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The neuroscience literacy of teachers in Greece

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Abstract

There is concern amongst neuroscientists and educators about the prevalence of neuromyths in education, which are often associated with poor or unevaluated practices in the classroom. The present study surveyed 217 primary and secondary school teachers in Greece. Analysis revealed that Greek school teachers held many misconceptions about concepts related to brain-based educational programs that have been observed elsewhere in Europe. These include believing that differences in hemispheric dominance (left brain, right brain) can help explain individual differences amongst learners, and the effectiveness of teaching to learning styles. However, international comparison with other studies also revealed some interesting differences reflecting the influence of cultural forces on teachers' ideas about brain function. For example, teachers in Greece appear to possess a more complex construction of the mind-brain relationship than observed in the UK and Netherlands, with most considering that this relationship is mediated by the soul. A relationship was also observed between attributing educational outcomes to genetics and a belief in a biological limit to student achievement.

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1. Introduction

As the dialogue increases between neuroscience and education, there is a growing concern about the prevalence of neuromyths in many schools. In 2002, the Organisation for Economic Co-operation and Development (OECD) defined "neuromyth" as "a misconception generated by a misunderstanding, a misreading, or a misquoting of facts scientifically established" (OECD, 2002). These myths are related to the practices of teachers and are often promoted by brain-based programmes and books marketed to teachers that are intended to inform their teaching strategies.

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There is good reason, therefore, to consider these misunderstandings contribute to poor practice in the classroom. Studies have found high levels of neuromyths amongst teachers in the UK, Netherlands, Portugal, Brazil, China and Turkey. Beyond the impact of commercial brain-based programmes in promoting myths, it seems likely that cultural contexts will influence the types of myth that become prevalent in a particular country. For example, only half of the UK population report any affiliation with any religion (Park, Clery, Curtice, Philips, & Utting, 2012) and here, only 15% of trainee teachers believed that the mind results from the spirit, or the soul, acting on the brain (Howard-Jones et al., 2009). In Brazil, however, whose people demonstrate notably high religious involvement, a small survey of teachers (N=42) showed 43% believed the mind was the result of supreme action of the soul over the brain (Bartoszeck and Bartoszeck, 2012). Greece stands out amongst European states in terms of the religiosity of its people (Hirschon, 2009), and so in our study we might expect similarly high levels of teachers who believe in a religious aspect to the mind-brain relationship. In scientific and philosophic terms, our understanding of how the mind is related to brain is intimately related to other concepts such as free-will and the malleability of our neural and cognitive abilities. It seems likely, then, that beliefs in neuromyths in Greece may reflect the specific contexts found within Greece and the Greek educational system. However, to date, no research has been undertaken to investigate the prevalence of neuromyths amongst Greek teachers. The present study aims to investigate this issue and shed light on the role of cultural contexts in the beliefs that teachers acquire about the brain. More specifically, the study sought to determine the knowledge and misconceptions about the brain amongst Greek school teachers, and their beliefs regarding biological concepts that may have implications for their practice in the classroom.

Based on tentative findings from the UK study of trainee teachers, it was hypothesized that teachers who agreed that subgroups of teachers as defined by their response to the two questions regarding biological limit to achievement (agree/disagree) would significantly differ in the percentage of educational outcome they would attribute to genetics. We were concerned with this relationship, since it sheds light on how ideas about biology may influence teachers' attitudes in the classroom in terms of how much they expect to achieve from their students. The two hypotheses related to these questions were directional, i.e. we expected to see greater attribution to genetics would be associated with stronger beliefs in the biological limit of students.

2. Method

2.1. Participants

Participants were 217 teachers employed in Athens and the Peloponnese region of Greece (155 females and 62 males) included 102 primary school teachers (47%) and 109 secondary school teachers (50%) and 6 teachers who worked in both types of school. The mean level of teaching experience within the sample was 15.1 (SD 9. 3) years with a range 1-33 years.

