Brief Contents

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About This Course

An Invitation to the Student

We all learn best when we can apply new concepts to the world we know. The ninth edition of *The World of Psychology* allows you to do just that. Highly interactive and active, clearly written, and thoroughly up to date, this new edition of our textbook will encourage you to think for yourself as you learn about, relate to, and apply the psychological principles that affect your life.

So that you can make the most of all the material in the following pages, this textbook package incorporates a number of helpful features and ancillary items.

A Clear, Engaging Writing Style

Over the years, few texts have received such positive responses from students as *The World of Psychology*, and first and foremost is praise for its writing style. In fact, class tests of the first edition got 100 percent positive feedback and it has received continued positive reviews for each subsequent edition of the book. The style is conversational, and the text uses numerous everyday examples and real-life events to help you grasp even the most complex concepts. As well, the contents of each chapter are organized into modules to help chunk the information for easier reference.

Each chapter opens with a vignette (a dramatic real-life story or series of stories) or an activity that draws you into the topics that will be covered in the chapter and shows how psychology relates to the world around you. Each vignette or activity is memorable and directly related to the chapter's content.

You'll be especially interested in the stories and activities related to

- The positive and negative impact of social media.
- How our brain has adapted to the use of emojis.
- How to control your dreams.
- What happens if a child is raised in the wild.

Canadian Connections introduces interesting historical or more recent Canadian news events with the goal of demonstrating how these experiences you have heard about fit within psychology. These interesting stories provide meaningful real-world examples to aid in understanding the material presented in the chapters. Some *Canadian Connections* boxes highlight cutting-edge contemporary research being conducted in Canadian universities. This will give you an opportunity to see what current research is being conducted in Canada with respect to the topics you are reading about and an idea of the diverse array of research being conducted across Canada today.

Interact with Your Textbook

What better way to learn new material—to make it fresh, interesting, and memorable—than for you to demonstrate the principles for yourself? The unique *Try It* feature encourages you to learn by doing. This highly praised feature provides simple experiments that you can perform without elaborate equipment, usually as you read.

Knowing what to study and how to discriminate between critical points and fine or more peripheral details is a challenge for any new learner to an area. The *Learning Objectives* at the beginning of each module will help orient you to the key ideas and organize information as you read. These features follow from a substantial body of research showing that memory and comprehension can be improved by organizing information.

In addition, research has shown that checking your progress at key points as you study will also help you remember what you have read. One other way you can interact with your textbook is by taking the quizzes at the end of each module.

Finally, you'll have a chance to relate psychological principles to your own life in the *Apply It* section at the end of each chapter. Each *Apply It* helps you to apply psychology to your personal life and issues. Topics include

- Tips to reduce anxiety about public speaking.
- How to prepare and make a good impression in job interviews
- How dangerous is it to talk on, text, or use a cellphone while driving?
- What should you consider when choosing a therapist?
- How can you improve your memory using mnemonic strategies?

Content Highlights

In preparing the ninth edition of this book, our primary goals were to introduce critical issues in psychology accurately and clearly to students, using a format that is both interesting and memorable. We present the principles of psychology using a clear and engaging writing style and a pedagogically sound learning format that is accessible and appealing to students.

Having taught thousands of students their first course in psychology, we are sensitive to the complexities of the teaching/learning process, and are acutely aware of the tremendous changes that have occurred in the field of psychology over the years. With this in mind, we sought to create a textbook that is sensitive to the changing needs of students and their professors and that will provide a context in which readers may learn about psychology's past, present, and probable future.

The Ninth Edition

Despite the overwhelming response to our first eight Canadian editions of *The World of Psychology*, we have incorporated a number of improvements into the new edition. In accordance with reviewer suggestions and the goals stated above, the ninth Canadian edition features the following elements:

- The modular structure introduced in our fifth edition was retained and further refined in this edition. The modular framework divides each chapter into manageable "chunks" of information that are easier for instructors to assign and for students to read. Organizing material into meaningful chunks helps improve students' memory by supporting the organization of information, and the smaller units make it easier to remember by minimizing the demands on working memory capacity—or memory span. It also allows for increased flexibility for instructors when assigning material.
- *Learning Objectives* appear at the beginning of each module, and learning objective numbers are presented with the corresponding material in the text. The goal of the learning objectives is to provide an organizer for students at the outset of each module. This will help students to understand how to read the material in each chapter by highlighting the critical information to be learned. This feature will enhance the learning experience by promoting greater memory and comprehension. Learning objectives and the corresponding summaries at the end of the chapter have been revised to ensure clear, succinct connections throughout this text.
- Canadian and international research has been updated to reflect new trends and areas of focus in psychology research as well as societal changes.
- The *Canadian Connections* boxes highlight events past and present that show how Canadians are or have been involved in the issues being presented in the text. For example, some *Canadian Connections* boxes highlight key Canadian researchers and their most recent work, while others integrate Canadian historical events with current issues. These boxes integrate Canadian contributions and events within the broader field of psychology.
- The opening vignettes share important stories to draw attention to the practical and real-world importance of the information in the chapter. New vignettes invite students to complete activities or mini-surveys to engage them more directly in the content that will follow.

Canadian Context

Our Canadian colleagues and their students find that many introductory psychology texts target an American audience. We believe that students learn best when materials are relevant to their lives. The Canadian content in this text includes events in the media, current research, and historical references to Canadian facts and contributors. By including information that is more meaningful to Canadian students, we hope to enhance their understanding and retention of the material.

Part of the Canadian identity is our recognition of the diversity in society. To acknowledge this, we have made an effort to include the influential work of psychologists from around the world. Also, we have tried to include events and studies from different regions of Canada. We believe this added value makes *The World of Psychology*, Ninth Canadian Edition, a balanced, universal text.

A Clear, Understandable, Interesting Writing Style

First and foremost, a textbook is a teaching instrument. A good psychology textbook must communicate clearly to a wide audience of various ages and levels of academic ability. Our book is appealing to accomplished students, yet accessible to those whose academic skills are still developing.

We achieved this objective (we hope) by explaining concepts in much the same way as we do in our own psychology classes. Throughout the text we sought to ensure flow and continuity by using a conversational style and avoiding abrupt shifts in thought. In addition, the text is filled with everyday examples that are pertinent to students' lives.

A Series of High-Interest Features That Will Appeal to Today's Students

Every chapter opens with a vignette or activity to capture student interest and build motivation. We have also included special features:

- *Apply It* sections show the practical applications of the principles of psychology.
- *Canadian Connections* discuss Canadian news events that demonstrate concepts outlined in the text and/or highlight contemporary research being conducted in Canadian universities.
- *World of Psychology* boxes in selected chapters explore issues that should be of special interest to students.

A Textbook That Encourages Students to become Active Participants in the Learning Process

Reading about psychology is not enough. Students should be able to practise what they have learned, where appropriate. Many of the principles we teach can be demonstrated, often without elaborate equipment and sometimes as the student reads. What better way to teach new material and make it fresh, interesting, and memorable than to have students demonstrate principles for themselves using an important and innovative

element of the book: *Try It* sections? The response to *Try It* demonstrations from professors and students has been so positive that this feature appears in every chapter. The *Try It* sections personalize psychology and make it come alive.

Student involvement is also promoted through the use of rhetorical questions and by casting the student in the role of the participant in selected studies and descriptions of real-life events. Thus, students who use *The World of Psychology* become active participants in the learning process rather than simply passive recipients of information.

An Emphasis on Critical Thinking

Thinking critically does not call for being critical of all viewpoints other than one's own. Rather, critical thinking is a process of evaluating claims, propositions, or conclusions objectively in order to determine whether they follow logically from the evidence presented. Critical thinkers are open-minded, objective, and unbiased, and they maintain a skeptical attitude that leads them to search for alternative explanations.

Help for Students to Understand Human Diversity and More Fully Comprehend the Part Multicultural Issues Play in Contemporary Psychology

Human diversity issues are integrated throughout the book, both within the main text presentation and as highlighted special features. This form of presentation parallels the presence of diversity in Canada as a mainstream and special-interest issue. Diversity issues include cultural, gender, and age concerns in selected topic areas in each chapter. For example, in Chapter 1 we focus on the problem of bias. Later, we discuss the impact of culture on memory, the effect of personality on perception, the interpretation of emotion, and preferred forms of therapy. These, along with other segments, help to promote understanding of human diversity and how it is an integral part of our perception of the world.

Current Coverage That Preserves the Classic Contributions in Our Field

Advances in knowledge and research are occurring at an ever-increasing pace, and modern authors must keep abreast. This edition introduces students to the most up-to-date research on many topics that feature rapid change, including advanced technologies, neuropsychology, gender, changes in social norms, violence, PTSD, aggression and stress, adolescent drug use, and new therapies.

Yet we do not value newness for its own sake. We include, as well, studies that have stood the test of time, and we explore the classic contributions to psychology in depth.

An Appreciation of Psychology's History and an Understanding That Psychology Is a Living, Growing, Evolving Science

A portion of Chapter 1 is devoted to psychology's history. But in our view, the history of psychology is best understood and appreciated in the context in which the contributions were made. Consequently, discussions of such topics as learning, memory, intelligence, emotion, and personality integrate both historical and recent research contributions to show how psychology has evolved up to the present day.

An Accurate and Thoroughly Researched Textbook That Features Original Sources

To accomplish our goal of introducing the world of psychology accurately and clearly, we have gone back to original sources and have read or reread the basic works of the major figures in psychology and the classic studies in the field. We have also reviewed countless new studies to ensure that the information provided is at the cutting edge of research. This has enabled us to write with greater clarity and assurance, without having to hedge or write tentatively when discussing what experts in the field have actually said. This book is one of the most carefully researched, up-to-date, and extensively referenced psychology textbooks available.

A Sound Pedagogical System in the Text and Learning Package

The pedagogical system in *The World of Psychology* consists of the following components:

- ***Learning Objectives.*** Learning objectives orient students to the critical information to be learned within each module.
- ***Review & Reflect Tables and Summarize It Widgets.*** We have expanded our use of the extremely popular summary tables and widgets, called *Review & Reflect* and *Summarize It*, which are useful for reviewing and comparing various perspectives, theories, and other concepts.
- ***Text-Embedded Glossary.*** A text-embedded glossary provides a ready reference for important key terms that appear in boldface in the text. Definitions appear in context and also in the *Glossary* at the back of the book.
- ***Summary & Review.*** These end-of-chapter features provide succinct summaries for key concepts.

About the Authors

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Samuel E. Wood (deceased) received his doctorate from the University of Florida. He has taught at West Virginia University and the University of Missouri–St. Louis and was a member of the doctoral faculty at both universities. From 1984 to 1996, he served as president of the Higher Education Center, a consortium of 14 colleges and universities in the St. Louis area. He was a co-founder of the Higher Education Cable TV channel (HEC-TV) in St. Louis and served as its president and CEO from its founding in 1987 until 1996.

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Ellen Green Wood received her doctorate in educational psychology from St. Louis University and was an adjunct professor of psychology at St. Louis Community College at Meramec. She has also taught in the clinical experiences program in education at Washington University and at the University of Missouri–St. Louis. In addition to her teaching, Dr. Wood has developed and taught seminars on critical thinking. She received the Telecourse Pioneer Award from 1982 through 1988 for her contributions to the field of distance learning.

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Denise Boyd received her Ed.D. in educational psychology from the University of Houston and has been a psychology instructor in the Houston Community College System since 1988. From 1995 until 1998, she chaired the psychology, sociology, and anthropology department at Houston Community College–Central. She has co-authored three other Pearson Allyn and Bacon texts: with Helen Bee, *Lifespan Development* (Sixth Edition), *The Developing Child* (Thirteenth Edition), and *The Growing Child* (First Edition); and with Genevieve Stevens, *Current Readings in Lifespan Development*. A licensed psychologist, she has presented a number of papers at professional meetings, reporting research in child, adolescent, and adult development. She has also presented workshops for teachers whose students range from preschool to college.

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Eileen Wood received her doctorate from Simon Fraser University. She is a full professor in the Department of Psychology at Wilfrid Laurier University. She conducts research in developmental and educational psychology. Her primary research interests involve studying how people acquire, maintain, and recall information, especially when technologies are involved. She applies this research to numerous contexts including: assessing software content and design for the acquisition of literacy and numeracy skills, multitasking in higher education classrooms, and instructional strategies to promote teaching and learning across cultural contexts. Her secondary research interests involve development of work and pay expectations and parent–child social interactions. Dr. Wood has authored many books, book chapters, and articles. She is a 3M Teaching Fellow and has received numerous teaching awards. Dr. Wood has also earned award recognition for her research. Dr. Wood primarily teaches introductory and developmental psychology at the undergraduate level and developmental psychology at the graduate level. She works collaboratively with school boards and teachers in Canada and internationally as well as community groups working toward enhancing learning for learners of all ages.

Serge Desmarais

Serge Desmarais received his Ph.D. in social psychology from the University of Waterloo. He is a full professor, a past recipient of a Canada Research Chair in applied social psychology, and the former Associate Vice-President (Academic) at the University of Guelph, a role he served in for more than ten years. Dr. Desmarais started teaching introductory psychology in his first academic position in 1990, and has taught this course regularly since the beginning of his career. He is the recipient of several University of Guelph teaching awards. Dr. Desmarais is an active researcher and the author of many articles and book chapters in the areas of teaching and learning, interpersonal relations, work and pay expectations, gender issues, and the personal consequences of social media.

Dedications

To Chris, for her humour and joy in good times, and for her care and patience in bad.

—S.D.

To my family, who are my inspiration, and my greatest delight.

—E.W.

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Chapter 1

Introduction to Psychology

Mark edwards/Fotolia

How often do you use social media? Do you use Facebook, Instagram, or Twitter? Are you a regular YouTube watcher? Our educated guess is that most of you rely heavily on social media for many aspects of your daily lives. After all, recent Canadian data show that 22.69 million Canadians, or roughly 62 percent of the population, are regular users of social media (Statistica, 2017). Social media are changing the very nature of social relationships and communications. This is especially true for college and university students who were the earliest to adopt social media and remain its most frequent users (Pew Research Center, 2017).

As all of you know, social media are now integrated in many, if not most, aspects of our daily lives. They can help you keep in touch with friends, family, and acquaintances, find new friends, show pictures of trips, share selfies, and even serve as a way to start—or end—relationships. Social media are also used to watch shows, engage in political conversations, or invite people to a party. While popular, engaging, and convenient, social media are not without problems. For instance, social media open up a person's world—activities, list of friends, and personal information—to full public scrutiny (boyd & Ellison, 2007), creating some serious concerns over issues of personal privacy (Acquisti, Brandimarte, & Loewenstein, 2015). Other research indicates that social media, such as Facebook, may also cause jealousy among romantic partners and may negatively impact romantic relationships (Muise, Christofides, & Desmarais, 2009, 2014). But the potential problems associated with social media do not change the fact that they are now a significant part of everyday life—how many of us could live without them? This fact raises many important questions: Is this technology changing us? Has it become so difficult to make personal connections in our daily lives that we must use social media as a way of keeping in touch with our friends or reconnecting with people we once knew? Why is it that people are now so willing to open up their lives for the world to see, whereas only a few years ago most of us would have hidden our diaries for fear of having our perceptions, dreams, and fantasies revealed? Has technology blurred the lines between public and private life?

