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Psychology training and its relationship with neuromyths

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Abstract

The important advance in neuroscience in recent years has generated a lot of knowledge about the brain and its functioning. Many times this knowledge has been misunderstood, causing the appearance of erroneous ideas that are known as neuromyths. The present study considers whether specific training in psychology can help reduce belief in these neuromyths. Two studies are carried out. In the first study, a bibliometric analysis is carried out with the VosWiever tool to know the different lines of research in the field of neuromyths. In the second study, a questionnaire with 32 statements, among which are several common neuromyths, is administered to 239 people, 104 without training in psychology and 135 with training in psychology, requesting that they indicate which of these statements are true or false. In the first study, 5 clusters are located that exemplify the different lines of current research in the field of neuromyths, among which are myths related to the brain (cluster 1), aspects related to education (clusters 3 and 5). and other more general ones about false beliefs (clusters 2 and 4). In the second study, it was detected that people with training in psychology are able to more easily identify sentences that correspond to neuromyths. However, there are several neuromyths that persist despite training in psychology. Our study shows that there are several specific lines of research into neuromyths related to the study of the brain and its application to the educational field. Furthermore, he points out that training in psychology can be useful in reducing belief in neuromyths, although it cannot eliminate all false beliefs. The need to delve into neuroscientific concepts within psychology is debated as a possible tool to eliminate these erroneous beliefs.

Keywords Neuromyths · Psychology · Misconceptions · Neuropsychology

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Recent decades have seen considerable growth in the neurosciences, owing largely to the development of novel neuroimaging techniques. This has improved our understanding of the functioning of the brain as the neural substrate of behaviour. These advances have also had a repercussion on society and the general population, with increasing numbers of news items and headlines raising awareness of neuroscientific terminology. So great has been the impact that the prefix "neuro-" has been used to reformulate numerous disciplines that have looked to neuroscience to establish an empirical basis for their postulates (neuroeconomics, neuromarketing, neuroeducation, neuroethics, etc.) (Weisberg et al., 2008).

Nonetheless, many of the conclusions established by neuroscientists have been distorted to generate exaggerated news stories and headlines, which then spread through society, becoming so-called "neuromyths" (Rousseau, 2021). Neuromyths, defined as misconceptions caused by "a misunderstanding, a misreading and, in some cases, a deliberate warping of the scientifically established facts" (OECD, 2002) have been particularly relevant in the educational setting (Autor, 2018).

Particularly in recent years, concern about neuromyths has led to studies examining their prevalence in the population in general, and in the education sector in particular, shedding light on the existence of a number of popular "pseudoconcepts" that are widespread among educators in very diverse cultures (Herculano-Houzel, 2002). Among these, we may cite learning styles (sensory preferences for the reception of information, which may help to improve learning) (Newton & Wang, 2022), the existence of opposing left and right brains (Corballis, 2014), and the Mozart effect (the possible improvement in overall intelligence in children after exposure to the music of Mozart) (Chabris, 1999; Jenkins, 2001); despite the scarcity of evidence supporting these beliefs, they are fairly widespread in the educational community (Geake, 2008; Rousseau, 2021; Zhou et al., 2023). Logically, any intervention based on these neuromyths will be far from effective and successful.

Therefore, it has been suggested that we must act to dispel these neuromyths in the general population, through a range of initiatives. For instance, a recent study sought to establish whether additional education in the science of learning helps to reduce the prevalence of some neuromyths (Ferreira & Rodríguez, 2022), reporting a lower rate of neuromyth beliefs after 16 weeks of specific training about neuroscience in a sample of 43 trainee teachers, compared to controls. This is consistent with the findings of other studies reporting that teachers with training in neuroscience are more likely to detect neuromyths (Carboni et al., 2021). To the contrary, some other studies have found that greater understanding of the brain seems, counterintuitively, to increase receptivity to these misconceptions (Janati Idrissi et al., 2020). In any case, there is a need to develop a clearer picture of what is understood by neuroscience training, and whether this training is universally accessible (Menz et al., 2021; Rousseau, 2021). What does appear evident is that there are a series of inconsistencies in the reported results on the effectiveness of neuroscience training in dispelling or preventing neuromyth beliefs among educators, with the effect perhaps not being as powerful as expected (Macdonald et al., 2017). Indeed, some evidence suggests that this training may be positively correlated with the presence of neuromyths among in-service teachers, whereas it would act as a "protective shield" among pre-service teachers (Rousseau, 2021).

One potentially relevant area of study in clarifying the effect of neuroscience training on the prevalence of neuromyths may be the training pathways in which it is included and gradually provided. In parallel to the growth of neuroscience, neuropsychology has taken root as a specialty within the field of psychology, and seeks to bring together knowledge about the brain and about behaviour, and particularly the interaction between the two (autor, 2020). This has led to the inclusion of a series of courses within the undergraduate psychology curriculum that may help identify neuromyths. However, few studies have addressed the possible influence of psychology training on belief in these myths. In a classic and influential essay, Bruer (1997) highlighted the challenges in achieving an adequate transfer of knowledge generated by neuroscience to educational practice, where cognitive psychology would play a crucial role. Bruer posited the existence of two bridges: one from cognitive psychology to education, which was quite robust based on late 20th-century cognitive psychology studies, and another, more recently constructed, between neuroscience and cognitive psychology. However, nearly 30 years later, difficulties persist in translating neuroscience advancements into educational practice, presumably due to a lack of measures preventing this knowledge from becoming truly necessary for teaching (Bowers, 2016).

