What Future Teachers Think About Brain Research

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As information becomes available, teachers of educational psychology must be ready to accept or resist change. This is especially true when it comes to the brain because as technologies advance, information about it is seeping into our lives. Deciding if, how much, and when this information fits into educational psychology coursework can be difficult. In this survey study, the authors gathered data from students (n = 215) enrolled in a professional teacher education program in the southwestern United States. The study targeted the opinions of future teachers in regard to the usefulness of brain research, the importance of learning about the brain, and concerns about the applicability of brain research. The results indicate future teachers think brain research is useful and valuable for educators. Participants were neutral about potential concerns.

Education advances as new information becomes available, and those who are teaching educational psychology must be ready to accept or resist change. This is especially important related to information about the brain. As researchers learn more and more about brain development, chemistry and structure theories of learning and motivation are being altered, confirmed, and changed. As technology advances, more and more educational psychology textbooks are referencing or containing entire chapters dedicated to the brain, how it develops and learns, and the things that motivate it to succeed. However, paradigm shifts are not always easy and deciding if, how much, and how this information fits into educational psychology coursework can be difficult especially if students desire it or are skeptical of its use. From our experience working with future teachers, we have noticed that some students are motivated to learn all they can about the brain. They avidly read the information on the brain in their textbook and seek Web sites and videos about the brain because they believe neuroscience will provide insights and strategies they can transform into classroom use. In contrast, we see other future teachers who remain skeptical. They invest little time learning about the brain because they believe findings from neuroscience should be kept in biology; they have no practical application for them. Given the dichotomy between our students' interests and the need for instructors of educational psychology to incorporate or eliminate brain research in their course, we wonder just where and if brain research fits into the lives of our students as future educators. As instructors of undergraduates, we are struggling to understand if, and how much, information from brain research should be incorporated into the courses we teach.

Our dilemma is timely because of the avalanche of new information being brought into educational psychology textbooks. In the 1990s, the "decade of the brain" new technologies allowed scientists to pry open the "black box" of the brain to see in vivo what was happening as an individual learned or performed a task (Restak, 2001; Willis, 2006). With improved technology, brain images were able to show the dramatic physical changes that occur in the brain with environmental stimulation and the dark, unlit areas that are present when a brain is deprived of the stimulation and affection it needs (Perry, 2007). New technologies are leading to an understanding of how the brain functions as it processes information and

why some individuals find learning so difficult (Shaywitz, 2005; Shaywitz, Shaywitz, & Fletcher, 1990). As a result of this new and growing body of knowledge, some researchers are calling for a paradigm shift in education, comparable in magnitude to the shift from a behavioralist orientation to a cognitive perspective in the 1960s and 1970s (Byrnes & Fox, 1998). Many believe that the findings from brain research can be transformed into practical strategies teachers can use to improve their teaching, and these are creeping into coursework and textbooks.

Some researchers, like Geake and Cooper (2003), believed that the findings from neuroscience are so important they need to be part of teacher education and professional development. These researchers argued that teachers, psychologists, and neuroscientists need to work together. These researchers brought teachers into the mix because they believed that they will be the ones who transform findings from neuroscience into reality. In their words, teachers will always be interested in gaining an understanding of the multitude of factors that govern the learning of their charges. Such teacher professional development, we suggest, should embrace an understanding of development of cognitive neuroscience. Therefore we propose that education adapt an interactive bio-psycho-social model, which can only come if educationists engage neuroscientists in dialogue to share each other's professional knowledge. (p. 11)

Similarly, Byrnes and Fox (1998) and Zull (2002) purported that if teachers learn about neurons, synapses, and brain chemistry they will be able to use that knowledge to teach effectively. Others like Berninger and Richards (2003) believed teachers not only need to know about the brain but that they have the right to know about the brain because they are the ones called to work with other professionals. These professionals (e.g., physicians, therapists, audiologists, etc.) learn about the brain, and to communicate teachers need the same language or vocabulary. Information about the brain will enable teachers to work with other professionals and generate effective strategies based on students' individual needs. It will also make teachers more critical consumers of information because they will be able to discern fallacies from facts, and effective treatments from unrealistic promises.