When you hear the word *psychology*, what is the first thing that comes to mind? Do you think about social media such as Facebook, Snapchat, or Twitter? Probably not. However, it is exactly these simple parts of our daily lives that connect us all to the field of psychology, from our daily actions and thoughts, to the way we present ourselves to others whether in person or online, to how our brain conceives of the world around us. Most people have a very poor conception of the area of psychology. They often think that this field of research tends to focus only on psychological disorders and what is done in psychotherapy. This incorrect perception is guided most frequently by what is shown in popular media, from TV shows that only portray psychologists working in criminal fields or with clients who have psychological disorders, to self-help books that often focus on relationships and personal growth. The fact is that psychology covers more issues than you'd expect, including the everyday exchanges we have with friends and others in our virtual and online worlds!

There are many branches of psychology and you will be introduced to them all in this text. Psychologists specializing in the different areas of psychology look at situations from different perspectives. For example, given today's use of social media to connect with our friends and social network, a social psychologist might want to examine whether connecting with people online affects the quality of those relationships; do people who frequently use Facebook, Twitter, or Instagram to keep in touch with their friends or family maintain as close a relationship with them as those who tend to meet face to face? A personality psychologist, on the other hand, might want to find out what personal characteristics are associated with using social media. Are shy people more likely to prefer this means of interaction? Are self-centred people more likely to take lots of selfies or reject selfies that don't project an idealized version of themselves? In contrast, a cognitive psychologist might want to investigate whether using social media influences the way we think, write, or communicate with others. Will the increased use of abbreviations, such as those we use when communicating with each other by text message, affect how people talk to each other? And a developmental psychologist might want to know whether children who start using social media early in life will develop a different understanding of themselves and the world around them—are children aware that the material they post on most social media may be entirely accessible by anyone? (For that matter, are *you* aware of that?)

It is not possible in this brief introduction to portray the full range of research possibilities that might interest psychologists wanting to study the impact that social media or other online communication tools have on our lives or even to consider the ways in which these various research avenues might be investigated. This book, *The World of Psychology*, is designed to expose you to psychological research and to help clarify some of the complexities of this academic discipline and its application.

Module 1.1 Introduction to Psychology

LO 1.1 Define *psychology*.
LO 1.2 Identify and explain psychology's four primary goals.
LO 1.3 Explain what a theory is.
LO 1.4 Compare and contrast basic and applied research.

The word *psychology* often conjures up images of mental disorders, abnormal behaviour, and adjustment to difficult periods of life. As we pointed out above, however, although psychologists do sometimes study the strange and unusual, they are most often interested in day-to-day events—the normal and commonplace.

Just what is psychology? Psychology has changed over the years and so has its definition. In the late 1800s, mental processes were considered to be the appropriate subject matter of psychology. Later, there was a movement to restrict psychology to the study of observable behaviour alone. Today, the importance of both areas is recognized, and **psychology** is now defined as the scientific study of behaviour and mental processes. **[LO 1.1]**

psychology
The scientific study of behaviour and mental processes.

Before you read the next section, answer the questions in the *Try It* below to see how much you already know about some of the topics we will explore in *The World of Psychology*.

Psychology: Science or Common Sense?

Most people tend to have a vague understanding of psychology. For instance, students often begin their first course in psychology with a sense that psychology is more common sense than science. But can we make a valid claim that psychology is a science?

Try It

Test Your Knowledge of Psychology

Indicate whether each statement is true or false.

1. Memory is more accurate under hypnosis.
2. All people dream during a night of normal sleep.
3. As the number of bystanders at an emergency increases, the time it takes for the victim to get help decreases.
4. There is no maternal instinct in humans.
5. Older adults tend to express less satisfaction with life in general than younger adults do.
6. Eyewitness testimony is often unreliable.
7. Children with high IQs tend to be less able physically than their peers.
8. Creativity and high intelligence do not necessarily go together.
9. When it comes to close personal relationships, opposites attract.
10. The majority of teenagers have good relationships with their parents.

Let's consider your own answers to the questions: Is it possible that what you believed to be common sense may have led you astray? All the odd-numbered items are false, and all the even-numbered items are true. So common sense, on its own, will not take you very far in your study of psychology.

Many people believe that whether a field of study is a science depends on the nature of its body of knowledge. Physics, for example, is a science, and so is chemistry. But neither qualifies as a science solely because of its subject matter. A science is a science not because of the nature of its body of knowledge, but because of the approach—the standards, methods, values, and general principles—employed in acquiring that body of knowledge. Psychology is considered a science because it uses the scientific method, which attempts to minimize biases, preconceptions, personal beliefs, and emotions (Christensen, Burke Johnson, & Turner, 2014).

The Goals of Psychology

What are the four goals of psychology?

The goals of psychology are the description, explanation, prediction, and influence of behaviour and mental processes. **[LO 1.2]** Psychological researchers always seek to accomplish one or more of these goals when they plan and conduct their studies.

The first goal, *description*, is usually the first step in understanding any behaviour or mental process. To describe a phenomenon, we must make accurate notes about the behaviours or situations we observe. These observations become our *data*—the specific pieces of information we use in our analyses. For instance, if you are examining how two strangers from different cultures relate to each other when they meet for the first time, you need to keep accurate notes about every detail of the interaction—how long they look at each other, how far away they stand from each other, along with all other details of their behaviour. The goal of description is usually more important in a very new area of research or in the early stages of research.

The second goal, *explanation*, requires an understanding of the conditions under which a given behaviour or mental process occurs. This step certainly goes beyond description. Here, researchers try to understand the causes of the behaviour or mental process. In other words, the explanation goal allows researchers to tell "why" a given event or behaviour occurred—for example, why do strangers who meet for the first time stand far away from each other? Why does one of them smile when the other one smiles? But researchers do not reach the goal of explanation until their results have been tested, retested, and confirmed. Researchers confirm an explanation by eliminating or ruling out other, competing explanations.

The goal of *prediction* is met when researchers can specify the conditions under which a behaviour or event is likely to occur. The goal here is to understand or predict the likelihood that an event will occur under a certain set of circumstances. Researchers might ask, for example, whether the distance at which strangers stand from each other differs as a result of the culture they come from. In other words, can culture predict social distance? Is there a predictable or replicable pattern? If researchers have identified all the prior conditions required for a behaviour or event to occur, they can predict the behaviour or event.

The goal of *influence* is accomplished when researchers know how to apply a principle or change a condition to prevent unwanted occurrences or to bring about desired outcomes. The ability to influence behaviour can have positive consequences. For instance, it enables psychologists to design types of therapy to prevent anxiety attacks or depression. It also enables researchers to develop techniques that can be employed to improve one's memory.

What Is a Theory?

Any science has a well-established body of theory to guide its research, and psychology is no exception. A **theory** is a general principle or set of principles that explains how a number of separate facts are related to one another. [LO 1.3] In other words, a theory is an attempt to explain why something happens. It is based on evidence and attempts to predict the future occurrence of an event or action. A theory enables researchers to fit many separate facts into a larger framework; it imposes order on what otherwise would be a disconnected jumble of data. The value of a theory depends upon how well it accounts for the accumulated research findings in a given area and upon how accurately it can predict new findings.

theory
A general principle or set of principles that explains how a number of separate facts are related to one another.

A theory serves two important functions: (1) it organizes facts—a necessary step toward arriving at a systematic body of knowledge; and (2) it guides research. When researchers conduct a new study, they test the theory's accuracy. If the theory's predictions are supported, this new finding serves to reinforce the general principles that underlie the theory. But it is important to remember that a good theory is one that provides an explanation that is clear, comprehensive, explicit, simple, and always *falsifiable*. A falsifiable theory is scientific because it is testable and can be rejected if the predictions are not confirmed. Theories are not certainties—they are made to be tested and changed if the data do not support the theory's predictions. Researchers often use theories to generate hypotheses, as we'll discuss later in this chapter.

Basic and Applied Research

What is the difference between basic and applied research?

The two main types of research that psychologists pursue to accomplish their goals are (1) basic, or pure, research and (2) applied research. [LO 1.4] The purpose of **basic research** is to seek new knowledge and to explore and advance general scientific understanding. Basic research investigates such topics as the nature of memory, brain function, motivation, and emotional expression; the causes of mental disorders such as schizophrenia, depression, sleep and eating disorders; and so on. Psychologists doing basic research usually seek to accomplish the first three goals—description, explanation, and prediction. Basic research is not intended to solve specific problems, nor is it meant to investigate ways to apply what is learned to immediate real-world problems. Yet very often the findings of basic research are later applied in real-world settings. For example, much basic research in neuroscience has resulted in the development of new drugs that have improved the lives of those who suffer from psychological disorders.

basic research
Research conducted for the purpose of advancing knowledge rather than for its practical application.

Applied research is conducted with the specific goal of solving practical problems and improving people's quality of life. Applied research focuses on such things as methods to improve memory or increase motivation, therapies to treat mental disorders, ways to decrease stress, and factors that improve people's job satisfaction. Applied

applied research
Research conducted for the purpose of solving practical problems.

Module 1.2 Descriptive Research Methods

- **LO 1.5** Identify and compare the several types of descriptive research methods.
- **LO 1.6** Compare and contrast naturalistic and laboratory observations, including their advantages and limitations.
- **LO 1.7** Compare and contrast case studies and survey research, including their advantages and shortcomings.
- **LO 1.8** Explain why researchers use correlational studies.
- **LO 1.9** Define *correlation coefficient* and explain how to interpret it.

Although naturalistic observation allows researchers to study behaviour in everyday settings, observer bias may cause them to see what they expect to see.

Bill Aron/PhotoEdit

psychologists are primarily concerned with the fourth goal of psychology—influence—because it specifies ways and means of changing behaviour. You will learn more about some fields of applied psychology at the end of this chapter.

The goals of psychological research—description, explanation, prediction, and influence—are typically accomplished in stages. In the early stages of research, descriptive methods are usually the most appropriate since they allow researchers to identify and describe a particular phenomenon. When using **descriptive research methods**, the intent is not to identify causes of behaviour; here, the goal is only to describe a behaviour. Naturalistic observation, laboratory observation, the case study, and the survey are examples of descriptive research methods. [LO 1.5]

descriptive research methods
Research methods that yield descriptions of behaviour rather than causal explanations.

Naturalistic Observation: Caught in the Act of Being Themselves

What is naturalistic observation, and what are some of its advantages and limitations?

Naturalistic observation is a research method in which researchers observe and record behaviour in its natural setting without attempting to influence or control it. [LO 1.5] Ethologists are researchers who study the behaviour patterns of animals in their natural environment. These researchers might observe their subjects through high-powered telescopes or from blinds that they build to conceal themselves.

naturalistic observation
A research method in which researchers observe and record behaviour without trying to influence or control it.

Often human participants are not aware that they are being observed. This can be accomplished by means of one-way mirrors, a technique researchers often use to observe children in nursery schools or special classrooms. At times, researchers may use hidden cameras or tape recorders to collect research data. The major advantage of naturalistic observation is that it allows one to study behaviour in normal settings, where it occurs more naturally and spontaneously. [LO 1.6] Naturalistic observation may be the only feasible way to study certain phenomena when an experiment would be impossible or unethical—for example, to learn how people react during disasters such as earthquakes or fires.

Laboratory Observation: A More Scientific Look at the Participant

Another method of studying behaviour involves observation that takes place not in a natural setting but in the laboratory. **[LOs 1.5 & 1.6]** There, researchers can exert more control over the environment, which helps limit the effect of unexpected factors. Making observations in a laboratory may also result in the use of more precise equipment to measure responses. Much of our knowledge about sleep, for example, has been gained by laboratory observation of participants who sleep for several nights in a sleep laboratory or sleep clinic. Of course, laboratory control can have its disadvantages. For instance, researchers may lose the spontaneity that occurs when behaviours take place in a more natural setting. This disadvantage is especially relevant for human interactions that tend to be strongly affected by environmental factors.

The Case Study Method: Studying a Few Participants in Depth

What is the case study method, and for what purposes is it particularly well suited?

Another descriptive research method used by psychologists is the **case study**, or case history. **[LO 1.7]** In a case study, a single individual or a small number of people is studied in great depth, usually over an extended period of time. A case study involves observation, interviews, and sometimes psychological testing. A case study is exploratory in nature, and its purpose is to provide a detailed description of some behaviour or disorder. This method is particularly appropriate for studying people who have uncommon psychological or physiological disorders or brain injuries. Case studies often emerge in the course of treatment of these disorders. In fact, much of what we know about unusual psychological disorders comes from the in-depth analyses provided by case studies.

case study
An in-depth study of one or a few participants consisting of information gathered through observation, interviews, and perhaps psychological testing.

Although the case study has been useful in advancing knowledge in several areas of psychology, it has certain limitations. In a case study, researchers cannot establish the cause of observed behaviours. Moreover, because so few people are studied, researchers do not know how generalizable their findings are to larger groups or to different cultures. **[LO 1.7]**

Survey Research: The Art of Sampling and Questioning

What are the methods and purposes of survey research?

Psychologists are interested in many questions that cannot be investigated using naturalistic observation or case studies. With a **survey**, researchers use interviews and/or questionnaires to gather information about the attitudes, beliefs, experiences, or behaviours of a group of people. **[LO 1.7]** Well-designed and carefully conducted surveys have provided much of the information available to us about the incidence of drug use, about the sexual behaviour of particular segments of the population, and about the incidence of various mental disorders.

survey
A method whereby researchers use interviews and/or questionnaires to gather information about the attitudes, beliefs, experiences, or behaviours of a group of people.

Selecting a Sample: More to Consider Than Numbers

What is a representative sample, and why is it essential in a survey?

Researchers in psychology rarely conduct experiments or surveys using all members of the group they are studying. For example, researchers studying the sexual behaviours

population
The entire group of interest to researchers to which they wish to generalize their findings; the group from which a sample is selected.

sample
The portion of any population that is selected for study and from which generalizations are made about the larger population.

representative sample
A sample of participants selected from the larger population in such a way that important subgroups within the population are included in the sample in the same proportions as they are found in the larger population.

of Canadian women do not attempt to study every woman in Canada. Instead of studying the whole **population** (the entire group of interest, or target population), they study a sample. A **sample** is a part of the population that is selected and studied in order to reach conclusions about the entire larger population of interest.

However, researchers must ensure that the sample is representative. A **representative sample** is one that includes important subgroups in the same proportion as they are found in the larger population. That is, the representative sample should reflect the economic, ethnic, cultural, and sexual diversity of the target population.