Moreover, the role of psychology in dispelling these neuromyths remains a topic of debate. While some authors advocate for psychologists to act as translators to bridge the gap between neuroscience and education (Wilcox et al., 2021), others argue that the concept of a gap is flawed and that a collaborative workspace between educators and psychologists should be established to create an "educational neuroscience" (Basso & Cottini, 2023). There is also the possibility that we are dealing with different, incommensurable levels of analysis for which no translation is possible (Horvath et al., 2018). This seems to question the potential for psychology to play a protective role against misinformation, such as neuromyths.

Several articles report the presence of neuromyths among psychology students or graduates, with their prevalence seeming to decrease after an intervention with specific education programmes on aspects of neuroscience and health (Furnham & Hughes, 2014; LaCaille, 2015; LaCaille et al., 2019). Overall, the presence of these myths among psychologists and psychology students at different stages of training remains a little-explored subject.

To address this lack of research and the inconsistencies in the reported results on the effect of neuroscience training on neuromyths, as well as the lack of data on the prevalence of these misconceptions among individuals with training in psychology, we performed two complementary studies to examine the potential relationship between psychology training and the ability to identify neuromyths. The first was a bibliometric analysis of the literature on neuromyths, enabling us to describe the current state of research on the subject and its relationship with psychology. The second study aimed to analyse the prevalence of neuromyths among a population of practising and trainee psychologists, compared to the general population.

Study 1

Methods

A literature search was conducted to identify articles addressing neuromyths, in order to subsequently generate two-dimensional bibliometric maps based on the co-occurrence of keywords; this enables the identification of different clusters and visualisation of the relationships between them. Thus, we are able to observe the semantic structure of this scientific domain, as well as its distribution, using a density map.

Search strategy

A literature search was conducted on the Web of Science-WOS (Clarivate Web of Science) database, specifically in the Web of Science collection, using the following strategy: **TOPIC:** "neuromyth OR neuromyths". By date, we searched for all records published up to 8 August 2023. By type of publication, only articles and reviews were included. The search yielded 129 records, which constituted our study sample.

Construction of the co-occurrence network map and density map

The results were downloaded in a plain text (TXT) file for processing with the VOSviewer bibliometric mapping software (van Eck & Waltman, 2010), using the articles' keywords as the criterion for grouping. This analysis used both the author-provided keywords and another set of keywords that also included words coinciding in the title and abstract of each article ("Keywords Plus"). This approach yields a robust set of terms enabling the formation of representative clusters for different focus points in the field of research. Cluster formation is conducted using an algorithm that positions and classifies the keywords appearing on the map, with the level of resolution determined ad hoc. Several levels of resolution were tested, and we ultimately selected a value of 4, an intermediate level, to avoid the formation of an excessively large or very restricted number of clusters that might prevent visualisation of different study areas (for more details, see the methodological appendix).

Clusters are identified by analysing the frequency of occurrences and co-occurrences of the keywords to construct a similarity matrix (the "visualisation of similarities" method), enabling calculation of the strength of association (for more details, see the methodological appendix). Through this analysis, occurrence and co-occurrence values are normalised to enable good fit of the values to the theoretical field in question.

Study 1: Results

The 137 records obtained in the literature search included a total of 498 keywords. Overall, 38 of these surpassed a pre-established threshold, resulting in a map including five clusters (Fig. 1).

The distributions and strength of links between the 38 terms in the five clusters are shown in Table 1.

Cluster 1 (Fig. 2A) comprises 11 items with the keyword "brain" as the word with the greatest link strength. This term appears in a central position on the bibliographic map, and presents the third-highest link strength of the total set of keywords. Its relationship with such terms as "knowledge," "cognitive neuroscience," "neuroeducation," and "seductive allure" suggests a field more focused on studying the effect of advances in understanding of the brain, with a tendency for these to be magnified in such fields as neuroscience.

Cluster 2 (Fig. 2B) includes 10 items, with the term "educational neuroscience" showing the greatest link strength. This cluster includes words related to interventions ("intervention" and "interventions") and teacher training. This cluster shows the smallest overlap with the remaining clusters.

