



Psychophysiological Measurement and Meaning



**Cognitive and Emotional
Processing of Media**



Robert F. Potter | Paul D. Bolls

PSYCHOPHYSIOLOGICAL MEASUREMENT AND MEANING

Psychophysiological Measurement and Meaning is a comprehensive resource for psychophysiological research on media responses, a new paradigm sweeping media research. It addresses the theoretical underpinnings, methodological techniques, and most recent research in this area. It goes beyond current volumes by placing the research techniques within a context of communication processes and effects as a field, and demonstrating how the real-time measurement of physiological responses enhances and complements more traditional measures of psychological effects from media.

This volume will introduce readers to the theoretical assumptions of psychophysiology as well as operational details of collecting psychophysiological data. In addition to discussing specific measures, it includes brief reviews of recent experiments that have used psychophysiological measures to study how the brain processes media. It will serve as a valuable reference for media researchers utilizing psychophysiological methodologies, or for other researchers needing to understand the theories, history, and methods in this area of research.

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Dedication

Writing this book has been a long intellectual adventure. During it we were especially blessed with encouragement from two amazing women—our wives, Pam Potter and Val Bolls. They provided the love and support we needed to finish this project; one which has helped us to grow as scholars and individuals. We dedicate this book to them with many thanks and much love.

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FOREWORD

Reading this book makes me feel old.

I must be old because I remember when the first version of this book was published in 1994 more clearly than I remember yesterday, or last week, or last year. I must be old because it doesn't feel like more than two or three years ago. The memories are so clear I don't see how that book could be out of print or out of date.

I must be old because I do remember punching cards and feeding them into a card reader to do my master's thesis (1983). I must be old because I also remember slogging through the snow in Wisconsin to go to the computer center where one could actually type commands on a keyboard and see responses on a monitor and stand in line at the output window to get a great big printout that said "ERROR" (1985)!

And I must be old because I remember the monolithic pen recording moving chart polygraph on which I collected the data for my first psychophysiological study (1987). Hmmm. So, maybe it is time to update this book!

But how could it be Paul D. Bolls and Robert F. Potter writing this book? I remember when Paul Bolls ran his first study—ever—and recruited subjects before the study was ready to run—with predictable consequences (1993). I remember when Rob Potter was planning a career in cultural studies (1995). I also remember building a wall with Paul and Rob in the kitchen of a tumble-down house in Bloomington, IN, to separate the subjects from the equipment (1996). I remember them learning how to build a lab, and collect and analyze physiological data, and do studies, and write dissertations, and get jobs, and get tenure . . . so I guess they *can* write this book.

But it does make me feel old.

On the other hand, it also makes me feel proud, and hopeful, and excited about the future of the field. I remember when nobody in mass communication

was doing psychophysiological research. I remember when only a few people were doing it and I pretty much knew all of them. Now there are plenty of people I don't know doing psychophysiological research in mass communication and a whole lot of people I do know because they are my colleagues, my academic children, and even my academic grandchildren.

Okay, so I'm old, and my academic children are now old and respected authorities who have written the book which you are about to read. What will you get out of it? A lot! Professors Bolls and Potter offer not just a compendium of measures but rather an integrated theoretical and methodological paradigm for studying communication as a complex embodied dynamic activity. The book begins with a careful consideration of how media researchers have historically used physiological measures (Chapter 1) followed by a comprehensive explication of the underpinnings of the field of psychophysiology (Chapter 2). In particular, they discuss the difference between measuring physiology in order to determine physiological responses and doing psychophysiology. Doing psychophysiology means that you are measuring real-time changes in the physiological system time-locked to some kind of stimulus in order to make inferences about psychological processes. Thus, it is not that we are looking for an increase or decrease in the activation of some physiological system or state, but rather, that we are looking for some specific, usually brief, and usually small change in a specific physiological measure, that has been shown, in a specific context, to be an indicator of a specific psychological event or process.

