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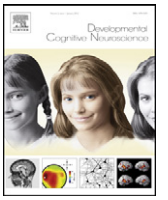

Editorial

Cognitive training research and the search for a transformative, translational, developmental cognitive neuroscience

The seven papers appearing in the current Special Issue of Developmental Cognitive Neuroscience embrace a particularly exciting theme in both basic and clinical neuroscience. This excitement reflects the unique potential to unite diverse groups all sharing a major interest in development, creating a transformative translational developmental cognitive neuroscience. These groups include scientists interested in basic approach to humans and model organisms as well as clinicians, policy-makers, and family members, all affected by pediatric mental illnesses and learning disorders. In each instance, excitement reflects the promise of research on cognitive training.

Recent years have witnessed a dramatic increase in research using cognitive training protocols designed to change a range of information-processing functions and associated neural correlates. This includes studies focused on basic cognitive functions, such as executive control, as demonstrated by Espinet et al., in this volume, or studies focused on information-processing functions that go awry in various psychological problems. In the current volume, this latter variety includes Tamm et al., Eberl et al., Waters et al., and Britton et al. This surge in translational science derives from multiple sources. Clearly, it is fueled by a general increasing level of knowledge about the function of specific cognitive mechanisms and their relation to psychopathology. However, these relatively general factors interact with other changes related more uniquely to cognitive training. This includes accumulating data about plasticity and development, increasing understandings of neural substrates that support specific, malleable cognitive functions, and major advances in computational power that allow an ever-growing sophistication in experimental design, data analyses, application, and dissemination in wide populations. Finally, because many cognitive functions mature with age, there has been specific interest in examining the ways in which development interacts with cognitive training to shape healthy and maladaptive information-processing functions. The current Special Issue of Developmental Cognitive Neuroscience embraces all of these themes.

Research on cognitive training has generated considerable excitement in basic quarters. This is because such research uses experiments in attempts to change information-processing and associated neural functions. This powerfully charts relationships among brain function, information-processing, development, and behavior, in a way that is more familiar in research with animal models than with humans, particularly children. Moreover, this uniquely powerful approach also provides a rare opportunity to shape clinical thinking. For virtually all cognitive and emotional mental or learning disorders, serendipity hasbeen the major force in treatment discovery. While this approach has generated clearly helpful interventions, in other areas of medicine, more powerful treatments have emerged when the underlying pathophysiology can be charted and manipulated. With the development of cognitive training, a comparable process may be emerging for mental and learning disorders. Fig. 1 describes the schema that one would hope this emerging approach to follow.

The scheme most easily may be applied to information-processing functions where considerable data already chart brain-behavior relationships. These include allocation of spatial attention, the nature of working memory, or basic process in perception-action. Such data have accumulated over decades of basic cognitive and cognitive-neuroscience research, allowing researchers to take the next step of testing whether individual differences in these basic human faculties relate to specific psychopathologies or maladaptive function more broadly defined. For instance, advances in the understanding of basic mechanisms related to attention capture and disengagement have led anxiety researchers to speculate that biased attention toward threats may be associated with the etiology and maintenance of anxiety disorders (Bar-Haim et al., 2007). Given the depth of this work, it is no surprise that four papers in the current issue, Fu et al., Britton et al., van den Bulk et al., and Waters et al., address related themes. Comparable approaches are also emerging for research on substance use and executive function, as illustrated by Espinet et al., Tamm et al., and Eberl et al., the other three papers in the issue. As exemplified by these seven papers, the early stages of clinical translation typically focus on testing whether the training protocols can effectively induce the intended changes in the targeted cognitive function. This is followed