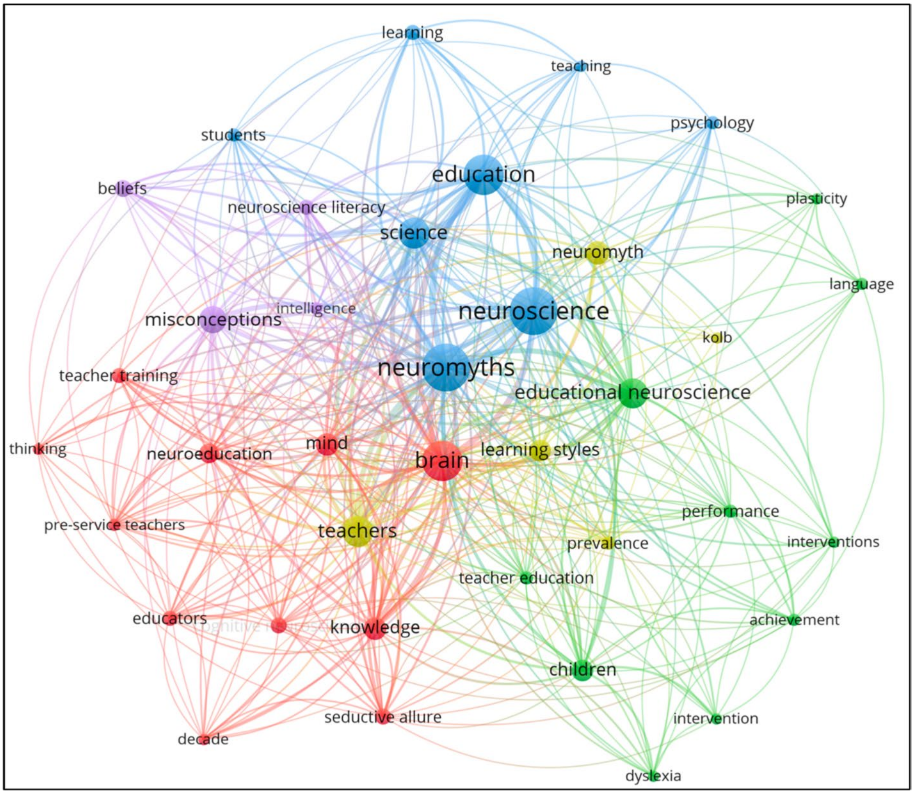

Fig. 1 Complete map of the distribution of keywords, showing the five clusters

Cluster 3 (Fig. 2C) includes 8 items, centred around the term "neuromyths." This cluster is also in a very central position in the bibliographic map, and presents the strongest observed link strength; this was to be expected, given that "neuromyths" was the main search term used. This cluster was linked with such terms as "neuroscience," "science," and "beliefs," suggesting that studies in this cluster focus on describing neuromyths. Furthermore, it is the only cluster including the keyword "psychology"; it is striking that neuropsychology, the interaction between both fields, is not included as a term, especially given the extremely well-established status of the discipline in recent years.

Cluster 4 (Fig. 2D) is made up of 5 items, with "teachers" being the main one. This term is closely connected to the other clusters, but also presents a strong link with the term "learning styles." This cluster appears to correspond to research focusing on the neuromyth of learning styles, given that another of the included keywords is "Kolb," the name of the author who proposed this widely refuted theory.

Cluster 5 (Fig. 2E) includes only 4 items, which are weakly connected but overlap considerably with the remaining items, with the main keyword being "misconception," referring to erroneous interpretations of the words making up the other clusters but which, combined with the concepts "beliefs" and "neuroscience literacy," appear to reflect these errors in neuroscience education.

Table 1 Frequencies, links, and link strength of the keywords

Cluster	Item	Occurrences	Links	Link Strength
1	Brain	52	36	253
	Knowledge	16	28	99
	Mind	16	23	99
	Neuroeducation	12	23	63
	Cognitive neuroscience	8	23	35
	Seductive allure	8	25	53
	Educators	7	20	39
	Teacher training	7	18	32
	Pre-service teachers	5	23	41
	Decade	4	18	32
	Thinking	4	15	19
2	Educational neuroscience	28	34	140
	Children	15	25	66
	Performance	6	22	33
	Teacher education	6	19	31
	Achievement	5	15	26
	Language	5	12	16
	Dyslexia	4	14	22
	Intervention	4	12	18
	Interventions	4	15	21
	Plasticity	4	10	14
3	Neuromyths	72	34	311
	Neuroscience	71	34	268
	Education	50	30	208
	Science	31	32	159
	Learning	7	16	40
	Psychology	6	16	25
	Students	6	17	31
	Teaching	4	14	23
4	Teachers	31	30	162
	Neuromyth	17	21	47
	Learning styles	15	28	74
	Prevalence	6	22	37
	Kolb	4	6	8
5	Misconceptions	23	29	131
	Beliefs	9	17	41
	Neuroscience literacy	7	20	49
	Intelligence	5	15	22

In addition to the cluster analysis, a density map (Fig. 3) was generated, which shows how the majority of the links between terms are highly concentrated in the central region, around the terms "neuromyths," "neuroscience," "brain," and "education," as well as some areas at the left of the map, representing terms in cluster 1 (related to interventions against neuromyths), and in the upper region, representing cluster 4 (learning styles). The term "psychology" is located far from the centre, within cluster 3.