For example, careful work by psychophysiologicals over two or three decades determined that three different kinds of attentional responses, the orienting response, the startle response, and the defensive response, could be differentiated by measuring very short-term change in heart rate (Graham, 1979). Specifically, it was shown that heart rate decelerated for about six beats following an orienting eliciting stimulus, but accelerated for six beats following a stimulus that elicited either a startle or a defensive response. This differentiation was shown to exist and to be valid when the stimuli which elicited the response were simple tones, white noise, and flashes in an equally simple context. In order to translate this finding into the media laboratory, studies were undertaken measuring heart rate time-locked to specific structural features of media that were thought to elicit orienting responses and checking to see if heart rate decelerated for six to seven beats following these features. Using this technique, it was determined that things like scene changes in TV, voice changes in radio, and animation in web content did indeed elicit orienting responses (Lang, 1990; Lang, Wise, Borse, & David 2002; Potter, 2000).

As can be seen, one of the things that needs to be done, in order to take these techniques for using physiological responses as indicators of psychological processes out of the psychophysiology lab and put them in the media researchers' arsenal, is the careful work of validating each measure as an indicator of the psychological process of interest within the context of a complex media message. One of the

many strengths of this book is that it has gathered together all of this information, organized it, and laid it out in a way that will allow the reader who is new to psychophysiology to employ complex, theoretically based measures in a valid and appropriate way.

Another strength of this book is the way it straightforwardly addresses the fact that any given physiological measure can simultaneously be an indicator of multiple psychological processes and that which process is being indicated is determined by the way the measure was collected and analyzed. Thus, a single measure can be used as an indicator of multiple psychological processes during the same message. This is because, over time, the embodied brain is engaging in multiple emotional and cognitive processes in response to a single mediated message. These affective and cognitive responses are reflected (albeit dimly) in the physiological systems that support thinking and feeling. Thus, a given measure, analyzed second by second at time point A may tell you something about attention while examining the average, at time point B, may tell you something about motivational activation or direction of emotional response. Understanding which measures, and which analyses, indicate which processes in what contexts is a complex body of knowledge which this book lays out forthrightly for the reader (Chapters 4 and 5).

In addition, the book considers and discusses the whole range of possible psychophysiological measures from easy and common measures like heart rate and skin conductance, to probe measures like startle and the post-auricular response, and finally to complex brain-centered measures like electroencephalography (EEG) and functional magnetic resonance imaging (fMRI). As a result, the book will serve as an extremely up-to-date and comprehensive reference volume for all the measures that have so far been used to track mediated messages through the black box that is the human motivated processing system.

Finally, this book is different from most books which focus on psychophysiology, in that it connects psychophysiological measures to other measures of mediated message processing (Chapter 7). The use of these measures is integrated with core mass communication theory and measures, and examples illustrate how psychophysiology can add to the understanding provided by our more traditional measures. Readers are provided with multiple avenues to approach and become adept at using these measures (Chapter 9), concluding with suggestions from experienced users of these measures about the many areas of media research that seem ripe for further investigation by a new generation of *media-psychophysiolgists*.

Enjoy the journey!

Annie Lang
Bloomington, IN, 2011

PREFACE

This is your brain on media! More than just a play on words—“borrowed” from a legendary anti-drug message—beginning this book with that statement reflects how the field of media research is in the process of an exciting paradigm shift. This paradigm shift is fueled by the efforts of researchers who work from an expanded methodological toolbox that includes a variety of psychophysiological measures enabling the observation of mental processes embodied in the brain that are engaged during media consumption. Data obtained from these measures, in essence, provide a view of the human brain “on” media. The growth in research examining how the brain processes media has reached a point where we believe it should be recognized as a new, specialized area of media research that, in this book, we have termed media psychology research. Media psychology researchers go far beyond insights provided by traditional media effects scholars to developing rich explanations of the dynamic mental processes that unfold across time as individuals consume and are impacted by media. Psychophysiology is part of the methodological core for media psychology research and this is the first book to exclusively focus on the application of psychophysiological measures to studying how the brain processes media content.

Our primary purpose in writing this book was to cover psychophysiological measures in a way that would be accessible and interesting to readers whose formal education is more likely to be in a media related field of study rather than psychophysiology. This objective makes it necessary to note up front that it is more accurate to consider this a book on media psychophysiology—the application of psychophysiological measures in media research—rather than a book that joins the ranks of excellent technical volumes on psychophysiology, such as the *Handbook of psychophysiology*. Those volumes are exclusively focused on psychophysiology, providing a more in-depth conceptual and operational

discussion of a wider range of specific measures than we have included here. Readers who will be engaging in media psychophysiology research should not consider our book a substitute for reading more specialized volumes on psychophysiology. Within the field of media psychology research, this book is intended to complement the valuable edited volume by Annie Lang, *Measuring psychological responses to media*. That volume should be considered the first methods book in media psychology research and included a couple chapters on psychophysiological measures. Our work builds on Annie Lang's volume by providing an entire book focused on media psychophysiology. Ultimately our hope is that this book serves to promote media psychophysiology as a scientific endeavor among the community of scholars that are more generally interested in media psychology research.

