

## Neuromyth prevalence in teachers at the University of Cienfuegos

### Prevalencia de neuromitos en docentes de la Universidad de Cienfuegos

### Prevalência de neuromito em professores da Universidade de Cienfuegos

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**Abstract:** The premature application of neuroscientific knowledge generates erroneous beliefs or neuromyths in professors. Hence the execution of a descriptive study aimed at identifying the prevalence of neuromyths in 40 university professors from the Faculty of Education Sciences of the University of Cienfuegos (Cuba) and the predictors that may influence false beliefs about the brain. For this purpose, a questionnaire designed to evaluate neuromyths and predictors was contextualized. An analysis of the variables was executed: 1) participants' characteristics, 2) neuromyths, and 3) predictors; for which linear regression was applied. The evaluation of the study hypothesis was carried out through the non-parametric Chi-Square Goodness-of-Fit Tests. The most significant result was the identification of predictors on the predominance of neuromyths in professors for their subsequent treatment in initial and continuous training.

**Keywords:** neurosciences; higher education; neuromitos

**Resumen:** La aplicación prematura del conocimiento neurocientífico genera creencias erróneas o neuromitos en docentes. De ahí la ejecución de un estudio descriptivo dirigido a identificar la prevalencia de neuromitos en 40 docentes universitarios de la Facultad Ciencias de la Educación de la Universidad de Cienfuegos (Cuba) y los predictores que pueden influir en las falsas creencias acerca del cerebro. A tales efectos se contextualizó un cuestionario diseñado para evaluar neuromitos y predictores. Se ejecutó un análisis de las variables: 1) características de los participantes, 2) neuromitos, y 3) predictores; para lo que se aplicó la regresión lineal. La evaluación de la hipótesis de estudio se realizó a través de la prueba no paramétrica Chi Cuadrado de Bondad de Ajuste. El resultado más significativo fue la identificación de predictores sobre el predominio de neuromitos en los docentes para su posterior tratamiento en la formación inicial y continua.

**Palabras clave:** neurociencias; educación superior; neuromitos



**Resumo:** Nesta pesquisa, dimensiona-se a violência em casais de estudantes universitários e explora-se sua relação com o ciúme e outros correlatos. Com um desenho transversal, foram estudados 186 alunos da Universidade de Cuenca. Os instrumentos utilizados foram o *Conflict in Adolescents Dating Relationships Inventory*, a *Multidimensional Jealousy Scale* e itens ad hoc sobre fidelidade, uso de substâncias e estresse no relacionamento. Os escores de violência foram baixos em geral, mas preocupantes em 5,4% dos participantes. 60,2% relataram ter cometido pelo menos um ato de violência física durante o relacionamento. Os subtipos de violência medidos tiveram distribuição semelhante entre homens e mulheres. A correlação entre o total de violência cometida e sofrida foi de .77 ( $p < .001$ ). Houve associação significativa entre pertencimento ao grupo de maior violência, ciúme comportamental e estresse sofrido durante o relacionamento.

**Palavras-chave:** violência de casal, estudante universitário, ciúmes, fidelidade, estresse, uso de substâncias

Received: 05/24/2020

Accepted: 11/23/2020

How to cite:

Jiménez Pérez, E. H., & Calzadilla-Pérez, O. O. (2021). Neuromyth prevalence in teachers at the University of Cienfuegos. *Ciencias Psicológicas*, 15(1), e-2358. doi: <https://doi.org/10.22235/cp.v15i1.2358>

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The interest of researchers and professors in linking the neurosciences and the educational sciences through the establishment of what Bruer calls bridges, constitutes a theoretical and practical problem in continuous ascent (Bruer, 1997, 2016). The criteria resulting from the scientific research on this matter show a point for the generation of basic and applied research, among which there is a common node: the added value of neuroscientific knowledge for educational practice as a way to promote sustainable human and social development (Calzadilla-Pérez, 2017; Castorina, 2016; Fernández, 2017; Román, 2013; Zuluaga, 2018).

