CHAPTER SUMMARIES AND KEY WORDS

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***Koutstaal, W. (2012). The Agile Mind*. New York: Oxford University Press.**

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1 - Agility of Mind and the Integrated Controlled-Automatic, Specific-Abstract (iCASA) Framework

This chapter begins with an explanation of why we need a new construct of mental agility. It then discusses how this book is about "bridges"—bridges within, and to, thinking. The material for the bridges comes from experimental and observational evidence, from psychology, cognitive neuroscience, and allied disciplines, regarding the factors that are most likely to foster what is called agility of mind, agile thinking, or mental agility. The chapter then sets out the book's central claim: optimal agility of mind requires the capacity to both move between varying levels of control (representational process) and varying levels of specificity (representational content). It outlines the principles of the integrated Controlled-Automatic, Specific-Abstract (iCASA) and discusses the meaning of abstract-specific representational content, and the levels of control and representational process. An overview of the subsequent chapters is also presented.

Keywords: mental agility, agile thinking, agility of the mind, representational content, representational process, oscillatory range

Part One Memory, Categorization, and Concepts

2 - Flexibly Using Memory and Categorical Knowledge, Part 1

This chapter highlights the effects of constrained versus free movements between levels of specificity in memory and categorization on agile thinking. It argues that agile thinking requires the retention and use of both specific and abstract

memory and knowledge—and the ability to move flexibly and adaptively between these as needed. It first considers the hazards of an overly extreme form of memory at either end of the specific-to-abstract continuum—either predominantly, and too consistently, specific or predominantly too categorical and abstract. It then considers several converging sources of evidence supporting the importance of movement between levels of specificity in enabling adaptive thinking. It shows that particular conditions that involve changes in an individual's capacity to access flexibly mental representations at differing levels of specificity, such as memory and information processing in clinical depression, or normal aging, frequently also involve disruptions in aspects of intentional control (control vs. automaticity). The chapter focuses on factors that shape flexible thinking that predominantly involve the content of representations, relating to where representations fall on the level of specificity continuum from abstract to specific.

Keywords: memory, categorization, specificity, agile thinking, mental representations, flexible thinking

3 - Flexibly Using Memory and Categorical Knowledge, Part 2

This chapter is conceptually closely paired with—and comprises a continuation of—Chapter 2. These two chapters share a central connecting theme in that both directly focus on factors that influence our ability to flexibly access memory and concepts or categorical knowledge at differing levels of representational specificity, with consequent effects on mental agility. However, whereas the earlier chapter predominantly emphasized the dimension of levels of specificity, this chapter now turns its attention to some of the important ways in which levels of representational specificity intersect with, and are modulated by, varying levels of control. Both unintentional, often automatic processes that may emerge outside of awareness, and intentional, deliberate processes aimed at altering our predominant level of specificity in thinking, are considered.

Keywords: memory, categorization, representational specificity, mental representations, thinking

4 - Thinking with Our Senses

This chapter outlines the important but underrecognized multiple contributions of sensory-perceptual and sensory-motor information to concepts and to thinking. It covers research and findings from developmental psychology, cognitive psychology, philosophical psychology, naturalistic experiments in economics, and other areas to argue for the essential role that "thinking with our senses" assumes in enabling agility of mind. At an abstract level, the chapter is broadly grouped into four sections, concentrating on: the integral contribution of perceptual and action-related information to mental concepts or representations; the ways in which both current perception and current actions (e.g., gestures) may guide and support thinking and insight; the key importance of the "embodied" and "grounded" nature of mental representations in enabling innovative, and even completely novel, uses of language; and the role of so-called epistemic objects in thinking, including the pervasive and sometimes illicit effects of the specifically physical nature of language (the sensory-perceptual aspects of words as objects in the world, that can be heard and/or seen) on the nature and direction of thought.

Keywords: sensory-perceptual information, sensory-motor information, mental representations, mental conceptions, perception, language, epistemic objects

Part Two Motivation and Emotion

5 - Action and motivation

This chapter further broadens the scope of our window into agile thinking beyond that of the representational world of memory, categorization, and concepts (the focus of Chapters 2 and 3), and beyond that of sensory-perceptual and motor inputs and guides to representations and thinking (the topic of Chapter 4), to encompass action and motivation, or the impetus for, and enactment of, agile thinking. This chapter consists of four main sections, each of which, in turn, is comprised of several subsections. The four sections focus on four main areas. Firstly, hierarchical models of action control and motivation are