We hope that a variety of scholars are intrigued by this book. We believe such scholars could include anyone who is curious about the nature of the exciting and dynamic interaction between media and the human brain, ranging from the scientist working in a media psychophysiology lab to interested students, professors, and media industry professionals. The effects of media content on individuals emerge from this interaction, making the topic of media and the human brain potentially relevant to anyone that has more than a passing interest in "media effects." However, this book is specifically for scholars whose intellectual interests create a need to learn more about the promises and pitfalls of applying psychophysiological measures to studying the fascinating and critically important ways individuals mentally process and are influenced by media content. This need could be driven by a desire to directly participate in the growing community of scholars conducting media psychophysiology research or simply an interest in being able to critically read the growing body of published research that includes psychophysiological data. We had both types of readers in mind when writing this book. That is why we have made a concentrated effort to include technical content that is critical to serving the practical needs of scientists who will incorporate these measures in their research labs as well as a more general discussion of the theoretical framework that has enabled psychophysiological measures to be more than a fleeting methodological fad in media psychology research.

The chapters in this book follow a logical progression starting with a focus on theoretical/conceptual background material before moving to a discussion of specific measures and the operational details of conducting media psychophysiology research. The first three chapters provide necessary background for understanding the current application of psychophysiological measures in media psychology research. Chapter 1 provides a historical review of media effects research, specifically highlighting early efforts to establish a link between human physiological responses and exposure to certain types of media content. In looking back at the history of media research one cannot help but appreciate the work of researchers who recognized the importance of a scientific approach to

understanding media effects and pioneered that effort. Chapter 1 not only reviews this history but also showcases how media research moved from a field focused on behavioral effects of media exposure to adopting an information processing paradigm, focused on bursting open the black box of the human mind in order to investigate mental processes believed to underlie the effects of media on individuals. This sets the stage for Chapter 2 where we formally introduce psychophysiology as the theoretical framework that has led to what we believe is the permanent establishment of psychophysiological measures as part of the methodological toolbox used in media research. Chapter 2 outlines the theoretical assumptions of psychophysiology that are the very foundation of any effort to validly apply psychophysiological measures in studying how the brain processes media. Chapter 3 introduces a more technical discussion of psychophysiological measures, covering the basics of recording physiological signals and introducing key terms and concepts involved in understanding patterns of variation that can be found in psychophysiological data.

We move from discussion of important background material to covering specific psychophysiological measures in Chapters 4–6. Despite the fact that the theoretical approach presented in this book does not draw a sharp distinction between human cognition and emotion, psychophysiological measures can be broadly organized around a distinction between measures that primarily index mental processes involved in the operation of human attention and memory and measures that index mental processes involved in human emotion. The organization of Chapters 4 and 5 reflects this distinction. In Chapter 4 we discuss psychophysiological measures of cognitive processes. Chapter 5 covers psychophysiological measures of emotional processes. Both chapters cover two psychophysiological measures that are well-established in the media psychophysiology lab. Chapter 4 highlights cardiac activity and EEG while Chapter 5 showcases skin conductance and facial EMG. The first part of each chapter provides a theoretical background for using psychophysiological measures to study cognitive and emotional processing of media content while the second part focuses on providing technical knowledge that is necessary to record and analyze data obtained with each measure. Chapter 6 features a discussion of emerging psychophysiological measures that have tremendous potential value in media psychophysiology research but have yet to be extensively used in published experiments. Measures discussed in this chapter include the startle eye-blink response—a measure that is showing particular promise in indexing the motivational value of media content—and fMRI—a particularly exciting psychophysiological measure that directly records highly localized activity in the human brain. Our discussion of these emerging measures includes a consideration of their potential value as well as general operational details.