The Use of Questionnaires

Researchers using the survey method rely on information gathered through questionnaires or interviews, or through some combination of the two. Questionnaires can be completed more quickly and less expensively than interviews.

Many people believe that a survey becomes more accurate when more people answer it. In fact, the number of people who respond to a survey is not the critical element. A researcher can generalize findings from a sample only if it is representative of the entire population of interest. For example, the readers of *Chatelaine* or *The Hockey News* do not represent a cross-section of Canadians. Similarly, questionnaires in magazines or conducted online are typically not scientific; neither are TV or radio phone-in surveys. Good surveys control wording, context, and format (Hippler, Schwarz, & Sudman, 2012; Schwarz, 1999).

The Interview

Skilled interviewers can gather accurate information by asking well-worded questions of a carefully selected sample of participants. When respondents feel comfortable with an interviewer, they feel freer to share personal information. Imagine that you are being interviewed about a sensitive subject such as your sexual behaviour. Will you be equally comfortable and truthful whether the interviewer is male or female? Young, middle-aged, or old? Chinese, black, francophone, or of another ethnic group? Christian, Muslim, or Jewish? The validity or truthfulness of responses can be affected by the interviewer's personal characteristics, which include gender, age, heritage, religion, social class, accent, and vocabulary.

Using the Internet for Survey Research

The internet now offers psychologists a way of soliciting participants and collecting survey responses that is fast, inexpensive, and often generates large numbers of responses (Gosling & Mason, 2015). Some researchers are concerned that internet survey samples are often biased because they represent only the population of internet users who choose to participate in online research studies. However, some recent studies of internet samples suggest that participants in these studies tend to match very closely those in other types of studies (Gosling & Johnson, 2010; Wolfe, 2017).

Advantages and Disadvantages of Survey Research

If conducted properly, surveys can provide highly accurate information about large numbers of people and can show changes in attitudes and behaviour over time. Yet large-scale surveys can also be costly and time-consuming. Researchers must have expertise in many areas—selecting a representative sample, constructing questionnaires, interviewing, and analyzing data.

The major limitation of the survey is that the respondents may provide inaccurate information. Respondents may give false information because of faulty memory or a desire to please the interviewer (saying what they think the interviewer wants to hear). Respondents may have a tendency to present themselves in a good light ("the social desirability response"). They may even deliberately mislead the researcher. **[LO 1.7]**

The Correlational Method: Discovering Relationships, Not Causes

What is the correlational method, and when is it used?

Researchers are often interested in understanding the relationship between two variables (any conditions that can be manipulated, measured, or controlled). For instance, we may want to know whether there is a relationship between the amount of time students devote to studying and their grade point average. Similarly, we may want to determine whether increases in stress are associated with poorer coping or whether increased use of marijuana is associated with lower interest in school and lower grades. To answer these types of questions, researchers often use what can be considered the most powerful type of descriptive method—the **correlational method**—which is used to determine the degree of relationship (correlation) between two characteristics, events, or behaviours. [LO 1.8]

correlational method
A research method used to establish the relationship (correlation) between two characteristics, events, or behaviours.

Correlations are not just important to scientists; they are also common in our everyday thinking. For example, you may have asked yourself whether the price of a new car relates to the social status you gain from owning it. Is it possible that as price goes up, status does as well? When researchers conduct correlational studies, they measure two variables with accuracy, and they apply a statistical formula to obtain a correlation coefficient that estimates the strength of association between the two variables.

The Correlation Coefficient: How Variables Relate

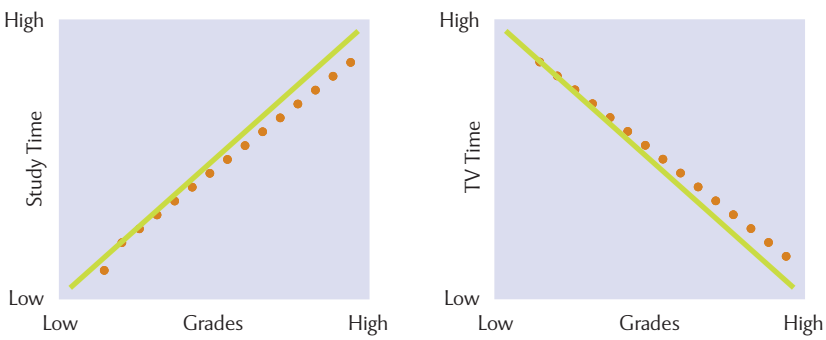
What is a correlation coefficient?

A **correlation coefficient** is a numerical value indicating the degree and direction of the relationship between two variables. [LO 1.9] A correlation coefficient ranges from +1.00 (a perfect positive correlation) to 0.00 (no relationship) to –1.00 (a perfect negative correlation). The sign of a correlation coefficient (+ or –) indicates whether the two variables vary in the same or opposite directions. A positive correlation indicates that two variables vary in the same direction. In other words, an increase in the value of one variable is associated with an increase in the value of the other variable, or a decrease in the value of one variable is associated with a decrease in the value of the other. There is a positive, though weak, correlation between stress and illness, for example. When stress increases, illness is likely to increase; when stress decreases, illness tends to decrease (see Figure 1.1).

correlation coefficient
A numerical value that indicates the strength and direction of the relationship between two variables; ranges from +1.00 (a perfect positive correlation) to –1.00 (a perfect negative correlation).

Figure 1.1 Positive and Negative Correlations

Here are two graphs showing positive and negative correlations. (a) When positively correlated scores on two variables are graphed, the points fall along a line that rises from left to right. This graph might represent two variables such as amount of time spent studying and grades on an exam. As study time goes up, exam grades go up as well. (b) When negatively correlated scores on two variables are graphed, the points follow a line that declines from left to right. This graph might represent two variables such as amount of time spent watching television and grades on an exam. As TV time goes up, grades go down.



(a) Positive Correlation, +.90 (b) Negative Correlation, -.94

A negative correlation means that an increase in the value of one variable is associated with a decrease in the value of the other variable. Think of a negative correlation as a seesaw—when one variable goes up, the other goes down. For example, there is a negative correlation between the number of cigarettes people smoke and the number of years they can expect to live. The more cigarettes people smoke, the shorter their life expectancy.

The number in a correlation coefficient indicates the relative *strength* of the relationship between two variables—the higher the number, the stronger the relationship. Examples of variables that are *not* correlated include grade point average and height, and illness and shoe size.

Correlation and Prediction

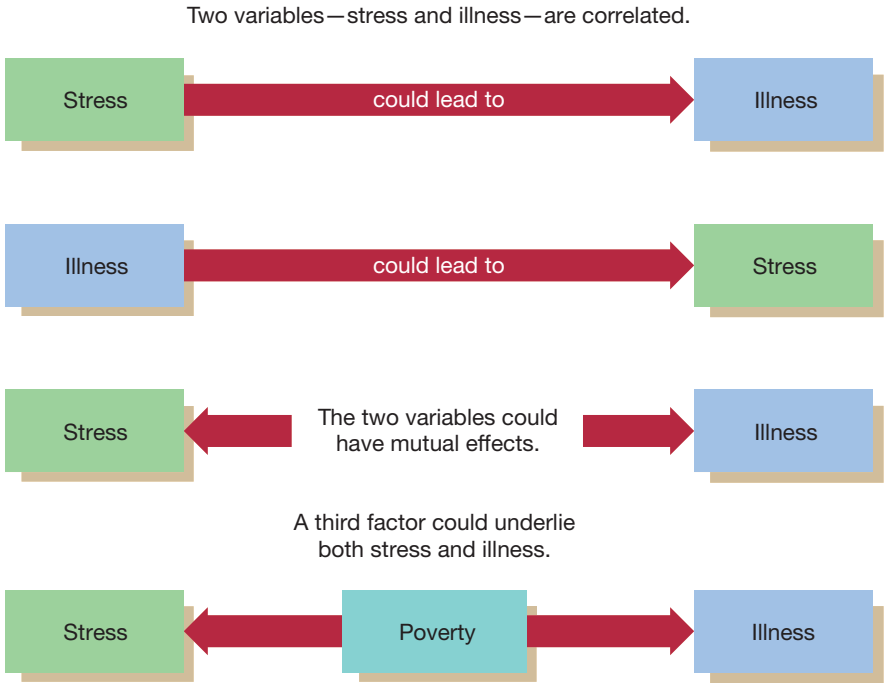
Correlations are useful in making predictions. The stronger the relationship between the variables, the better the prediction. A perfect correlation (+1.00 or −1.00) would enable you to make completely accurate predictions.

The fact that there is a correlation between two variables does not necessarily mean that one variable causes the other. Only the experimental method allows us to reach conclusions about cause and effect. When two variables such as stress and illness are correlated, we cannot conclude that stress makes people sick. It might be that illness causes stress, or that a third factor such as poverty or poor general health increases susceptibility to both illness and stress, as shown in Figure 1.2.

So, you might be thinking: If a researcher can't draw cause–effect conclusions, why do correlational studies? There are two main reasons. One reason is that it is sometimes impossible, for ethical reasons, to study variables of interest using more direct methods.

Figure 1.2 Correlation Does Not Prove Causation

A correlation between two variables does not prove that a cause–effect relationship exists between them. There is a correlation between stress and illness, but that does not mean that stress necessarily causes illness. Both stress and illness may result from another factor, such as poverty or poor general health.



Scientists can't ethically ask pregnant women to drink alcohol just so they can find out whether it causes birth defects. The only option available in such cases is the correlational method. We can ask mothers about their drinking habits and note any association with birth defects in their babies.

Another reason for using the correlational method is that many variables of interest to psychologists cannot be manipulated. We may want to know whether poverty causes health problems, but we can't assign individuals to be poor or rich so we can determine whether it causes health complications. In this case, the only option is to determine whether income and illness are correlated.

Module 1.3 The Experimental Method: Searching for Causes

LO 1.10 Define the *characteristics*, *process*, *advantages*, and *disadvantages* of experimental research.

LO 1.11 Define the following terms and explain their relationship to experimental research:

1. hypothesis
2. independent and dependent variables
3. experimental and control groups
4. selection bias
5. random assignment
6. the placebo effect
7. experimenter bias

What is the main advantage of the experimental method?

Descriptive research methods (naturalistic observation, the case study, the survey, and even the correlation) are all well suited for satisfying the first goal of psychology—namely, description. From descriptions, researchers may propose possible explanations for the behaviours they study. At some point researchers usually seek to determine the causes of behaviour and various other psychological phenomena.

What, for example, are the causes of depression, insomnia, stress, forgetfulness, and aggression? The **experimental method**, or the experiment, is the only research method that can be used to identify cause–effect relationships. **[LO 1.10]**

experimental method
The research method whereby researchers randomly assign participants to groups and control all conditions other than one or more independent variables, which are then manipulated to determine their effect on some behaviour measured—the dependent variable in the experiment.

An experiment is designed to test a hypothesis. A **hypothesis** is somewhat of an educated guess; it is a testable expectation about the relationship between causes and consequences; it is a specific prediction about a cause–effect relationship between two or more conditions or variables. **[LO 1.11-1]** A variable is any condition or factor that can be manipulated, controlled, or measured. Let's consider one variable that is of great interest to you—the grade you will receive in this psychology course. Another variable that probably interests you, given how important is has now become to keep on track with work, friends, and information, is the extent to which you can multitask. For example, is it possible to attend your psychology class, pay some attention to the lecture, but still check other things on your computer? In other words, do you suppose there is a cause–effect relationship between multitasking in class and the grades you will receive?

hypothesis
A prediction about the relationship between two or more variables.

The answer to that question is yes. In 2013, Faria Sana of McMaster University, along with Tina Weston and Nicola Cepeda from York University, conducted an experiment to determine the impact of in-class laptop use on student learning (Sana et al., 2013). Their goal was to see whether multitasking in class affected students' capacity to learn and recall information presented in a lecture. Forty students taking the

introductory psychology course participated in this experiment and were divided into two groups:

1. *Multitasking*: Twenty students were asked to pay attention to the lecture while also completing a series of tasks that "were meant to mimic typical student browsing during class" such as checking websites of interest including Google, Facebook, and YouTube (p. 26). Participants in this condition completed this multitasking activity for roughly 40 percent of the lecture.
2. *No Multitasking*: In this condition, the remaining twenty participants were asked to pay attention to the lecture but were not required to multitask.

Following the lecture, all participants were asked to complete a 40-question multiple-choice comprehension test to evaluate the extent to which they retained basic facts from the lecture (20 questions) and could apply this knowledge in a different context (20 questions).

What were the results? As you probably figured out, the participants who multitasked during the lecture scored significantly lower than those who did not multitask. This effect remained whether questions focused on basic facts from the lecture or application of knowledge. Overall, multitasking reduced recall on the quiz, which should be a lesson for you all as you decide how to spend your time in class to increase your likelihood of receiving better grades (see Figure 1.3).

Independent and Dependent Variables

What is the difference between the independent variable and the dependent variable?

independent variables
In an experiment, the factors or conditions that the researcher manipulates (the treatment) in order to determine their effect on another behaviour or condition, known as the *dependent variable*.

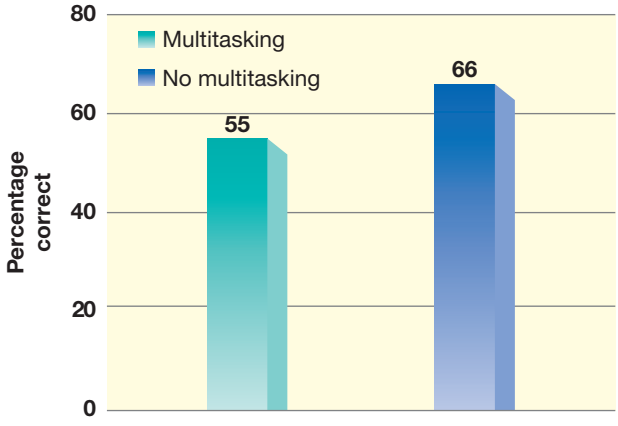
In all experiments there are two types of variables. First, there are one or more **independent variables**—variables that the researcher manipulates in order to determine whether they cause a change in another behaviour or condition. **[LO 1.11-2]** Sometimes the independent variable is referred to as the *treatment*. In the experiment by Sana and colleagues (Sana et al., 2013), there was one independent variable—the multitasking condition that was assigned.

dependent variable
The variable that is measured at the end of an experiment and that is presumed to vary as a result of manipulations of the independent variable.

The second type of variable found in all experiments is the **dependent variable**. It is measured at the end of the experiment and is presumed to vary (increase or decrease) as a result of the manipulations of the independent variable or variables. **[LO 1.11-2]** The dependent variable is presumed to depend on or to be affected by changes in the independent variable. In the study by Sana and colleagues, the dependent variable was the performance on the comprehension test administered after the lecture.

