

*The Emergence of Insight Research**Steven M. Smith, Jennifer Wiley, and Carola Salvi*

Where do insights come from? What causes those moments when, unexpectedly, a marvelous new idea flashes into consciousness, possibly accompanied by feelings of surprise and delight? Sudden insights are rare, yet everyone appears to be familiar with the experience that may be alternatively described as an “Aha!” or “Eureka” moment: a sudden realization, an epiphany, illumination, revelation, or satori. The ideas resulting from insight experiences range from mundane to historic. Insight is defined not so much by the importance or significance of the content produced, but rather by the cognition and the phenomenology of the event. At its core, the insightful solution process begins with the solver holding an incorrect representation, and ends (if successful) with a nonobvious solution. But there is much more to know: What is insight, and how does a solution emerge unexpectedly into awareness? Is there a set of steps, a pathway that leads to insight? What are the mechanisms that underlie insightful solutions? Are there conditions that can increase the likelihood of insight? Is the insight experience instantaneous, or do unobserved signs mark the impending awareness of the insight? Why do people seek insight? What are the consequences of insight experiences? How can insight be observed and measured? In this volume, we bring together a diverse array of prominent researchers from around the world who have been examining the mysterious experience of insight, and who present their own research and ideas on human insight.

The historic path of research on insight can be traced to the early twentieth century when researchers brought insight into the laboratory. Luminaries of Gestalt research such as Köhler, Wertheimer, Duncker, Luchins, and Maier devised brilliant methods for studying insight and fixation in the form of what are now classic insight problems. Contemporary with this research, Wallas published *The Art of Thought*, which presented a theoretical account of the stages that underlie the creative process. The view of creative problem solving to emerge from

this era was that productive (as opposed to reproductive) problem solving consists of an early impasse that involves an ultimately flawed mental structure of the problem (fixation), followed by a period of incubation in which the problem is put aside, finally leading to an abrupt perceptual-like restructuring of the problem referred to as *insight*. The Gestalt notion that insight was a sudden, unexpected, and special phenomenon contrasted with the prevailing associationist canon that problems are solved in an incremental, stepwise fashion: the business-as-usual account. The Gestalt view of creative insight is essentially consistent with modern interpretations (Ohlsson, 1992).

After decades in which empirical research on insight slowed to a trickle, a new wave of interest in fixation, insight, and creative thinking arose when, late in the twentieth century, researchers revived and revitalized research on these topics. Arguments over incremental steps versus sudden restructuring were intensified by important empirical findings. In support of the sudden insight view, Metcalfe (1986a, b; Metcalfe & Wiebe, 1987) showed that the use of metacognitive reports (feelings of warmth or proximity to a solution) over the course of problem solving revealed a sharp increase in ratings just seconds prior to insight. Furthermore, Schooler and colleagues (e.g., Schooler & Melcher, 1995; Schooler, Ohlsson & Brooks, 1993) found that creative insight can involve ineffable, nonreportable processes. Bowers, Regehr, Balthazard, and Parker (1990) showed that gradual increases in spreading activation underlie intuitive hunches that guide problem solving, which has been interpreted as evidence for an incremental view, while Smith and Kounios (1996) proposed that it is the sudden emergence of the idea in consciousness and a lack of access to partial solutions that leads to the Aha! experience. Research on fixation emerging from a *forgetting fixation* perspective revealed its critical role in observing incubation effects (Smith & Blankenship, 1989, 1991), and the constraining effects of examples on creative conceptual design, a phenomenon known as *design fixation* (Jansson & Smith, 1991). Other research explored how impasses, failures, and the *Zeigarnik* effect (enhanced memory for unfinished tasks) pave the way for *opportunistic assimilation* of cues during problem solving or incubation (Patalano & Seifert, 1994; Seifert et al., 1995). Research also showed that expertise that is usually shown to facilitate more successful analytic problem solving can sometimes lead to fixation or *mental set* when creative solutions are required (Wiley, 1998).