In this context of encounters between educational and neuroscientific knowledge, neuromyths become relatively false theories, without a sufficient scientific basis, and that due to their recurrence are installed in the social representations of the subjects (Barraza & Leiva, 2018; Ferreira, 2018; Ferreira & Gómez, 2019; Nancekivell, Shah, & Gelman, 2020; Román, 2013). These point to novel teaching methods, styles and activities that attempt to develop learning based on the functioning of the brain and, in the worst case, without prior systematization of scientific criteria and their critical transfer. Several of the neuromyths that persist today have emerged from the dissemination of laboratory results, which is far from the classroom environments in which the teacher educates, instructs and teaches under natural conditions.

In this sense, it is pertinent to refer to the full maturation of emerging scientific disciplines such as Neuroeducation, Neuropedagogy and Neurodidactics, as an expression of the common task of researchers and professors to create new bridges of knowledge integration with scientific foundations that disprove false beliefs. Although these disciplines do not have absolute consensus

in their recognition, the new knowledge generated in research projects, the increase of master and doctoral programs, and the rising number of publications, show their relevance (Battro, Fischer, & Pierre, 2008; Blakemore & Frith, 2007; Codina, 2014; Geake, 2005; Goswami, 2004, 2006; Howard-Jones, 2010; Mora, 2013).

In this line of thought, previous studies were found such as those of Beiras (1998), who stated that after the implementation of Neuroscience and Neuroscience modules, students tend to show a favorable attitude to accept neuroscientific information, considering its interdisciplinary character. Román (2013) concluded the existence of professors who still think about Neurosciences as an exclusive part of medicine. On the other hand, López (2017) defends that neuroscientific knowledge has a significant influence on the cognitive, affective and conative component of the attitudes of professors in training. These criteria coincide in some points of analysis of Zabalza (2018), who when referring to the contributions of Neurosciences to Child Education, states:

“(...) the need to incorporate this theme into the curricula of future educators of young children. [...] Unfortunately, little by little, careers in the preparation of professors have been excessively pedagogized and these other essential contributions to the understanding of child development have been lost” (2018, p. 83).

In fact, applied research considers as one of the causes of the proliferation of neuromyths the weak level of treatment of the knowledge of neurosciences in the curricula for teacher training. In spite of what has been proposed in the last two decades, the interest of experts and professors in their integration in the training of educational professionals persists. This affirmation is palpable in the results of research developed by Bacigalupe and Mancini (2014), Calzadilla-Pérez (2015, 2017), Calzadilla-Pérez et al. (2018), Carvalho and Villas (2018), Horvath and Donoghue (2016), López (2017), Luque and García (2017), Martín (2012), Melo (1998), Román (2013, 2018), Tapia (2013), and Resende and Colombo (2018).

Contradictorily, professors have among their challenges to reverse the prevalence of neuromyths through the transfer and pedagogical validation of neuroscientific knowledge, with the purpose of transforming practice in their classrooms from the domain of theory. This purpose increases its scope when it comes to teacher training in higher education.

In accordance with the fact that neuroscientific knowledge is part of the social right to information, research on this subject shows that education professionals currently show a flexible attitude due to the gradual improvement of teaching based on this knowledge; however, the multiplication of neuromyths as a practice limits the realization of this challenge (Ansari, De Smedt, & Grabner, 2012). This concern has generated research on the prevalence of neuromyths in students and professors from several countries, which are concentrated in Europe and North America, with a lower number in Latin America (Lipina, 2016).

In fact, research on the prevalence of misconceptions or neuromusic knowledge among professors in different countries demonstrates the relevance of their study, which is intended by the authors as a preamble to further training programs. In this regard, it is illustrative to mention the work done in countries such as the United Kingdom and the Netherlands (Dekker, Lee, Howard-Jones, & Jolles, 2012), Portugal (Rato, Abreu, & Castro-Caldas, 2013), Turkey (Karakus, Howard-Jones, & Jay, 2015), China (Pei, Howard-Jones, Zhang, & Liu, 2014), Switzerland (Tardif, Doudin, & Meylan, 2015), Spain (Fuentes & Risso, 2015) and Ecuador (Falquez & Ocampo, 2018).

