Educating the Human Brain: Book Review
By Amanda Hudson

Educating the Human Brain
Michael I. Posner & Mary K. Rothbart
Washington, DC, US: American Psychological Association. (2006).

Posner and Rothbart's Educating the Human Brain ambitiously assimilates findings from several decades of research in developmental psychology and neuroscience. It provides a comprehensive, evidence-based summary of brain development in a way that is informative for researchers, clinicians, and educators alike. Perhaps most important, Posner and Rothbart present this information in a way that has meaningful implications for how we educate today's children and youth. Despite painting a promising picture of the role of research in informing educational initiatives, the authors remain true to the intricacies and limitations of science, noting that challenges can arise when transferring knowledge from the laboratory to the classroom. With its balance of vision and pragmatism, surely this book will prove to be a valuable resource for knowledge sharing and research translation amongst educational psychologists, researcher-clinicians, and school personnel.

As the authors assert, we are at a new age in brain science, where, for the first time, we can observe the human brain in action. With the advent and refinement of brain imaging technology, researchers have been able to study how aspects of brain development support school readiness, various learning strategies, and expertise in academic tasks such as numeracy and literacy. In turn, this knowledge can be used to improve current educational practices. For instance, documented changes in neural connectivity (myelination, pruning) and anatomy (cortical thickness) may be useful for predicting points in development at which individuals are most responsive to instruction and for pinpointing age-appropriate teaching techniques. More specifically, the speeded communication between brain regions (axonal myelination) and enhanced opportunity for rewiring (synaptic pruning) that characterize childhood and adolescence designate these ages as opportune times for learning (Huttenlocher & Dabholkar, 1997). Moreover, the late maturation of the prefrontal cortex that occurs throughout adolescence and early adulthood can be informative in understanding school-aged students' struggles with abstract subjects like calculus or their minimal receptiveness to learning approaches that rely on metaphorical reasoning.

Brain research has not only recommended new directions for educational practices, but has also provided feedback on current educational models and specialized interventions. Neuroscientists have made significant headway in exploring the neural mechanisms implicated in various academic tasks, including reading, which means that it is now possible to observe the effects of instruction and training on brain activity in designated regions of interest. Consider the finding that children who receive intensive literacy remediation show practice effects on reading-related neural activation, as well as observable improvements in decoding and fluency (Shaywitz et al., 2004). What is more, recent imaging work has outlined the brain loci involved in different component operations of reading (phonology, orthography, semantics), which may hold relevance for designing and assessing targeted interventions for specific reading problems. Positive training effects on behaviour and neural activity are not constrained to reading interventions, but have also been observed following training protocols targeting attention, self-regulation, memory, and numeracy (Sohlberg & Mateer, 1989;

Griffin et al., 1995; Rueda et al., 2005). The notion that we can improve domain-specific neural function through practice and instruction is empowering. Admittedly, genetics have some part in determining the efficiency of neural networks, but experience is now also recognized as an influential factor. That said, with this power comes responsibility. As Posner and Rothbart put it, as teachers educate, they are shaping the way in which the brain will organize future information related to that domain of knowledge.

Educating the Human Brain also provides insight into links between brain science and education by clearing up some commonly held misconceptions. For instance, the authors address the myth that overall brain size reflects mental aptitude, stating several findings that invalidate this notion. However, the relation between specific brain compartments and specialized functions appears to be more complex. Indeed, Posner and Rothbart review a series of studies that have indicated connections between the volume of particular frontal regions and attentional capacity, as well as risk for developmental pathology (Casey et al., 1997; Filipek et al., 1997). Another widespread misconstruction is that a child’s temperament, or his or her behavioural disposition/ emotional reactivity, is fixed and unchanging. We now know this is not true and that there is ample opportunity for change in temperament across the lifespan (Rothbart & Bates, 2006). As Rothbart describes, temperament has a large impact on children’s ability to comply with classroom demands. Thus, knowing that temperament is amenable to modification should encourage educators to revise their attitudes toward difficult students and do away with set expectations.

Another way in which Educating the Human Brain sheds light onto current educational theories is by providing new perspectives on predictors of school success. Posner and Rothbart suggest that academic performance is typically attributed to students' cognitive skills, and perhaps wrongly so. Learning also relies heavily on children's goals, motivations, and emotional tendencies (Harter, 1981; Shiner, 2000). As a result, effective teaching requires consideration of motivational and emotional components of learning, in addition to conventional cognitive influences. For the most part, creating a learning environment that fosters positive emotions and attitudes is thought to elicit increased interest and motivation in students. This might entail tailoring curricular materials to student interests and providing positive feedback and rewards for students' efforts and achievements. However, Posner and Rothbart propose that there is also a time and a place for mild punishment and constructive feedback. For some time, punishment was thought to be an ineffective motivator for learning. This was based on work by the behaviourist B.F. Skinner (1968) who found that rats receiving error-evoked shocks showed impaired learning. Later, these learning impediments were associated with the severity of the shock rather than the general act of punishing mistakes. The current consensus is that we need a balance between reward and mild punishment (disciplinary action for behavioural outbursts; constructive advice following errors) to optimize educational outcomes.

