

# Creativity

Understanding Innovation in  
Problem Solving, Science, Invention, and the Arts



Robert W. Weisberg

---

Creativity



---

# Creativity

*Understanding Innovation in  
Problem Solving, Science, Invention,  
and the Arts*

Robert W. Weisberg



WILEY

John Wiley & Sons, Inc.

This book is printed on acid-free paper. ☺

Copyright © 2006 by John Wiley & Sons, Inc. All rights reserved.

Published by John Wiley & Sons, Inc., Hoboken, New Jersey.  
Published simultaneously in Canada.

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, scanning, or otherwise, except as permitted under Section 107 or 108 of the 1976 United States Copyright Act, without either the prior written permission of the Publisher, or authorization through payment of the appropriate per-copy fee to the Copyright Clearance Center, Inc., 222 Rosewood Drive, Danvers, MA 01923, (978) 750-8400, fax (978) 646-8600, or on the web at [www.copyright.com](http://www.copyright.com). Requests to the Publisher for permission should be addressed to the Permissions Department, John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, (201) 748-6011, fax (201) 748-6008.

**Limit of Liability/Disclaimer of Warranty:** While the publisher and author have used their best efforts in preparing this book, they make no representations or warranties with respect to the accuracy or completeness of the contents of this book and specifically disclaim any implied warranties of merchantability or fitness for a particular purpose. No warranty may be created or extended by sales representatives or written sales materials. The advice and strategies contained herein may not be suitable for your situation. You should consult with a professional where appropriate. Neither the publisher nor author shall be liable for any loss of profit or any other commercial damages, including but not limited to special, incidental, consequential, or other damages.

This publication is designed to provide accurate and authoritative information in regard to the subject matter covered. It is sold with the understanding that the publisher is not engaged in rendering professional services. If legal, accounting, medical, psychological or any other expert assistance is required, the services of a competent professional person should be sought.

Designations used by companies to distinguish their products are often claimed as trademarks. In all instances where John Wiley & Sons, Inc. is aware of a claim, the product names appear in initial capital or all capital letters. Readers, however, should contact the appropriate companies for more complete information regarding trademarks and registration.

For general information on our other products and services please contact our Customer Care Department within the United States at (800) 762-2974, outside the United States at (317) 572-3993 or fax (317) 572-4002.

Wiley also publishes its books in a variety of electronic formats. Some content that appears in print may not be available in electronic books. For more information about Wiley products, visit our website at [www.wiley.com](http://www.wiley.com).

***Library of Congress Cataloging-in-Publication Data:***

Weisberg, Robert W.

Creativity : understanding innovation in problem solving, science, invention, and the arts / by

Robert W. Weisberg.

p. cm.

ISBN-13: 978-0-471-73999-9 (cloth)

ISBN-10: 0-471-73999-5 (cloth)

1. Creative ability. I. Title.

BF408.W387 2006

153.3'5—dc22

2005026281

Printed in the United States of America

10 9 8 7 6 5 4 3 2 1

---

# Contents

<i>Preface</i>	<i>xi</i>
<i>Acknowledgments</i>	<i>xvii</i>
<i>Credits</i>	<i>xix</i>
<b>CHAPTER 1 Two Case Studies in Creativity</b>	<b>1</b>
Beliefs about Creativity	4
Two Case Studies in Creativity	6
Creativity in Science: Discovery of the Double Helix	6
Conclusions: Watson and Crick's Discovery of the Double Helix	31
Artistic Creativity: Development of Picasso's <i>Guernica</i>	34
Structure in Creative Thinking: Conclusions from the Case Studies	51
Revisiting the Question of Artistic Creativity versus Scientific Discovery	54
Beyond Case Studies: Outline of the Book	57
<b>CHAPTER 2 The Study of Creativity</b>	<b>59</b>
Outline of the Chapter	59
Creative Product, Creative Process, and Creative Person: Questions of Definition	60
Method versus Theory in the Study of Creativity	72
Methods of Studying Creativity	73
An Introduction to Theories of Creativity	90