In the search of causes that favor the presence of neuromyths in Cuban university professors, the criteria resulting from two previous studies are weighted. In the first one, it is affirmed that "the integration of neuroscientific knowledge in education has been characterized by the insufficient pedagogic and didactic argumentation, and relative decontextualization to the particularities of the development stages through which the subject passes in his ontogenesis" (Calzadilla, 2017, p. 1). In the second study (Calzadilla-Pérez et al., 2018) it was concluded that,

although the integration of neuroscientific knowledge does not have a sufficiently explicit treatment in the programs for teacher training, its mastery is content of the pedagogical training that deserves the didactic treatment in programs of disciplines and subjects. However, among the causes that have limited its more explicit and intentional treatment are the following:

- Limitations in the access to the results of foreign and Cuban researches that contribute to neuroscientific knowledge in education, which limited the pedagogic vision of its added value in the educational process and the formation of an interdisciplinary culture in university professors that would allow basing education, also from its biological bases.
- Fragmentation of neuroscientific knowledge in the curricular design and weak search of nodes and interdisciplinary relations, from the methodological work in the organizational levels of the career, which limited its integration and gradual treatment in the solution of professional problems and the assimilation of contents for the satisfaction of the functions and tasks of its role, from the disciplines and academic years.

This explains the need to offer treatment in the curricular design of the careers, in programs of professional overcoming and academic formation for professors to the foundations that singularize the integration of neuroscientific knowledge as a *sine qua non* condition to understand, argue and demonstrate the spontaneous and empirical character of the neuromyths that prevail in university professors.

Consequently, the objective of this work is: to determine the prevalence of neuromyths in university professors of the Faculty of Education of the University of Cienfuegos, since the mastery of this knowledge lays the foundations for the execution of improvement programs, future research lines and the enrichment of didactic management in teaching groups at the level of subjects, academic disciplines and careers.

## Materials and Methods

A descriptive, cross-sectional study was conducted (Hernández, Fernández, & Baptista, 2014). The study period is from September to December 2018 in the Faculty of Educational Sciences of the University of Cienfuegos.

### *Participants*

The sample is of probability type and was proceeded from simple random sampling. It was made up of 40 professors who were present on the day the instrument was applied in the departments assigned to the Faculty of Education. Thus, 82.5% ( $n= 33$ ) of the professors are graduates in Education and 17.5% ( $n= 7$ ) are graduates in Technical Sciences. The age range of those surveyed is 23 and 67 years ( $M= 46.20$ ,  $DE= 14.21$ ) and their work experience in education is from 3 months to 47 years ( $M= 2.62$ ,  $DE=14.97$ ). Of these, 5 were male, and 35 were female.

In the characterization of the participants, it was corroborated that most of them hold the scientific degree of Doctor of Science and the main teaching category of Assistant Professor. 82.5% of them have a degree in education sciences, and only 17.5% in technical sciences, the latter belonging to the Faculty of Education because they have postgraduate degrees in education; in addition, all of them are linked to teacher training. The categorical composition of the participants is significant in that 72.5% were trained as Master or Doctor of Science in a specific discipline, and 52.5% hold the main teaching categories of Assistant Professor or Full Professor.

### *Instrument*

An adaptation to the instrument designed by Dekker et al. (2012) in its Spanish language version was made, being conformed by 25 items, 14 corresponding to the study of the knowledge

on neuromyths and 11 to the domain of general aspects about the brain. According to the original instrument, the items are focused on semi-closed questions with the options of true (V), false (F) or don't know (NS). In addition, general questions taken from the survey elaborated by Falquez and Ocampo (2018) were added for the study. These questions consist of placing in a Likert scale from 1 (equivalent to very low) to 7 (equivalent to very high), the level of self-evaluation of their performance as university professors, the level of interest in Neuroeducation, the knowledge about it and the level of security in responding.