The last three chapters of this book cover a range of important topics. Chapter 7 addresses the importance of conducting media psychology research using a combination of psychophysiological as well as self-report and behavioral measures. This chapter opens with a discussion of the specific role of psychophysiological

measures in advancing knowledge of how the brain processes media and outlines how distinct types of measures only capture a part of the ultimate mental experience of consuming and being influenced by media content. Chapter 7 concludes with a review of specific measures that are particularly useful to combine with psychophysiological measures in media psychophysiology research. Chapter 8 is a “how-to” guide to setting up and running a media psychophysiology lab. This chapter was particularly informed by our 15 years of both mistakes and accomplishments in setting up labs and conducting media psychophysiology research. We discuss considerations in finding a lab space, ordering equipment, training, as well as conducting experiments. This could actually be the first chapter you want to read if you are either in the process of setting up or currently running a media psychophysiology lab. Chapter 9 concludes this book with a consideration of important contributions to knowledge experiments utilizing psychophysiological measures have already made to media psychology research as well as our thoughts about the exciting future of media psychophysiology research.

A distinct feature of this book that we hope readers will find particularly interesting is that throughout several chapters we have included brief reviews of research that has utilized psychophysiological measures to study how the brain processes media. Ideally this will not only help you better understand these measures but spark ideas for ways that psychophysiological measures might be used to advance your own work and general understanding of media psychology research. We consider it a privilege to be part of the community of scholars engaged in media psychophysiology research and offer this book as a tool that will hopefully help our colleagues both present and future in this endeavor.

ACKNOWLEDGMENTS FOR ROBERT F. POTTER

This book has been a *long* time in the making. And looking back, before it was even a consideration, there were people who were preparing me to write it. As Annie Lang mentions in the Foreword, when we first met I was a confused graduate student not finding particular intellectual satisfaction in cultural studies courses I was taking. I guess she was the first person to push me toward writing this book when—on what I remember as being only our second meeting together—she asked me “Do you want to help me unpack my new lab equipment, it just arrived today?” Annie, I thank you for unleashing a fascination for psychophysiological enquiry that gets bigger with each passing day.

Another person who prepared me to write it was my first departmental Chair, Loy Singleton in the Telecommunications and Film Department at the University of Alabama. Loy was steadfast in his belief that the time of junior faculty should be protected so they could nurture and build research momentum, something so easy to lose during the transition from student to faculty. Because of him—and one other person—I was able to set up my first psychophysiology lab.

That other person was Ed Cook of the Department of Psychology at the University of Alabama at Birmingham. In Chapter 8 I encourage young media psychophysiologicalists to contact those longstanding in the field for input and assistance. I do so based entirely on the warm reception Ed gave me when I called him and said “I can’t get this stuff to work right, can you help?” He came to Tuscaloosa and worked with me to put the final pieces of my lab puzzle together for little more than a burrito lunch at Pepitos, the local Mexican restaurant. Thanks Ed.

Walter Gantz also helped launch this project. As my Chair at Indiana University, Walt appointed me the Director of the Institute for Communication Research (ICR) and allowed my colleagues and me to design an ideal collaborative

social scientific laboratory. I thank him for that opportunity and for the encouragement during the final stages of the writing process.

The bulk of the initial writing took place during my sabbatical year at the Interactive Television Research Institute in Perth, Australia. Thanks to my ITRI colleagues—Duane Varan, Steve Bellman, Jenny Robinson, and Shiree Treleaven-Hassard—for a wonderful opportunity to get away from home and devote myself to the project.

That initial writing had to be edited, and I thank the students of T602 from the Fall of 2010 who provided valuable comments and insight.

Sharon Mayell is the Lab Manager at the ICR and Reed Nelson is my department's Fiscal Officer. Both do an unbelievable job keeping the facility running smoothly, allowing me time to tinker in the lab, explore ideas, and learn the things I tried to share in this book.

And finally immense thanks to Linda Bathgate, our extraordinary editor and my occasional bowling partner. This book exists because of your encouragement, patience, and sense of humor.