However, there are others who have reservations about the potential usefulness of brain research in education. For example, in *Educational Psychology*, Anita Wolfolk (2007) cautioned her readers to be wary of brain research because even though much has been written suggestions are often oversimplified. Likewise, in *Educational Psychology: Developing Learners*, Jeannie Ormrod stated that brain physiology does not explain how best to foster learning and cognitive development. Ormrod noted that educators enthusiastic about brain-based learning are likely to be talking about what psychologists have known for years. This way of thinking is echoed by long-time critic of neuroscience in the classroom, John T. Bruer (1999). Bruer noted that even though neuroscience provides information about how the brain operates, much of what is being sold to teachers is really little more than a repackaging of 1970s cognitive science. Bruer (1999) suggested that even though neuroscience provides images of the brain at work, those images tell teachers little about behavior or effective strategies.

Others worry about the profits being made. Judy Willis (2006), a neuroscientist and middle school teacher, warned that many of the products being marked as brain enrichment actually misinterpret or

overextend findings from brain research. Likewise, learning expert Jill Stamm (2007) noted that many of the promises being made by companies selling toys, DVDs, and computer games to accelerate brain development are not realistic because they are based on making a profit and not on the knowledge of neuroscientists who understand firsthand the facts and fallacies about brain function (p. xi). Furthermore, with the availability of the Internet there are many Web sites of questionable validity related to the brain. For example, if you Google *left brain + right brain* you will find Web sites that tell you which side of your brain is dominant simply responding to statements like, "I wear a watch." and "Some people think I'm psychic." Although dominance is a result of brain structure, determining one's dominant hemisphere by responding to simple statements is questionable. In addition, there are Web sites that claim they can raise intelligence scores, cure attention deficits, and make babies more motivated to learn. In these cases, information from neuroscience is being overextended, and this is especially troubling when parents and teachers of children with disabilities put their faith in unfounded causes or cures.

In *Constructing Autism*, Nadesan (2005) reported her concerns about making life-altering decisions about children and their learning from images, electrical patterns, and analyses of brain chemistry. Nadesan believed brains are complex structures with variations and that variations challenge the very notion of using brain scans and other technologies. Drawing lines as to which brain is defective gets messy because two brains that are both considered normal (or abnormal) can look and function similarly and differently.

Regardless of the views of the experts and textbook writers, our experience shows that brain research is making its way into educational psychology textbooks and class discussions. Yet, when we did a search for information about students' thoughts about neuroscience, or the beliefs of practicing teachers, no information could be found. To begin to fill in these gaps and help us to understand where brain research might fit into our courses, we created a questionnaire to solicit the opinions of the preservice teachers in our courses. Our research questions were (a) What sources do future teachers use to get information about the brain and where might they go in the future to get more information? (b) Do future teachers believe that information about the brain will lead to better instruction? (c) Do future teachers believe that learning about the brain should be a part of teacher education? and (d) How concerned are future teachers about the use of brain research in education?

Method

Participation in the project was voluntary and anonymous. Participants completed the questionnaire at the end of a class session in an educational psychology, assessment, or child development course in which they were enrolled. Course instructors, none of whom were connected with this research study, distributed and collected the questionnaires. There were no points toward the course grade or any other compensation offered as an incentive. A scripted statement was used to introduce the study and explain procedures. After this introduction, students were given and asked to read a letter that explained potential risks of participation and their rights. The students who decided not to participate in the project were asked to leave the room. If students agreed to participate, then they were handed a questionnaire to complete. In

an effort to uncover the individual opinions of the participants, participants were not allowed to talk to or discuss items with their colleagues during the administration. The questionnaires were returned to the instructor immediately after their completion. Although participation was voluntary, everyone who was asked to participate in the study did. Possibly, this is an indication of these future teachers' interest in brain research. In addition, the high level of participation eliminated the possibility that participants self-selected, an issue that comes to bear on the validity of many survey studies.

Participants

The participants were all full-time students, in their junior year in college, enrolled in an undergraduate teacher education program at a state university in the southwest region of the United States. Within the college of education, participants were enrolled in various programs such as early childhood education (26, 12%), elementary education (59, 27%), secondary education (40, 19%), special education (40, 19%), and bilingual education (34, 16%). We were unable to determine the placement of 16 (8%) participants because they supplied no response to this demographic question. Of the 215 who completed the questionnaire, 167 (78%) were female and 48 (22%) were male. The majority of participants were relatively young, 157 (73%) were between 20 and 29 years of age and 163 (76%) were White. Demographic information is provided in Table 1.