2.2. Procedure

The translation and suitability of the survey was first validated through preliminary interviews with three teachers and piloting with five teachers not included in the final survey sample. A total of 15 schools were recruited to take part in the study by phone and email, and the head teachers of participating schools circulated electronic or print copies of the survey to their teachers asking them to be completed and returned to the researchers. The research was presented as a study of how teachers think about the brain and its influence on learning.

2.3. Instruments

Participants were asked to complete a survey used in a previous study of UK trainee teachers (Howard-Jones et al., 2009). This consisted of 40 assertions (15 correct and 16 incorrect factual assertions, and 9 open to subjective

opinion) to which participants were asked to respond agree, don't know or disagree and is provided in Appendix A. Of these 40 assertions in our survey, 38 statements were originally created by combining assertions used in a study of public neuroscience literacy Herculano-Houzel (2002) with ideas that have arisen in interviews with educators (see Howard-Jones et al., 2009 for further details concerning the underlying rationale for including these statements). The survey included the two additional statements of subjective opinion ("There is a biological limit to what some individuals can achieve in their education", "There is no biological limit to what any individual can achieve in their education") that Howard-Jones et al. (2009) used in a follow-up survey to explore ideas around genetic determination. Related to this issue, respondents were asked what percentage of educational outcome they attributed to a student's genes, their educational environment and their home environment. Participants also provided background information for the purpose of characterizing the sample (type of school, years of experience, gender, age, etc.)

3. Results

The summary of responses of our sample of teachers to our 9 statements of subjective opinion is shown in Table 1. Summaries of responses to assertions related to general knowledge and educational issues regarding the brain are shown in Tables 2 and 3.

Table 1. Beliefs of our sample of Greek teachers regarding 9 statements that might be regarded as open to subjective opinion, including the mind-brain relationship, the impact of developmental difference on moral responsibility and belief in a biological limit to achievement.

	Response as percentage % of sample			
	Agree	Don't know	Disagree	No response
The mind is the result of the action of the spirit, or of the soul, on the brain	72	16	11	1
State of mind is a reflection of the brain state in a given moment	41	51	7	1
If there are ways to study brain activity, the mind can be studied through them	58	35	6	1
The mind is a product of the working of the brain	56	27	15	2
Without a brain, consciousness is not possible	71	18	11	0
Intuition is a "special sense" that can't be explained by the brain	46	24	28	2
Individuals are not responsible for behavior associated with a developmental difference in brain function	44	36	19	1
There is a biological limit to what some individuals can achieve in their education	13	22	63	2
There is no biological limit to what any individual can achieve in their education	19	20	55	6

Table 2. Responses of our sample of Greek teachers to general assertions regarding the brain (C = correct statement, I = incorrect statement). It should be noted that some scientific evidence supporting one statement (marked C*) has recently been found, raising questions about the correctness, or otherwise, of this statement.

	Response as percentage % of sample			
	Agree	Don't know	Disagree	No response
Brain activity depends entirely on the external environment: with no senses stimulated, we don't see, hear or feel anything (I)	25	11	61	3
Emotional brain processes interrupt those brain processes involved with reasoning (I)	44	36	19	1
Cognitive abilities are inherited and cannot be modified by the environment or by life experience (I)	4	2	94	0
Learning is not due to the addition of new cells to the brain (C*)	31	49	20	0
One's environment can influence hormone production and, in turn, personality (C)	79	18	2	1
We use our brains 24 hours a day (C)	76	12	12	0
To learn how to do something, it is necessary to pay attention to it (C).	76	3	20	1
Learning occurs through modification of the brain's neural connections (C)	59	38	3	0
Performance in activities such as playing the piano improves as a function of hours spent practicing (C)	90	3	7	0
It is with the brain, and not the heart, that we experience happiness, anger, and fear (C)	70	9	20	1
Hormones influence the body's internal state, and not their personality (I)	25	17	57	1
Memory is stored in the brain much like as in a computer. That is, each memory goes into a tiny piece of the brain (I)	59	29	11	1
We mostly only use 10% of our brain (I)	45	44	11	0
Memory is stored in networks of cells distributed throughout the brain (C)	51	44	5	0
Keeping a phone number in memory until dialing, recalling recent events & distant experiences, all use the same memory system (I)	12	47	41	0
When we sleep, the brain shuts down (I)	5	6	89	0