### ***Procedure***

Initially, participants were notified by email of their availability to answer an instrument that was part of an ongoing research project and the need to sign an informed consent form in which they gave their permission for the partial and total production of their answers, while maintaining their anonymity. The surveys were then applied in printed format, where professors answered in their own handwriting. They were carried out during one week during working hours and the researchers accompanied the participating professors at all times. However, it was not possible for the population under study to participate in its entirety, due to time constraints, work rhythms and access to mail where prior notice was given. Likewise, the research is part of the educational diagnosis of a master's thesis and this facilitated the approval and endorsement of the scientific committee of the Master's Degree in Education of the University of Cienfuegos.

### ***Data analysis***

The collected data are analyzed through the Statistical Package for the Social Sciences (SPSS) version 22.0 for Windows. Taking into consideration that the working hypothesis is limited to the determination of the significant prevalence of neuromyths in university professors of the Faculty of Educational Sciences of the University of Cienfuegos, the studied variables are: 1) neuromyths, 2) neuromyths predictors and 3) general knowledge about Neuroscience. The first one is analyzed through inferential statistics with the non-parametric Chi Square Goodness-of-Fit Test in order to evaluate the hypothesis. The second one is analyzed through the linear regression where the dependent variable was the neuromyths that prevailed in the participants and the third one through the descriptive statistics.

## **Results**

The results show the description of the variables: 1) *prevalence of neuromyths, and, 2) general knowledge about Neuroscience and predictors of neuromyths.*

After applying the instrument, it was found that the largest number of participants (67.5%) declared that they had not received training in the neurosciences applied to education, which evidences a bias with respect to the treatment of guiding nuclei of the current Curriculum "E" in which "anatomophysiological knowledge is perceived in the program of the discipline General Pedagogical Training as an integrating nucleus" (Ministry of Higher Education, 2016). However, more than half of the sample (60%) mentioned having a high level of interest in Neuroeducation, although less than half (35%) recognized not having knowledge about it.

97.5% declared that they practice reading popular science publications and 82.5% reading scientific magazines, in which knowledge about Neuroeducation is made visible. On the other hand, half of the participants valued as "very high" their performance as professors. Also, six out of ten participants valued as "high" and "very high" the level of security in answering the questions of the questionnaire. This shows the sample's tendency towards high values on the instrument's scale.

The most prevalent neuromyths in professors were the following:

- N 7. Students learn best when they receive information in their preferred learning style (auditory, visual and kinesthetic), in 90% of participants.
- N 10. Environments that are rich in stimuli improve the brain development of early childhood children, with 97.5%.

Other neuromyths considered moderately prevalent are:

- N 8. Short sessions of coordination exercises can improve the integration of brain function of the hemispheres, with a prevalence of 70% of the sample.
- N 12. Physical exercises that promote coordination of perceptual-motor skills can improve reading and writing skills in 87.5% of professors.
- N 14. For learning to be even more effective, the skills of left hemisphere and right hemisphere must be stimulated (67.5%).

Table 1 shows the percentages presented by the neuromyths, with respect to the question in which the professors had to answer with the answers of true (T), false (F) or don't know (Dk). Note the predominance of the neuromyths 7, 10 and 12, as well as the level of information that the professors do not master in order to support from science the neuromyths 7, 10 and 12, fundamentally.

Table 1 *Neuromyths prevalence*

<b>Neuromyths</b>	<b>T</b>	<b>F</b>	<b>Dk</b>
N 7. Students learn best when they receive information in their preferred learning style (auditory, visual, kinesthetic)	90%	7.5%	2.5%
N 8. Short sessions of coordination exercises can improve the integration of brain function of the hemispheres	70%		30%
N 10. Environments that are rich in stimuli enhance early childhood brain development	97.5%		2.5%
N 12. Physical exercises that promote the coordination of perceptual-motor skills can improve reading-writing skills	87.5%		12.5%
N 14. The most effective learning is to stimulate the skills of the right hemisphere and the left hemisphere	65.5%	5%	27.5%

Finally, the results of the non-parametric Chi-Square Goodness-of-Fit Tests, as the calculated  $X^2 = 57.95; 27.59; 55.51; 42.72; 22.52 > X^2$  Theoretical = 5.9914,  $p > .05$  can be rejected the null hypothesis and it can be affirmed, with a significance level of 95%, that the prevalence of five neuromyths in the university professors participating in this study is significant.