Table 1. *Demographic Information of Participants*

Current placement	No.	%
Early childhood education	26	12.1
Elementary education	59	27.4
Secondary education	40	18.6
Special education	40	18.6
Bilingual education	34	15.8
No response	16	7.5
Ethnicity		
American Indian or Alaskan Native	4	2
Asian or Pacific Islander	7	3
Biracial or Bicultural	1	1
Black or African American	4	2
Hispanic or Latino	31	14
White–Caucasian	163	76
Other	4	2
Missing	1	1
Age (in years)		
Under 20	1	1
20–29	157	73
30–39	30	14
40–49	20	9
Over 50	7	3

Gender		
Female	167	78
Male	48	22

Development of the Questionnaire

The questionnaire included two items to gather information about these future teachers' sources of information about the brain. To spark their thinking about where they typically had found information about the brain, we listed potential sources of information (i.e., Internet, television, radio, magazines, journals, courses, workshops), and participants marked all that applied. The listed sources were based on our observations of where the general public and educators might see information about the brain. An additional choice, "other," provided the participants the opportunity to include additional, unlisted sources. A parallel item asked participants to predict what sources they would use in the future to access information about the brain.

The remainder of the questionnaire comprised items based on the research cited in the introduction of this manuscript. For example, the idea posed by Berninger and Richards (2003) that learning about the brain offers educators a common language to communicate was the basis for, "Learning about the brain gives teachers the vocabulary they need to communicate effectively with other professionals like doctors and psychologists." Other items were written on the opposing view and express what could be concerns, for example, Bruer's (1999, 2006) ideas as to the true applicability and usefulness of brain research for educators became, "There are too many bold statements about brain research and its implications for education."

The items were grouped under the three overarching themes being investigated, later referred to as subscales: (a) Information about the brain can lead to better instruction (*better*), (b) learning about the brain should become a part of teacher preparation (*prepare*), and (c) there are potential problems with the application of brain research to education (*concerns*). The items were formatted with a 6-point Likert scale. Participants indicated their level of agreement with each statement as *strongly agree*, *agree*, *mildly agree*, *mildly disagree*, *disagree*, or *strongly disagree*.

Data from the 22 items in regard to questions two, three, and four were entered into SPSS with 1 (*strongly disagree*) and 6 (*strongly agree*). Reliability of the 22 Likert-type items was computed by using coefficient alpha. The 22 items had a reliability of .72 with reliabilities of the subscales at .84 (*better*), .80 (*prepare*), and .52 (*concerns*).

Results

Information Sources

In regard to the first question, "What sources do future teachers use to get information about the brain and where might they go in the future to get more information?" participants indicated that they relied on multiple sources. The mean number of sources participants reported using in the past and projected using in the future were both 3.0. Although the mean number of sources remained the same, the rankings of sources changed. For example, the Internet and television were the most popular sources in the past, whereas, the Internet and journals were the most popular

sources expected to be used in the future. Sources listed in the "other" category were colleagues and books. See Table 2 for the percentage of use of all sources for both past and future.

Table 2. *Sources of Information by Percentage of Participants*

Source	Past sources (%)	Future sources (%)
Internet	64.2	73.5
Television	52.6	18.1
Journals	47.9	67.9
Courses	49.3	47.9
Magazine	41.4	27.0
Workshop	13.5	30.7
Inservice	9.3	14.0
Radio	11.6	3.7
Other	7.4	3.3
Not interested	3.7	2.3

Subscales and Participants' Perceptions

Means and standard deviations were calculated for each subscale. Because the questionnaire had a 6-point Likert scale we considered means greater than 3.5 (the midpoint on the scale) an indication of agreement, means below 3.5 an indication of disagreement, and their distance from 3.5 an indication of their strength of agreement or disagreement. Group means and standard deviations on each of the three subscales were 4.69 (0.76) for *better*, 4.63 (0.71) for *prepare*, and 3.56 (0.65) for *concerns*. A series of paired sample *t* tests ($p < .01$) revealed that the means for *better* and *prepare* were not significantly different, however, they were both significantly higher than the mean for *concerns*.