Table 3. Responses of our sample of Greek teachers to assertions regarding the brain that are related to educational practice (C = correct statement, I = incorrect statement).

	Response as percentage of sample			
	Agree	Don't Know	Disagree	No response
Children are less attentive after sugary drinks and snacks (I)	48	29	22	1
Omega 3 supplements do not enhance the mental capacity of children in the general population (C)	11	38	50	1
Extended rehearsal of some mental processes can change the shape and structure of some parts of the brain (C)	52	40	7	1
Environments that are rich in stimulus improve the brains of preschool children (I)	97	0	2	1
Individuals learn better when they receive information in their preferred learning style (e.g. visual, auditory, kinesthetic) (I)	97	3	0	0
Short bouts of co-ordination exercises can improve integration of left and right hemispheric brain function (I)	56	40	4	0
Regular drinking of caffeinated soft drinks reduces alertness (C)	39	25	36	0
Differences in hemispheric dominance (left brain, right brain) can help explain individual differences amongst learners (I)	71	24	5	0
Learning problems associated with developmental differences in brain function cannot be remediated by education (I)	29	13	57	1
There are no critical periods in childhood after which you can't learn some things, just sensitive periods when it's easier (C)	60	15	24	1
Vigorous exercise can improve mental function (C)	65	15	20	0
Individual learners show preferences for the mode in which they receive information (e.g. visual, auditory, kinesthetic) (C)	97	2	1	0
Drinking less than 6-8 glasses of water a day can cause the brain to shrink (I)	12	65	23	0
Exercises that rehearse co-ordination of motor-perception skills can improve literacy skills (I)	72	21	6	1
Production of new connections in the brain can continue into old age (C)	55	31	13	1

The mean percentage of educational outcome that participants attributed to genetics, home environment and school environment were 27 (SD= 13.2), 33 (SD=14.4) and 36 (SD=13.6) respectively. The mean percentage of educational outcome attributed to genetics that participants who agreed (N=131) and disagreed (N=29) with the statement "There is a biological limit to what some individuals can achieve in their education" was 29% (SD 12%) and 23% (SD 12%) respectively. An independent samples one-tailed t-test revealed this difference to be significant ($t(158)=2.26$, $p=0.012$). The mean percentage of educational outcome attributed to genetics that participants who agreed (N=41) and disagreed (N=161) with the statement "There is no biological limit to what any individual can

achieve in their education” was 25% (SD 11%) and 29% (SD 13%) respectively. An independent samples one-tailed t-test revealed this difference to be significant ($t(158)=1.79, p=0.038$).

4. Discussion

The research revealed that Greek participants held many neuromyths and misconceptions about the brain that have been recorded elsewhere in Europe. These include almost three-quarters (71%) of teachers believing that differences in hemispheric dominance (left brain, right brain) can help explain individual differences amongst learners, and the great majority (97%) believing in the effectiveness of teaching to learning styles.

However, as expected, most Greek teachers possessed a complex construction of the mind-brain relationship that included a more “mysterious” approach than recorded in the UK study of trainee teachers. High levels of religiosity characterize a large proportion of the Greek people (Hirschon, 2009) and the majority of this population are Christian Orthodox. According to the Greek Orthodoxy ‘the man’s soul is in the image of God, the soul gives life to the attached body, the soul is all through the body, both the whole man and the body itself can be regarded as in the image of God’ (Hierotheos, 2006:118). The ontological aspect of the soul in Greek Orthodox tradition is considered a very important aspect of faith, and is very related to the concept of a human individual as a spiritual, biological and intellectual being reflecting the image of God. In addition, as described by Xrisostomos (1998:126), the soul is considered to be related to three interlinked cognitive abilities: the senses with which the external world can be perceived, and the biology and the spirituality of the mind. The perception of such an indissoluble relation of brain, mind, spirit and soul with God may explain some of the results we report here.