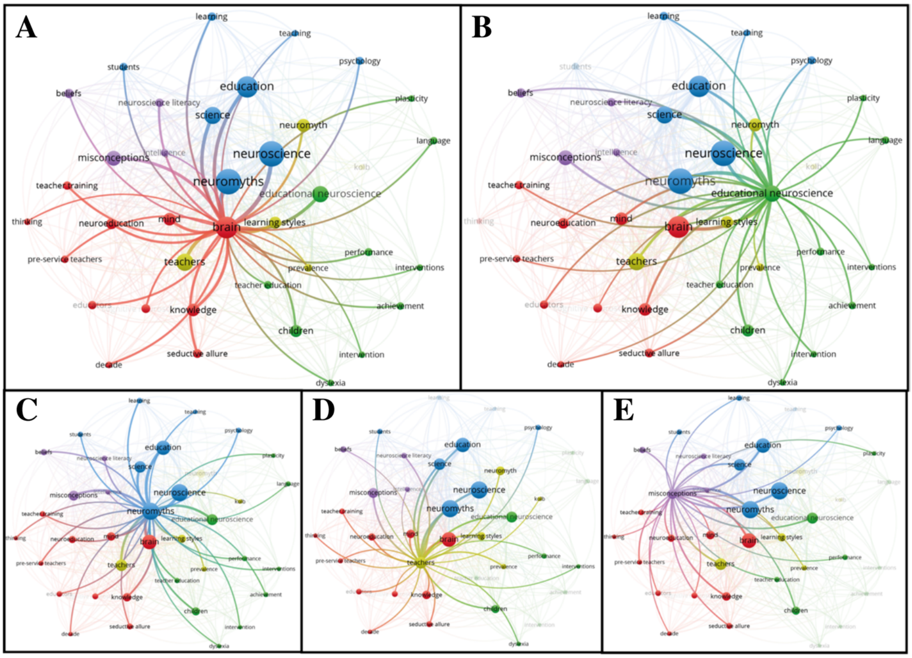

Fig. 2 Clusters obtained according to the main term. **A**) In red, connections in cluster 1, based around the term "brain." **B**) In green, connections in cluster 2, based around the term "educational neuroscience." **C**) In blue, connections in cluster 3, based around the term "neuromyths." **D**) In yellow, connections in cluster 4, based around the term "teachers." **E**) In purple, connections in cluster 5, based around the term "misconceptions."

Study 1: Discussion

The bibliometric analysis of the 137 references identified in the literature search for articles addressing neuromyths yielded five clusters representing subdomains within this field of study. These clusters present high density around the terms "neuromyths," "neuroscience," "education," and "brain," with considerable overlap between clusters 1, 3, and 5, suggesting that these subdomains are poorly differentiated. This is consistent with the fact that the earliest studies identified in the search were published little more than 10 years ago (Geake, 2008; Purdy, 2008). That is to say, if neuroscience is a relatively young field, the detection of myths derived from inaccuracies in its dissemination is an even newer phenomenon.

We did observe two lines of research that were clearly differentiated from the remaining items: clusters 2 and 4. The latter reflects a field that has received considerable attention, the neuromyth of learning styles (Newton & Wang, 2022; Rodrigues et al., 2022), which is widespread in educational settings and constitutes a central focus of research, as demonstrated by the density map.

Cluster 3 is also relevant to our research, as it is the only cluster including the term "psychology." This term appears to have received little attention in research into neuromyths. Although it is included in a cluster related to neuromyths, and is linked to educational neuroscience, this is evidence of the lack of studies into the relationship between neuromyths and psychology in general.

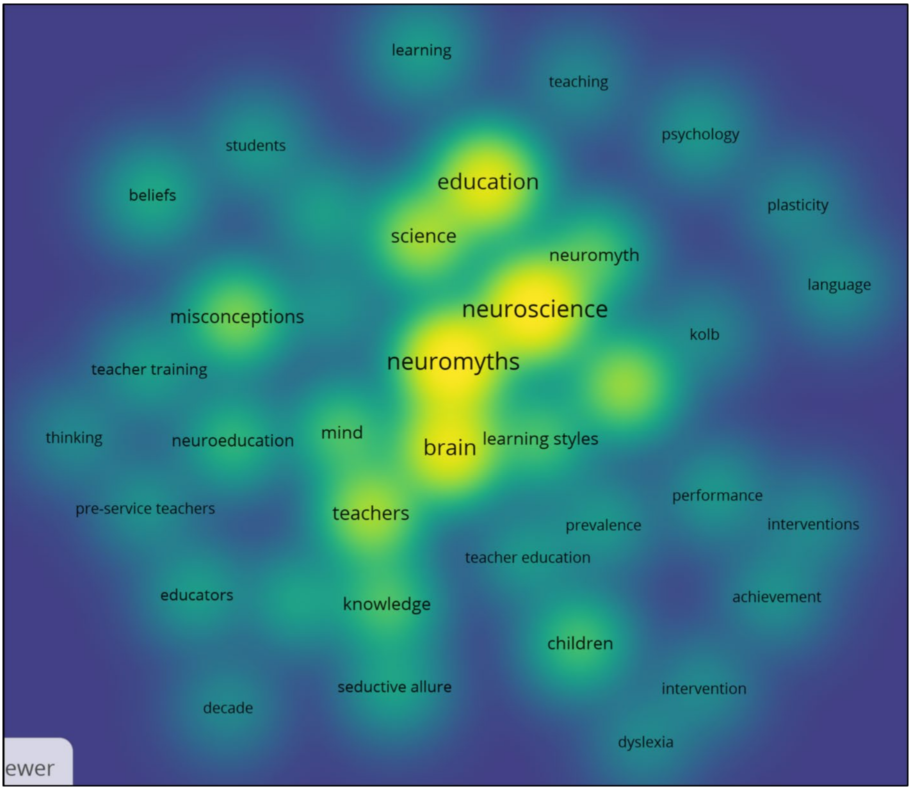

Fig. 3 Density map of the keywords. A high-density area is observed in the central region, around the terms "neuromyths," "neuroscience," "education," and "brain." The remaining clusters are distributed around this nucleus

