Human Development 2008;51:162–164
DOI: 10.1159/000135753

Human Development

Changing Minds, Changing Brains

Silvia A. Bunge

University of California at Berkeley, Berkeley, Calif., USA

Measures of brain function are used today in many areas of psychological research, and developmental psychology is no exception. The infusion of cognitive neuroscience into psychology has been met variably with enthusiasm, skepticism, and opposition. The most productive attitude towards this sea change, I maintain, consists of a healthy dose of both enthusiasm and skepticism [see also Kagan, 2006]. The business of a developmental psychologist is to understand age-related changes in cognition, but measures of overt behavior alone do not provide a complete account of mental processes. Below, I discuss four ways in which neuroscientific methods, like noninvasive brain-imaging techniques, can complement behavioral techniques in the study of the developing mind [for a summary of these and other neuroscientific techniques, see Bunge & Kahn, 2008].

First, neuroscientific methods can provide a deeper mechanistic understanding of developmental changes in behavior. Do we perform a particular task better as adults than as children because of increased efficiency of one or more cognitive processes? If so, children and adults should recruit the same brain network while performing this task, but adults should engage it less strongly. Or, do we perform the task better as adults because an additional, or different, cognitive process is involved? If so, adults should engage additional or distinct brain regions with respect to children.

Second, even in the *absence* of substantial behavioral changes, neuroscientific methods can uncover informative changes in brain function. On the basis of the unexpected finding that children engaged the left frontal lobe whereas adults involved the right frontal lobe while performing a cognitive task, we hypothesized that children adopted a verbal strategy, whereas adults adopted a visuospatial strategy. We subsequently obtained behavioral evidence for this brain-based prediction. Another example of changes in brain function without large changes in behavior comes from the aging literature. Older adults exhibit bilateral frontal activation on tasks for which younger adults recruit only the left or right frontal cortex [Bunge et al., 2002]. Thus, older adults achieve similar levels of performance to younger adults by recruiting additional brain regions.

KARGER

Fax +41 61 306 12 34
E-Mail karger@karger.ch
www.karger.com

0018–716X/08/0513–0162$24.50/0

Accessible online at:
www.karger.com/hde

Silvia A. Bunge, Department of Psychology and
Helen Wills Neuroscience Institute
University of California at Berkeley, 210L Barker Hall
Berkeley, CA 94720 (USA)
E-Mail sbunge@berkeley.edu

Third, neuroimaging methods allow us to directly measure multiple stages of cognitive processing, whereas behavioral measures allow us to directly measure only the participant's final, overt response. Neuroscientific techniques can help to determine which of the cognitive processes underlying a given behavior change with age. Let us consider the following example: behavioral studies on the development of long-term memory have shown that adults remember more studied items than do children. Are age-related improvements in recognition associated with deeper encoding of the stimuli during the study phase, more effective retention, and/or more effective retrieval? In behavioral studies, we may be able to *infer* whether encoding, retention, and/or retrieval processes change with age by manipulating various aspects of the task, such as the type of task used at encoding, the duration of the retention interval, or the presence of distracters at test. Functional brain imaging techniques allow us to measure brain activation during both memory encoding and retrieval, making it possible to directly test for age-related changes at each of these stages of memory.

Fourth, we can interpret age-related changes in brain function and behavior in light of what we already know about the functions of specific brain regions. For example, regions in the frontal cortex are known to play a role in strategic aspects of memory. Thus, if you were to find that adults exhibit stronger activation of a particular part of the frontal cortex than children during memory retrieval, you would infer that adults engage in more effective retrieval strategies. In this way, psychological research can be informed by a century of neuroscientific research in humans and other animals.

It is important to note that there are good and bad ways to conduct neuroscientific research, just as there are good and bad ways to conduct any research. The initial fervor surrounding neuroimaging techniques led to numerous ill-conceived studies, but the current generation of cognitive neuroscientific studies is substantially more sophisticated. There are areas of psychological research – such as the study of social interactions and group dynamics – in which behavioral methods continue to provide much more traction than neuroscientific ones [for a discussion of the limits of reductionism, see Bunge, 2003]. By the same token, there are other areas – such as the study of memory – into which the neuroscientific approach has breathed new life.

Will measures of brain function obviate the need for good behavioral research? Certainly not. Can they provide novel insights into the study of human development? Absolutely.

References

Bunge, M. (2003). Emergence and convergence: Qualitative novelty and the unity of knowledge. Toronto: University of Toronto Press.

Bunge, S.A., Dudukovic, N.M., Thomason, M.E., Vaidya, C.J., Gabrieli, J.D.E. (2002). Immature frontal lobe contributions to cognitive control in children: evidence from fMRI. *Neuron, 33,* 301–311.

Bunge, S.A., & Kahn, I. (in press). Cognition, neuroimaging. In G. Adelman & B.H. Smith (Eds.), *The encyclopedia of neuroscience* (4th ed.). Amsterdam: Elsevier Science.

Kagan, J. (2006). Biology's useful contribution: A comment. *Human Development, 49,* 310–314.

Editor's Corner and Letters to the Editor

The Editors invite subscribers and readers of the journal to send in letters to the editor in response to essays in the Editor's Corner, articles, commentaries, and essay reviews that appear in *Human Development*. The letters will be reviewed by the Editors, and those that are selected will be posted on the journal web page www.karger.com/journals/hde/hde_jh.htm, and sent by e-mail as a pdf file to subscribers. The letters will be sent out every other week to maintain a dialogue in-between journal issues. If you wish to submit a letter to the editor, send it by e-mail to HDletter@uic.edu.

Readers who wish to suggest topics for the Editor's Corner may do so by sending an e-mail to the Editor at Humandev@berkeley.edu.