In summary, since many of the myths we report here are directly related to practice and to brain-based learning programmes with an unscientific basis, we conclude that the knowledge and practice of teachers in Greece would benefit from more accurate knowledge of the brain, as might be received from teacher training and in-service professional development. This may be an important first step for future efforts in Greece to enrich education with insights from neuroscience. Comparison of our results with international data sets suggests cultural factors influence teachers’ understanding of the brain, and better understanding of these factors would be a valuable target area for future research.

Appendix A. The complete set of statements used in the questionnaire. Participants were asked to indicate their agreement with these statements as agree, don’t know or disagree.

The mind is the result of the action of the spirit, or of the soul, on the brain
 “State of mind” is a reflection of the brain state in a given moment
 If there are ways to study brain activity, the mind can be studied through them
 The mind is a product of the working of the brain
 Without a brain, consciousness is not possible
 Intuition is a “special sense” that cannot be explained by the brain
 Individuals are not responsible for behavior associated with a developmental difference in brain function
 There is a biological limit to what some individuals can achieve in their education
 There is no biological limit to what any individual can achieve in their education
 Brain activity depends entirely on the external environment: with no senses stimulated, we don’t see, hear or feel anything (I)
 Emotional brain processes interrupt those brain processes involved with reasoning (I)
 Cognitive abilities are inherited and cannot be modified by the environment or by life experience (I)
 Learning is not due to the addition of new cells to the brain (C*)
 One’s environment can influence hormone production and, in turn, personality (C)
 We use our brains 24 hours a day (C)
 To learn how to do something, it is necessary to pay attention to it (C).
 Learning occurs through modification of the brain’s neural connections (C)
 Performance in activities such as playing the piano improves as a function of hours spent practicing (C)
 It is with the brain, and not the heart, that we experience happiness, anger, and fear (C)
 Hormones influence the body’s internal state, and not their personality (I)
 Memory is stored in the brain much like as in a computer. That is, each memory goes into a tiny piece of the brain (I)
 We mostly only use 10% of our brains (I)

Memory is stored in networks of cells distributed throughout the brain (C)
 Keeping a phone number in memory until dialing, recalling recent events & distant experiences, all use the same memory system (I)
 When we sleep, the brain shuts down (I)
 Children are less attentive after sugary drinks and snacks (I)
 Omega 3 supplements do not enhance children's mental capacity in the general population (C)
 Extended rehearsal of some mental processes can change the shape and structure of some parts of the brain (C)
 Environments that are rich in stimulus improve the brains of preschool children (I)
 Individuals learn better when they receive information in their preferred learning style (e.g. visual, auditory, kinesthetic) (I)
 Short bouts of co-ordination exercises can improve integration of left and right hemispheric brain function (I)
 Regular drinking of caffeinated soft drinks reduces alertness (C)
 Differences in hemispheric dominance (left brain, right brain) can help explain individual differences amongst learners (I)
 Learning problems associated with developmental differences in brain function cannot be remediated by education (I)
 There are no critical periods in childhood after which you can't learn some things, just sensitive periods when it's easier (C)
 Vigorous exercise can improve mental function (C)
 Individual learners show preferences for the mode in which they receive information (e.g. visual, auditory, kinesthetic) (C)
 Drinking less than 6-8 glasses of water a day can cause the brain to shrink (I)
 Exercises that rehearse co-ordination of motor-perception skills can improve literacy skills (I)
 Production of new connections in the brain can continue into old age (C)

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