Figure 1.3 The Effect of Multitasking on Comprehension of Lecture Content

SOURCE: Based on Sana, S., Weston, T., & Cepeda, N. J. (2013). Laptop multitasking hinders classroom learning for both users and nearby peers. Computers & Education, 62, 24–31.



Experimental and Control Groups: The Same Except for the Treatment

How do the experimental and control groups differ?

Most experiments are conducted using two or more groups of participants. There must always be at least one **experimental group**—a group of participants who are exposed to the independent variable or the treatment. [LO 1.11-3] In the experiment described above, Sana and colleagues used only one experimental group; that is, the multitasking group.

In most experiments it is desirable to have a **control group**—a group that is similar to the experimental group and is used for purposes of comparison. The control group is exposed to the same experimental environment as the experimental group but is not given the treatment. [LO 1.11-3] The non-multitasking group in the Sana experiment was not exposed to the independent variable—that is, this group was not asked to multitask and, instead, just listened to the lecture. Because this group was similar to the experimental group and was exposed to the same experimental environment, it should be considered a control group. At the end of an experiment, the effect on the dependent variable is measured for all groups, including the control group.

experimental group
In an experiment, the group of participants that is exposed to the independent variable or treatment.

control group
In an experiment, a group that is similar to the experimental group and that is exposed to the same experimental environment but is not exposed to the independent variable; used for purposes of comparison.

Control in the Experiment: Attempting to Rule Out Chance

By conducting experiments in a laboratory, the experimenters can control the environmental setting to rule out other factors. For example, frustration, pain, and extreme noise or heat can change responses. Researchers carefully control the environment to ensure that these conditions are not present. They vary only the independent variables. That way, they can be reasonably certain that the manipulation of the independent variables is what causes any differences among the groups.

Generalizing the Experimental Findings: Do the Findings Apply to Other Groups?

What should we conclude from the Sana experiment? Can we conclude that students should never multitask during a lecture? Before we reach such a conclusion, we should consider several factors:

- The only participants used in this experiment were introductory psychology students. Can we be sure that the same results would have occurred if individuals of other ages or groups had been used?
- The participants in the multitasking condition were asked to do so for a specific amount of time, roughly for 40 percent of the lecture. Would the same results be true for students who multitasked for a shorter amount of time?

To apply this experiment's findings to other groups, researchers would have to replicate, or repeat, the experiment using different populations of participants.

Potential Problems in Experimental Research

If an experiment is properly designed and conducted, the researcher should be able to attribute changes in the dependent variable to the manipulations of the independent variable. But several factors other than the independent variables can cause changes

in the dependent variable, thereby destroying the validity of the experiment. Three of these potential problems are selection bias, the placebo effect, and experimenter bias. Researchers must design experiments to control for these and other problems, which could invalidate the results.

selection bias
The assignment of participants to experimental or control groups in such a way that systematic differences among the groups are present at the beginning of the experiment.

random assignment
In an experiment, the assignment of participants to experimental and control groups through a chance procedure, which guarantees that all participants have an equal probability of being placed in any of the groups; a control for selection bias.

Selection Bias: Bias from the Start

What is selection bias, and what technique do researchers use to control for it?

Selection bias occurs when participants are assigned to groups in such a way that systematic differences among the groups are present at the beginning of the experiment. **[LO 1.11-4]** If selection bias occurs, differences at the end of the experiment may not reflect the manipulation of the independent variable; rather, they may be due to preexisting differences in the groups.

To control for selection bias, researchers must use **random assignment**. This involves selecting participants through chance (such as drawing names out of a hat) to ensure that all have an equal probability of being assigned to any of the groups. **[LO 1.11-5]** Random assignment maximizes the likelihood that the groups will be similar at the beginning of the experiment. If there had been preexisting differences in the

Review & Reflect 1.1

Research Methods in Psychology

Method	Description	Advantages	Limitations
Naturalistic observation	Researcher observes and records behaviour in its natural setting. Participants may or may not know they are being observed.	Good source of descriptive information. Can provide basis for hypotheses to be tested later. Behaviour studied in everyday setting is more natural.	Researchers' expectations can distort observations (observer bias). Presence of researcher may influence behaviour of participants. Little or no control over conditions.
Laboratory observation	Observation under more controlled conditions where sophisticated equipment can be used to measure responses.	More control than naturalistic observation.	Possible observer bias. Behaviour of participants may be less natural than in naturalistic observation.
Case study	In-depth study of one or a few participants using observation, interviews, or psychological testing.	Source of information for rare or unusual conditions or events. Can provide basis for hypotheses to be tested later.	May not be representative of condition or event. Time-consuming. Subject to misinterpretation by researcher.
Survey	Interviews and/or questionnaires used to gather information about attitudes, beliefs, experiences, or behaviours of a group of people.	Can provide accurate information about large numbers of people.	Responses may be inaccurate. Sample may not be representative. Characteristics of interviewer may influence responses.
Correlational method	Method used to determine the relationship (correlation) between two events, characteristics, or behaviours.	Can assess strength of relationship between variables. Provides basis for prediction.	Does not demonstrate cause and effect.
Experimental method	Random assignment of participants to groups. Manipulation of independent variables and measurement of their effects on the dependent variable.	Enables identification of cause–effect relationships.	Laboratory setting may inhibit natural behaviour of participants. Findings may not be generalizable to the real world. In some cases, experiment is unethical.
Psychological tests	Tests used for measuring intelligence, scholastic achievement, aptitudes, vocational interests, personality traits, psychiatric problems.	Provide data for educational and vocational decision making, personnel selection, research, and psychological assessment.	Tests may not be reliable or valid.

level of prior knowledge of the lecture material in the Sana experiment, random assignment would have spread those differences across the groups.

The Placebo Effect: The Power of Suggestion (for the Participant)

What is the placebo effect, and how do researchers control for it?

Another factor that can influence the outcome of an experiment is the **placebo effect**. This occurs when the response to a treatment is due to the person's expectations rather than to the actual treatment itself. [LO 1.11-6] Suppose a drug is prescribed for a patient, and the patient reports improvement. The improvement could be a direct result of the drug, or it could be the result of the patient's expectation that the drug will work. Studies have shown that remarkable improvement in patients can sometimes be attributed solely to the power of suggestion—the placebo effect.

placebo effect (pluh-SEE-bo)
The phenomenon that occurs when a person's response to a treatment (or response to the independent variable in an experiment) is due to expectations regarding the treatment rather than to the treatment itself.

The researcher must use a control group to test whether results in an experiment are due to the treatment or to the placebo effect. So people in the control group are given a fake treatment. In drug experiments the control group is usually given a **placebo**—a harmless substance such as a sugar pill or an injection of saline solution. To control for the placebo effect, researchers do not let participants know whether they are in the *experimental* group (receiving the treatment) or in the *control* group (receiving the placebo). If getting the real drug or treatment results in a significantly greater improvement than receiving the placebo, the improvement can be attributed to the drug rather than to the power of suggestion.

placebo
Some inert substance, such as a sugar pill or an injection of saline solution, given to the control group in an experiment as a control for the placebo effect.

But what about the expectations of those who conduct the experiments—the researchers or confederates (the experimenters or anyone else associated with the study) themselves?

Experimenter Bias: The Power of Suggestion (for the Experimenter)

What is experimenter bias, and how is it controlled?

The expectations of the experimenter are a third factor that can influence the outcome of an experiment. **Experimenter bias** occurs when researchers' preconceived notions or expectations cause them to find what they expect to find. A researcher's expectations can be communicated to the participants, perhaps unintentionally, through tone of voice, gestures, and facial expressions. [LO 1.11-7] These communications can influence the participants' behaviour. Expectations can also influence a researcher's interpretation of the experiment's results, even if no influence occurred during the experiment. When the interpretation supports the researcher's expectations in this way, it is called a *self-fulfilling prophecy*.

experimenter bias
A phenomenon that occurs when the researcher's preconceived notions in some way influence the participants' behaviour and/or the interpretation of experimental results.

To control for experimenter bias, researchers must not know which participants are assigned to the experimental and control groups. The identities of both the experimental and control participants are coded, and their identities are not revealed to the researcher until after the research data are collected and recorded. (Obviously, someone assisting the researcher must know which participants are in which group.) When neither the participants nor the experimenters knows which participants are getting the treatment and which are in the control group, the **double-blind technique** is being used. The double-blind technique is the most powerful procedure for studying cause–effect relationships.

double-blind technique
An experimental procedure in which neither the participants nor the experimenters knows who is in the experimental and control groups until the results have been gathered; a control for experimenter bias.

Advantages and Limitations of the Experimental Method

The overwhelming advantage of the experiment is its ability to reveal cause–effect relationships. This is possible because researchers are able to exercise strict control over the experimental setting. This allows them to rule out factors other than the independent variable as possible reasons for differences in the dependent variable. But often, the more control the experimenter exercises, the more unnatural and contrived the research setting becomes, and the less generalizable the findings will be to the real world. When participants know that they are taking part in an experiment, they may behave differently than they would in a more natural setting. When a natural setting is considered to be an important factor in a study, researchers may run a field experiment (i.e., an experiment conducted in a real-life setting). The advantage of field studies is that participants behave more naturally. For example, in many field studies, the researchers cannot control for background noise, amount of sunlight, temperature, and other environmental variables. These variables are, however, assumed to be less important.

A major limitation of the experimental method is that in many areas of interest to researchers, an experiment is either unethical or impossible. Some treatments cannot be given to humans because their physical or psychological health would be endangered or their rights violated.

Module 1.4 Participants in Psychological Research

LO 1.12 Explain why psychologists use psychological tests.

LO 1.13 Compare and contrast reliability and validity, and explain how these two issues relate to psychological tests.

World of Psychology

Avoiding Ageism, Sexism, and Cultural Bias in Psychological Research

In planning and conducting psychological inquiries, researchers need to consider many factors besides scientific methodology. Of greatest concern is the worry about bias in psychological research. Our awareness of these biases makes us more careful when designing and interpreting studies.

For example, ageism is a continuing source of bias. This is seen in some clinicians' preferences for younger clients (Tomko & Munley, 2013) and in the fact that research papers on aging often focus on loss, deterioration, decline, and dependency, which implies that all older individuals are defined by deterioration, forgetfulness, and deficits.

Research also suggests that familiarity with clients' cultural heritage and gender issues facilitates effective counselling (Diller, 2014) and research investigations (Leung, Wang, & Deng, 2014). For instance, in one Canadian study, seven out of eight researchers were expelled from a Cree community because their research techniques were too rigid and were insensitive to traditional Cree values (Darou, Kurtness, & Hum, 2000). The lack of flexibility on the part of the researchers not only had a negative impact on the community, but also had the potential to restrict their ability to investigate a unique population and, hence, to limit our understanding of this group. Recent counselling research conducted with indigenous communities has also reached similar conclusions (Wendt & Gone, 2016). Greater awareness of cultural orientations, expectations, and traditions would improve both clinicians' and researchers' effectiveness when working with diverse communities.

Inequities regarding gender issues have aroused concern among psychologists and researchers in psychology (Hegarty & Pratto, 2010). Fortunately, gender bias in the selection of research participants has decreased over time, although more recent research suggests that psychological studies often treat men as the norm and women as the exception (Bailey & LaFrance, 2017; Cundiff, 2012; Hegarty & Pratto, 2010). In addition, there is a growing body of literature that advocates a greater awareness of gender, culture, age, and sexual orientation in order to promote more effective research and counselling.

Human Participants in Psychological Research

For practical reasons, most studies with humans in the past 40 years have used college or university students. Students are a convenient group to study, and researchers/professors often encourage their participation by offering pay or points toward a course grade. Psychology studies have also used a disproportionate number of males and whites (Cundiff, 2012; Hegarty & Pratto, 2010; Thomas, Dovidio, & West, 2014).

Heavy reliance on college and university students presents a problem. Students are a relatively select group in terms of age, socioeconomic status, educational level, and cultural diversity. How generalizable the findings of such studies are to the general population depends on the nature of the specific study. Studies that investigate basic psychological processes such as sensation, perception, and memory are likely to be relatively generalizable because these processes probably function in similar ways in most adults. But in research on human social behaviour, great individual and cultural variation leads to a problem in generalizing the results of studies with college and university students to other segments of the population. (See the discussion of ageism, sexism, and cultural bias in psychological research in the *World of Psychology* box, above.)

Psychological Tests: Assessing the Participant

Participants are also needed when psychologists develop and use a wide range of tests for measuring intelligence, scholastic achievement, aptitudes, creativity, vocational interests, personality traits, and psychiatric problems. Psychological tests are used in a variety of situations—in schools, in the workplace, and in therapeutic settings. Test results also provide information that can be used in educational decision making, personnel selection, and vocational guidance. But these psychological tests, and all other types of tests, are useless unless they are both reliable and valid. [LO 1.12]

Reliability refers to the consistency of a test. A reliable test will yield nearly the same score time after time if the same person is tested and then retested. **Validity** is the test's ability to measure what it is intended to measure. Just as a clock is a valid instrument for measuring time but not speed, so a psychological test must be able to measure accurately and adequately the specific area it is designed to measure—achievement or vocational aptitude, for example. [LO 1.13]

reliability
The ability of a test to yield nearly the same scores when the same people are tested and then retested using the same test or an alternative form of the test.

validity
The ability of a test to measure what it is intended to measure.

Psychologists often use testing in conjunction with their research. Tests may be administered as part of a case study. And in an experiment, the dependent variable might be the score on a psychological test. For example, an educational psychologist who is experimenting with a new educational program might use an achievement test to compare the performances of experimental and control participants.

Ethics in Research: First and Foremost

What are some ethical guidelines governing the use of human participants in research?

In 2017, the Canadian Psychological Association adopted a revised set of ethical standards governing research with humans. These standards safeguard the rights of research participants while supporting the goals of scientific inquiry. Participation must be voluntary, and there must be respect for confidentiality. Moreover, participants must be free

Most psychologists recognize that many scientific advances would not have been possible without animal research. Where do you stand on this issue?

Eric Isselee/Shutterstock

to withdraw from the study at any time and, after completing any study, they must always be debriefed about the full purpose of the study and its implications. At a more local level, colleges and universities must have ethics committees to approve any research studies proposed by professors or students.

Some studies use deception. In such studies, participants are informed that the nature of the research is different from what it actually is. This method is used when researchers believe that a participant's awareness of the true purpose of the study may affect the validity of the results. Psychologists have long debated whether studies that use deception can be justified on scientific grounds. Many psychologists believe they can be, but others are against deception in any circumstances (Kimmel, 2012). Even so, deception is used in many research studies, particularly in the field of social psychology. Today the Canadian Psychological Association's *Canadian Code of Ethics for Psychologists* (CPA, 2017) allows deception under the following circumstances:

1. if the benefits of the research are weighed against the research participant's moral right to self-determination and the importance of public and personal trust in psychology
2. if full and accurate disclosure would likely influence the responses of the research participants and thus invalidate the results.
3. if the researcher does not withhold information about the level of risk, discomfort or inconvenience that might affect their willingness to participate; and
4. if research participants are debriefed as soon as possible after their involvement when incomplete disclosure or deception is used and to clear up any misconceptions they may have had about what occurred during the study. Researchers want to erase any harmful effects of the deception and to ensure that participants understand that no other participants were actually harmed.

