CORTEX 45 (2009) 546–547

available at www.sciencedirect.com

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

Discussion forum

Thinking about mechanisms is crucial to connecting neuroscience and education

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For the most part, neuroscientists do not typically consult the education literature to generate hypotheses and conduct studies with an educational application in mind. Similarly, for the most part, educationalists do not typically consult the neuroscience literature to decide how to teach a child. So how is it that neuroscience and education have become increasingly interlinked within recent years, and how should these fields be connected?

Despite the recent development of the new field of mind, brain, and education or MBE [e.g., Organisation for Economic Co-operation and Development (OECD), 2007], there has been little discussion in either the neuroscience or education literature about how the interaction among mind, brain, and education will work in practical terms and what results it can be expected to generate. In view of this, a concerted effort is needed to think about the goals and benefits of connecting education and neuroscience (e.g., Ansari and Coch, 2006). While there are often great expectations for direct application of neuroscientific data to pedagogy, we believe that very few findings from neuroscience are directly applicable in a broad educational context. Rather, basic neuroscience findings need to be tested – rigorously and scientifically – in the classroom before any ''educational application'' or ''translation'' can become clear. Thus, an important goal of MBE must be to provide realistic information about the potential outcomes of interactions between neuroscience and education. It is also important that this new field does not involve the establishment of a hierarchy of knowledge such that neuroscience is perceived as a panacea for educational problems. Indeed, most teachers and educational scientists likely know more about learning in the classroom than most neuroscientists do; such knowledge is valuable and no less important than knowledge based on brain scans, and it should be a goal of MBE to integrate classroom- and laboratory-based knowledge. Relatedly, there should be efforts within the field of MBE to eschew offering neuroscience findings to education as yet another quick fix. Instead, we envision MBE as mutually beneficial to educators, education scholars, and neuroscientists, based on an interactive and iterative process of asking questions, testing, and refining hypotheses and methods across the lab and classroom.

One of the central issues in the continued development of the field of MBE is to determine what concrete mechanisms will enable useful interdisciplinary connections. We contend that one of the crucial mechanisms to establish in order to develop a sustainable science of MBE and prevent the misuse of neuroscience findings in education is training, for both educationalists and neuroscientists. It is clear that many educators are interested in neuroscience and believe that there is a natural connection between education and neuroscience, given the brain's role in learning (e.g., Pickering and Howard-Jones, 2007), but teachers are rarely exposed to primary source neuroscience evidence or neuroscientific methods in their training. Instead, they often depend on the summaries and interpretations of others in the popular press (e.g., Jensen, 2000). While it is not our argument that initial teacher training should mirror neuroscientist training, we would argue that training teachers in neuroscience basics will be useful in developing teachers who can be informed and critical consumers of so-called ''brain based'' strategies and programs

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doi:10.1016/j.cortex.2008.06.001

and the neuroscience research on which they are purportedly based (as well as other neuroscience research, see also Eisenhart and DeHaan, 2005). Such training will provide teachers with the skills and knowledge to be able to evaluate the extent to which commercial, "brain based" educational programs are supported by rigorous, peer-reviewed efficacy studies (e.g., Editorial, 2004, 2005, 2007). Currently, there are many such programs available, most of which lack published evidence for effectiveness and long-lasting transfer effects. Teachers trained in neuroscience basics are crucial to the field of MBE, as they will be at the forefront of discouraging misuse of neuroscience findings in schools and will be likely to seek collaboration with neuroscientists in order to build the science of MBE.

Similarly, we believe that neuroscientists who focus on questions of development and learning should have training in basic educational theory and methodology. In many cases, central questions about children in the classroom (such as how children learn a particular concept) should also be addressed in the developmental neuroscience laboratory. Unfortunately, such integrative training is rare; one of the first reports of a graduate course in MBE was only recently published (Blake and Gardner, 2007). While neuroscience traditionally investigates, describes, and interprets, the question has been posed: should it also be prescriptive? Our answer is yes – if neuroscientists have some grounding in education and consider classroom context; if studies are designed *a priori* with such goals in mind; if findings are tested in an iterative fashion in classroom and lab; and if neuroscience is just one source of evidence, in combination with behavioral data and supporting theory. Such translational efforts are best carried out by professionals who have interdisciplinary training, with shared vocabulary and theoretical frameworks (e.g., see Shonkoff, 2000). Thus, training and the generation of scientist–practitioners are, in our view, key to the success of MBE and connecting neuroscience research meaningfully with the education of children. Research conducted by such professionals is likely to be useful, and mutually beneficial, to both neuroscience and education, and less likely to be misused by either.

Knowledge about the brain, particularly knowledge from developmental cognitive neuroscience, can be relevant in both designing sound educational programs and evaluating existing educational programs, but neuroscience must be considered as just one source of evidence that can contribute to evidence-based practices in education (e.g., see Huston, 2008; Slavin, 2002; Thomas and Pring, 2004) – it should not be considered alone, out of context from theory or behavioral evidence or the classroom. Indeed, as rightly has been emphasized (e.g., Stern, 2005), there is a wealth of information from a long history of learning sciences research that should be considered together with neuroscientific data in terms of educational significance. The essential parties involved in MBE, neuroscientists and educationalists alike, should have adequate knowledge of both neuroscience and education to be able to make informed decisions about research questions, applications, implications, and policy. In our view, training is one crucial mechanism for development of useable and useful knowledge in MBE.

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Received 24 March 2008
Revised 9 May 2008
Accepted 2 June 2008
Action editor Sergio Della Sala
Published online 11 June 2008