ACKNOWLEDGMENTS FOR PAUL D. BOLLS

Writing a book like this is a humbling experience. My mind helped produce this work that we hope serves to inspire and promote the use of psychophysiological measures within media research to study a topic I am very passionate about, the media/mind interaction. However, as I worked to produce this volume I became keenly aware of how much I owe to a great scientist, mentor, friend, and my “academic mom” Annie Lang. Annie took me under her wing as a wide-eyed student in a “janitor closet” lab at Washington State and through two labs at two different universities molded me into a productive member of this community of scholars. There are numerous members of the community of scholars who have inspired, prodded, and provided other forms of support that have contributed to the completion of this book. I want to specifically thank my co-directors of the PRIME Lab, Glenn Leshner and Kevin Wise, for their friendship and for bearing the brunt of keeping a lab running while I worked on “the book!” I also want to thank Esther Thorson and Margaret Duffy for helping create an encouraging intellectual work environment where I could complete this project. It is also critical that I thank the students who inspire my work in the PRIME Lab. Your intellectual curiosity helps fuel my passion for this field of research. I need to specifically thank PRIME Lab students, Petya Eckler, Jessica Freeman, Jana Hainey, Anastasia Kononova, Jaime Williams, and Nathan Winters who posed for pictures. Elisa Day shot some of the pictures in this book and Saleem Alhabash helped produce figures. Throughout this endeavor I have been blessed with support from students who at times seemed more excited about the completion of this book than even me. I hope you all know that more than just being my students, you are my friends. Finally, a huge debt of gratitude is owed to Linda Bathgate at Routledge. It is impossible for me to even imagine completing this book without your significant help. You knew exactly when to “cheerlead” and when to “coach” us through FINALLY finishing this book!

1

PSYCHOPHYSIOLOGY IN THE CONTEXT OF MEDIA PROCESSES AND EFFECTS RESEARCH

The general task of a social scientist is to ask questions about how human beings act within a complex world. For most of you reading this book your specific interests focus on how human beings interact with mediated messages—communications coming from television sets, computer monitors, mobile media devices, radios, game consoles, and the like. Social scientists explore these interactions in a variety of ways. Some take a fine-grained and systematic look at what is contained in the content of media messages using a method called content analysis. Others conduct surveys, using a wide range of instruments (phone interviews, mail surveys, website questionnaires) to assess people’s attitudes toward media-related issues. Most of this book, however, will focus on a third common technique used by social scientists: the laboratory experiment. If you have taken even the most basic high school science class you are somewhat familiar with the steps of experimental research. In a controlled environment a small number of variables are isolated and precisely varied in order to measure the effects of the manipulations on outcome variables of interest. There are fine books available to guide you in the general practice of experimental design (Babbie, 2010; Kirk, 1994). The overarching goal of *this* book is to show how **psychophysiological measures**—indices of bodily responses reflecting variation in psychological states—are used in experiments conducted by researchers interested in discovering how the brain processes mediated messages. By the time you are finished you will have a working understanding of what psychophysiological indices validly measure and be able to read the ever-increasing body of work being published in the area, some of which will be reviewed throughout this book.

But in order to understand how psychophysiological research methods are used in the modern media psychology lab, it’s helpful to first take a general look at the history of social scientific research in media processes and effects. As you’ll

2 Media processes and effects research

see, the measurement of bodily responses to media messages makes two brief appearances in the early part of that history, quickly retreating each time. The first appearance is actually only a single study, a module of the iconic **Payne Fund Studies**. Following that, the application of physiological measures disappears from media research for almost three decades due to the rapid and almost complete swing of the psychological discipline toward the behaviorist approach. The second appearance of research that included the observation of physiological responses to media occurs late within that behaviorist tradition, but even then only generates a handful of published studies before again being abandoned. With the luxury of hindsight, this seems to be primarily a result of prevailing, but mistaken, thoughts at that time concerning how different human physiological systems respond to arousing situations. The belief that all physiological indices should increase in response to arousing situations resulted in unpredicted and—at least at the time—inexplicable results. Once again, physiological measures virtually disappear from the media psychology researcher's toolkit for several decades.

Not until media researchers fully embraced the theoretical underpinnings of *psychophysiology*—as opposed to just viewing physiological responses as more and different media effects one could measure—were they able to successfully utilize indices like heart rate, skin conductance and brain wave patterns as indicators of psychological states that vary in meaningful ways during the processing of mediated messages.