The Use of Animals in Research

Why are animals used in research?

Where would psychology be today without Pavlov's dogs, Skinner's pigeons, the ubiquitous white rat, and the many other species of animals used to advance scientific knowledge? Psychologists recognize that laboratory animals have been and still are immensely important in research; most psychologists favour their continued use. The most recent estimates suggest that animals are used in 7 to 8 percent of psychological experiments; 90 percent of the animals used have been rodents and birds, principally rats, mice, and pigeons (American Psychological Association [APA], 2006b, 2012).

Many of the marvels of modern medicine would not have been available today without the use of animals in research. Why are animals used in research? There are at least five reasons: (1) They provide a simpler model for studying processes that operate similarly in humans. (2) Researchers can exercise far more control over animal subjects and thus be more certain of a study's conclusions. (3) A wider range of medical and

other manipulations can be used with animals. (4) It is easier to study the entire lifespan and multiple generations in some animal species. (5) Animals are cheaper to use and are available at the researcher's convenience. (Of course, researchers also use animals when they want to learn more about the animals themselves.)

Those conducting animal research in Canada are bound by the *Canadian Code of Ethics for Psychologists* (CPA, 1993/2017) as well as by the ethical guidelines of the Canadian Council on Animal Care (1989). These documents support the humane treatment of animals. This means that researchers must do everything possible to minimize discomfort, pain, and illness in animal subjects. The Canadian Council on Animal Care is also responsible for regularly checking active laboratories. Furthermore, research with animals is supported only when there is a reasonable expectation that valuable knowledge will be obtained.

Nevertheless, controversy has long surrounded the use of animals in research. Animal rights advocates have been very active in their efforts to stop animal research. Some have broken into research laboratories, freed laboratory animals, destroyed research records, and wrecked laboratory equipment and other property. Many activists are also against using animals for food, clothing, or any other purpose.

Module 1.5 The Historical Progression of Psychology: Exploring the Different Perspectives

LO 1.14 Define the following early schools of psychology:

1. structuralism
2. functionalism
3. Gestalt
4. behaviourism
5. psychoanalysis
6. humanistic psychology
7. cognitive psychology

If we were to trace the development of psychology from the beginning, we would need to stretch far back to the earliest pages of recorded history, even beyond the early Greek philosophers such as Aristotle and Plato. People have always had questions about human nature and human behaviour. For centuries these questions were considered to be in the realm of philosophy.

Wilhelm Wundt: The Founding of Psychology

What was Wilhelm Wundt's contribution to psychology?

It was not until experimental methods were applied to the study of psychological processes that psychology became recognized as a formal academic discipline. Three German physiologists—Ernst Weber, Gustav Fechner, and Hermann von Helmholtz—were the first to apply experimental methods to the study of psychological processes. In so doing, they profoundly influenced the early development of psychology.

Although a number of early researchers contributed to the new field of psychology, Wilhelm Wundt is generally thought of as the founder of psychology. His psychological laboratory in Leipzig, Germany, founded in 1879, is considered the "birthplace" of psychology as a formal academic discipline. However, the studies and experiments that

Wundt, his associates, and his students performed in that early laboratory were very different from psychology as we know it today.

For Wundt, the subject matter of psychology was experience—the actual, immediate, conscious experiences of individuals. Wundt believed that mental experiences could be reduced to basic elements, just as the early chemists were able to describe water as composed of the basic elements of hydrogen and oxygen (H_2O). In other words, Wundt was searching for the structure of conscious experience.

Wundt and his associates conducted experiments on reaction times and on attention span. They also studied the perception of a variety of visual (sight), tactile (touch), and auditory (hearing) stimuli, including rhythm patterns.

Wundt had an important influence on Canadian psychology. Some of his students, including August Kirschmann, James Mark Baldwin, and George Humphrey, became founding members of Canada's first psychology departments. Kirschmann and Baldwin went on to teach at the University of Toronto, and Humphrey established himself at Queen's University in Kingston, Ontario (M. J. Wright & Myers, 1982).

Titchener and Structuralism: Psychology's Blind Alley

What were the goals and methods of structuralism, the first school of psychology?

Wundt's most famous student, Edward Bradford Titchener (1867–1927), introduced psychology to North America. Although Titchener differed from Wundt on some points, he pursued similar goals. He gave the name **structuralism** to this first school of thought in psychology, which aimed at analyzing the basic elements, or the structure, of conscious mental experience. [LO 1.14-1]

structuralism
The first formal school of psychology, aimed at analyzing the basic elements, or the structure, of conscious mental experience through the use of introspection.

Structuralism was most severely criticized for its primary method: introspection. Introspection relies on self-observation and is simply the reporting of any thought, idea, or feeling. Introspection was severely criticized because it was not objective, even though it involved observation, measurement, and experimentation. When different introspectionists were exposed to the same stimulus, such as the click of a metronome,

Canadian Connections

Our History Highlights

Despite the immense popularity of psychology as a field of study in today's colleges and universities, the evolution of psychology programs in Canada and the United States was fairly slow. For instance, no full psychology curriculum was developed in Canada until the 1920s.

James Mark Baldwin established the first Canadian psychology laboratory at the University of Toronto in 1889. The first psychology department was established at McGill University in 1924, soon followed by the creation of a psychology department at the University of Toronto in 1926. In the 1930s and 1940s, several other universities followed suit, such as the University of Western Ontario (1931), the University of Manitoba (1936), the Université de Montréal (1942), the University of Saskatchewan (1947), and Dalhousie and Queen's universities (1948). The 1960s and 1970s saw the greatest growth in psychology programs as this field of research became somewhat more established within academia (M. J. Wright & Myers, 1982).

A significant milestone for the advancement of psychology in Canada was the founding of the Canadian Psychological Association in 1939. In conjunction with the American Psychological Association, the Canadian Psychological Association serves as the governing body for psychologists in Canada, providing ethical guidelines and research initiatives.

they often reported different experiences. And when the same person was exposed to exactly the same stimulus at different times, he or she often reported somewhat different experiences. Structuralism was not considered a viable school of thought for long. Later schools of thought in psychology were established partly in reaction against structuralism, which collapsed as an approach when Titchener died.

Functionalism: The First North American School of Psychology

What was the goal of the early school of psychology known as functionalism?

As structuralism was losing its influence in the early 1900s, a new school of psychology called *functionalism* was taking shape. **Functionalism** was concerned not with the structure of consciousness but with how mental processes function—that is, with how humans and animals use mental processes in adapting to their environment. [LO 1.14-2]

functionalism
An early school of psychology that was concerned with how mental processes help humans and animals adapt to their environments; developed as a reaction against structuralism.

An influential book by Charles Darwin, *On the Origin of Species by Means of Natural Selection* (1859), had a strong impact on the leading proponents of functionalism. Darwin's ideas about evolution and the continuity of species were largely responsible for the increasing use of animals in psychological experiments.

Another British thinker (and a cousin of Darwin) was Sir Francis Galton, who did pioneering work in the study of individual differences and the role of genetic inheritance in mental abilities. He also made a significant contribution in the areas of measurement and statistics.

Darwin's and Galton's ideas contributed much to the new school of functionalism. American psychologist William James (1842–1910) was an advocate of functionalism, even though he did much of his writing before this school of psychology appeared. James's best-known work is his highly regarded *Principles of Psychology*, published more than 100 years ago (1890). James taught that mental processes are fluid and that they have continuity rather than a rigid or fixed structure (which is what the structuralists had suggested). James spoke of the "stream of consciousness," which he said functioned to help humans adapt to their environment.

Functionalism broadened the scope of psychology to include the study of behaviour as well as mental processes. It also included the study of children, animals, and people who were mentally impaired. These groups had not been studied by the structuralists because they could not be trained to use introspection. Functionalists also established the subfield of applied psychology—for example, the psychology of education, the workplace, and individual differences.

Gestalt Psychology: The Whole Is More Than Just the Sum of Its Parts

What is the emphasis of Gestalt psychology?

Several schools of thought arose in part as a reaction against structuralism. Gestalt psychology was one of these. This school appeared in Germany in 1912, at around the same time that John B. Watson was launching behaviourism (discussed next). The Gestalt psychologists objected to the central idea of structuralism—that we can best understand conscious experience by reducing it to its basic elements. **Gestalt psychology** emphasized that individuals perceive objects and patterns as whole units, and that the whole thus perceived is more than just the sum of its parts. The German word *Gestalt* roughly means "whole, form, or pattern." [LO 1.14-3]

Gestalt psychology (geh-SHTALT)
The school of psychology that emphasizes that individuals perceive objects and patterns as whole units and that the perceived whole is more than just the sum of its parts.

The leader of the Gestalt psychologists was Max Wertheimer (1880–1943), who introduced a famous experiment demonstrating the phi phenomenon. Perhaps you have seen flashing neon lights that you perceive as figures moving back and forth. Actually, the separate lights are being flashed on and off with precision timing: this is the phi phenomenon. We perceive wholes or patterns, not collections of separate and independent sensations. For the Gestaltists, the phi phenomenon proved that perceptions do not all arise from independent sensations, as the structuralists contended.

Other prominent Gestalt psychologists were Kurt Koffka and Wolfgang Köhler. Gestalt psychologists are still influential in the psychology of perception, which will be discussed in Chapter 3.

Behaviourism: Never Mind the Mind

How did behaviourism differ from previous schools of psychology?

Psychologist John B. Watson (1878–1958) looked at the study of psychology as defined by the structuralists and functionalists and disliked virtually everything he saw. In Watson's view, the study of mental processes, the concepts of mind and consciousness, and the primary investigative technique of introspection were not scientific. Watson pointed out that each person's introspection is strictly individual. He further maintained that self-reflection and internal pondering cannot be observed, verified, understood, or communicated in objective, scientific terms. He argued that all the strictly subjective techniques and concepts in psychology must be thrown out. He did not deny the existence of conscious thought or experience. He simply did not view them as appropriate topics for psychology.

behaviourism
The school of psychology founded by John B. Watson that views observable, measurable behaviour as the appropriate subject matter for psychology and emphasizes the role of environment as a determinant of behaviour.

Watson proposed a radically new approach to psychology. This new school of psychology, called **behaviourism**, redefined psychology as the "science of behaviour." Behaviourism confined itself to the study of behaviour because it was observable and measurable and, therefore, objective and scientific. Behaviourism also emphasized that behaviour is determined primarily by factors in the environment. **[LO 1.14-4]**

B. F. Skinner: Continuing the Behaviourist Tradition

Behaviourism soon became the most influential school of thought in North American psychology. It is still a major force in modern psychology, in large part because of the profound influence of B. F. Skinner (1904–1990).

Skinner agreed with Watson that concepts such as mind, consciousness, and feelings were neither objective nor measurable and, therefore, not the appropriate subject matter of psychology. Furthermore, Skinner argued that these concepts were not needed to explain behaviour. We can explain behaviour, he maintained, by analyzing conditions that were present before the behaviour occurred and by analyzing the consequences of the behaviour.

Skinner's research on operant (i.e., deliberate) conditioning emphasized the importance of reinforcement in learning and in the shaping and maintaining of behaviour. When a behaviour is reinforced (i.e., followed by pleasant or rewarding consequences), it is more likely to be performed again. Skinner's work has had a powerful influence on modern psychology.

Behaviourism has been criticized for ignoring inner mental processes such as thoughts and feelings. Many behaviourists today do not take as extreme a view as Skinner and his colleagues did. They still emphasize the study of behaviour, but they are also willing to consider how mental processes explain behaviour.

Psychoanalysis: It's What's Deep Down That Counts

What was the role of the unconscious in psychoanalysis, Freud's approach to psychology?

The behaviourists completely ignored unobservable mental forces in their explanations of behaviour. This is precisely where Sigmund Freud (1856–1939) looked in formulating his theory. Freud emphasized that unseen, unconscious mental forces were the key to understanding human nature and behaviour.

Freud developed a theory called **psychoanalysis**. He maintained that human mental life is like an iceberg. The smallest, visible part of the iceberg represents the conscious mental experience of the individual. But underwater, hidden from view, floats a vast store of unconscious impulses, thoughts, wishes, and desires. Although people are not aware of them directly or consciously, it is these unconscious forces that have the largest impact on behaviour. **[LOs 1.14-4 & 1.14-5]**

psychoanalysis (SY-ko-ah-NAL-ih-sis)
The term Freud used for both his theory of personality and his therapy for the treatment of psychological disorders; the unconscious is the primary focus of psychoanalytic theory.

Freud believed that the unconscious acts as a storehouse for material that threatens the conscious life of the individual—for disturbing sexual and aggressive impulses as well as traumatic experiences that have been repressed, or "pushed down" to the unconscious. Once there, rather than resting quietly, the unconscious material festers and seethes.

Freud's psychological theory does not paint a very positive or hopeful picture of human nature. He believed that we do not consciously control our thoughts, feelings, and behaviours, but rather that these are determined by unconscious forces that we cannot see or control.

The overriding importance that Freud placed on sexual and aggressive impulses caused much controversy, both inside and outside the field of psychology. The most notable of Freud's famous students—Carl Jung, Alfred Adler, and Karen Horney—broke away from their mentor and developed their own theories of personality. These three are often referred to as the *neo-Freudians*.

Freud's influence on psychology is not nearly as strong as it once was (Robins, Gosling, & Craik, 1999) although recent research has used some of Freud's concepts to show "how thought and emotion just below the surface of our awareness shape the way we relate" to others (Bargh, 2014, p. 37). When people think of Freud, most imagine a psychiatrist psychoanalyzing a patient who is lying on a couch. The general public is familiar with such terms as the *unconscious*, *repression*, *rationalization*, and the *Freudian slip*. Such familiarity has made Freud a larger-than-life figure.

Humanistic Psychology: Looking at Human Potential

What is the focus of humanistic psychology?

Humanistic psychology emerged in part as a reaction against behaviourism and psychoanalysis and is often labelled the "third force in psychology." **Humanistic psychology** focuses on the uniqueness of human beings and their capacity for choice, growth, and psychological health. The humanists reject the behaviourist notion that people have no free will and are shaped and controlled strictly by the environment. Humanists also reject Freud's theory that people are determined and driven from within, acting and marching to the dark drums of the unconscious. **[LO 1.14-6]**

humanistic psychology
The school of psychology that focuses on the uniqueness of human beings and their capacity for choice, growth, and psychological health.