---

CONTENTS

<b>CHAPTER 3 The Cognitive Perspective on Creativity, Part I: Ordinary Thinking, Creative Thinking, and Problem Solving</b>	<b>104</b>
Outline of the Chapter	105
Basic Cognitive Components of Ordinary Thinking	106
General Characteristics of Ordinary Thinking	108
Creative Thinking and Ordinary Thinking: Conclusions	118
The Cognitive Analysis of Problem Solving	119
An Example of Problem Solving	121
Solving a Problem: Questions of Definition	123
A Brief History of the Cognitive Perspective on Problem Solving	128
Problem Solving: Processes of Understanding and Search	135
Strategies for Searching Problem Spaces	141
Weak Heuristic Methods of Problem Solving and Creative Thinking: Conclusions	152
<b>CHAPTER 4 The Cognitive Perspective on Creativity, Part II: Knowledge and Expertise in Problem Solving</b>	<b>153</b>
Outline of the Chapter	154
Use of Knowledge in Problem Solving: Studies of Analogical Transfer	155
Strong Methods in Problem Solving: Studies of Expertise	168
Outline of a Cognitive-Analytic Model of Problem Solving: Strong and Weak Methods in Problem Solving	178
The Cognitive Perspective on Problem Solving and Creativity: Conclusions and Implications	180
The Creative Cognition Approach: A Bottom-Up Analysis of Creative Thinking	183
Skepticism about Expertise and Creativity	189
Practice or Talent?	191
Expertise and Achievement: Reproductive or Productive?	198
Expertise, Knowledge, and Experience versus Creativity: The Tension View	203
The Cognitive Perspective on Problem Solving and Creativity: Conclusions	207
<b>CHAPTER 5 Case Studies of Creativity: Ordinary Thinking in the Arts, Science, and Invention</b>	<b>209</b>
Outline of the Chapter	210
Basic Components of Ordinary Thinking	210
The 10-Year Rule in Creative Development	212
Case Studies of Creativity in the Visual Arts	223

---

*Contents*

Case Studies of Creativity in Science	237
Scientific Creativity: Scientific Discovery as Problem Solving	254
The Wright Brothers' Invention of the Airplane	255
Thomas Edison as a Creative Thinker: Themes and Variations Based on Analogy	261
James Watt's Invention of the Steam Engine	275
Eli Whitney's Cotton Gin	278
Ordinary Thinking in Invention: Summary	280
Case Studies of Creativity: Conclusions	280
<b>CHAPTER 6 The Question of Insight in Problem Solving</b>	<b>282</b>
Outline of the Chapter	286
The Gestalt Analysis of Insight: Problem Solving and Perception	286
Evidence to Support the Gestalt View	291
The Neo-Gestalt View: Heuristic-Based Restructuring in Response to Impasse	302
Challenges to the Gestalt View	308
An Elaboration of the Cognitive-Analytic Model to Deal with Restructuring and Insight	325
A Critical Reexamination of Evidence in Support of the Gestalt View	330
Insight in Problem Solving: Conclusions and Implications	339
<b>CHAPTER 7 Out of One's Mind, Part I: Muses, Primary Process, and Madness</b>	<b>341</b>
Outline of the Chapter	342
Messengers of the Gods	342
Primary Process and Creativity	343
Genius and Madness: Bipolarity and Creativity	356
Mood Disorders and Creativity: The Question of Causality	363
The Role of Affect in Creativity	368
Genius and Madness: Schizophrenia and Creativity	371
Social Factors and Genius and Madness	375
A Reconsideration of Some Basic Data	382
Genius and Madness: Conclusions	384
<b>CHAPTER 8 Out of One's Mind, Part II: Unconscious Processing, Incubation, and Illumination</b>	<b>386</b>
Outline of the Chapter	386
Unconscious Associations and Unconscious Processing	387
Poincaré's Theory of Unconscious Creative Processes	389

---

CONTENTS

Wallas's Stages of the Creative Process	397
Hadamard's Studies of Unconscious Thinking in Incubation	398
Koestler's Bisociation Theory	399
Campbell's Evolutionary Theory of Creativity: Blind Variation and Selective Retention	400
Simonton's Chance Configuration Theory	402
Csikszentmihalyi's Theory of the Unconscious in Creative Thinking	407
Unconscious Thinking in Creativity: Conclusions	413
Laboratory Investigations of Incubation and Illumination	414
Evidence for Incubation and Illumination: A Critique	428
Illumination without Unconscious Processing?	433
Incubation, Illumination, and the Unconscious: Conclusions	445
<b>CHAPTER 9 The Psychometric Perspective, Part I: Measuring the Capacity to Think Creatively</b>	<b>447</b>
Outline of the Chapter	448
Guilford and the Modern Psychometric Perspective on Creativity	448
Methods of Measuring Creativity	451
Cognitive Components of the Creative Process: Testing for Creative-Thinking Ability	461
Testing the Tests: The Reliability and Validity of Tests of Creative-Thinking Capacity	470
The Generality versus Domain Specificity of Creative-Thinking Skills	483
Testing Creativity: Conclusions	487
<b>CHAPTER 10 The Psychometric Perspective, Part II: The Search for the Creative Personality</b>	<b>488</b>
Creative versus Comparison or Control Groups	489
Questions about Method in Studies of the Creative Personality	492
A Model of the Role of Creative Personality in Creative Achievement in Science	496
Is It Futile to Search for <i>The</i> Creative Personality in the Arts and the Sciences?	504
Creativity and the Need to Be Original: A Reexamination of Divergent Thinking and Creativity	506
Personality, Cognition, and Creativity Reconsidered: The Question of Openness to Experience and Creativity	508
Divergent Thinking and the Creative Personality: Conclusions	515