considered, particularly in relation to higher level versus lower level construals of our actions, and the interactions between controlled and automatic processing in forming and implementing intentions are examined. Secondly, the next section looks at the need for moderate and changing levels of control, emphasizing the correlation of moderate levels of control with increased resiliency and the growing evidence that executive control or self-regulatory processes may, under some conditions, become depleted if the need for high levels of self-regulatory control is sustained for prolonged periods. The following section analyzes forms of motivation and incentives, especially evidence that contests the often proposed conflict between intrinsic and extrinsic motivation, and that underscores the important synergistic effects that may be obtained by a combination of intrinsic and extrinsic motivational orientation. Finally, the last section examines the potential powerful role of reinforcement in encouraging organisms not only to repeat but also to vary, including in innovatively creative ways. Thus, further developing the integrated Controlled-Automatic, Specific-Abstract (iCASA) framework, the chapter focuses on alterations in our level of representational specificity, and our level of control, with regard to actions and our motivation for action, in enabling mental agility.

Keywords: action control, motivation, construals, intentions, self-regulatory processes, incentives, reinforcement, integrated Controlled-Automatic, Specific-Abstract framework, iCASA

6 - Emotion, Self, Personality

This chapter provides a treatment of some of the most important ways in which aspects of emotion, self, and personality intersect with—both facilitating and impeding—agile thinking. It begins with a consideration of positive emotions, including the fundamental question of what the functional role of positive emotions is. This leads into an outline of the “broaden and build” theory of positive emotional experiences, according to which the modification and extension of our understanding and skills is most likely to occur when we are in mildly positive emotional states such as interest or contentment. Subsequent sections examine both the evidence for, and against, the effects of

positive mood on flexible thinking. The broader role of the self and personality in mental agility is then explored through, first, an examination of the effects of an apparently modest but quite potent social-motivational and cognitive intervention known as "self affirmation" and, second, a consideration of the role of the personality characteristic of "openness to experience" in enabling agile thinking and adaptive learning.

Keywords: positive emotions, agile thinking, positive mood, flexible thinking, mental agility, self affirmation, openness to experience, adaptive learning

7 - Thoughts about Thoughts

This chapter focuses on levels of cognitive control versus noncontrol (e.g., spontaneity, automaticity) with respect to a person's "thoughts about thoughts", involving higher level beliefs about cognition and oneself. It also focuses on the intersections of metacognition with more affectively and motivationally related states such as absorption and "flow", and intolerance of ambiguity or uncertainty. These are considered particularly with respect to how these states may affect an individual's predominant level of representational specificity or level of control and, in turn, how these can bolster, or impede, agile thinking. Each of the sections in the chapter testifies, in different ways, to the complex "whole person" nature of mental agility and further illustrates how thinking is neither entirely generated by nor conclusively and concisely guided by that "small voice in the head" that we may associate with explicit, deliberate, directed thinking.

Keywords: cognition, cognitive control, metacognition, representational specificity, agile thinking, whole person, mental agility

Part Three Brain and Environment

8 - Brain Bases of Levels of Specificity and Levels of Control, Part 1

This chapter focuses predominantly on the relatively more controlled and abstract ends of the levels of control and levels of specificity continua. It considers evidence at several levels, including that of neural systems (e.g., the frontal-parietal

network) and also, although less extensively, neurochemical and neurophysiological levels. It begins with an overview of ways in which the frontal cortex is uniquely situated to play an adeptly adaptive and abstract representational role. Subsequent sections focus on evidence from single-cell recordings for the flexible abstract representation of categories and rules, neuroimaging evidence for hierarchical and functional distinctions within the frontal cortex, and neurochemical and neuroanatomical contributors to three forms of cognitive flexibility, including set shifting, reversal learning, and task switching. Neuro-psychological and lesion evidence for cognitive flexibility of a more "spontaneous" form, such as typically called on in tasks of fluency and divergent thinking, is then considered. A final section takes up the interrelated topics of goal neglect, fluid intelligence, and working memory, and underscores the need to go "beyond frontal cortex" to consider the dynamic and continually changing interactions of frontal regions with parietal and occipitotemporal cortex.

Keywords: specificity, neural systems, frontal cortex, cognitive flexibility, abstract representation, goal neglect, fluid intelligence, working memory

9 - Brain Bases of Levels of Specificity and Levels of Control, Part 2

A companion to the preceding chapter, this chapter concentrates on experimental findings from cognitive neuroscience and neuropsychology that help to illuminate the neural bases of levels of representational specificity, levels of control, and their interrelations in enabling agility of mind. It begins by considering the bases of the representation of semantic knowledge and concepts in the brain. It then examines the importance of the nature of brain activity and the patterns of brain connectivity that are present during times of "nondirected" and "spontaneous" thinking. Two sections explore the brain bases of "bouncing back" or resilience, and of adaptive responding to novelty, respectively. The section on resilience draws attention to the top-down influence of ventral medial prefrontal cortex, the role of serotonergic function, and the mechanisms by which physical exercise and certain early experiences may promote resilience to stress; the section on adaptive responding to novelty focuses

especially on the role of the locus coeruleus- norephinephrine system in novelty, reward, and exploration. The final section turns to the dynamic interplay of cognition, emotion, and motivation that determine the emergence of behavioral approach versus behavioral avoidance.