The new wave of research on insight and creative thinking was marked by, among other things, the publication in 1995 of two edited volumes in which cognitive psychology researchers turned their attention and their

research toward these difficult-to-study phenomena: *The Nature of Insight* (R. J. Sternberg and J. E. Davidson; 1995) and *The Creative Cognition Approach* (S. M. Smith, T. B. Ward, and R. A. Finke; 1995). The contributing authors explored questions about the roles of memory, perception, mental imagery, analogical transfer, and conceptual processing in creative thinking and insight. Long treated as a frivolous subject about imaginative but impractical fun and games, creative insight was drawn into the mainstream of the cognitive psychology paradigm. The end of the twentieth century also marked the beginning of research on the cognitive neuroscience of insight problem solving (Beeman & Bowden, 2000; Bowden & Beeman, 1998; Jung-Beeman et al., 2004).

Methods for studying creative cognition have proliferated in the past three decades, and their use has become more sophisticated. Consistent with many research paradigms in cognitive psychology, studies of insight problem solving now typically use tasks consisting of many similar problems, rather than a single problem, thereby providing more observations and increasing statistical sensitivity to experimental manipulations. Various sets of problems and manipulations that instill fixation, *Einstellung*, or mental set have been developed to study insight, including anagrams, remote associates test (RAT; aka compound remote associates [CRA]) problems, rebuses, riddles, matchstick and coin puzzles, and videos of magic tricks. Measures of insight have also proliferated as studies attempt to track the processes underlying solutions using solution times and accuracy, as well as think-aloud or protocol analyses, metacognitive monitoring reports, indices of problem representations, eye movements, move tracking and gesture analysis. Neural and physiological signatures as well as subjective reports of experiences and affective reactions have also been used to explore Aha! and Eureka moments. And other work has begun to explore individual differences in abilities, dispositions, traits, and attentional states that may enable or limit the experience of insight.

What are researchers studying now, in the newest wave of interest in creativity and insight? New research questions and emerging researchers continue to revitalize interest in the subject. Some of those emerging researchers, as well as some long-time researchers who have continued to study creative insight, have contributed thoughtful perspectives on their current research to the present volume.

After this Introduction (Part I), the next section (Part II) of this volume is concerned with the pivotal role of fixation in insight research. In “The Past and Future of Research on So-called ‘Incubation’ Effects,” **Steven M. Smith** and **Zsolt Beda** ask what causes incubation effects, focusing on forgetting

fixation as an essential factor in explaining how insight experiences occur as a function of taking a break from a fixated problem. Their research examines how “red herrings,” or experimentally manipulated wrong answers, are forgotten, or kept out of mind because of forgetting that occurs due to breaks. In a similar vein, **Benjamin C. Storm** and **Mercedes T. Oliva** ask how mental blocks can be weakened in “Forgetting and Inhibition as Mechanisms for Overcoming Mental Fixation in Creative Problem Solving.” In this chapter they ask whether mental fixation can be resolved best when people can forget, inhibit their memory retrieval, and stop unwanted responses. In “Overcoming Internal and External Fixation in Problem Solving,” **Rebecca Koppel**, **Tim George**, and **Jennifer Wiley** ask if the ability to resolve fixation or mental set arising from expert knowledge differs from overcoming experimentally induced fixation. Whereas both types of fixation cause poorer performance on a word-fragment completion task, Koppel et al. examine the effects of working-memory capacity and warnings about fixating solutions on the likelihood of solving problems. The first section concludes with the chapter “How Impasse Leads to Insight: The Prepared Mind Perspective,” by **Colleen M. Seifert**, whose opportunistic assimilation theory (1995) first explained the benefits of serendipitous hints on resolving initial problem-solving impasses. In this chapter, Seifert presents an account of how reaching an impasse can prepare us to maximize opportunities for creative insight and innovation.