---

Contents

<b>CHAPTER 11</b>	<b>Confluence Models of Creativity</b>	<b>517</b>
	Outline of the Chapter	517
	The Social Psychology of Creativity:	
	Amabile's Componential Model	518
	Economic Theory of Creativity: Buy Low, Sell High	534
	The Darwinian Theory of Creativity	552
	Confluence Models of Creativity: Summary	570
<b>CHAPTER 12</b>	<b>Understanding Creativity: Where Are We?</b>	
<b>Where Are We Going?</b>		<b>572</b>
	Outline of the Chapter	572
	Ordinary versus Extraordinary Processes in Creativity	573
	Ordinary Thinking in Creativity	575
	Extraordinary Processes in Creativity?	586
	On Using Case Studies to Study Creativity	592
	Is It Possible to Test the Hypothesis That "Ordinary Thinking" Is the Basis for Creativity?	594
	On Creative Ideas and Creative People	596
<i>References</i>		600
<i>Index</i>		613

---

# Preface

In my last book on creativity, written over 10 years ago, I noted in the preface that it was an exciting time to be studying creativity, and I think that that statement is even more true today. The study of creative thinking has undergone what one might call a mini-boom in recent years, with an increasing stream of important work, both empirical and theoretical, being produced. We have accumulated an ever-expanding database of information that can serve as the foundation for thinking about the processes underlying creativity and the characteristics of creative people. In addition, the field has taken steps toward maturity, as evidenced by the increasing numbers of sophisticated models that have attempted to integrate and explain findings across disparate areas.

These recent advances have been presented in several recent edited handbooks, by Sternberg (1999), by Runco (1997), and by Shavinina (2003), which present cutting-edge chapters on various aspects of creativity written by experts. However, those developments have not been summarized and evaluated in an overall manner for students and researchers. There is thus a real need in the study of creativity thinking: There has been a growth in research without a comprehensive review of that research that will be useful for advanced students and scholars. The present book is designed to meet that need; it provides a comprehensive historically based review of research and theory concerning creative thinking, at the level of an advanced undergraduate or graduate-level course. I also believe that the presentation of material is comprehensive enough to make the book useful for scholars and researchers.

My plan in writing this book, as noted, has been to present a broad-

ranging historically based survey of research and theory concerning creativity. There is also a second purpose behind this project. I take what can be called a “cognitive” perspective on creativity—a view advocated also by Perkins (1981) and Simon and his coworkers (Newell & Simon, 1972; Simon, 1986), among others—which proposes that creative products of all sorts are brought about by our ordinary cognitive processes, such as those involved in our day-to-day problem-solving activities. From the point of view of the researcher studying creativity, there may be no difference in the processes that bring about a great scientific or artistic advance and those underlying someone’s making a new salad from leftovers in the refrigerator. Much of the mystery that we sometimes feel about creative thinking and creative people is the result of our ignorance about the phenomena in question. When one examines creativity from the perspective of the cognitive psychologist, one finds that many groundbreaking creative advances are comprehensible without assuming that anything ordinary is occurring in the way of thought processes. This conclusion can be contrasted with views that propose that there are extraordinary aspects of the person who is able to produce significant new works. Those postulated extraordinary aspects vary from theory to theory, but they include ways of thinking (“divergent” thinking, or leaps of insight, or unconscious thinking) or personality characteristics (“openness to experience”; psychoticism).

