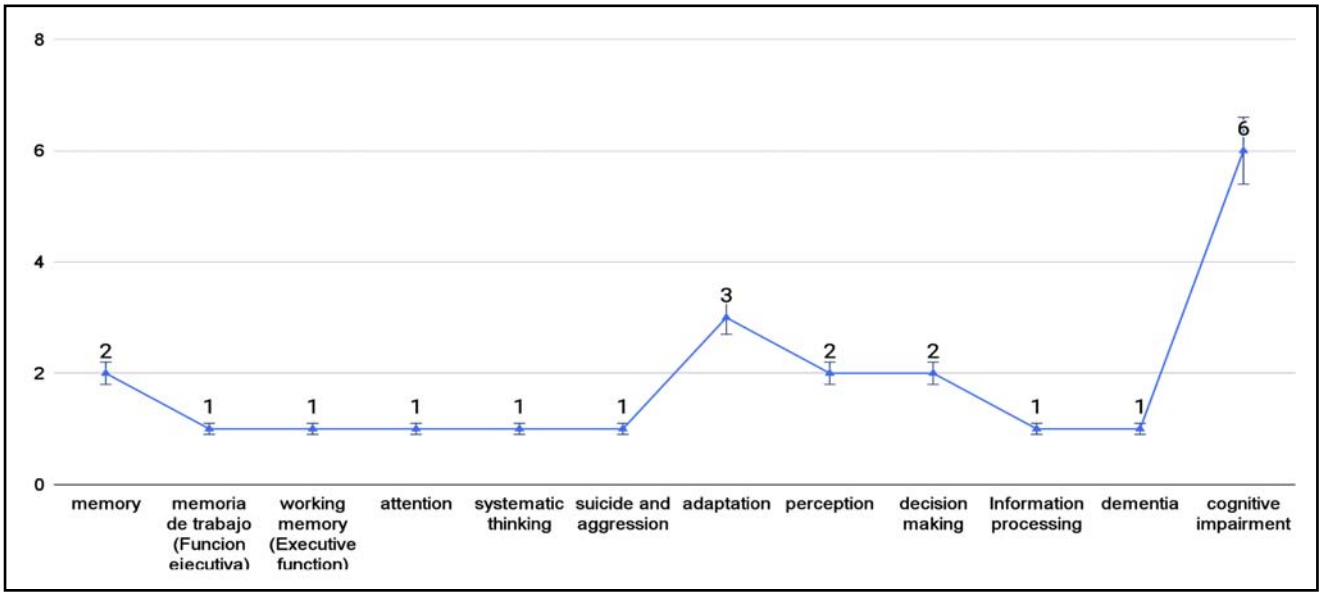


Fig. 4. Traditional Cognitive Variables Reported as Affected by Climate Change.
Note: Working memory (executive function) is reported as an executive process rather than a memory system. Referenced in the Main Studies.

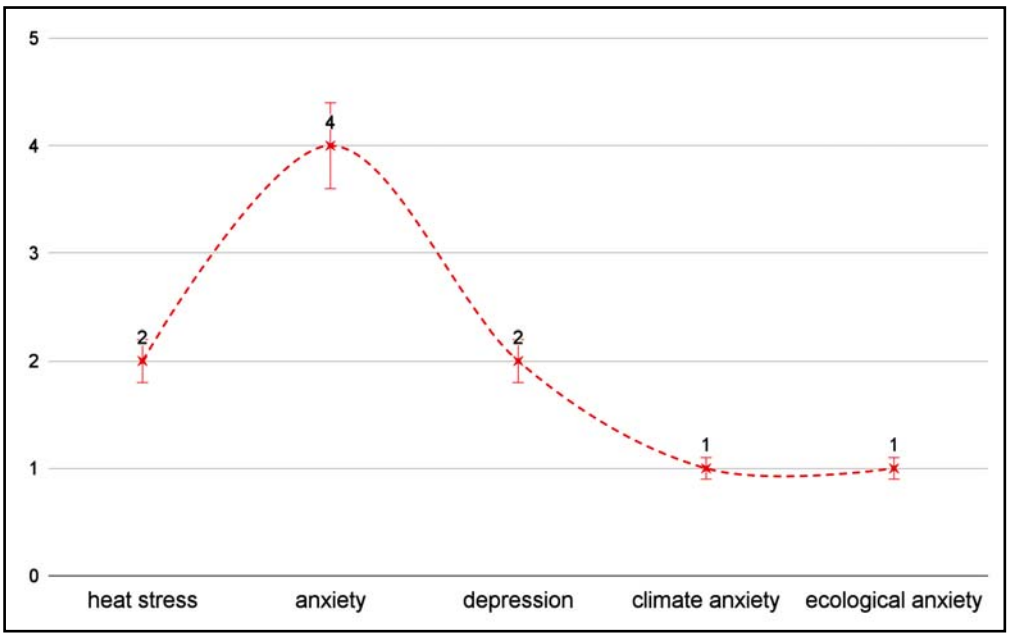


Fig. 5. Variables That May Influence Cognition

climatic conditions. However, while such neologisms help recognize climate change as a cognitive threat, they may confuse clinical approaches, as their definitions do not add substantial information beyond the known impact of stress on cognition (Cano-Vindel 1997).

According to the reviewed studies, the most vulnerable populations to the cognitive effects of climate change are elderly adults (due to natural deterioration), individuals with major neurocognitive disorders or dementia (whose adaptive capacity is already impaired), and those with demanding academic or work schedules. For example, extreme temperatures may affect students' information processing (Park *et al.* 2020) and workers' performance (International Labor Office 2018). Considering global aging trends (United Nations 1992) and increasingly intense work and academic demands (Wang *et al.* 2013), climate change could become a general threat to the population.

Most of the reviewed studies obtained data from healthcare centers, showing a lack of neuropsychological intervention. This may stem from neuropsychology viewing climate change as a distant phenomenon. However, the environment directly shapes cognition (Skinner 1972), and neuropsychology should not be limited to controlled settings like clinics (Blunden 2010). This study could contribute to new lines of research

within neuropsychology that focus on reflection, intervention, and prevention with regard to the cognitive impact of climate change.

Limitations of the findings

The main challenge identified in this research was the lack of homogeneity in the data, populations, and methodologies used in the reviewed studies, which represents a significant difficulty for the replicability of the results.

Conclusion

Climate change is a stressor that affects cognition, particularly adaptability, perception, decision-making, and memory as well as related variables such as anxiety and depression. This may be due to damage in brain structures like the hippocampus, cerebellum, and frontal lobe, which are associated with those cognitive processes. Therefore, neuropsychology should no longer view climate change as external to its field and must address this issue from its core practice. The most affected populations include elderly adults, people with intense academic or work schedules, and individuals diagnosed with dementia or neurocognitive disorders. The main challenge identified in this study was the lack of homogeneity in data, populations, and methodologies used in the reviewed research, which limits study replicability.

Acknowledgements

Jakub Rajčáni (PhD) and Manuel Andrés Osorio, BSc (cand.) in Psychology, for their support in editing and writing this article.

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