In relation to the knowledge about Neurosciences in which professors showed greater lack of knowledge, we find the following (see also Table 2):

- academic achievement can be affected by skipping breakfast;
- circadian rhythms (the biological clock) change during adolescence, causing students to feel tired during the first few classes of the day;
- fatty acid (omega-3 and 6) supplements have been scientifically proven to have a positive effect on academic performance; and,
- children are inattentive after consuming sugary drinks or candy.

Table 2 *General knowledge of neuroscience*

Items	True	False	Do not know
Academic achievement can be affected by skipping breakfast	47.5%	32.5%	20%
Circadian rhythms (the biological clock) change during adolescence, causing students to feel tired during the first classes of the day	42.5%	15%	42.5%
Fatty acid supplements (omega 3 and 6) have been scientifically proven to have a positive effect on academic performance	30%	10%	60%
Children are inattentive after consuming sugary drinks or candy	22.5%	30%	47.5%

On the other hand, as shown in Table 3 the linear regression analysis revealed that the level of interest in Neuroeducation is a significant predictor ( $\beta = 0.03$ ;  $p < .05$ ) of the five neuromyths that prevailed in the present study.

Table 3 *Predictors of neuromyths*

Predictors	B	ED	t	p
Interest in educational neuroscience	0.332	0.153	2.166	.038*
Age	0.023	0.012	1.048	.063
Years of experience	0.007	0.004	1.761	.086
Neuroscience training	0.260	0.143	1.811	.079
Knowledge of educational neuroscience	0.405	0.224	1.803	.081

Likewise, neuromyths referring to differences in children's learning after consuming sugary drinks or foods are not recurrent, as only 22.5% claim to be true. Regarding the positive effect on academic achievement of fatty acid supplements (omega-3 or omega-6), 30% claim to be true. For this reason, it can be affirmed that only five of the seven most predominant neuromyths according to Dekker et al. (2012) prevail in the surveyed Cuban university professors.

## Discussion

In relation to the predictors, there is no similarity with the previous research since the predictor in this case is the interest in Neuroeducation. This means that the greater interest that professors have in Neuroeducation, the greater the belief in neuromyths. Although the typical contradiction between the unknown and the new neuroscientific knowledge in a specific time frame can be affirmed as one of the epistemic factors that condition the emergence of neuromyths, another cause lies in the excessive and subjective interest in applying uncritically the advances in neurosciences in education.

Likewise, the explosion of information about the brain has caused false interpretations about its contributions and the invisibility of the applications of Neuroeducation (Goswami, 2006). On the other hand, the gap that exists between researchers, neuroscientists and professors has facilitated the rapid proliferation in educational centers of the so-called neuromyths, or misconceptions about the brain (Howard-Jones, 2014). In this framework, consequences are assured that demonstrate the existence of educational programs, supposedly, based on neuroscience that lack scientific evidence to prove their effectiveness.

Each of these distorted beliefs of reality, in addition to proliferating speculative learning, places professors in labeled samples due to lack of neuroscientific knowledge. This leads to the creation of activities, programs and exercises without solid scientific foundations for education, mainly in early childhood (Gleichgerrcht, Luttges, Salvarezza, & Campos, 2015).

This study has among its added values to constitute scientific evidence to generate research that offers convincing arguments to mitigate false theories about the brain. In this context of analysis, a comparative analysis of the average prevalence of neuromyths per country according to the data offered by Falquez & Ocampo (2018) is made with respect to the work of Dekker et al. (2012), Ferrero et al. (Fuentes & Risso, 2015) and Gleichgerrcht et al. (2015) as shown in Figure 1.