Part III of the book examines various pathways that can lead to insight experiences, including the potential benefits of curiosity, mind-wandering, and task-switching. In “The Role of Curiosity₁ and Curiosity₂ in the Emergence of Insight,” **William James Jacobs** and **Janet Metcalfe** ask about the role of curiosity in the quest for insight, distinguishing between a habit-based goal-centered reinforcement system (Curiosity₁) and a discursive, default-mode, medial temporal lobe-based system (Curiosity₂). They discuss how an impasse can trigger the switch from a habitual responding mode (Curiosity₁) to a more exploratory mode (Curiosity₂). **Jonathan W. Schooler**, **Madeleine E. Gross**, **Claire M. Zedelius**, and **Paul Seli**, in their chapter “Mind Wondering: Curious Daydreaming and Other Potentially Inspiring Forms of Mind-Wandering,” ask if the road to insight is paved with a type of daydreaming that they call “mind wondering.” Schooler et al. distinguish among various types of mind-wandering, and they examine evidence that suggests only curious “mind wondering” facilitates the discovery of creative ideas. The possible benefits of mind-wandering are further discussed by **Nicholaus P. Brosowsky**, **Madeleine E. Gross**, **Jonathan W. Schooler**, and **Paul**

Seli in “Jumping About: The Role of Mind-Wandering and Attentional Flexibility in Facilitating Creative Problem Solving.” These authors consider the role of attentional flexibility in creative thinking and the potential benefits of task-switching.

Part IV examines the insight experience itself, as well as the cognitive and metacognitive causes and consequences of Aha! moments. **Ruben E. Laukkonen**, in “The Adaptive Function of Insight,” asks why the feelings that accompany Eureka moments occur, and he considers the role of a metacognitive heuristic (the *Eureka* heuristic) for selecting ideas from the stream of consciousness. Laukkonen reviews evidence about the accuracy of insights, and applies the theory to delusions, false beliefs, and misinformation. In “The Insight Memory Advantage,” **Amory H. Danek** and **Jennifer Wiley** ask why insight experiences are remembered so well. They review findings of the insight memory advantage, and try to disentangle the effects of feelings of confidence, feelings of pleasure, and cognitive consequences of the restructuring process.

Part V explores the neuroscience of the insight experience. An introduction to research on the neurocognitive underpinnings of insight experiences is presented in “Waves of Insight: A Historical Overview of the Neuroscience of Insight ” by **Christine Chesebrough**, **Carola Salvi**, **Mark Beeman**, **Yongtaek Oh**, and **John Kounios**. The authors discuss what they call the “third wave” of research into the cognitive neuroscience of insight, focusing on research from the authors’ own labs to explicate the neural activity prior to Aha! moments and the neurocognitive activity that occurs during those moments, as measured by fMRI and EEG studies and manipulated by transcranial stimulation. In “Why My ‘Aha!’ Is Your ‘Hmm ...’: Individual Differences in the Phenomenology and Likelihood of Insight Experiences,” **Christine Chesebrough**, **Yongtaek Oh**, and **John Kounios** explore individual differences that determine the likelihood and nature of insight experiences, including trait-like variations in neural activity. In the final chapter in this section, “Insight: What Happens Backstage?,” **Carola Salvi** and **Edward Bowden** focus on the ineffability of processes leading up to insight moments and the affectively positive consequences of those Aha! experiences, drawing conclusions about the neural underpinnings of these two properties and the role of unconscious processes leading to insight experiences.

The contributors to this volume, assembled from academic institutions around the world, include prominent authors who have been studying insight for the past four decades and emerging researchers who are taking the science of insight in important new directions. The chapters of *The*

Emergence of Insight review past research on insight experiences, report some of the newest findings on the subject, and provide speculation about future research questions that remain to be addressed. Some goals for this volume are to help the field to see the amount of progress that has been made, but also to identify where we have been fixated and where we might be at impasse, and to spark curiosity and mind wondering that might move the field even further forward.

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