

INTRODUCTION

Neuropsychology in the New Millennium: Prognostications, Dreams, and Warnings

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The purpose of a broad look back or forward is to better define our journey, and the past few decades have been a truly amazing trip for the field of neuropsychology. It is sobering to remember that just 20 years ago, most methods of neuropsychological investigation were purely behavioral. There was only occasional use of techniques that provide images of brain activation. Measures of cerebral blood flow were a novelty and very few labs had the equipment. There were quite a few research teams equipped for event-related potentials, but these accounted for only a tiny minority of active labs in the field. Besides, most investigations at that time simply documented that something was happening in the brain that made sense with respect to cognitive performance, such as reaffirming over and over that linguistic functions primarily depend on left-hemisphere mechanisms. Even studies of individuals with brain trauma, including case studies, primarily used brain imaging to document the site of injury; brain activation was not the dependent measure that it has now become. With the proliferation of brain activation imaging techniques, the limits of investigation seem (on a good day) to be limited only by the investigator's imagination. More often though (and especially on a bad day), the wealth of new techniques overwhelm us and reveal that there are basic problematical issues in cognitive neuropsychology that have not gone away.

For this special issue marking the new millennium, we asked the authors to address in just a few pages one particular issue that they considered to be key for the study of cognition and the brain as we pass this major milestone. The issue could focus on where the field is going in terms of theory, practice, research, or technology. It could take a positive stance concerning hopes for the field or warn of impending problems that must be addressed. What we received was a wide variety of submissions addressing all aspects, all with their own particular perspective.

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Common and Uncommon Themes

Not surprisingly, several of the essays in this volume concern developments in brain imaging. Considering the rapid pace of this technology, it is hard to not assume that within a decade or so current practical limitations will no longer impede us. The main concern at the moment, of course, is the trade-off between time sensitivity and spatial resolution—achieving brain activation imaging with millisecond sensitivity along with millimeter accuracy. Once this engineering problem has been solved—and new technologies are being developed all the time (Erwin & Rao; Hochman; Servos)—we will still have, however, questions concerning what to do with the data. Issues of appropriate experimental design and interpretation of activation patterns will still must be addressed (Posner; Sidijs; Sartori & Umiltà).

One of the recurring themes is the need to view the brain as a dynamic organ just as much as we view the mind as such. This need has been articulated before, in fact just before the turn of the last century, when Dewey (1896) urged his colleagues to see perception as a dynamic process. Our technologies find this difficult, though, now as then (Doody). Some of our authors remind us that even with millisecond resolution of brain activation (with EEG or MEG measures), we need to keep aware of the amazing speed of information processing, and of course its parallel nature. Just because we see an activation burst time-locked to a stimulus presentation does not mean that it reflects the initial processing of the event (Dywan; Sereno & Rayner). It could be a reaction to the processing, or a reaction to the reaction to the processing. Another aspect of this issue is that our models are rarely dynamic; i.e., our dependent measures rarely take into account how the brain's fluctuating activation pattern influences its own activity. Some progress has been made using parameters from chaos theory to capture some of these dynamics, and the future holds many challenges along these lines (Melançon, Joannette, & Bélarin).

Another common theme is rehabilitation, assessment, recovery of function, and plasticity (Connolly; Dennis, Spiegler & Hetherington; Doody; Khatri & Hier; Mateer & Kerns; Ogdan; Tröster; Winocur et al.). The rehabilitation issue has grown tremendously in the past few years with dramatic improvement in emergency medicine and markedly increased survival rates that challenge our technical and research skills, as well as our ability to deal with ethical dilemmas (Schönle & Stemmer). At the same time, recent developments in behavioral and neurobiological plasticity are tremendously exciting. The need for this integration has been growing apace in the last decades and promises to be with us for some time yet.

Some of our authors chose philosophical themes on the structure of our science, such as "on putting the brain back together again" (Hellige; Banich & Weissman), on taking neural networks seriously (Kinsbourne), and on "lumping and splitting" (Boles). Similarly, consciousness and abstract

thought—the grand themes of psychology—are not neglected with respect to current issues (Dalla Barba; Grafman; Miyawaki; Rapcsak & Kaszniak) and an historical perspective (Eling).

Many of the papers can also be grouped into paradigm issues within specific subareas of cognition—memory (Dywan), communication (Feyerisen) and laughter (Vaid & Kohler), motor and guidance systems (Elliott & Carlson; Darling & Pizzimenti), and musical processing (Peretz & Hébert). Some issues, e.g., category-specific agnosia (Crosson et al.; Dixon), look like controversies that may actually be resolvable before the next millennium.

Developmental neuropsychology by its very nature crosses levels of analysis, whether concerned with child growth (Johnson) or adult aging (Halpern). One can also consider the developmental aspect of cultural influences on the brain. For example, the effects of linguistic and communication tools on the growth of mind is obvious and much has been written on this, but by the same token we should be concerned with their influence on the growth of brain. Charting the effect of cultural influences on the organization of the brain is a serious challenge (Eviatar; Morais & Kolinsky).

Other essays concern the opening up of cognitive neuropsychology to new research topics—emotional integration of the person (Bulman-Fleuning, Grimshaw, & Berenbaum; Davidson; Schmidt, & Schulkin) and the role of the autonomic nervous system in cognition (Peters), evolutionary issues (Mesulam; Snyder), and a new look at old issues—laterality (Banich & Weissman; Corballis), individual differences (O'Boyle), and knowledge and skill development (Schmuller; Segalowitz).

While neither we nor the authors think that the essays here provide the last word on the topics addressed, we do hope they will be useful in articulating issues that are sometimes forgotten or lost in the masses of data that now assail us. By insisting on the format of a very concise presentation, we hope we have managed to make these articulations more consumable, thought-provoking, and useful. Finding a mental organization for the 48 papers has not been easy, nor should it be. Each essay raises many issues that overlap with others, which is natural for an integrative field. One can begin to have a sense of how we are seeing the growth of a truly interdisciplinary cognitive neuropsychology. This is for us the most exciting part of cognitive neuropsychology as we enter the new millennium.

REFERENCE

Dewey, J. 1896. The reflex arc concept in psychology. *Psychological Review*, 3, 357–370.