I have tried to be even-handed in my presentation of the facts, but I have not been reluctant to inform the reader of the interpretation of those facts that I felt was most useful. I saw my first responsibility as an unbiased presentation of the relevant information. That presentation could then be followed by the presentation to a now informed reader of possible interpretations of that information. The reader can then assess any theoretical claims from a knowledgeable position. I have tried to use my overall orientation to structure the presentation of the material while at the same time giving competing views a fair hearing and allowing readers to decide for themselves which interpretation to accept for the present. I have also criticized what I see as various shortcomings in my own view, again to assist the reader in making an informed independent judgment as to what to believe.

One unique aspect of this book concerns the “data” that are presented concerning creativity. In my own research, in addition to carrying out traditional laboratory studies of undergraduates solving simple problems, I have also examined historical case studies of the development of creative products (e.g., Weisberg, 2006). Examples have included the development of the double-helix model of DNA, the invention of the airplane and the lightbulb, and the development of *Guernica*, one of Picasso’s most famous paintings. I believe that case studies provide readers with compelling ex-

amples of how creative thinking functions at its best, and that they can provide us with “data” relevant to the scientific study of creative thinking, including creative thinking in the arts. I have used case studies as an important source of information concerning how the creative process works when it is functioning at the highest levels. In this book I present a wide range of case studies to which I constantly refer as I work my way through discussions of various phenomena. As noted earlier, this tactic allows the reader to approach material from a knowledgeable perspective, which allows him or her to play a more active role in the learning process.

While it is impossible for an author to judge the quality of his or her work, there is no doubt that this is my biggest book on creativity. There is a larger set of topics covered in this book than in my earlier ones. For example, the coverage of invention has been expanded, with information about various aspects of Edison’s career, and the material on scientific creativity is also covered more broadly and deeply. Musical creativity is also covered in more detail. There is also much more known about creativity, which requires more coverage. Beyond my own perspective, a number of other theories of creativity are covered in detail, research relevant to each theory—positive and negative—is discussed, and the relative merits of the various theories are evaluated, using what one might call a “compare and contrast” method. In conclusion, I believe that this book represents a unique addition to the literature on creativity. It presents an integrated review of recent research and theory, from a perspective that enables a fresh look at many phenomena. That viewpoint is supported with research findings, including case studies that are intrinsically interesting as well as not presented elsewhere. Finally, the presentation allows a comparison of several theories that have attempted to explain creative functioning.

The first chapter of the book presents a general introduction to my perspective on creativity. Rather than going directly to a relatively abstract discussion of issues of definition, I then present two case studies of creative thinking at the highest level—Watson and Crick’s discovery of the double helix and Picasso’s creation of the painting *Guernica*—which will illuminate in the best way the functioning of creative thinking, and provide the beginnings of a database from which the reader can assess theoretical proposals that will be presented later. Chapter 2 then serves to provide a general orientation to the area. It presents an overview of the study of creativity, including my particular definition of the relevant terms, which is a bit different from that typically used in the literature. The broad range of research methods used to study creativity is also critically examined. The chapter concludes with a brief introduction to some of the major theoretical perspec-

tives—including my own—that have been used to explain and understand creativity, and which will be discussed in detail throughout the book.

Chapters 3–5 present the details of the cognitive perspective that serves to organize my presentation. Chapter 3 discusses problem solving as an example of creative thinking and introduces many of the concepts used by the cognitive perspective to discuss problem solving, such as searching of problem spaces and the role of analogical transfer in problem solving. Chapter 4 examines the role of expertise in problem solving and in creative thinking more generally. Proposing that expertise is important in creativity immediately raises the question of the role of talent in creativity, and this issue is considered. Recent findings may require us to rethink the notion of talent. Chapter 5 presents a number of case studies from various domains—the arts, invention, and science—to provide support for the cognitive view presented in the earlier chapters. Throughout Chapter 5, the case studies are used as data to test specific aspects of the cognitive view as well as to provide examples of application of the concepts underlying the cognitive perspective.

Chapters 6–11 examine various aspects of the competition to my view; that is, those chapters examine other ways of understanding creativity. Chapter 6 examines the notion of insight in problem solving (and by implication in creative thinking): the idea that solutions to problems sometimes come about as the result of processes that bring about sudden changes in the way the problem is perceived. Those processes are different from those postulated by the cognitive view presented in the earlier chapters. The notion that creative advances come about through a sudden leap of insight has been in psychology for more than 100 years, and I review its development and the current status of its empirical support. Chapter 7 examines the question of genius and madness, the idea that psychopathology may play a role in fostering creative production. This too is an idea that has been around for a long time, and I again examine its history. In addition, this is an area in which increasingly nuanced work has taken place in recent years, and I examine those developments in some detail, since they allow us to move away from the simple idea that madness does (or does not) support genius. The issues are much more complicated but (to me at least) much more interesting.