The percentages of participants agreeing with each statement were also computed and can be found in Table 3. One item from *better* was agreed to by over 95% of the participants: "Learning about the brain will help teachers understand learning differences." Three items from the subscale *prepare* had over 95% agreement: (a) "Information from brain research should be used to improve instruction." (b) "It is important for teachers to be informed about current brain research." (c) "It is important to translate findings from brain research to practical teaching strategies." No items from the subscale *concerns* had agreement above 95%. The item with which there was the least agreement (25%) was from *concerns*, that is, "Brain research is conducted in clinical situations so findings should not be applied to children in our schools."

Table 3. *Percentage of Agreement With Questionnaire Items*

Subscale name and item	%
Better	
Learning about the brain will help teachers understand learning differences.	96.3
I believe findings from brain research will lead to a better education for all students.	94.9
I believe brain research will lead to better identification of students with special needs.	93.5
Learning about the brain will help teachers design programs to optimize learning.	91.1
Teachers need to know about how the brain functions to understand teaching and learning.	82.8
Teachers should be expected to consider the brain when they prepare lessons.	80.5
Prepare	
Information from brain research should be used to improve instruction.	97.7
It is important for teachers to be informed about current brain research.	97.2
It is important to translate findings from brain research to practical teaching strategies.	96.8
Learning about the brain is not too complicated for teachers.	92.1
Learning about brain functions has little to offer teachers.	89.3
School psychologists receive training about the brain and so should teachers.	83.2
Learning about the brain should be included in both the biological sciences and in teacher preparation.	82.8
Learning about the brain gives teachers the vocabulary they need to communicate effectively with other professionals like doctors and psychologists.	78.1
Teacher education is incomplete without information about the brain.	69.8
I believe learning about brain research is beyond the scope of what teachers should be expected to learn.	68.8
Concerns	
There is misunderstanding among educators about how brain research applies to education.	76.7
I am concerned that brain research will be used to decide who will receive educational enrichment.	61.4
There are too many bold statements about brain research and its implications for education.	58.6
I am concerned that the use of brain research will create an additional financial burden on schools.	57.7
I am concerned that in the future, brain research will be used to decide who will receive special education services.	46.6
Brain research is conducted in clinical situations so findings should not be applied to children in our schools.	25.1

About 75% of the participants were White women between the ages of 20 and 29. To determine variations between this majority demographic and the remaining 25% of the participants, we used multiple analyses of variance (MANOVAs) to determine the effect of ethnicity (White, non-White), gender (male, female), and age (20–29, over 29) on the three subscales. No significant differences were found for any of the three factors, indicating that the sample was homogeneous and that the findings are applicable to all demographics included in the study.

Further, about 50% of the sample indicated a course as a past source of information about the brain. We wondered if educators who had learned about the brain from a formal source (i.e., a course) might have more positive beliefs in regard to brain research in education. MANOVA used to determine the effect of having taken a course as a source of information about the brain (took a course, did not take a course) on the three subscales revealed significant differences between the two groups, $F(3, 211) = 8.13$, $p < .01$. Analyses of variance (ANOVA) on each dependent variable were conducted as follow-up tests. The ANOVA was significant for *prepare*, $F(1, 213) = 11.61$, $p < .01$, with means of 4.80 and 4.47 for those who took a course about the brain compared with those who did not. The results for *better* and *concerns* were not significant.

Discussion

As instructors we became aware of the debates concerning the relevance of brain research for educators, were seeing more and more information about the brain being brought into educational psychology textbooks, and began witnessing varied levels of enthusiasm from our students about brain research. This experience led us to wonder if, and how much, information from brain research we should incorporate into our courses. We wondered where future teachers get information about the brain and what they thought about the use and applicability of brain research for education. We found participants in this study use an average of three sources to acquire information about the brain and would likely continue to rely on three sources in the future. The use of multiple sources, both in the present and future, indicates that these individuals, like many, appear to be interested in brain research. It seems as though the "decade of the brain" is filtering into the lives of both preservice and practicing educators.