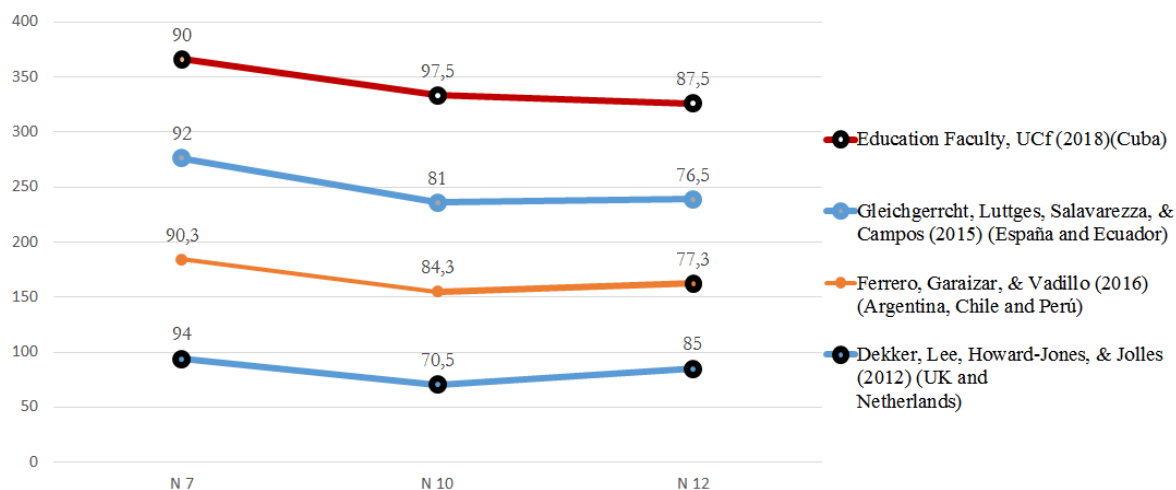


Figure 1. Results of baseline studies on prevalence of neuromyths

In effect, the data show the N 7 as the one with the highest prevalence of the reference studies in Figure 1, with a percentage index that is not very significant in terms of the difference between these. The N 10 and the N 12 are the other two with the highest percentage of prevalence in all cases, and the percentage rates within them are higher. In general, the result of this research coincides with the average prevalence of the countries in which the reference studies are carried out.

However, it is not coincidental that, regarding the percentage, the Cuban study shows higher figures, and among the factors that condition it, besides those previously referenced in this same work by Calzadilla-Pérez et al. (2018), there is the fact that Neuroeducation and its related vertebral branches such as Neuropedagogy and Neurodidactics have not been able to consolidate as solid methodological and research work lines. Hence, the pedagogical systematization of neuroscientific knowledge in the curricula for teacher training does not constitute a directed and priority edge of the national career commissions.

## Conclusions

The results achieved allowed determining the prevalence of neuromyths in university professors of the Faculty of Education of the University of Cienfuegos. The most difficult knowledge and the predictor of the neuromyths that prevail in the participants. Although, in this case the number of neuromyths was lower than those found in professors from other countries, the difficulties in the knowledge tend to be higher. Likewise, the predictor interest in Neuroeducation reveals professors motivated by this discipline. The studies reviewed in this work allowed making a relation between the results provided for a certain sample of education



professionals from other countries and Cuban professionals belonging to the University of Cienfuegos. This corroborated that the surveyed Cuban university professors do not have neuromyths that in other samples assure prevalence, which can find an answer in the integration of neurosciences in international and national congresses that take place in the university during the last year, where there are presented topics that approach this discipline and its contributions to educational sciences.

However, it is concluded that the prevalence of neuromyths in the professors of the study has its fundamental cause in the weak integration and treatment of neuroscientific knowledge in the curricular grids. This is reflected in the initial training and in the offer of continuous education. In this context, the lack of research projects that manage as a study variable the evaluation of professor training curricula and generate the scientific updating of these with neuroscience contents becomes one of the causes, as it was exposed in the research of Calzadilla-Pérez (2017, 2018).

Among the added value of the results presented is that they offer information to generate future research for curricular improvement from the functions of the national career commissions and the university faculties.

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Authors' participation: a) Conception and design of the work; b) Data acquisition; c) Analysis and interpretation of data; d) Writing of the manuscript; e) Critical review of the manuscript. E.H.J.P. has contributed in a,b,c,d,e; O.O.C.P. in c,d,e.

Scientific Editor in charge: Dra. Cecilia Cracco