The cognitive perspective outlined in Chapters 1–5 assumes that creative thinking is the result of ordinary conscious thought, which raises the question of the possible role of the unconscious in creativity. Chapter 8 examines various aspects of the unconscious that have been postulated by researchers as playing a role in creative thinking, and also examines empirical support for those components. Chapter 9 is the first of two chapters examining the psychometric perspective on creativity. This is the general idea that one

can use tests to ascertain important aspects of creative individuals, and thereby determine what it is that allows them to do what they do. Chapter 9 examines tests that have been developed to measure the thinking strategies underlying creative thinking, and examines the support for the idea that there is a critical type of thinking underlying creativity and that one can measure that thinking type using “creativity tests.” Chapter 10 examines research that has used tests to isolate critical features of people’s personalities that play a role in creative accomplishment. Finally, Chapter 11 critically reviews three theories that have been proposed to explain creativity. Each of them provides an alternative to the cognitive perspective underlying my presentation, which will allow readers to determine, based on the evidence presented earlier as well as new evidence presented in Chapter 11, which view they believe is most reasonable at this time. The last chapter provides a summary of the discussion in the book and presents suggestions for where we might go in the future.

---

## Acknowledgments

This book has benefited from the influence of many people. Students and colleagues over the last several years have helped me shape my ideas and have introduced me to new ways of thinking about things. Among those people are my present and former students Joe Buonanno, Anthony Dick, Lila Chryssikou, Jessica Fleck, Rick Hass, John Rich, Pamela Shapiro, and Liza Zaychik. My colleagues Nora Newcombe, Bill Overton, Larry Steinberg, and Diana Woodruff-Pak have lent sympathetic ears and critical minds to discussions over the years and have stretched my ideas in directions in which I never would have gone alone. Cynthia Folio and Aleck Brinkman have led me through some of the intricacies of music theory with a kind and supportive hand. The folks at John Wiley, beginning with Dennis Layner, and including Tisha Rossi and Isabel Pratt, were enthusiastic about the project from its inception, and that enthusiasm, especially Tisha's support for the way I wanted to organize the book and present the material, played an important role in the book reaching completion in the form that it did. Several anonymous reviewers for John Wiley are also deserving of thanks. Preparation of the manuscript was supported by a Temple University Summer Research Fellowship, for which I am grateful.

---

# Permissions

Thank you to the following for permission to reprint:

- 1.1B Museo Nacional Centro de Arte Reina Sofía, Madrid; © 2006 Estate of Pablo Picasso/Artists Rights Society (ARS), New York
- 1.4 The King's College Archives, King's College London.
- 1.6 The King's College Archives, King's College London.
- 1.8 Musée Picasso, Paris; © 2006 Estate of Pablo Picasso/Artists Rights Society (ARS), New York
- 1.9A Museo Nacional Centro de Arte Reina Sofía, Madrid; © 2006 Estate of Pablo Picasso/Artists Rights Society (ARS), New York
- 1.9B Museo Nacional Centro de Arte Reina Sofía, Madrid; © 2006 Estate of Pablo Picasso/Artists Rights Society (ARS), New York
- 1.9C Museo Nacional Centro de Arte Reina Sofía, Madrid; © 2006 Estate of Pablo Picasso/Artists Rights Society (ARS), New York
- 1.9D Museo Nacional Centro de Arte Reina Sofía, Madrid; © 2006 Estate of Pablo Picasso/Artists Rights Society (ARS), New York
- 1.9E Museo Nacional Centro de Arte Reina Sofía, Madrid; © 2006 Estate of Pablo Picasso/Artists Rights Society (ARS), New York
- 1.10 Philadelphia Museum of Art; © 2006 Estate of Pablo Picasso/Artists Rights Society (ARS), New York
- 1.12A Bibiloteca Nacional Madrid
- 1.12B Biblioteca Nacional Madrid
- 4.6 Reprinted with permission of Lorna Selfe
- 5.3 Chase Manhattan Bank Art Collection; © 2006 Estate of Alexander Calder/Artists Rights Society (ARS), New York