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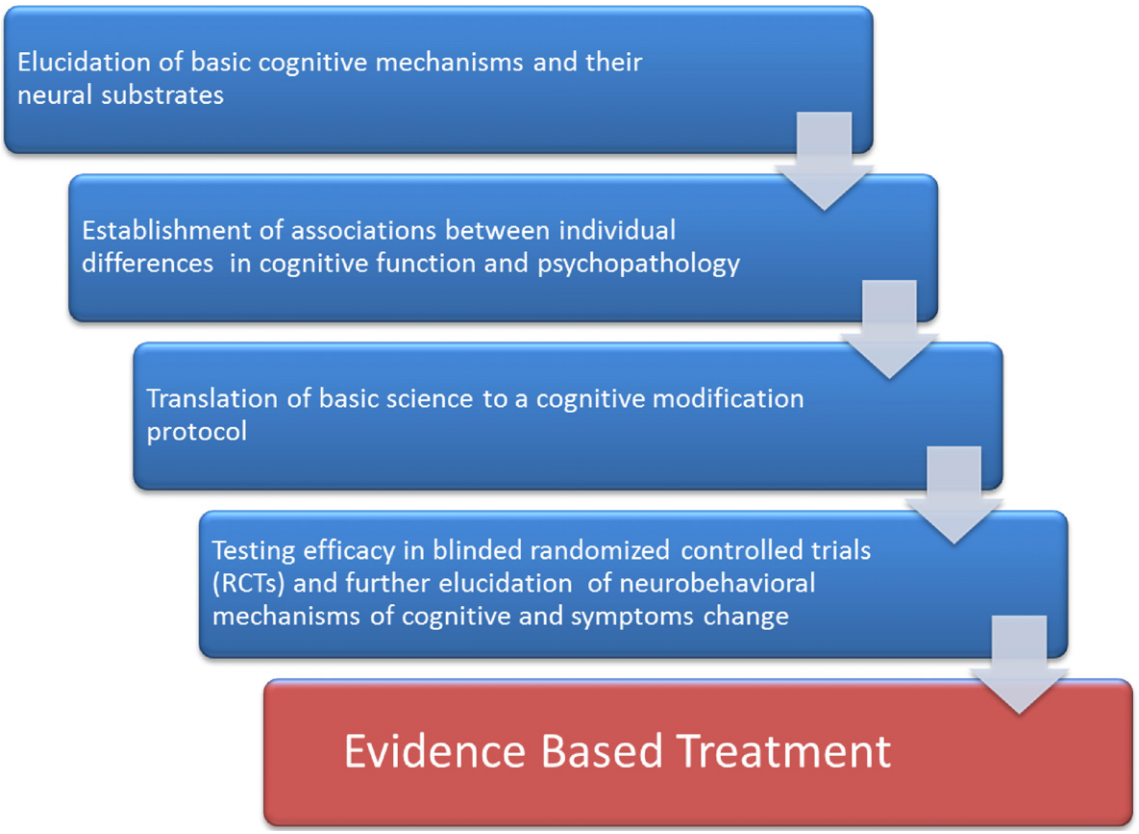

Fig. 1. A cognitive-neuroscience approach to treatment development.

by studies examining the effects of such changes, both on brain function and a range of behaviors. Eventually, these gains would be expected to inform large, double-blind, randomized controlled trials (RCTs) focused on impairing mental or cognitive disorders. One would hope that such an RCT might emerge in the coming decade from the early, suggestive findings appearing in this issue. Finally, research in other areas of medicine found promising early findings to generate two other windfalls. First, identification of underlying pathophysiology in humans can stimulate research in experimental animals, which then produces further breakthroughs and other novel treatments. Thus, basic-clinical translation exemplified by cognitive training research can create a mutual reinforcing cycle of discovery and RCTs. Second, promising initial findings in small-scale RCTs can support larger-scale multi-site RCTs. When these larger studies replicate findings from the initial smaller studies, broad changes in clinical practice can accrue, meaningfully altering the overall health of our communities.

In many areas of medicine, advances often come late for children. This is understandable, given the complications of conducting research in children and the thankfully healthy aspects of children in many communities. However, research on children is likely to assume a unique place in the emerging cognitive training paradigm. This is because plasticity, as it manifests in changing information-processing function, represents a core aspect of human development; as such, any attempt to understand how cognitive training influences behavior will remains incomplete until it charts the way that development modulates such influences. Clearly, such developmental research will vitally inform basic understandings of behavior stability and change. However, since most mental and cognitive disorders begin early in life, such developmental research also undoubtedly will be central to our efforts to most powerfully improve the health of our communities.

Conflict of Interest

Drs. Pine and Bar-Haim report no conflict of interest.

Reference

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