When asked about sources they have typically used in the past, 64% of the participants indicated that they relied on the Internet, also the most frequently listed source for future information (74%). Considering the participants' ages and educational levels, along with the times in which we live, it seems reasonable that the Internet was the most frequently indicated source of information. There is an incredible amount of information about brain research and education on the World Wide Web. A Google search for *brain + education* results in millions of hits, for example, *PowerBrain Education* and the *Education Connection*.

The second most common past source was television (53%). Public television and cable channels offer programs on health and wellness that many times focus on the brain, learning, or both. A Google search of *PBS + brain* reveals PBS programs, such as, *Secret Life of the Brain*; *The Brain Fitness Program*, *Frontline: Inside the Teenage Brain*; and *Change Your Brain, Change Your Life*. In addition, brain research is becoming a common topic in the news and as a result, television may be an incidental source of information, not sought out but

present in a program being watched for other reasons. However, the proportion of those reporting that they would use television as a future source of information was only 18%. A similar decline is seen in the use of magazines and radio.

In regard to the three subscales, the future teachers felt somewhat strong agreement (4.69) that learning about the brain could make them better teachers, especially in regard to learning differences. There was also somewhat strong agreement for the subscale of *prepare* (4.63). These future teachers believe that their preparation should include information about the brain, especially practical strategies based on brain research, because they will improve their instruction. Just as Berninger and Richards (2003) believed teachers have a right to learn about the brain, it seems these participants believed the same. They believed information about the brain should be made available as part of the coursework they receive.

The participants' beliefs in regard to *concerns* were neutral (3.56). These future teachers neither agreed nor disagreed about misunderstanding or misinterpreting information from brain research. They were less inclined to be concerned about the use of brain research to diagnose children and provide enrichment. These participants have neutral concerns that brain research is being overstated or that its use will cause additional financial burdens on schools. The item that was agreed to most strongly in this subscale was, "There is misunderstanding among educators about how brain research applies to education" (77%). This may be an indication of these future teachers' awareness that there is much information available that is either misunderstood or false.

Follow-up MANOVA results provided further insight. The effect of having taken a course as a past source of information had a significant effect on the *prepare* subscale. Participants who had taken a course agreed significantly more (4.80) that information about the brain should be included in teacher education than those who had not (4.47).

Implications for Teachers of Educational Psychology

Understanding future teachers use the Internet as a primary source of information about the brain could be of value for those interested in their training and this includes those teaching educational psychology. The brain is a complex organ and simple, quick understandings provided on the Internet do not help them understand how the brain learns or struggles to learn. Therefore it is important that future teachers be introduced and directed to reputable Web sites with valid information. Examples of these include Brain Connection (www.brainconnection.com) and the Dana Alliance for Brain Initiatives (www.dana.org/braincenter). These groups are working alongside neuroscientists to translate what is being found into practical ideas. We propose that if future teachers are given this information they will think critically about what they are being sold and what they are doing in their classrooms. Using Web sites like these, along with information in educational psychology textbooks and theories like information processing, could provide the solid information students need.

The participants in this study believe they are capable of understanding how the brain learns and that this should be part of the education and professional development they receive. They want information so that they may provide good instruction based on science and research. A second implication

is that future teachers need to be taught how to take valid information and transfer it into what they do with children. New discoveries about the brain and how it learns are being made every day. These discoveries are challenging our beliefs and enriching what we know about teaching, learning, motivation, and human behavior. It seems reasonable for future teachers to receive this latest information in courses that help them not only to learn the information from brain research but also to transform it into practice. Many educational psychology textbooks contain good facts, and these courses would be a good place for this information. Ways to blend ideas from cognitive science, development, and motivation with neuroscience would provide up-to-date information and help students discern facts from fallacies.

As instructors we recognize there is a lot to teach in a short amount of time and that standards often drive our work. However, there is no denying that information from neuroscience is seeping into our daily lives, the lives of our students, and into the courses we teach. This study raised issues about information sources and perceptions of future teachers, and this is important because teachers hold the learning of our nation's children in their hands. Preservice teachers should receive the best and most up-to-date information available, and they should be taught to be critical of unreliable information being sold for profit. Even if standards do not contain this information they do propose best practices and critical thinking. Information from this study may help those concerned with professional development, especially those who teach educational psychology courses.

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