---

Permissions

- 5.4A © 2006 Estate of Alexander Calder/Artists Rights Society (ARS), New York
- 5.4B Circus on extended loan to the Whitney Museum, New York; © 2006 Estate of Alexander Calder/Artists Rights Society (ARS), New York
- 5.4C Private collection; © 2006 Estate of Alexander Calder/Artists Rights Society (ARS), New York
- 5.5 Present location unknown; © 2006 Estate of Alexander Calder/Artists Rights Society (ARS), New York
- 5.6A Center-of-Gravity Systems. L. E. Knott Apparatus Company (1925). *Apparatus for Physics*. Cambridge, MA. Accessed from the world-wide web: [http://vlp.mpiwg-berlin.mpg.de/library/data/lit13684/index\\_html?pn=53](http://vlp.mpiwg-berlin.mpg.de/library/data/lit13684/index_html?pn=53). Accessed March 6, 2006
- 5.6B © 2006 Estate of Alexander Calder/Artists Rights Society (ARS), New York
- 5.7 Museum of Modern Art; © 2006 Estate of Pablo Picasso/Artists Rights Society (ARS), New York
- 5.8A Öffentliche Kunstsammlung Basel, Kupferstichkabinett; © 2006 Estate of Pablo Picasso/Artists Rights Society (ARS), New York
- 5.8B Musée Picasso, Paris; © 2006 Estate of Pablo Picasso/Artists Rights Society (ARS), New York
- 5.8C Philadelphia Museum of Art; © 2006 Estate of Pablo Picasso/Artists Rights Society (ARS), New York
- 5.9 Musée National des Antiquités, Saint-Germain-en-Laye; Réunion des Musées Nationaux/Art Resource NY
- 5.10A Private collection; © 2006 Artists Rights Society (ARS), New York/ADAGP, Paris
- 5.10B Philadelphia Museum of Art
- 5.11A Courtesy Center for Creative Photography, University of Arizona; ©1991 Hans Namuth Estate
- 5.11B Musée national d'art moderne, Centre de Création Industrielle, Centre Georges Pompidou; © 2006 The Pollock-Krasner Foundation/Artists Rights Society (ARS), New York
- 5.13A Reprinted courtesy of The Thomas A. Edison Papers
- 5.13B Reprinted courtesy of The Thomas A. Edison Papers
- 5.14A Reprinted courtesy of The Thomas A. Edison Papers
- 5.14B Reprinted courtesy of The Thomas A. Edison Papers
- 5.14C Reprinted courtesy of The Thomas A. Edison Papers
- 5.15A Philadelphia Free Library
- 5.16 Reprinted courtesy of The Thomas A. Edison Papers

---

This book is dedicated to the memory of my father, who first taught me how to think; to my mother, who keeps me on my toes and who never ceases to amaze me; and to Alana, who is teaching me to wonder all over again.

## Two Case Studies in Creativity

**C**reative thinking brings about new things—*innovations*—ranging from solutions to simple puzzles and riddles to ideas and inventions that have radically altered our world. *Creative people* are those who produce such innovations, and the *creative process* consists of the psychological processes involved in bringing about innovations. Figures 1.1A and 1.1B give examples of some of the more impressive products of creative thinking. In Figure 1.1C are some simple exercises that might result in creative thinking on your part. If you had never seen those puzzles and riddles before, and if you solved one or more of them, then you were thinking creatively when you did so—you produced something new. In this book, we will consider the full range of creativity, ranging from solving simple puzzles to producing the seminal innovations shown in Figures 1.1A and 1.1B. We will examine a wide range of recent research on creativity, as well as theories that have been developed to explain the processes involved when people produce innovations.

There are many reasons why creativity is a critically important topic for psychologists to understand. First of all, our world has been shaped by the products of creative thinkers. All of our modern conveniences—the telephone and other modes of communication, the automobile, the airplane, computers, and so forth—have been brought about through the creative work of inventors and scientists. Our healthy existences and our ever-longer lives are the result of scientific and medical advances, which are the result of creative thinking on the part of scientists in many domains. Much of the richness of our lives—art, music, drama, literature, poetry—is the result of artistic creativity. Society values greatly the products of creative thinking;