This fact may be related to the idea that neuromyths can actually be understood in a more pluralistic rather than homogeneous way. This is consistent with what was stated in a previous bibliometric study, which highlighted that most studies on neuromyths could be found among psychology, pedagogy, and neuroscience journals in a heterogeneous manner (Zhou et al., 2023). The debate has arisen whether neuromyths are truly independent entities or if they are actually part of general errors within psychology itself (Grospietsch & Lins, 2021; Rousseau, 2021). The map seems to show us two lines of research: one more developed line focused on educational neuromyths (clusters 2 and 4) and another, more diffuse line related to psychology or erroneous beliefs within psychology.

Study 2

To examine the role of psychology training in relation to neuromyth beliefs, we developed a scale including a series of statements about the brain and neuroscience, many of which were neuromyths. The scale was administered to participants with and without training in psychology.

Study 2: Methods

Sample and data collection procedure

The scale was administered to a sample of 239 individuals. Participants were recruited at a psychology exhibition held in Seville in October 2019. During this two-day outreach event, different areas of psychology work were exhibited for the general public. Attendees typically include both practising and trainee psychologists, as well as people without training in the discipline. The scale was distributed at an information stand about neuromyths, organised by the neuropsychology working group of Official College of Psychologists of Western Andalusia. Participants were given their results after completing the test. The sociodemographic characteristics of the sample are shown in Table 2.

Tools

The study was based on an ad hoc scale comprising 32 sentences or statements about neuroscience and the brain, including several neuromyths that are frequently mentioned in the literature and education, with three possible responses for each statement ("true," "false," "don't know") (Table 3).

Participants were asked to respond anonymously to the 32 statements, and to provide sociodemographic data: age, sex, current/last profession, and level and discipline of academic qualifications.

Statistical analysis

Statistical analyses were performed using the SPSS statistics software, version 24.0. In a descriptive analysis, means and standard deviations (SD) were calculated for participants' results for each of the 32 scale items in the different groups. In the inferential analysis, the ANOVA was used to compare the results of different groups on the total scale and in a subdivision of false items into two groups: neuromyths and common errors in psychology. The t-test was used to analyze the differences between groups on the items with the highest percentage of error. To minimize Type I error, the Benjamini–Hochberg method was applied to the 64 comparisons performed.

We calculated the total number of correct responses for each neuromyth, considering the response "don't know" to be incorrect, as these respondents did not know the correct answer.

Table 2 Sociodemographic characteristics of the study sample

Psychology training	n	Age		Sex	
		Mean	SD	M	W
Non-psychologists	104	35.1	16.1	43	61
Students	78	25	7.3	18	60
Practising psychologists	57	41.2	12.3	12	45

M, men; *W*, women

Table 3 Neuromyth scale used in study 2

		T	F	DK
1	The mind is the product of our brain's activity	X		
2	Some people have "out of body experiences" during which they are able to see objects distant from their physical body		X	
3	Listening to Mozart during childhood increases intelligence		X	
4	If it were possible to transplant our brain into another body, we would continue being ourselves, but in a new body	X		
5	The brain remains active while we sleep	X		
6	We only use 10% of our brain		X	
7	The world we see is not real, but rather a construct made by our brain	X		
8	A common sign of dyslexia is perceiving rotated letters		X	
9	The development of the brain ends in adolescence		X	
10	Children learn better when they receive information in their preferred learning style (visual, auditory, etc.)		X	
11	When one part of the brain is damaged, other parts take over its functions	X		
12	Physical exercise improves mental capacity	X		
13	Thought comes before emotion		X	
14	All of our actions are conscious		X	
15	Intelligence is genetic and cannot be changed by the environment or experience		X	
16	The production of new connections in the brain continues throughout our lives, even in old age	X		
17	The mind is the result of the spirit or soul acting on the brain		X	
18	Some people use the right hemisphere more and others use the left hemisphere more		X	
19	Children must be exposed to a rich, stimulating environment, or they will permanently lose some capacities		X	
20	The brain works like a computer		X	
21	No two brains are the same	X		
22	A person may recall events that never took place	X		
23	Intuition is a special sense that cannot be explained by the brain		X	
24	Different parts of the brain communicate through electrical impulses and chemical substances	X		
25	Learning results from the incorporation of new cells into the brain		X	

Table 3 (continued)

		T	F	DK
26	It is better for children to first learn their mother tongue before learning a second language		**X**	
27	Hypnosis is helpful for recalling traumatic or unconscious experiences		**X**	
28	Emotions influence reasoning and decision-making	**X**		
29	The brain stores memory similarly to the hard drive of a computer		**X**	
30	Learning is the result of changes to the connections in the brain	**X**		
31	Some people have special abilities such as telekinesis, telepathy, or extrasensory perception		**X**	
32	Children are less focused after drinking sugary drinks		**X**	

T, true; *F*, false, *DK*, Don´t Know

Results

In the overall sample, the mean score (SD) was 20.2 (4) points (maximum possible score: 32). The group of respondents without training in psychology scored lower than those with psychology training group (18.6 [3.8] vs 21.5 [3.8]). With regard to the level of qualification in psychology, undergraduate students scored a mean of 22.5 (3.8), whereas postgraduate students scored 20.4 (4.4). The group of psychologists who had completed their training presented a mean score of 21.37 (3.5).

