CORTEX 45 (2009) 548–549

available at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/cortex

Discussion forum

Bridging neuroscience and education: A two-way path is possible

*Lucia Mason**

University of Padua, Italy

From my experience, it seems that teachers hold some of the ''neuromyths'' described in the literature (Della Sala, 1999; Goswami, 2004). In particular, a frequent teacher misconception is that since students preferentially use one type of processing, they can be divided into ''left-brained'' and ''right-brained'', that is processing language, logic and number, or forms, images, and spatial elements, respectively. Another incorrect conception is that a certain type of learning only occurs within a critical period, otherwise it becomes very difficult or is lost forever.

Why is this misinformation, based on an over-simplification and over-generalization of issues from neuroscientific research, found in school? Multiple reasons may underlie this negative phenomenon. The commercial interest of the ''brain-based learning industry'', outside the scientific research world, plays a not entirely marginal role. From my perspective as an educational psychologist, however, one of the main reasons echoes what Bruer (1997) defined years ago as ''a bridge too far''. That is, the relationship between education and neuroscience, is still distant. No doubt what is known about neurons, neural networks, brain plasticity, distributivity, redundancy and development has the potential to contribute to educational research and practice (Blakemore and Frith, 2005).

However, the direct or automatic applications of neuroscience findings to education should not be encouraged. This is not (or not only) simply because neuroscientists use a language that is scarcely understood by teachers, nor because they are too focused on the rigor of their experimental research, and therefore they are not the most qualified communicators with the practitioners of education, who need ''broad brush messages'' and prefer to be told ''what works'' (Goswami, 2007). These direct applications must be avoided, first, because the brain is only one component of learning, and neuroscience, although relevant to education, cannot be prescriptive in this regard. Biological processes interact with social, cultural and contextual factors – including teachers' attitudes, values and beliefs which cannot be disregarded – in producing learning outcomes. Therefore, neuroscience research should be taken into account together with other relevant areas of scientific research that contribute to our understanding of school learning processes, products and contexts.

I believe that the current gap between neuroscience and education can be bridged, at least as the first step, by educational psychology, which is interested in developing descriptive, interpretive and prescriptive models of student learning and other educational phenomena. Widely-held misconceptions and misunderstandings about brain functioning can be eliminated to the extent to which findings from neuroscientific research are interpreted from an educational point of view by scholars who deal with a bigger ''picture'' of learning and teaching processes in the classroom.

A decade ago, Byrnes and Fox (1998) recommended that educational psychology incorporate findings from cognitive neuroscience, and I agreed with them: a plausible cognitive theory in education cannot ignore what is known about brain functions. At the same time, however, I could not help but note that few outcomes could really be considered relevant to scholars concerned with learning that takes place in natural and complex contexts, such as classrooms, and with trying to make those learning environments powerful. Although there has been progress in this direction, it does seem that what emerges from some neuroscientific research based on brain imaging techniques tells us what we already know, or the tasks investigated are simple compared with the learning of

* University of Padua, Italy.
E-mail address: lucia.mason@unipd.it
0010-9452/$ – see front matter
doi:10.1016/j.cortex.2008.06.003

complex knowledge or skills required in school. As underlined by Mayer (1998), it is not particularly informative to know which brain areas are active when an individual pays attention to visual stimuli or remembers a word. Studies that are only technology-driven are unnecessary, instead theory-driven studies are needed. It is, therefore, very important to understand the function of the various brain areas involved in cognitive processing, especially in cognitive activities performed by students with different cognitive and motivational characteristics.

The bridge that, from my perspective, educational psychology could build to connect neuroscience and education implies a two-way path. If the path is one-way, neuroscience is intended to be applied to educational practice, and the theorizing on student cognition and learning that the brain makes possible, should be adjusted. A two-way path, in contrast, implies that outcomes from neuroscience influence education since they act as a sort of constraint on that theorizing. At the same time, education influences neuroscience since it suggests the tasks to be investigated, as well as theories or models to be tested (Ansari, 2005; Mayer, 1998). Educational psychologists may be the ''bilingual'' scholars who are versed in the language of neuroscience and in teaching and learning processes. For example, recent issues in neuroscience have revealed connections between emotion, decision making and social functioning (Immordino-Yang and Damasio, 2007). Pedagogical practice in the classroom may pose serious educational questions regarding the emotional bases of performance in important school tasks. Neurobiological underpinnings of higher-order thinking processes may help understand further the role of affect in learning and open new areas of study of emotional thought in the classroom. To exemplify, if neuroimaging research can show that the brain changes as an effect of learning (Posner and Rothbart, 2005; Stewart et al., 2003), both functionally and structurally, educational research may pose questions about the real and enduring effectiveness of educational interventions implemented to improve students' knowledge or skills in particular school content areas. In this regard, to find relationships between cognitive and cortical changes means linking mind and brain in the educational enterprise.

To conclude, I believe that there are scholars who can guide toward an appropriate use of neuroscience in education, avoiding dangerous misuses. The sooner educational psychologists invest their efforts in building a solid bridge, the more pedagogical practice and neuroscientific research will benefit from each other. The emerging discipline of educational neuroscience (Szúcs and Goswami, 2007) is promising territory for building this bridge if the intermediary role between neuroscience and education is played by scientists who are (also) expert in school-related learning and teaching.

REFERENCES

Ansari D. Paving the way towards meaningful interactions between neuroscience and education. *Developmental Science*, 8: 459–471, 2005.

Blakemore SJ and Frith U. *The Learning Brain: Lessons for Education*. Oxford: Blackwell, 2005.

Bruer J. Education and the brain: a bridge too far. *Educational Researcher*, 26: 4–16, 1997.

Byrnes JP and Fox NA. The educational relevance of research in cognitive neuroscience. *Educational Psychology Review*, 10: 297–342, 1998.

Della Sala S. *Mind Myths: Exploring Popular Assumptions about the Mind and Brain*. New York: Wiley, 1999.

Goswami U. Neuroscience and education. *British Journal of Educational Psychology*, 74: 1–14, 2004.

Goswami U. Neuroscience and education: from research to practice? *Nature Review Neuroscience*, 7: 406–413, 2007.

Immordino-Yang MH and Damasio A. We feel, therefore we learn: the relevance of affective and social neuroscience to education. *Mind, Brain, and Education*, 1: 3–10, 2007.

Mayer RE. Does the brain have a place in educational psychology? *Educational Psychology Review*, 10: 389–396, 1998.

Posner MI and Rothbart MK. Influencing brain networks: implications for education. *Trends in Cognitive Sciences*, 9: 99–103, 2005.

Stewart L, Henson R, Kampe K, Walsh V, Turner R, and Frith U. Brain changes after learning to read and play music. *NeuroImage*, 20: 71–83, 2003.

Szúcs D and Goswami U. Educational neuroscience: defining a new discipline for the study of mental representations. *Mind, Brain, and Education*, 1: 114–127, 2007.

Received 31 March 2008
Reviewed 20 May 2008
Accepted 2 June 2008
Action editor Sergio Della Sala
Published online 11 June 2008