Review & Reflect 1.2

Traditional and Modern Schools of Thought in Psychology

School	Description
Structuralism Wilhelm Wundt Edward Titchener	The first formal school of psychology. Focuses on analyzing the basic elements or structures of conscious mental experience through the use of introspection.
Functionalism William James	The first North American school of psychology. Concerned with the study of mental processes and their role in facilitating adaptation to the environment. Broadened the scope of psychology to include the study of behaviour as well as mental processes, and the study of children, people who are mentally impaired, and animals.
Gestalt psychology Max Wertheimer Kurt Koffka Wolfgang Köhler	Emphasizes that individuals perceive objects and patterns as whole units. The perceived whole is more than just the sum of its parts and is not best understood by analysis of its elemental parts (as suggested by the structuralists).
Behaviourism John B. Watson B. F. Skinner	Views observable, measurable behaviour rather than internal mental processes as the appropriate subject matter of psychology. Stresses the roles of learning and the environment in determining behaviour.
Psychoanalysis Sigmund Freud	Emphasizes the role of unconscious mental forces and conflicts in determining behaviour.
Humanistic psychology Abraham Maslow Carl Rogers	Focuses on the uniqueness of human beings and their capacity for choice, growth, and psychological health. Called the "third force in psychology" (behaviourism and psychoanalysis being the other two forces).
Cognitive psychology	Focuses on mental processes such as memory, problem solving, reasoning, decision making, language, and perception. Uses information-processing approach.

Abraham Maslow (1908–1970) and other prominent humanistic psychologists, such as Carl Rogers (1902–1987), emphasized a much more positive view of human nature. They maintained that people are innately good and possess free will. Humanists believe that people are capable of making conscious, rational choices that can lead to growth and psychological health.

Maslow proposed a theory of motivation that consists of a hierarchy of needs. He considered the need for self-actualization (developing to one's fullest potential) to be the highest need in this hierarchy. Carl Rogers developed his person-centred therapy and, with other humanists, popularized encounter groups and other techniques that are part of the human potential movement.

Cognitive Psychology: Focusing on Mental Processes

What is the focus of cognitive psychology?

cognitive psychology
A specialty that studies mental processes such as memory, problem solving, reasoning and decision making, language, perception, and other forms of cognition; often uses the information-processing approach.

Cognitive psychology is a special branch of psychology that focuses on mental processes such as memory, problem solving, concept formation, reasoning and decision making, language, and perception. **[LO 1.14-7]** Just as behaviourism developed in part as a reaction against the focus on mental processes that was characteristic of structuralism and functionalism, so cognitive psychology grew and developed partly in response to strict behaviourism (Barsalou, 2014). Ironically, several psychologists who were behaviourists during the 1950s provided the greatest impetus to the development of cognitive psychology.

Cognitive psychologists see humans not as passive recipients who are pushed and pulled by environmental forces, but as active participants who seek out experiences, who alter and shape them, and who use mental processes to transform information in the course of their own cognitive development.

The advent of the computer provided cognitive psychologists with a new way to think of mental processes. According to the information-processing approach, our brain processes information in sequential stages, much as a computer does. But as computers have become more sophisticated, so have cognitive theory models. For example, many contemporary researchers are examining the human memory system's capacity for *parallel processing*, the management of multiple bits of information at once, a type of information processing that is commonly used in today's computers (Bajic & Rickard, 2009; Musslick et al., 2016).

Review & Reflect 1.2 summarizes the various traditional and modern schools of thought in psychology.

Moreover, unlike the early behaviourists, psychologists today *can* observe some mental processes directly. Thanks to modern brain-imaging techniques, such as the PET scan, and sophisticated computer technology, researchers can observe the action (behaviour) of specific clusters of brain cells (neurons) as they carry out various mental processes (Le Bihan, 2007; Raichle, 1994). Such mental activities as thinking, remembering, solving a problem, listening to a melody, speaking, viewing images and colours, and so on have all been "observed," and this has provided a rich field of knowledge that cognitive psychologists use in their work.

Module 1.6 Psychology Today

LO 1.15 Describe the newer perspectives in modern psychology.

LO 1.16 Compare and contrast the newer perspectives in modern psychology.

LO 1.17 Identify the various fields of work available to psychologists.

Current Perspectives in Psychology: Views on Behaviour and Thinking

Modern psychologists are not easily categorized by specific schools of thought. There are no structuralists roaming the halls of psychology departments, and to our knowledge there are no professors who call themselves functionalists. Today, rather than discussing schools of psychology, it is more appropriate to refer to psychological perspectives—points of view used for explaining people's behaviour and thinking, whether normal or abnormal. Psychologists need not limit themselves to only one perspective or approach. Some take an eclectic position, choosing a combination of approaches to explain a particular behaviour or psychological problem.

Biological Perspective: It's What's Inside That Counts

What is the focus of the biological perspective?

Psychologists who adopt the **biological perspective** emphasize biological processes and heredity as the keys to understanding behaviour and thinking. **[LOs 1.15 & 1.16]** To explain thinking, emotion, and behaviour—both normal and abnormal—biologically

biological perspective
A perspective that emphasizes biological processes and heredity as the keys to understanding behaviour.

oriented psychologists study the structures of the brain and central nervous system, the functioning of the neurons, the delicate balance of neurotransmitters and hormones, and the impact of genes. For example, we know that having too many or too few different neurotransmitters in the brain is related to various mental disorders such as schizophrenia and depression. Some drugs now being used to treat some of these disorders are designed to restore the brain's biochemical balance.

Researchers and theorists who adopt the biological perspective include physiological psychologists, psycho-biologists, and neuropsychologists. Many biological psychologists work as part of an interdisciplinary field known as *neuroscience*, which combines the work of psychologists, biologists, biochemists, and medical researchers. Many important findings in psychology have resulted from their work. In fact, neuroscience has become a driving force in biological research, not only in psychology but in other scientific areas as well.

Neuroscience—the study of brain functioning—is divided into several subfields. Most relevant to psychology are two specific areas. *Behavioural neuroscience* is now an important area of psychological research; it investigates how the brain processes activities and behaviours, including our emotions and sensations. *Cognitive neuroscience* uses new brain technology to examine the brain's cognitive functions, including memory, language, and problem solving.

Evolutionary Perspective: Adapting to the Environment

What is the focus of the evolutionary perspective?

evolutionary perspective
A perspective that focuses on how humans have evolved and adapted behaviours required for survival against various environmental pressures over the long course of evolution.

The **evolutionary perspective** focuses on how humans have evolved and adapted behaviours required for survival in the face of various environmental pressures over the long course of evolution (Cosmides & Tooby, 2013). The basic argument of evolutionary psychology is that the adaptation of the mind has not progressed at the same rapid pace of change as that of our social circumstances. Evolutionary psychologists suggest that the human brain is still adapted to a way of life from many thousands of years ago and that it is still mostly concerned with its reproductive success. **[LOs 1.15 & 1.16]** Evolutionary psychologists study how inherited tendencies and dispositions in humans influence a wide range of behaviours such as helping behaviour, aggression, danger avoidance, and food preferences (Cosmides & Tooby, 2013). However, much of the research has focused on issues associated with human reproduction, such as the way we select mates, sexual attraction, jealousy, mate retention, and allocations of resources to parents and family (Buss, 2014).

Advocates of this perspective argue that an evolutionary perspective can be applied to any topic within the field of psychology, given that evolutionary principles are common to all humans (Buss, 2015). However, this perspective has its many critics who argue that human behaviour cannot be reduced to our biology (H. Rose & Rose, 2010) and that social and cultural influences can also explain the same phenomena (Eagly & Wood, 1999, 2013). This critique is partly rooted in the sociocultural perspective.

Sociocultural Perspective: The Cultural Impact of Our World

sociocultural perspective
A perspective that emphasizes social and cultural influences on human behaviour and stresses the importance of understanding those influences when we interpret the behaviour of others.

What is the focus of the sociocultural perspective?

The **sociocultural perspective** highlights the social and cultural influences on human behaviour. In the same way that someone who is quoted out of context is misunderstood,

we may misinterpret the actions or gestures of those from other cultures if we do not understand the cultural context in which they occur. **[LOs 1.15 & 1.16]** Most psychologists now agree that we must consider cultural factors when researching aspects of people's behaviours, relationships, and expectations (Heine, & Ruby, 2010; Matsumoto & Juang, 2016).

Psychologists at Work

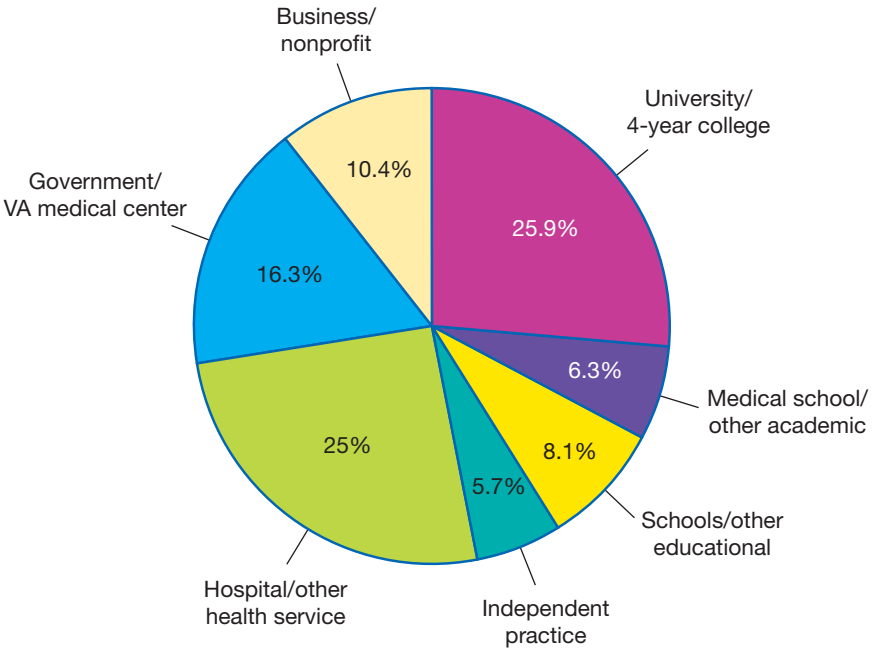
What are some specialties in psychology, and in what settings are they employed?

In this chapter we have discussed the many fields of academic specializations within psychology. The fact is that most psychology researchers are employed in colleges and universities, where they conduct their own research and teach, or in hospitals and other health services. But what type of work can psychologists do if they are not employed in a college or university or hospital? What are their specialties, and in what settings are they employed? **[LOs 1.17]**

Although no data are available regarding the employment status of Canadian psychologists, we can use data from the United States to give us some information about where psychologists work (see Figure 1.4). Professional psychologists have a broad number of choices of workplaces, depending on their area of expertise. Clinical psychologists make up the largest group of psychologists, followed by counselling psychologists. Both groups of professionals apply psychological principles to assist

Figure 1.4 Where Psychologists Work

Psychologists work in a variety of settings. The largest group—about 70 percent of psychologists—work in colleges and universities and in hospitals and other health services.



Note: The chart represents employment settings for those with recent doctorates in psychology. Totals amount to 97 percent due to rounding and exclusion of 17 "not specified" responses.

SOURCE: Based on American Psychological Association. (2011). 2009: Doctorate Employment Survey. Retrieved June 11, 2018 from http://www.apa.org/workforce/publications/09-doc empl/index.aspx?tab=4

Psychologists work in a wide range of settings.

Richard T. Nowitz/Science source

people who are dealing with psychology-related issues. *Clinical psychologists* are responsible for the diagnosis and treatment of often complex psychological disorders, whereas *counselling psychologists* tend to help those whose problems are not as severe. But do not confuse clinical psychologists and psychiatrists! Psychiatrists are physicians who have specialized in the treatment of psychiatric disorders, whereas psychologists do not study medicine.

Aside from the clinical and counselling fields, many psychologists work in education, either as school psychologists or educational psychologists. *School* and *educational psychologists* provide psychological services to students within the context of a school setting. They often work for school boards and are involved in the educational, social, linguistic, or vocational assessment of students.

Many subfields of psychology fall under the broad umbrella term of *applied psychology*. Applied psychologists use their knowledge of research methodology to examine how various aspects of human life such as emotion, motivation, social interactions, and cognitive errors affect our health, our decisions, and our work. Two related emerging fields are forensic and health psychology. There has been a recent increase of interest among college and university students in the field of forensic psychology. Much of this interest can likely be linked to popular television shows and movies that glamorize this field of work. *Forensic psychologists* apply their knowledge of psychological research to the legal system. For instance, they study issues such as the accuracy of eyewitness testimony in court cases or how to better handle hostage-taking negotiations. Some forensic psychologists work within the correctional system to diagnose and treat offenders. *Health psychologists* work in a more general field with many options—they work with patients or conduct research on the relationship between psychological processes and physical health. Some health psychologists examine the impact of stress on well-being, or how to help improve the effect of particular treatment programs. For example, health psychologists have examined how to help dieters stay on their healthy eating program, and how to help those who begin exercising persist with their new regimen. And some psychologists are specifically involved with issues of exercise and sports. *Sport psychologists* apply psychological principles to help improve the performance of athletes.

Finally, many applied psychologists work within organizations. *Industrial* or *organizational psychologists* help businesses deal with issues such as the hiring and retention of qualified personnel, employee satisfaction, workplace violence, and occupational health. They help managers improve their leadership skills and motivate their employees. They study the difficult balance of work and family demands and also consider the negative impact of unhealthy working conditions on the work and personal lives of workers.

This section has provided only a brief overview of the many fields of work where psychologists are employed. Wherever you find human activity—the workplace, schools, hospitals, professional sport, government, and the public service—you will likely find psychologists. The table below outlines the modern perspectives in psychology.

Apply It

Being a Good Consumer of Psychological Research

If someone asked you where to buy a car, you wouldn't send him or her to a junkyard. Similarly, in psychology you must be a wise consumer—and become a critical thinker—in order to get accurate information.

Some publications are more scientifically respectable than others—*Science News* and *Psychology Today* are more credible than the *National Enquirer* and *The Toronto Sun*. Science writers have more experience reading and understanding research and usually give more accurate reports of psychological research than general reporters do. Science writers tend to write more objectively than non-science writers and are less likely to suggest that the researchers' findings are the last word on the subject. General reporters, on the other hand, are much more likely to make sweeping statements and extreme claims such as, "The most important study of our time," "Amazing new cure," and "Dramatic new results show . . .." Let's not be fooled by promises that seem too good to be true.

To evaluate any scientific information, you must be able to answer three key questions: "Who says so? What do they say? How do they know?"

To critically evaluate research, you need to know who conducted the study and what methodology was used. You need a description of the participants—their number, how they were selected, whether they were human or animal, and, if they were human, information such as their age, gender, and other characteristics that are relevant to evaluating the researcher's conclusions.

Critical thinkers are those who determine whether the methodology used in the research would enable the authors to reach their conclusions, whether those conclusions are logical, whether they are supported by the data, and whether there are alternative explanations for the findings.