A brief history of media effects research

Early research—the impact of film content

With the development and widespread distribution of each medium comes public concern over the effects of exposure to its content. Of particular focus is the impact of seemingly salacious materials on children. With electronic media, this reaction was first seen in the early 1920s as the number of movie theaters in cities and towns across the country rapidly increased. Interested in the impact of the new phenomenon, individual researchers from sociology and psychology conducted meticulous studies primarily focusing on the effects of movie houses on specific municipalities. Reverend J. J. Phelan, for example, published *Motion pictures as a phase of commercial amusement in Toledo Ohio* in 1919, claiming to “gather all available data and allow the reader to make his own interpretation” (p. 11) concerning the impact of film on society. The conclusions drawn in publications like this, however, did not derive from experimentation or careful observation. Instead they seem to have sprung from common understanding of the day concerning human cognition; namely that psychological mechanisms of thought, knowledge, attitude formation, and behavior were uniform across individuals

(Sparks, 2002). As a result, Phelan and others crusading for governmental censorship of the motion picture industry believed that film content had very powerful effects. Under this powerful-effects view, it was, to use Phelan's own imagistic language, as if the attitudes, knowledge, and beliefs contained in a motion picture were applied directly to the psyches of each audience member like they were being poured into the brain by a ladle!

This powerful-effects view resulted in Phelan giving a list of "specific dangers" to children who frequented movie theaters. Things like: an incapacity of sustained studying of school materials, the awaking of morbid curiosity, the development of an abnormal imagination, and even "false delineation of what constitutes true Americanism" (p. 112) all awaited any child who watched too many movies.

Although the research done during this time has largely been associated with a **Hypodermic Needle Theory** of media effects, an examination of individual works show more caution and reticence among researchers of the time (Wartella & Reeves, 1985). For example, although William Healy, a prominent scholar in the field of juvenile delinquency, warned that movies—and perhaps even more so, the darkness of the movie theaters themselves—led to increased sexual activity among youth, he also believed that the susceptibility to such effects was highly variable across individuals (Jowett, Jarvie, & Fuller, 1996).

In the early 1930s came the publication of a series of eight volumes under the title "Motion pictures and youth." Today, students of media history are more familiar with them as The Payne Fund Studies, an interesting fact given that members of the private, philanthropic Payne Fund eventually attempted to distance the use of the fund's name from the publications (Jowett et al., 1996). The reason for their lack of enthusiasm was the fervent political nature of the project's leader Reverend William Harrison Short. Short's intention was to use a series of social scientific research studies to gather enough damning evidence of the effects of motion pictures on youth that demands of governmental censorship would take hold. He believed that the best way to gather this evidence was by enlisting the leading researchers across several fields to design experiments using the highest standards of scientific rigor. In the end, it was likely the scientists' objectivity and precision—which they placed above their own possible personal disdain for movie content—that ultimately led to results which made it hard to suggest strong, uniform effects resulted from movie exposure (Jowett et al., 1996).

Given the focus of this book, it is interesting that one of the 11 Payne Fund Studies relied heavily on the measurement of physiological reactions to movie content. **Wendell S. Dysinger**, a graduate student at Iowa State University, and his professor **Christian A. Ruckmick** were two members of the Payne Fund Study team whose goal was to "discover the emotional effects produced by various types of incidents in motion pictures on children and adults" (Dysinger

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& Ruckmick, 1933, p. 3). They did so by designing a series of laboratory and field studies where subjects between the ages of six and 50 watched popular films while dipping two fingers into a box about the size of a small loaf of bread. The box contained liquid electrode allowing skin resistance readings to be taken off their fingers. Pulse rate data were also recorded using a leather arm strap. Even by today's standards, the extent of the Dysinger and Ruckmick data collection task is impressive. Not only did they record physiological data from 89 people across six age categories in the controlled environment of their research labs, but they negotiated to bring their equipment into the back three rows of local movie theaters, allowing them to collect additional data from 61 subjects in a more naturalistic setting.

In contrast to the declarations made by the likes of Phelan, the results of Dysinger and Ruckmick did not show uniform emotional reactions to film. Instead there were interesting variations across the different age categories. For example, skin resistance reactions to scenes from the "erotic" movie *The Feast of Ishtar* showed more arousal among the 16-year-old subjects than any other age group. Now remember, this was in the 1930s when erotic scenes consisted of kissing and groping that would likely be considered mild by today's standards. But still, Dysinger and Ruckmick found fewer reactions to them in the older movie viewers compared to 16-year-olds. Furthermore, even *within* the 16-year-old age group there were substantial differences; some responded with very high levels of skin resistance and some had barely any resistance at all indicative of large arousal reactions. This led to the conclusion that the impact of film "is a matter of individual mental lives and must be regulated or at least judged according to the individual psychophysiological organism . . . of his peculiar mental and physical constitution" (Dysinger & Ruckmick, 1933, p. 115).