Two groups were created: neuromyths (items 3–6-8–9-10–15-18–19-20–25-26–29-32) and common errors in psychology (items 2–13-14–17-23–27-31) to categorize the false statements. in the neuromyths subgroup, the non-psychologists group had a mean of 6.3 (2.2), while the students group had a mean of 7.5 (2.3) and the practising psychologists group had a mean of 7 (2), in the common errors subgroup, the non-psychologists group had a mean of 3.4 (1.5), while the students group had a mean of 4.6 (1.4) and the practising psychologists group had a mean of 4.3 (1.3).

For eight items (2, 4, 8, 10, 18, 19, 27, and 32), fewer than 40% of participants responded correctly (Fig. 4).

Inferential analyses

We compared the three groups (non-psychologists and groups with psychology training) on scores obtained in the total scale of 32 items using an analysis of variance (ANOVA). The result reflected significant differences between the groups (F = 17.192; df = 2; $p < 0.001$). Post-hoc analyses indicated differences between the group of practising psychologists and non-psychologists group ($p < 0.001$), and between students group and non-psychologists group ($p < 0.001$), without finding differences among the groups with psychology training.

We also compared the groups on scores from the neuromyths subgroup, obtaining similar results in the ANOVA conducted. The result showed significant differences between the groups (F = 6.93; df = 2; $p < 0.01$). Post-hoc analyses revealed differences between the group of practising psychologists and non-psychologists group ($p < 0.001$), and between

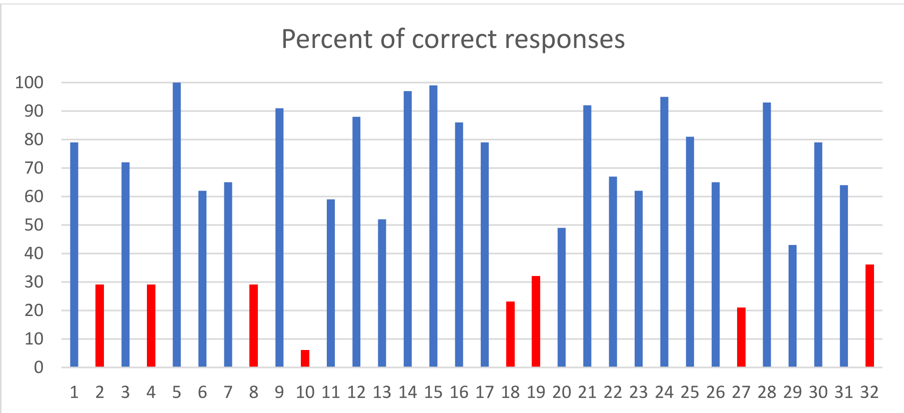

Fig. 4 Percentage of correct responses for each scale item in the total sample. Items for which fewer than 40% participants responded correctly are shown in red

students group and non-psychologists group ($p < 0.05$), without finding differences among the groups with psychology training.

Lastly, an ANOVA was conducted on the subgroup of common errors in psychology. The result showed significant differences between the groups (F = 17.2; df = 2; $p < 0.01$). Post-hoc analyses indicated differences between the group of practising psychologists and non-psychologists ($p < 0.001$), and between students group and non-psychologists group ($p < 0.001$), without finding differences among the groups with psychology training.

Additionally, correlations were performed between the scores obtained from the neuromyths and common errors subgroups, showing positive correlations in all three sample groups: non-psychologists (r = 0.479; $p < 0.001$), students (r = 0.371; $p < 0.01$), and practising psychologists (r = 0.321; $p < 0.05$).

A separate analysis of each individual item was conducted to identify any specific differences between the groups of participants with and without training in psychology, and between trainee and practising psychologists (Table 4). For 9 items, the analysis revealed significant differences in the percentage of correct responses between participants with and without training in psychology, with a higher percentage in the former group in all cases. In the comparison between trainee and practising psychologists, the percentage of correct responses was higher in the former group for items 2 and 32, and in the latter group for items 11 and 12, but only showing a marginal tendency at the limit of significance.

Study 2: Discussion

This second study sought to establish the effect of specific training in psychology on the prevalence of neuromyths in the population, considering the possibility that this training may enable the identification of these misconceptions within a set of statements about neuroscience.

