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USING MULTIPLE STRATEGIES TO ADDRESS NEUROMYTHS IN PRESERVICE TEACHERS

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Abstract

Neuromyths, popular misconceptions about brain development, are shown by research to be common in preservice teachers. This is concerning, because an accurate understanding of brain development enhances teachers' understanding of how their students learn. Accordingly, researchers designed a study to address prevalent neuromyths and their alleviation. Eight preservice teachers were provided with information on neuromyths, along with accurate brain development information, in a unit situated within an educational psychology course at a University in the Southeastern United States. Researchers sought to determine which neuromyths were present in the preservice teachers, and whether the unit would alleviate those neuromyths. The unit included inviting a neuroscientist into the preservice classroom to share accurate knowledge about brain development at different stages throughout K-12 schooling. Preservice teachers were asked to reflect about "What did you learn that surprised you? How will you use the information from today to understand students?" following the presentation by the neuroscientist. Preservice teachers also watched a video, attended a preservice teacher's presentation, and read relevant articles and book chapters. Preservice teachers were given a pre-test, post-test, and an end-of-semester test which included ten neuromyths and 20 general brain knowledge items. Data were analyzed to determine to what degree neuromyths were alleviated right after the brain development unit ended (during week 6 of a 16-week semester) and to what degree the information was retained by the end of the semester. Because of the small sample size, data were analyzed qualitatively. Pre-, post- and end-of-semester-assessment results were compared. Responses to the discussion post were used to provide consistency and depth to results from the post-assessment. An examination of which neuromyth beliefs were lessened and which were persistent revealed that the neuromyths concerning left brain/right brain and the belief that caffeine increases alertness were commonly held yet mostly alleviated. Preservice teachers expressed surprise in class discussions about these neuromyths because they had been heard and believed by many. The belief that children are less attentive after consuming sugary drinks and/or snacks was revealed in class discussions to be based on preservice teachers' anecdotal observations, and was shown to be a persistent neuromyth. The distinction between individuals preferring to learn in a particular style and lack of research supporting the belief that individuals learned better when they received information in a particular style caused some confusion, as seen in the results. It was determined that more clarity was needed on this topic.

Keywords: *Educational psychology, teacher education, neuromyths, brain development.*

1. Introduction

Neuromyths can be distortions or misinterpretations of proven hypotheses reported in the media (Pasquinelli, 2012). The first use of the term neuromyth has been attributed to the neurosurgeon Alan Crockard, who coined it in the 1980s when he referred to unscientific ideas about the brain in medical culture (Crockard, 1996 as cited in Howard-Jones, 2014), and the term became more popular after mention by the Organization for Economic Co-operation and Development [OECD (2002)]. Neuromyths appeal to the general public, including preservice teachers, because they reinforce intuitive beliefs and observations (Howard-Jones, 2014; Pasquinelli, 2012; Purdy & Morrison, 2009) According to Pasquinelli (2012), "the persistence of neuromyths is sustained by specific cultural conditions, such as the circulation of pieces of information about the brain and the appetite for brain news, but has its roots in deeper cognitive intuitions." (p.89). It may be difficult for people who lack neuroscientific expertise to recognize misconceptions about brain research in the popular media (Beck, 2010). For example, Carter et al. (2020)

searched for sources of information for 15 neuromyth and 17 general brain knowledge statements. Depending on the belief, participants relied on general knowledge, academic staff, school staff, and popular media. Tardif et al. (2015) also found the media, readings, and teacher training courses to be a source of neuromyths. Conversely, Karakus, et al. (2014) found that most respondents identified the source of neuromyths as based on their own experience, or did not remember the source.

Coch (2018) stressed the importance of accurate knowledge of brain development in preservice teachers, specifically noting the importance of recognizing how social economic status is related to brain development as well as how an understanding of brain plasticity leads to a growth mindset. Coch (2018) additionally stated "Neuroscience can contribute to the development of at least two of these four components of pedagogical content knowledge in preservice teachers: what teachers know about their subject matter and their students' learning" (p. 312). Without access to accurate brain development information, preservice teachers rely on their own ideas gleaned from various resources, which can be detrimental to their teaching practices (Howard-Jones et al., 2009). Knowledge of brain development cannot be used to the benefit of students if neuromyths are prevalent; in fact, resources may be misallocated in support of programs based on neuromyths (Pasquinelli 2012; Sylvan & Christodoulou, 2010). Gardner (2019) himself has noted that, regarding the theory of multiple intelligences, "I have gone to great pains to emphasize that even if the theory is plausible, no educational recommendations follow directly from it" (p. 3).