Keywords: representational specificity, levels of control, mental agility, semantic knowledge, brain connectivity, thinking, resilience, adaptive responding, novelty

10 - Making Brain Paths to Agile Thinking, Part 1

Our day-to-day environment is a crucial but not always sufficiently recognized sculptor of our brains and of our ability to use agile thinking. The things we see, hear, imagine, and plan each day, the activities we perform, and the "contents" of our leisure and work pursuits simultaneously and reciprocally shape our thinking and our brains. Research findings from a wide range of methodologies and disciplines converge in demonstrating a simple fact: agile thinking thrives in stimulating environments. This chapter considers indirect—correlational and longitudinal—evidence that is broadly consistent with this claim. The consideration of indirect forms of evidence begins by focusing on clear cases of brain plasticity associated with prolonged behavioral alterations in one's experiences, such as the acquisition of complex skills (e.g., learning to play a musical instrument) or adaptations to the loss of a particular sense modality. The chapter then turns to a consideration of the many longitudinal and epidemiologic studies that have sought to identify longer term contributions of our day-to-day cognitive, intellectual, and social-emotional environments to the preservation and optimization of cognitive function, and also to the likelihood and timing of the onset of degenerative brain diseases, such as Alzheimer's disease. A final section considers the outcomes of longitudinal field experiments that aim to determine the effects of a cognitively and socially engaged lifestyle on cognitive vitality.

Keywords: agile thinking, mental agility, stimulation, brain plasticity, cognitive function, cognitive vitality

11 - Making Brain Paths to Agile Thinking, Part 2

This chapter first explores extensive experimental work that has been carried out on “environmental enrichment” with nonhuman animals, which has been fundamental in establishing causal connections between stimulating environments, behavioral flexibility, and corresponding brain changes. It then turns to the multiple, often highly innovative and creative, approaches that have been adopted in the effort to examine plasticity of brain function in humans, in relation to experimentally assigned sensory-motor and cognitive interventions. Included here are physical and cardiovascular fitness interventions, training in deliberate recollection in older individuals and of working memory in younger and older adults, and training of attention in young children. Two additional sections consider the benefits for flexible cognition that may be derived from, on the one hand, playing certain forms of real-time video games and, on the other hand, certain forms of experiences with the natural environment. An experimental intervention with older individuals based on multimodal engagement in novel activities designed to invite playful and imaginative participation points toward further promising approaches. The chapter also considers a recent speculative theoretical proposal regarding the linkages between stimulating physical activity and the generation of new neurons (neurogenesis), particularly in the hippocampal dentate gyrus. It suggests that, broadly speaking, diverse forms of cognitive and other stimulation may be seen as extending our “exemplar space” of objects, events, people, qualities, and so on, thereby increasing the range of instances and sets of instances that we can draw upon in thinking, reasoning, and acting.

Keywords: environmental enrichment, brain plasticity, flexible cognition, interventions, stimulating physical activity, neurogenesis

12 - Implications and Applications of the iCASA Framework for Fostering Agile Thinking

This chapter considers the implications and applications of the integrated Controlled-Automatic, Specific- Abstract (iCASA) framework, and outlines some of the many important research questions that remain regarding when, and how, we can more

consistently and more optimally realize the forms of adaptive flexibility in thought and action that our agile minds can make possible. The chapter is organized in the form of broad questions that are then expanded by selected reminders of key findings, additional evidence regarding possible applications or implications, and more specific questions and research directions. The primary aim is to "put the iCASA framework to work" and to identify the sometimes surprising implications and possibilities opened up by this way of looking at our minds. A secondary aim, accomplished through the question-plus-elaboration format, is both to underscore some of the central findings considered and to interrelate and integrate findings across and within chapters. To this end, the questions span all three parts of the book—memory, categorization, and concepts; motivation and emotion; and brain and environment. The questions are very broadly grouped into four sections, concerning oscillatory range in levels of specificity and levels of control; environmental enrichment and stimulation; the interpenetration of concepts with perception, action/motivation, and emotion; and broader educational, policy, and ethical implications.

Keywords: iCASA, adaptive flexibility, thought, mental agility, memory, categorization, motivation, emotion, environmental enrichment, stimulation