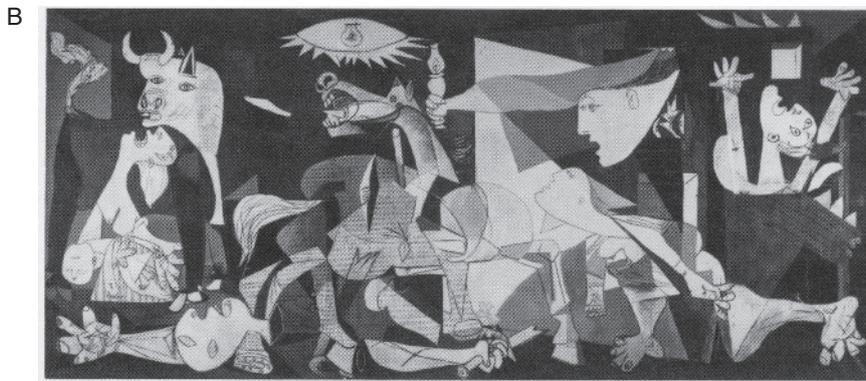
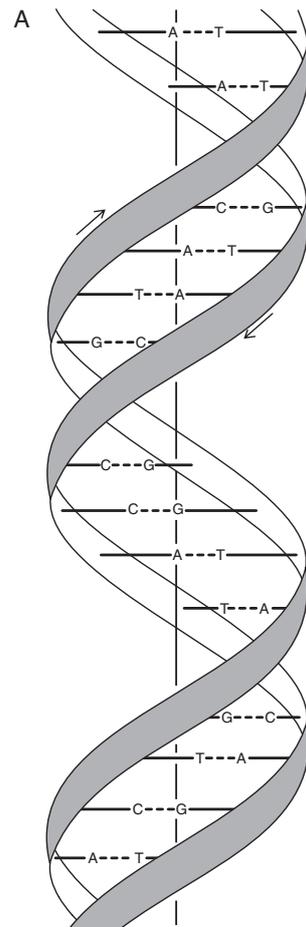


Figure 1.1 Examples of creative thinking (1937): A, DNA: The double helix; B, Picasso's *Guernica*; C, Examples of problems

C	<b>Balance</b> You have four indistinguishable coins—two heavy and two light. How can you tell which are which in two weighings on a balance scale? <i>Solution:</i> Weigh any two coins. (A) If they do not balance, one is heavy and one is light. Repeat with the other two. (B) If they balance, they are both light or both heavy. Replace one coin with one of the two that remain, that will tell you whether the original pair is light or heavy.
	<b>Cards</b> Three cards are lying face down. To the left of a queen is a jack; to the left of a spade is a diamond; to the right of a heart is a king; to the right of a king is a spade. Assign the proper suit to each card. <i>Solution:</i> Lay out information in an array: Jack of hearts, king of diamonds, queen of spades.
	<b>Prisoner</b> A prisoner in a tower finds a rope reaching halfway to the ground. He divides it in half, ties the two pieces together, and escapes. How? <i>Initial solution:</i> The problem is impossible. <i>Solution:</i> He unravels the rope <i>lengthwise</i> and ties the two pieces together.
	<b>Basketball game</b> Our basketball team won last night, 74–55, and yet not one man on the team scored so much as a single point. How is that possible? <i>Solution:</i> It was our women’s basketball team.

Figure 1.1 (continued)

we bestow honors, such as Nobel Prizes, on those who have produced such things, and the stories of their lives and accomplishments fill our history books and encyclopedias. By understanding how creative products are brought about, we may be able to increase the likelihood that innovations will occur, thereby making life better for us all.

In addition, creative thinking is also big business. Our largest and most prestigious corporations, as well as the largest government agencies, are constantly searching for ways to be more innovative, and they pay handsome fees to consultants who will help them achieve new levels of innovation from their employees. Institutions of higher education also take interest in teaching creative thinking. Many university business schools offer courses that are designed to provide business leaders—both those of the future and present-day ones who return for a refresher—with skills that will enable them to solve on-the-job problems. At the grassroots level, one constantly

reads accounts of debates concerning the best way to structure our educational system so that children come out as young adults who are able to think creatively. It is therefore important that we have some idea of how creativity comes about, so that we can make decisions concerning how individuals might be helped in dealing with situations that demand creativity.

### *Beliefs about Creativity*

There are two difficulties in discussing research on creativity. Some people, even people with very deep knowledge of psychological phenomena, come to the subject of creativity with the belief that the topic is so mystical and/or subjective that it could never be captured by psychological methods (Sternberg & Lubart, 1996). In this view, we cannot even define what terms like *creativity* and *creative* mean, so as a consequence we cannot even discuss them coherently, much less study them using scientific methods. I have sometimes been asked by other cognitive psychologists—that is, people whose professional lives are involved in bringing difficult-to-study psychological phenomena under scientific scrutiny—how one could ever study creative thinking. They cannot see how one can bring creativity under scientific investigation. One purpose of this book is to demonstrate how something as seemingly difficult to pin down as creativity can be defined and brought under scientific study.