This brings the authors to another issue with current educational systems - that students' motives for academic achievement are often misplaced. Students' quest for academic success can be ego-driven or motivated by a genuine interest and desire to learn. More times than not, academic excellence is pursued in the name of competition and recognition rather than with the goal of true expertise. The first of these two motivators may lead students to focus on superficial outcomes (i.e., grades) rather than the process of learning and the material of interest (Dweck, 2000). Alternatively, when students study with the goal of mastery and expertise, they demonstrate a deeper level of understanding and can draw connections between new concepts and the studied material (Chi & Koeske, 1983; Pintrich et al., 1993). This association between study mode and level of understanding has implications for designing academic assessments, implying that questions should be asked in a way that requires extension and application, rather than simple regurgitation, of learned information. Another problem that arises when competitive goals underlie educational endeavours is that the value in making mistakes can be lost. Posner and Rothbart recommend that educators strive to frame mistakes and errors as opportunities to learn instead of indicators of relative self-worth.

As noted, Educating the Human Brain fulfills the impressive feat of outlining ever accumulating knowledge of the development of the human brain and discussing this information in terms of important educational connotations. Although it is by no means a light read, research and applications are presented in a way that is digestible for a vast array of professionals, including psychologists and educators. Though any flaws with this work are few and far between, as attentional researchers, the authors devote a disproportionate amount of text to attention system developments. In fact, they tend to prescribe a preeminent role to attentional processes in explaining everything from self-regulation to academic competence, where other functions are surely also at play. Despite this bias for using attentional networks to explain various early life developments, as a whole, the book provides a detailed account of human brain development and suggests evidence-based techniques for improving various aspects of learning.

Author Note: Amanda Hudson is a PhD candidate in the department of psychology at Dalhousie University. Her research covers a range of topics including the development of self-control and emotion regulation, emotional and attentional problems in clinical populations (problem gamblers), and hormonal effects on affect and behaviour.

References

Casey, B. J., Trainor, R., Giedd, J., Vauss, Y., Vaituzis, C. K., Hamburger, S., Kozuch, P., & Rapoport, J.L. (1997). The role of the anterior cingulate in automatic and controlled processes, a developmental neuroanatomical study*. Developmental Psychobiology, 30*, 61–69.

Chi, M. T. H., & Koeske, R. D. (1983). Network representation of a child's dinosaur knowledge. *Developmental Psychology, 19,* 29-39.

Dweck, C. (2000). Self-Theories: Their role in motivation, personality, and development. Philadelphia: Psychology Press.

Griffin, S., Case, R., & Siegler, R. S. (1995). Rightstart: providing the central conceptual prerequisites for first formal learning of arithmetic to students at risk for school failure. In K. McGilly (Ed.), *Classroom Lessons: Integrating Cognitive Theory and Classroom Practice* (pp. 25–49). Cambridge, MA: MIT Press.

Harter, S. (1981). A new self-report scale of intrinsic versus extrinsic orientation in the classroom: motivational and informational components. *Developmental Psychology, 17*, 300-312.

Huttenlocher, P. R. & Dabholkar, A. S. (1997). Regional differences in synaptogenesis in human cerebral cortex. *Journal of Comparative Neurology, 287,* 167–178.

Filipek, P. A., Semrud-Clikeman, M., Steingard, R. J., Renshaw, P. F., Kennedy, D. N., & Biederman , J. (1997). Volumetric MRI analysis comparing subjects having attention-deficit hyperactivity disorder and normal controls. *Neurology, 48*, 589–601.

Pintrich, P. R., Marx, R. W., & Boyle, R. A. (1993). Beyond cold conceptual change:

The role of motivational beliefs and classroom contextual factors in the process of conceptual change. *Review of Educational Research, 63,* 167-199.

Rothbart, M. K., & Bates, J. E. (2006). Temperament in children's development. In W. Damon & R. Lerner (Series Eds.) & N. Eisenberg (Vol. Ed.). *Handbook of child psychology: Vol. 3, Social, emotional, and personality development (6th ed., pp. 99-166).* New York: Wiley.

Rueda, M. R., Rothbart, M. K., McCandliss, B. D., Saccamanno, L., & Posner, M. I. (2005). Training, maturation, and genetic influences on the development of executive attention. *Proceedings of the National Academy of Sciences USA, 102*,14931–14936.

Shaywitz, B. A., Shaywitz, S. E., Blachman, B. A., Pugh, K. R., Fulbright, R. K., Skudlarski, P., et al. (2004). Development of left occipitotemporal systems for skilled reading in children after a phonologically-based intervention. *Biological Psychiatry, 55*, 926–933.

Shiner, R. L. (2000). Linking childhood personality with adaptation: Evidence for continuity and change across time into late adolescence. *Journal of Personality and Social Psychology, 78,* 310–325.

Skinner, B. F. (1968). *The technology of teaching*. New York: Appleton-Century-Crofts.

Sohlberg, M. M. & Mateer, C. A. (1989). *Cognitive rehabilitation: Introduction to theory and practice.* New York: Guilford Press.