Table 4 Items for which significant differences were detected between groups

Item	Psychologists vs non-psychologists	Students vs practising psychologists
2	-	+
3	***	-
6	+	
7	**	
11	***	+
12		+
16	+	
17	***	
23	***	
27	**	
29	**	
30	***	
31	***	
32		+

*p<.05; **p<.01; ***p<.001.; + : Marginal Trend

The results show that individuals with training in psychology were better able to identify false statements than the general population; thus, we may infer that this training may reduce the prevalence of neuromyths, as reported in other studies (Furnham & Hughes, 2014; Kowalski & Taylor, 2009; LaCaille, 2015; LaCaille et al., 2019).

Our study represents an interesting contribution as it is the first to be conducted on psychology students and professionals in the Spanish population, given the potential influence of cultural and social factors on the prevalence of neuromyths (Furnham & Hughes, 2014). Additionally, we employed a scale with 32 potential neuromyths that can be completed in a short period of time, and analysed differences between psychology students and practising psychologists. For instance, LaCaille's study (2015) exclusively focused on American students who were exposed to a myth debunking campaign they developed, yielding positive results against the presence of neuromyths resulting from their participation. On the other hand, Furnham and Hughes (2014) obtained their results from a sample of 829 English students who evaluated 249 myths using a scale that required more time for administration. They found that studying psychology could be considered a protective factor against neuromyths despite somewhat limited effect sizes.

A recent study conducted by Novak-Geiger (2023) aimed to identify differences in beliefs about neuromyths between psychology students and trainee teachers. Using a scale similar to ours comprising 20 neuromyths and 20 verified neuro-facts, they determined that psychology students showed better discrimination between correct and incorrect facts, although some myths were equally prevalent in both samples. This finding aligns with ours, suggesting that some myths appear to resist psychological training.

These differences were also observed when analyzing two potential subgroups of neuromyths: one related to neuroscience and education (neuromyths subgroup) and another based on general errors within psychology, suggesting that neuromyths may not be considered a homogeneous set or may stem from common misconceptions in psychology (Grospietsch & Lins, 2021; Rousseau, 2021). This leads to the conclusion that the protective role of psychology may extend beyond its own field to other areas, such as education.

The ideas of out-of-body experiences, the effects of brain transplantation, the rotation of letters as a sign of dyslexia, learning styles, an erroneous conception of left/right brain dominance, the irreversible effect of lack of stimulation on the developing brain, the scientific use of hypnosis, and the effect of sugary drinks on attention (items 2, 4, 8, 10, 18, 19, 27, and 32, respectively) continue to be associated with myths and inaccurate ideas, even among people with psychology training, as our results seem to show. It is very possible that psychology degree curricula may include content that diverges from the existing scientific evidence, giving rise to misconceptions that may sustain these myths, or that interpretations of neuroscientific studies may not reflect the results presented. Many of these myths are widespread in the general population, and also appear resistant to specific training in the education sector, as they appear highly intuitive (Rousseau, 2021; Thomas et al., 2019).

Furthermore, this protective effect did not significantly differ between current students, whether at the undergraduate or postgraduate level, and practising psychologists who were no longer in training, with no overall difference between the two groups. Differences between the two groups were only observed as a marginal tendency for four specific myths. On the one hand, trainee psychologists showed a greater tendency to incorrect responses regarding the role of neuronal plasticity following a lesion (item 11) and the effect of physical exercise on cognition (item 12). The first of these statements is rather an oversimplification of the functioning of the brain in its reorganisation, whereas the second seems to be rooted in a mind/body dichotomy, and appears still to be intuitive. These results suggest that we should re-evaluate how these subjects are addressed in degree curricula.

On the other hand, practising psychologists showed a lower percentage of correct responses than trainee psychologists with regard to two other neuromyths, the possibility of out-of-body experiences and the effect of sugary drinks on attention (items 2 and 32, respectively), although again as marginal tendencies. In the light of this, continued training or courses may be needed to update professionals' knowledge of subjects related to neuroscience and neuropsychology. Nonetheless, and unlike those of other authors, our results do not show greater prevalence of neuromyths among trainee psychologists (Janati Idrissi et al., 2020) or among practising psychologists due to outdated information (Rousseau, 2021). It is important to note that in our study, reference is made to formal education in psychology rather than specific training in neuroscience or a refutational approach to incorrect claims, which could have a much clearer effect if added to mere exposure (Kowalski & Taylor, 2009).

General discussion

The aim of this study was to explore the potential relationships between psychology training and the ability to identify misconceptions about neuroscience, or neuromyths. To that end, the first study evaluated the current state of research into neuromyths through a bibliometric study to identify potential underlying lines of research, with particular emphasis on psychology and neuromyths. To our knowledge, no previous bibliometric study has been performed in this area of research.

Although five clusters were identified, they presented considerable overlap, and did not reveal any clear lines of research; this seems logical, given the recency of the concern over the existence and spread of neuromyths. In fact, the earliest studies on the subject were published less than 20 years ago (Geake, 2008; Purdy, 2008). Despite the implementation of some science and neuroscience education interventions addressing neuromyths (Carboni et al., 2021; Ferreira & Rodríguez, 2022), the term "psychology" occupies only a small position in cluster 3 (related to neuroscience), reflecting the small number of studies on the subject. An even more striking finding was the absence of the term "neuropsychology" in the results. As neuropsychology represents the link between neuroscience and psychology (or between brain, mind, and behaviour), it may be useful for education about neuromyths to begin precisely in the field of neuropsychology. This may result in better adapted interventions, clarifying the scope of research findings about the brain and behaviour.