Other people, from inside and outside psychology, come to the discussion of creativity with the belief that, even if we can define creativity and begin to study it, there is no purpose in doing so, because creativity comes about as the result of almost supernatural powers. In this view, the people who bring about things like those in Figures 1.1A and 1.1B are basically different from ordinary people: They are endowed with gifts that the rest of us do not have. Learning about what they do and how they do it, even if it were possible to do so, might be of some interest in its own right, but it would not tell us much that would be useful. The differences between the creative greats and ordinary people are in this view assumed to be of two sorts. On the one hand, the greats do not think as you and I do, and the differences between “real” creativity and the activities that you and I carry out are so great as to be unbridgeable. The relatively simple problems presented in Figure 1.1C may require some creativity for solution, but those problems are so different from the situations in which great artists, inventors, and scientists work that entirely different cognitive processes must be involved. So the processes involved when you and I solve such problems would not tell us much about “real” creativity. Second, there are

assumed to be critical differences in personality structure between creative and ordinary individuals, and those differences are assumed to play a role in making some people creative.

Most psychologists who have developed theories on creative thinking and creative persons take a different perspective on these issues. Although many psychologists believe that creative thinking depends on specific thought processes, they also believe that those processes can be carried out to some degree by all of us. Those who produce great creative advances might be *better* creative thinkers, but the same thought processes are available to or present in all of us. Similarly, if there is a specific set of personality characteristics that are related to creative achievement, those characteristics are assumed to be present to some degree in many if not all of us; they are simply present to a higher degree in those who produce great creative achievement. According to this perspective, then, creative capacity may to some degree be present in all of us (e.g., Amabile, 1996; Csikszentmihalyi, 1996; Eysenck, 1993; Guilford, 1950; Sternberg & Lubart, 1995).

There is also a minority view in psychology (e.g., Perkins, 1981; Newell, Shaw, & Simon, 1962; Weisberg, 1980, 1986, 2003), to which I subscribe, that proposes that the thought processes underlying the production of innovations are the same thought processes that underlie our ordinary activities. From this perspective, the term *creative thinking* is misleading at least and perhaps a misnomer, because one thinks creatively by using ordinary thinking; one just uses that ordinary thinking to bring about innovations (see also Klahr & Simon, 1999). This does not mean that there is no such thing as creativity, however. There is no doubt that scientists, artists, and inventors, for example, bring forth innovations. It is just that those innovations are based on the ordinary thought processes that we all carry out.

One task of this book is to review a representative sample of the various theories of creativity proposed by psychologists and to examine their structure, the predictions that are derived from them, and the evidence for and against them. A further task of this book will be to show that there is a relatively close relationship between creative thinking and other forms of cognition, such as problem solving, reasoning, and the use of memory. That is, the view motivating the presentation in this book is that creative thinking is not different from ordinary thinking—the thinking that we use in carrying out our day-to-day activities. I will show also that the differences in personality and other psychological characteristics between creative individuals and ordinary people may not be very large, and, furthermore, those differences may not be crucial in making creative people creative.

---

sample content of Creativity: Understanding Innovation in Problem Solving, Science, Invention, and the Arts

- [read online Game Physics Engine Development: How to Build a Robust Commercial-Grade Physics Engine for your Game \(2nd Edition\) pdf, azw \(kindle\), epub, doc, mobi](#)
- [Encyclopedia of Foods: A Guide to Healthy Nutrition pdf](#)
- [read \*Inside Syria: The Backstory of Their Civil War and What the World Can Expect online\*](#)
- [Tome of the Undergates \(The Aeons' Gate, Book 1\) pdf, azw \(kindle\), epub, doc, mobi](#)
  
- <http://aneventshop.com/ebooks/Game-Physics-Engine-Development--How-to-Build-a-Robust-Commercial-Grade-Physics-Engine-for-your-Game--2nd-Editio>
- <http://metromekanik.com/ebooks/Encyclopedia-of-Foods--A-Guide-to-Healthy-Nutrition.pdf>
- <http://aneventshop.com/ebooks/The-Poison-King--The-Life-and-Legend-of-Mithradates--Rome-s-Deadliest-Enemy.pdf>
- <http://aircon.servicessingaporecompany.com/?lib/Tome-of-the-Undergates--The-Aeons--Gate--Book-1-.pdf>