Several studies in the recent past have documented the existence of neuromyths in preservice and inservice teachers. For example, in an early study, Howard-Jones et al., (2009) investigated the brain development and neuromyth knowledge of preservice teachers in the UK, and found that the preservice teachers' ideas reflected popular neuromyths concerning the influence of environment and genetics on student success. Following this investigation, Dekker et al. (2012) devised an instrument to look for evidence of neuromyths and brain development knowledge in teachers in the UK and Netherlands. Teachers' beliefs reflected those found by Howard-Jones et al., (2009), leading Dekker et al. to conclude that teachers find it difficult to identify pseudo-science. Other researchers subsequently used either the instrument from Howard-Jones et al. (2009) or the instrument from Dekker et al. (2012), with similar findings (e.g. Deligiannidi & Howard-Jones, 2015; Dundar & Gunduz, 2016; Ferrero et al., 2016; Gleichgerrcht et al., 2015; Hughes et al., 2020; Karakus et al., 2014). However, studies have shown that collaborations and interdisciplinary communication between science and education can reduce misconceptions, lead to meaningful, productive theories and result in more efficient teaching and learning strategies (Dekker et al., 2012; Hughes et al., 2020; Pasquinelli, 2012; Pickering & Howard-Jones, 2007; Sigman et al., 2014).

Given the prevalence of neuromyths in past studies, and recommendations for the collaboration between science and education, researchers in this study collaborated to provide a neuroscience unit to preservice teachers. Researchers asked the questions, What neuromyths are present in second-year preservice teachers, and are any of the neuromyths present able to be alleviated by the neuroscience unit short-term and long-term? Which neuromyths are more resilient? Preservice teachers were provided with information on neuromyths, along with accurate brain development information, in a unit situated within an educational psychology course. The unit consisted of collaboration between an educator and a neuroscientist, as recommended by Coch et al. (2009). Neuromyths were made transparent to preservice teachers, as seen in Grospietsch and Mayer (2018), and refuted throughout the unit in a similar way as seen in McMahon et al. (2019).

2. Methods

For this study, the sample consisted of eight secondary preservice teachers in their second year of undergraduate teacher education, enrolled in an adolescent development and psychology course at a Southeastern university in the United States. Preservice teachers included two Black and two White males, as well as one Black and three White females. Researchers collaborated to provide accurate brain development information to preservice teachers with a unit that included inviting a neuroscientist into the preservice classroom to share accurate knowledge about brain development at different stages throughout K-12 schooling. In addition, preservice teachers watched a video, attended a preservice teacher's presentation, read two articles, and read relevant chapters in their textbooks.

2.1. Data collection and analysis

Preservice teachers were given a pre-test, post-test, and end-of-semester test. In addition, preservice teachers were asked to reflect about "What did you learn that surprised you? How will you use the information from today to understand students?" following the presentation by the neuroscientist. The pre-, post-, and end-of-semester survey of 30 questions was developed from the instruments used by

Howard-Jones et al. (2009) and Dekker et al. (2012), with additions from Kim and Sankey (2018) and Blanchette Sarrasin et al. (2019), and changes to wording of some questions recommended by Macdonald et al. (2017). Several questions deemed vague or controversial, based on new research, were removed from the original Dekker et al. (2012) survey. Responses allowed were Agree, Disagree, or Don't Know. Twenty of the items in the survey were general assertions about the brain and ten of the items were neuromyths. Data were analyzed to determine to what degree neuromyths were eliminated right after the brain development unit ended (during week 6 of a 16-week semester) and to what degree the information was retained by the end of the semester. Because of the small sample size, data were analyzed qualitatively. Pre-, post- and end-of-semester-assessment results were compared. Responses to the discussion post were used to provide consistency and depth to results from the post-assessment (Krathwohl, 2009).

2.2. Brain development unit

Following administration of the pre-inventory assessment, which occurred during week four of the course, preservice teachers read the shaded portions of Schultz (2009) and discussed what they found interesting or new information. The following week, a guest speaker, one of the authors who is a neuroscientist, visited the classroom and presented a 45-minute interactive lecture to preservice teachers. After the guest speaker left, preservice teachers completed their reflection questions as mentioned above, then read and discussed pp. 1-2 of Howard-Jones (2014).

Preservice teachers were assigned chapters about brain development and cognitive development in their textbook (Durwin & Reese-Weber, 2018) to read for the following week. Discussion about those readings asked preservice teachers to identify material from the readings that was related to the neuroscientist's lecture. Preservice teachers then watched a TED video on brain development in adolescence and identified commonalities and new information (Blakemore, 2012). A preservice teacher gave a presentation about how hunger is a problem for students, which addressed the item about missing breakfast being detrimental to students' learning. Preservice teachers were then assigned the rest of the Howard-Jones (2014) article to read and discuss. The brain inventory was administered as a post-assessment at the end of the unit, and again as an end-of-semester assessment to gauge what information had been retained long-term.