Critical thinkers understand the difference between scientific and non-scientific research evidence. Testimonials and accounts of personal experience are non-scientific evidence. Testimonials appeal most often to emotions rather than to intellect.

Critical thinkers carefully consider the biases of the writers or researchers. Do they have axes to grind? Are they expressing information that can be confirmed as factual, or are they merely expressing their opinion?

Finally, critical thinkers do not accept the results of one study as definitive evidence. They want to know whether the research has been replicated and what other studies have been published on the subject. As a critical thinker, you would not modify your life on the basis of one study that you read.

Summary & Review

1.1 Introduction to Psychology

What are the four goals of psychology?

The four goals of psychology are the description, explanation, prediction, and influence of behaviour and mental processes.

What is the difference between basic and applied research?

Basic research is designed to explore the fundamental aspects of life and to gain new knowledge without practical goals in mind. Applied research is conducted with the specific goal of solving practical problems and improving people's quality of life.

1.2 Descriptive Research Methods

What is naturalistic observation, and what are some of its advantages and limitations?

Naturalistic observation is a research method in which researchers observe and record behaviour in its natural setting without attempting to influence or control it. The major advantage of naturalistic observation is that it allows one to study behaviour in normal settings, where it occurs more naturally and spontaneously. Its main limitation is that it only allows a researcher to observe behaviours, without the capacity to test why they are happening as they are.

What is the case study method, and for what purposes is it particularly well suited?

The case study is an in-depth, sometimes long-term study of one or several participants through observation, interview, and sometimes psychological testing. It is particularly appropriate for studying people who have rare psychological or physiological disorders.

What are the methods and purposes of survey research?

The survey is a research method in which investigators use interviews and/or questionnaires to gather information about the attitudes, beliefs, experiences, or behaviours of a group of people.

What is a representative sample, and why is it essential in a survey?

A representative sample is a sample of participants selected from the population of interest in such a way that important subgroups within the whole population are included in the same proportions in the sample. A sample must be representative for the findings to be applied to the larger population.

What is the correlational method, and when is it used?

The correlational method is used to determine the degree of correlation or relationship between two variables. It is often used when an experimental study cannot be conducted because it is either impossible or unethical.

What is a correlation coefficient?

A correlation coefficient is a numerical value indicating the degree and direction of the relationship between two variables.

1.3 The Experimental Method: Searching for Causes

What is the main advantage of the experimental method?

The experimental method is the only research method that can be used to identify cause–effect relationships.

What is the difference between the independent variable and the dependent variable?

In an experiment, an independent variable is a condition or factor manipulated by the researcher to determine its effect on the dependent variable. The dependent variable, measured at the end of the experiment, is presumed to vary as a result of the manipulations of the independent variable.

How do the experimental and control groups differ?

The experimental group is exposed to the independent variable. The control group is similar to the experimental group and is exposed to the same experimental environment but is not exposed to the independent variable.

What is selection bias, and what technique do researchers use to control for it

Selection bias occurs when there are systematic differences among the groups before the experiment begins. Random assignment—assignment of participants to groups by means of a chance procedure—maximizes the probability that groups are similar at the beginning of the experiment.

What is the placebo effect, and how do researchers control for it?

A placebo effect occurs when the response to a treatment is due to the person's expectations rather than to the treatment itself.

What is experimenter bias, and how is it controlled?

Experimenter bias occurs when the researcher's expectations affect the outcome of the experiment. It is controlled for by the use of the double-blind technique, in which neither the experimenters nor the participants knows which participants are in an experimental group and which are in a control group.

1.4 Participants in Psychological Research

What are some ethical guidelines governing the use of human participants in research?

Participation in research must be strictly voluntary; there must be respect for confidentiality; participants must be free to withdraw from the study at any time; and participants must be debriefed as soon as possible after they participate.

Why are animals used in research?

Animals are used because they provide a simpler model for studying similar processes in humans; because researchers can exercise more control over animals and use a wider range of medical and other manipulations; because it is easier to study the entire lifespan (and even several generations in some species); and because animals are readily available and more economical to study.

1.5 The Historical Progression of Psychology: Exploring the Different Perspectives

What was Wilhelm Wundt's contribution to psychology?

Wilhelm Wundt is generally thought of as the founder of psychology. He conducted experiments in search of the basic elements of the conscious experience.

What were the goals and methods of structuralism, the first school of psychology?

Structuralism's main goal was to analyze the basic elements, or the structure, of conscious mental experience through the use of introspection.

What was the goal of the early school of psychology known as functionalism?

Functionalism was concerned with how mental processes help humans and animals adapt to their environment.

What is the emphasis of Gestalt psychology?

Gestalt psychology emphasizes that individuals perceive objects and patterns as whole units and that the perceived whole is more than just the sum of its parts.

How did behaviourism differ from previous schools of psychology?

Behaviourism, the school of psychology founded by John B. Watson, views observable, measurable behaviour as the only appropriate subject matter for psychology. Behaviourism also emphasizes that behaviour is determined primarily by factors in the environment.

What was the role of the unconscious in psychoanalysis—Freud's approach to psychology?

According to Freud's theory of psychoanalysis, our thoughts, feelings, and behaviour are determined primarily by the unconscious—the part of the mind that we cannot see and cannot control.

What is the focus of humanistic psychology?

Humanistic psychology focuses on the uniqueness of human beings and their capacity for choice, growth, and psychological health.

What is the focus of cognitive psychology?

Cognitive psychology focuses on mental processes such as memory, problem solving, concept formation, reasoning and decision making, language, and perception.

1.6 Psychology Today

What is the focus of the biological perspective?

The biological perspective emphasizes biological processes and heredity as the keys to understanding behaviour and thinking.

What is the focus of the evolutionary perspective?

The evolutionary perspective focuses on how humans have evolved and adapted behaviours required for survival in the face of various environmental pressures over the long course of evolution.

What is the focus of the sociocultural perspective?

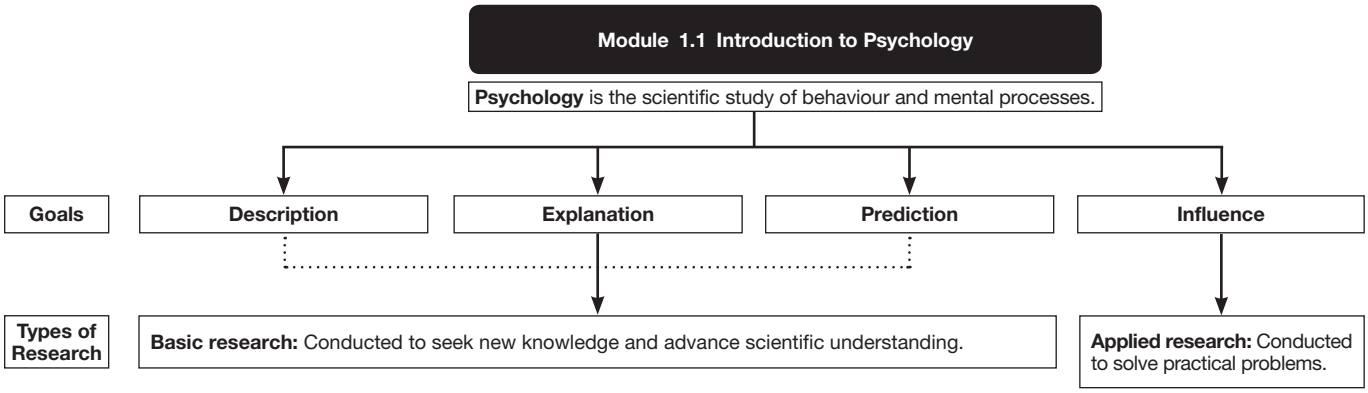
The sociocultural perspective highlights the social and cultural influences on human behaviour.

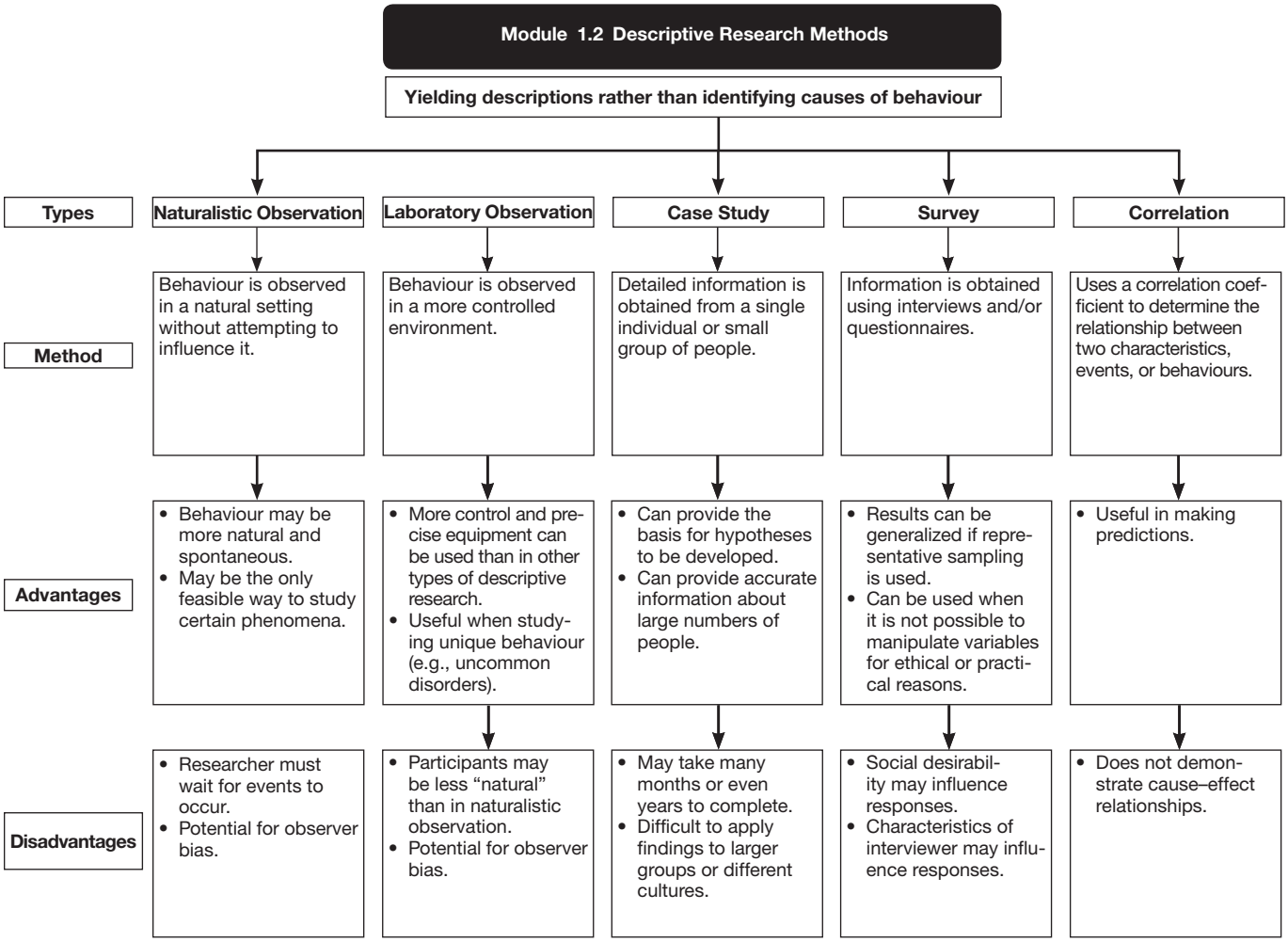
What are some specialties in psychology, and in what settings are they employed?

Most psychology researchers work in colleges and universities, where they conduct research and teach. Clinical psychologists are responsible for the diagnosis and treatment of often complex psychological disorders. Counselling psychologists assist people who are dealing with psychology-related issues that are less severe. School and educational psychologists provide psychological services to students in a school setting. Forensic psychologists apply their knowledge of psychological research within the legal system. Health psychologists work with patients or conduct research on the relationship between psychological processes and physical health. Sport psychologists apply psychological principles to help improve the performance of athletes. Industrial or organizational psychologists help businesses deal with issues such as the hiring and retention of qualified personnel, employee satisfaction, workplace violence, and occupational health.

CHAPTER 1 • CONCEPT MAP

INTRODUCTION TO PSYCHOLOGY





Module 1.3 The Experimental Method

Identifying cause–effect relationships

Two types of variables

The **independent variable** is the factor that is manipulated (treatment versus no treatment).

The **dependent variable** is the factor measured at the end of the experiment.

Two types of groups

The **experimental group** consists of participants who are exposed to the treatment.

The **control group** consists of participants who are exposed to the same environment as the experimental group, except for the treatment.

Random assignment is a control for selection bias whereby assignment to groups is through a chance procedure, which guarantees that participants have an equal probability of being placed in any of the groups.

Key Advantages

- Employs a high degree of control to rule out other sources of influence.
- Only research method that has the ability to reveal cause–effect relationships.

- **Key Disadvantages**
- Generalizability issues.
- Cannot be performed in many areas of psychology due to ethical issues.
- Potential for experimenter effects and placebo effects if double-blind technique is not used.

Module 1.4 Participants in Psychological Research

- Researchers often use convenient samples of students. This strategy may reduce generalizability.
- Psychologists must develop tests that are reliable and valid.
- Psychologists must abide by a strict code of ethics for both human and animal research.

Module 1.5 The Historical Progression of Psychology

Wilhelm Wundt, the founder of psychology, established a laboratory in 1879 and focused on immediate, conscious experience.

→ **Structuralism** (Titchener) tried to break conscious experience down to its basic elements. Introspection was used as the primary technique.

→ **Functionalism** (James) studied the function, or purpose, of consciousness (i.e., how mental processes help one to adapt to one's environment).

→ **Gestalt psychology** (Wertheimer, Koffka, Köhler) emphasizes that individuals perceive objects and patterns as whole units, and the perceived whole is more than just the sum of its parts.

→ **Behaviourism** (Watson, Skinner) rejects the study of consciousness in favour of observable behaviour. Focuses on how behaviour is determined by factors in the environment.

↓

Psychoanalysis (Freud) emphasizes that unconscious mental forces are the key determinants of behaviour.

← **Humanistic psychology** (Maslow, Rogers) focuses on the uniqueness of human beings and their capacity for choice, growth, and psychological health.

← **Cognitive psychology** focuses on mental processes such as memory, reasoning, language, and perception.

Module 1.6 Psychology Today

Modern psychologists need not limit themselves to only one perspective or approach.

Some perspectives in modern approaches include

- **Biological:** Emphasizes biological processes and heredity as the keys to understanding behaviour and thinking.
- **Evolutionary:** Emphasizes the role of inherited tendencies that have proven adaptive in humans.
- **Sociocultural:** Emphasizes social and cultural influences on human behaviour.