In the light of the lack of studies and definition of this field of research, our second study aimed to examine the potential protective effect of training in psychology against neuromyths. The results may be considered partial as, although this training appears to have a moderate effect in improving the identification of neuromyths compared to the general population, this protection is incomplete, with trainee and practising psychologists failing to identify certain misinterpretations or oversimplifications; similar results are reported by other authors (Macdonald et al., 2017; Rousseau, 2021). This incomplete protection may partly be explained by heterogeneity in psychology degree curricula. Due to the existence of different currents within psychology, students may receive information that is occasionally contradictory, favouring belief in these myths. These currents include radical behaviourism, which minimises the importance of the relationship between brain and behaviour (Fernández et al., 2010; Parga, 2020), and areas such as neuropsychoanalysis, which have adapted information from the neurosciences to establish a basis for positions whose evidential underpinning remains subject to debate (Ouss-Ryngaert & Golse, 2010).

This heterogeneity, together with the lack of depth of neuropsychology training in the general curriculum, sheds light on the continued presence of these myths about neuroscience and behaviour among trainee and practising psychologists, despite their training. Following the metaphor proposed by Bruer (1997), neuropsychology could be that less-traveled bridge between cognitive psychology and neuroscience that allows practical meaning to be derived from neuroscience findings.

Our results do appear to show that structured psychology training has a similar effect in protecting against neuromyths in both trainee and practising psychologists. While this finding seems coherent, there is a need for more detailed study of such other variables as continued training, interest in neuroscience training, and specialisation in neuropsychology.

This study presents certain limitations that should be taken into account in future studies seeking to replicate and refine our results. Firstly, the literature search in study 1 could be extended to other databases to complement and expand the sample of articles reviewed to characterise the field of study. Furthermore, the sample used in study 2 was gathered in a single city and linked to specific universities. While it is interesting to understand regional differences in the presence of myths (Furnham & Hughes, 2014), this complicates the generalization of results. In addition to the heterogeneity of psychology itself, we must consider differences between universities in the development of curricula, which may result in differences in terms of the basic neuroscientific and neuropsychology training provided. Similarly, it would be beneficial to consider including more variables potentially involved in the associations observed. It is important to highlight that a quasi-experimental design, as proposed, may introduce a number of uncontrolled variables, for example within the sample itself, which being self-selected could obscure motivational or interest-related variables on these topics that may partially explain the differences.

Another significant limitation lies in the scale used to assess the presence of neuromyths. Upon analyzing our scale, it would be interesting for future studies to explore the possibility of different factors and groupings of myths, as other authors have done in their studies (Furnham & Hughes, 2014), which would require a significant expansion of the sample size. Similarly, it would be relevant to consider the possibility that some statements have been formulated inaccurately or that there are myths whose validity depends on how sentences are interpreted, such as considering the brain's behaviour as that of a computer. It is important to highlight that the few differences between trainee psychologists and practising psychologists are based on marginal tendencies that should be explored further in the future. Finally, the scale could be expanded, or presented in different formats to avoid a potential response bias.

However, despite these limitations, our results may help shed light on a subject that, according to our bibliometric study, has received little research attention and that is relevant in avoiding therapeutic or training approaches based on misconceptions of neuroscientific developments. While psychology may serve as a tool to reduce the prevalence of neuromyths, it is not a silver bullet, and seems to present limitations.

Appendix

Methodological Appendix: VOS Viewer Clustering Algorithm

The VOS Viewer algorithm employs the Visualization of Similarities (VOS) technique to generate clusters. The process is outlined below:

Network Construction: A network is constructed where nodes represent elements (such as keywords) and links represent the similarity or relationship between them. For instance, in a keyword co-occurrence analysis, nodes are keywords and links represent the frequency with which keywords co-occur in the same documents (van Eck & Waltman, 2010).

Weight Assignment: Each link between nodes is weighted based on the strength of the relationship. For keywords, this may be based on co-occurrence frequency (Perianes-Rodriguez et al., 2016).

Clustering: The algorithm groups nodes into clusters by maximizing link density within clusters and minimizing links between different clusters. This is achieved iteratively by adjusting node assignments to clusters until the network structure is optimized (Waltman et al., 2010).

Visualization: Finally, VOS Viewer generates a visualization where nodes within the same cluster are visually grouped and similarly colored, facilitating the interpretation of relationships and underlying structures in the data (Ninkov et al., 2022).

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Data availability All data is collected in a confidential database that can be shared with anyone who requests it.

Declarations

Ethical approval and consent Informed consent was obtained from participants. Data were kept anonymous.

Conflict of interest The authors declare no conflicts of interest. This work has not received any public or private funding or financial support.

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Current themes of interest:

The authors are currently carrying out lines of research related to the prevalence of neuromyths in psychology.

Another line of work is developed by Balmaseda-Serrano, Fernández del Olmo and Cruz-Cortés in neuropsychological evaluation and child neurodevelopment at UNIR.

Most relevant publications in the field of Psychology of Education:

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