3. Findings

Ten neuromyths were included in the Inventory (see Table 1). On the pre-test, 100% of preservice teachers agreed with the myth that "Individuals learn better when they receive information in their preferred learning style (e.g. auditory, visual, kinesthetic)", and 75% agreed with the myth "Some of us are "left-brained" and some are "right-brained" and this helps explains differences in how we learn". For the neuromyth "Children are less attentive after consuming sugary drinks and/or snacks", 37.5% agreed, and 25% indicated they did not know. One neuromyth was worded to be true: "Regular drinking of caffeinated drinks reduces alertness" which 25% marked as true while 75% marked as don't know.

Table 1. Assessment results.

Neuromyth (T true or F false)	Percent correct pre-test	Percent correct post-test	Percent correct end-of-semester
Children must acquire their native language before a second language is learned. If they do not do so neither language will be fully acquired (F)	62.5	87.5	50
We only use 10% of our brain (F)	62.5	100	100
Some of us are "left-brained" and some are "right-brained" and this helps explains differences in how we learn (F)	25	87.5	87.5
There are critical periods in childhood after which certain things can no longer be learned (F)	62.5	75	75
Individuals learn better when they receive information in their preferred learning style (e.g. auditory, visual, kinesthetic) (F)	0	75	62.5
Children are less attentive after consuming sugary drinks and/or snacks (F)	37.5	75	50
Regular drinking of caffeinated drinks reduces alertness (T)	25	75	87.5
Extended rehearsal of some mental processes can change the shape and structure of some parts of the brain (T)	62.5	75	62.5
Individual learners show preferences for the mode in which they receive information (e.g. visual, auditory, kinesthetic) (T)	100	87.5	100
Learning problems associated with developmental differences in the brain function cannot be remediated by education (F)	50	75	75

Preservice teachers mentioned content related to four questions from the survey when they wrote their reflections after the neuroscience lecture. Three preservice teachers made comments about left brain/right brain related to questions six and seven (6. The left and right hemispheres of the brain work together and 7. Some of us are “left-brained” and some are “right-brained” and this helps explain differences in how we learn). Circadian rhythms were mentioned by one preservice teacher, related to question 19 [Circadian rhythms (“body clock”) shift during adolescence causing students to be tired during the first lessons of the school day]. Of the three preservice teachers who mentioned left brain/right brain, one agreed with question six and two marked Don’t Know on the pre-test. All three agreed with the statement (which was true) on the post-test. For question seven, all three agreed with the statement on the pre-test and disagreed with the statement (which was false) on the post-test. These responses were in line with the comments made in the reflection, as seen in the comment by one preservice teacher, ‘I had definitely heard the wrong information about "left brain" vs "right brain" and it was interesting to learn that it was not true.’ The preservice teacher who mentioned circadian rhythms agreed with the true statement in question 19 on both the pre- and post-test. In the reflection, this preservice teacher commented’ “I will use the information we learned about circadian rhythms to understand why they are so tired in the morning and barely focus in the earlier classes”.

4. Discussion

An examination of which neuromyth beliefs were lessened and which were persistent revealed that the neuromyths concerning left brain/right brain and that caffeine increases alertness were commonly held yet mostly alleviated. The left brain/right brain neuromyth was mentioned in the lecture by the neuroscientist, in the article by Howard-Jones (2014), and in the textbook (Durwin & Reese-Weber, 2018), while the caffeine neuromyth was addressed solely in the lecture by the neuroscientist. The neuromyth that we only use 10% of our brain was not commonly held and was completely alleviated. This myth was addressed in four ways – in the neuroscientist’s lecture, in the Durwin and Reese-Weber (2018) textbook, and in both the Howard-Jones (2014) and Schultz (2009) articles. It is hypothesized that the left brain/right brain and the 10% of our brain neuromyths were alleviated in part because of multiple strategies addressing these myths, while the caffeine neuromyth was alleviated because it was the most personal to the preservice teachers who comprised the sample.

The belief that children are less attentive after consuming sugary drinks and/or snacks, which was addressed in the Howard-Jones (2014) reading, was revealed in class discussions to be based on preservice teachers’ anecdotal observations and was found to be persistent at the end of the semester. Another persistent neuromyth was the belief that children must acquire their native language before a second language is learned, which was addressed in the neuroscientist’s lecture and in the reading by Scholtz (2009). The distinction between individuals preferring to learn in a particular style and research showing that individuals learned better when they received information in a particular style caused some confusion, as seen in the results. This topic was addressed in the textbook (Durwin & Reese-Weber, 2018) and in the Howard-Jones (2014) article. It was determined that more clarity was needed on this topic. The three other neuromyths were addressed by one or two strategies, and showed no or small decreases in beliefs.

Limitations of the study include the small sample size, and the uneven addressing of neuromyths. Future research will seek to more deeply address prevalent neuromyths, as well as expanding the unit to prepare preservice teachers to critically evaluate the research claims and educational resources they may encounter in their future careers.

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