Chapter 2
Biology and Behaviour

D A Barnes/Alamy Stock Photo

Recently, two Canadians became pioneers in an effort to test whether it is possible to train brains to see again, using a revolutionary eye implant device (CBC, 2014). The device, called the Argus Retinal Prosthesis System (Argus II), is

comprised of a tiny video camera attached to a special set of glasses, a small computer device, and a tiny patch containing 60 electrodes which is surgically implanted onto the surface of the retina (University Health Network, 2014). How does it work? The video camera records the visual information that we would normally see in our world. This information is converted into electrical impulses which are sent to the electrodes in the implant device. The implant sends signals directly to the retinal nerves, and these signals are then forwarded to the brain. This is where training the brain occurs. Since the recipients of the implant have no vision (or virtually no vision), their brains have to learn how to understand the information being sent to them. This requires extensive training.

The outcomes would be considered modest in terms of what sighted people expect to see in their everyday lives. For example, one recipient learned to "see" a black and white striped pattern. This took many trials over many weeks of exposure to images on a screen that presented high black and white contrasts. Yet, for the recipient who could not see before, it was a remarkable moment to discover that she not only saw something, but also understood it was stripes. Her brain had been trained, and this was just the beginning.

Every thought we think, every emotion we feel, every sensation we experience, every decision we reach, every move we make—in short, all human behaviour—is rooted in a biological event. Therefore, we launch our exploration of psychology with the study of biology and behaviour. Our story begins where the action begins, in the smallest functional unit of the brain—the nerve cell, or neuron.

Module 2.1 The Neurons and the Neurotransmitters

- **LO 2.1** Define the function of the three types of neurons.
- **LO 2.2** Identify the three key structures of a neuron.
- **LO 2.3** Explain how neural impulses work.
- **LO 2.4** Contrast excitatory and inhibitory effects of neurotransmitters and how they affect behaviour.
- **LO 2.5** Understand the role of the following neurotransmitters: acetylcholine, dopamine, norepinephrine, epinephrine, serotonin, amino acids, and endorphins.

All our thoughts, feelings, and behaviours can be traced to the activity of specialized cells called **neurons**. These cells perform several important tasks: (1) Afferent (sensory) neurons relay messages from the sense organs and receptors—eyes, ears, nose, mouth, and skin—to the brain or spinal cord. (2) Efferent (motor) neurons convey signals from the brain and spinal cord to the glands and muscles, enabling us to move. (3) Interneurons, thousands of times more numerous than sensory or motor neurons, carry information between neurons in the brain and between neurons in the spinal cord. **[LO 2.1]**

neurons (NEW-rons)
Specialized cells that conduct impulses through the nervous system and contain three major parts—a cell body, dendrites, and an axon.

The Neurons: Billions of Brain Cells

Anatomy of a Neuron: Looking at Its Parts

What is a neuron, and what are its three parts?

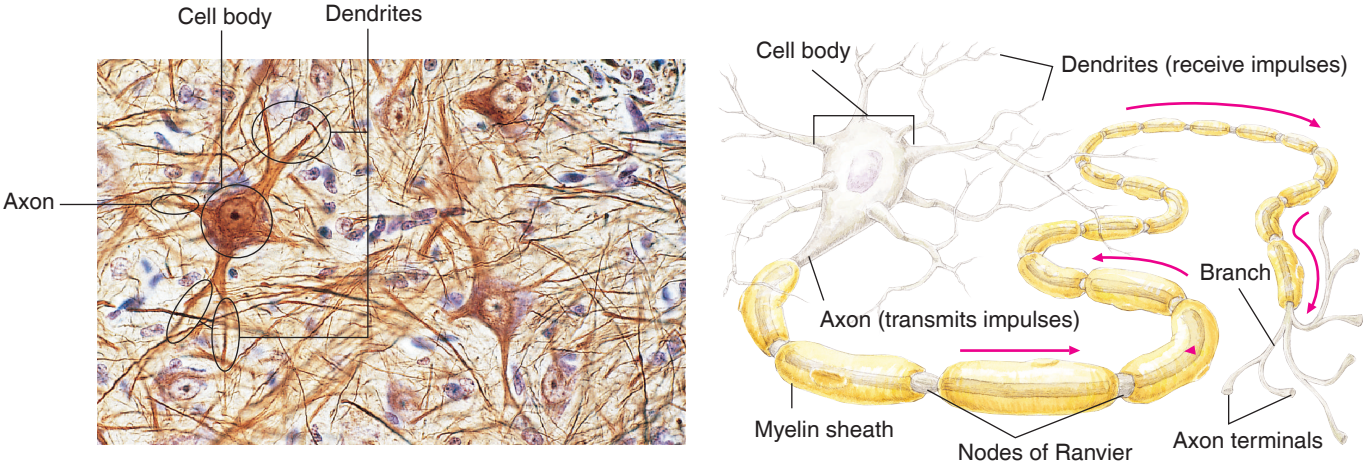
Although no two neurons are exactly alike, nearly all are made up of three parts: the cell body (soma), dendrites, and an axon. **[LO 2.2]** Figure 2.1 shows the structure of a neuron. The **cell body** contains the nucleus and carries out the metabolic, or life-sustaining,

cell body
The part of the neuron that contains the nucleus and carries out the metabolic functions of the neuron.

Figure 2.1 The Structure of a Typical Neuron

A typical neuron has three major parts: (1) a cell body, which carries out the metabolic functions of the neuron; (2) branched fibres called *dendrites*, which are the primary receivers of the impulses from other neurons; and (3) a slender, tail-like extension called an *axon*, the transmitting end of the neuron, which sprouts into many branches, each ending in an axon terminal. The photograph above shows human neurons greatly magnified.

Biophoto Associates/Science Source



dendrites (DEN-drytes)
The branch-like extensions of a neuron that receive signals from other neurons.

axon (AK-sahn)
The slender, tail-like extension of the neuron that transmits signals to the dendrites or cell body of other neurons or to the muscles, glands, or other parts of the body.

functions of the neuron. Branching out from the cell body are the **dendrites**, which look much like the leafless branches of a tree. The dendrites are the primary receivers of signals from other neurons, but the cell body can also receive the signals directly. Dendrites can also relay messages backward—from the cell body to their own branches (a process called *back propagating*). These backward messages appear to shape the dendrites' responses to future signals they receive (Eyal, Mansvelder, de Kock, & Segev, 2014; Magee & Johnston, 1997; Sejnowski, 1997).

The **axon** is the slender, tail-like extension of the neuron that sprouts into many branches, each ending in a rounded axon terminal. The axon terminals transmit signals to the dendrites or cell bodies of other neurons, and to muscles, glands, and other parts of the body. In humans, some axons are short—only thousandths of a centimetre. Others can be up to a metre long—long enough to reach from the brain to the tip of the spinal cord, or from the spinal cord to remote parts of the body.

Supporting the Neurons

glial cells (GLEE-ul)
Cells that help to make the brain more efficient by holding the neurons together, removing waste products such as dead neurons, making the myelin coating for the axons, and nourishing tasks.

Glial cells are specialized cells that facilitate brain functioning. They are smaller than neurons and make up more than half of the volume of the human brain. There are many different kinds of glial cells, and each serves a specific function (Franklin & Bussey, 2013). The functions of the glial cells include holding the neurons together, removing waste products (such as dead neurons) from the brain, handling metabolic tasks, and assisting in the production of myelin for cell transmission tasks. In addition, some glial cells assist in the generation of new cells, including neurons, while others facilitate creation of cerebrospinal fluid. Glial cells in the spinal cord, for example, are also involved in the transmission of pain sensations from the various parts of the body to the brain.

Communication Between Neurons: The Synapse

synapse (SIN-aps)
The junction where the axon of a sending neuron communicates with a receiving neuron across the synaptic cleft.

What is a synapse?

Neurons are not physically connected. The axon terminals are separated from the receiving neurons by tiny, fluid-filled gaps called *synaptic clefts*. The **synapse** is the junction where the axon terminal of a sending neuron communicates with a receiving

neuron across the synaptic cleft. There may be as many as 100 trillion to a quadrillion constantly changing synapses in the human brain (Finemma, et al., 2016; Furber, 2013; Pakkenberg et al., 2003), with each neuron potentially connecting with thousands of other neurons.

How big is one trillion? Numbers in the trillions are hard for us to comprehend. You know how short a time period of one second is. It takes almost 32 000 years for one trillion seconds to pass. Now try to imagine how incredibly complex your brain must be if there are between 100 trillion to a quadrillion synapses across which your neurons are passing and receiving messages.

If neurons are not physically connected, how do they communicate with one another?

The Neural Impulse: The Beginning of Thought and Action

What is the action potential?

Cells in the brain, the spinal cord, and the muscles generate electrical potentials. Every time we move a muscle, experience a sensation, or have a thought or a feeling, a small but measurable electrical impulse has occurred. How does this biological electricity work? **[LO 2.3]** Even though the impulse that travels down the axon is electrical, the axon does not transmit it the way a wire conducts an electrical current. What actually happens is that the *permeability* of the cell membrane increases. In other words, the membrane changes in a way that makes it easier for molecules to move through it and into the cell; the membrane becomes more *permeable*. This process allows *ions* (electrically charged atoms or molecules) to easily move into or out of the axon. Body fluids contain ions, some with positive electrical charges and others with negative electrical charges. Inside the axon, there are normally more negative than positive ions. When at rest (not firing), a neuron carries a negative electrical potential (or charge) relative to the fluid outside the cell. This slight negative charge is referred to as the neuron's **resting potential**.

resting potential
The membrane potential of a neuron at rest, about 70 millivolts.

When a neuron is sufficiently stimulated by an incoming signal, ion channels begin to open in the cell membrane, allowing positive ions to flow into the axon. This inflow of positive ions causes the membrane potential to change abruptly to a positive value (Pinel, 2000). This sudden and brief reversal of the resting potential is called the **action potential**. Then, the ion channels admitting positive ions close, and other ion channels open, forcing some positive ions out of the axon. As a result, the original negative charge, or resting potential, is restored. The opening and closing of ion channels progresses segment by segment down the length of the axon, causing the action potential to move along the axon.

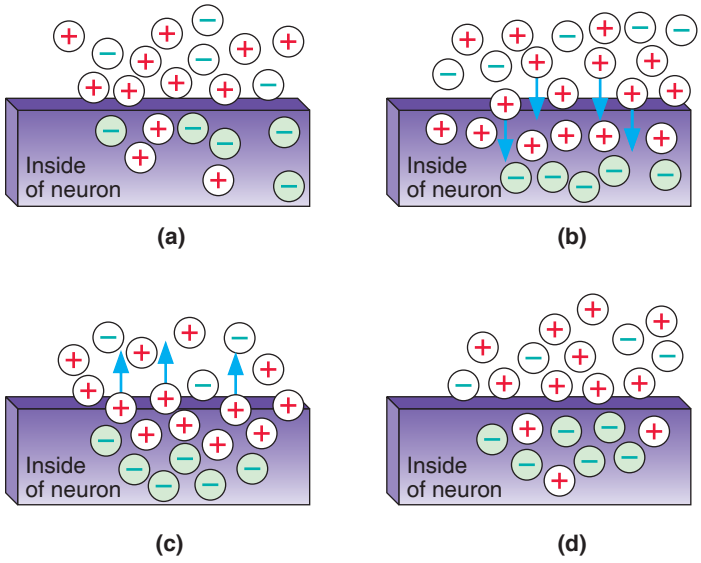
action potential
The sudden reversal of the resting potential, a reversal that initiates the firing of a neuron.

The action potential operates according to the "all or none" law—a neuron either fires completely or does not fire at all. Immediately after a neuron reaches its action potential and fires, it enters a refractory period, during which it cannot fire again for one to two milliseconds. This rest period is very short. Neurons can fire up to 1000 times per second. Figure 2.2 illustrates the movement of positive ions across the cell membrane—movement that stimulates the neuron to its action potential.

Consider this important question: if a neuron only either fires or does not fire, how can we tell the difference between a very strong and a very weak stimulus? a jarring blow and a soft touch? a blinding light and a dim one? a shout and a whisper? The answer lies in the number of neurons firing at the same time and their rate of firing (the number of times per second). A weak stimulus may cause relatively few neurons to fire; a strong stimulus may cause thousands of neurons to fire at the same time. Furthermore, a weak stimulus may cause neurons to fire very slowly; a strong stimulus may cause neurons to fire hundreds of times per second (normally the firing rate is much slower).

Figure 2.2 The Action Potential

(a) When a neuron is at rest (not firing), the inside of the neuron has a slight negative electrical charge compared to the outside; this is referred to as the neuron's *resting potential*. **(b)** When a neuron is stimulated, more positively charged particles flow into the cell, making the inside suddenly positive compared to the outside of the cell. This sudden reversal is the *action potential*. **(c)** Immediately after the neuron fires, some positive particles are actively pumped out of the cell. **(d)** The neuron returns to its resting potential and is ready to fire again if stimulated.



myelin sheath (MY-uh-lin)
The white, fatty coating wrapped around some axons that acts as insulation and enables impulses to travel much faster.

The most important factor in the speed of the impulse is the **myelin sheath**—a white, fatty coating wrapped around some axons that acts as insulation. If you look again at Figure 2.1, you will see that this coating has numerous gaps called *nodes of Ranvier*. These nodes cause the myelin sheath to look like links of sausage strung together. The electrical impulse is retriggered or regenerated at each node (or gap) along the axon. Thus, impulses travel up to 100 times faster along axons with myelin sheaths.

Neurotransmitters: The Chemical Messengers of the Brain

What are neurotransmitters, and what role do they play in the transmission of signals from one neuron to another?

neurotransmitters (NEW-ro-TRANS-miters)
Chemicals that are released into the synaptic cleft from the axon terminal of the sending neuron, cross the synapse, and bind to appropriate receptors on the dendrites or cell body of the receiving neuron, influencing the cell either to fire or not to fire.

Once a neuron fires, how does it get its message to other neurons? Messages are transmitted between neurons by one or more of a large group of chemical substances known as **neurotransmitters**.

Where are neurotransmitters located? Inside the axon terminal are many small, sphere-shaped containers with thin membranes, called *synaptic vesicles*, which hold the neurotransmitters. When an action potential arrives at the axon terminal, synaptic vesicles move toward the cell membrane, fuse with it, and release their neurotransmitter molecules into the synaptic cleft. This process is shown in Figure 2.3.

The Receptor Sites: Locks for Neurotransmitter Keys

receptors
Sites on the dendrite or cell body of a neuron that will interact only with specific neurotransmitters.

Once released, neurotransmitters do not simply flow into the synaptic cleft and stimulate all the adjacent neurons. Each neurotransmitter has a distinctive molecular shape. **Receptors** on the surfaces of dendrites and cell bodies also have distinctive shapes. Neurotransmitters can affect only those neurons that contain receptors designed to receive