Behaviorism's strong influence

As we will see later in this chapter, Dysinger & Ruckmick interpreted their results in accord with several of the theoretical precepts of modern psychophysiology, recognizing the importance of both external and internal *contexts* in being able to predict how individuals will react to a media message. However, this contextual way of thinking was overshadowed in the 1930s by the growing momentum of a major scientific paradigm: **behaviorism** and **classical conditioning**. In the early 1920s, Russian scientist **Ivan Pavlov** demonstrated how organisms could be conditioned to expect certain outcomes following a signal input (Samoilov, 2007). He did this first by repeatedly giving dogs food following a standard signal—such as a ticking metronome or the ringing of an electronic buzzer—and then measuring the activity in their salivary glands in response to the food presentation (Pavlov, 1927). After multiple conditioning trials, the dogs began to associate the signal with the onset of good things to eat. Eventually Pavlov's data showed the

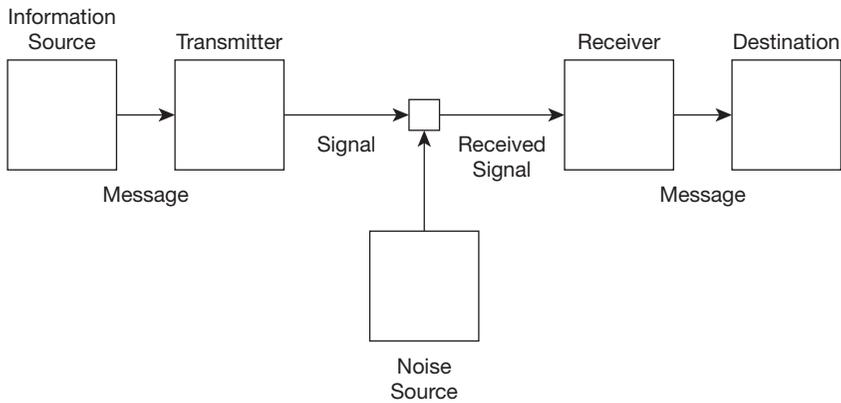


FIGURE 1.1 The Shannon-Weaver model of communications, circa 1949.

dogs beginning to salivate in response to the signal alone, whether food was given or not. This pairing of a stimulus (the buzzer) with an identifiable response (increased saliva in the dogs' mouths) became a guiding metaphor for much of the work done in psychology for the next several decades—an approach known generally as *behaviorism*.

One of the most famous and influential scientists associated with behaviorism—**B. F. Skinner**—believed that the only things necessary for explaining the behavior of any organism—including humans—was a description of the important elements of the external environment and an understanding of the functional connections between them and the behavior of interest (Smith, 1996). According to Skinner and other strict behaviorists, it was not only unnecessary but also somewhat foolish to develop theories about what was going on inside the brain of the animal since we could not possibly measure with any accuracy something that we could not directly observe (Smith, 1996). So, to return to the Pavlovian metaphor, the task of most experimental psychology conducted from the 1930s to 1950s became essentially one of matching an external stimulus to observable responses.

Communication researchers and theorists during this time reflected behaviorist approaches in their work, primarily because many scholars migrating to the field had been trained—and therefore highly influenced by—psychologists immersed in the paradigm (Paisley, 1984). The pattern of the **Stimulus-Response Model**, for example, is apparent in the classic definition of communication from Lasswell (1927/1971): “Who says What to Whom and with What Effect.” Later, the **model** proposed in Shannon and Weaver’s (1949) *Mathematical theory of communications* (see Figure 1.1) still conceptualized communicative acts in a manner just slightly more elaborated than Pavlov’s description of salivating dogs responding to signals 20 years previously.

Early behaviorist communication research

Of course, with communication research in its infancy, using a behaviorist model to establish predictable responses from well-explicated causal stimuli was important and necessary work. Many notable relationships were identified during the early years of the field. Consider the research conducted by Hadley Cantril who explored the massive panic caused by the radio performance of H. G. Wells' *War of the Worlds* on CBS's "Mercury Theater of the Air." The broadcast, which occurred on October 30, 1938, contained multiple on-air reminders that the show was merely a dramatic performance. Nevertheless, all over North America people believed they were hearing a live broadcast of an interplanetary invasion by Martians intent on destroying the Earth! The extent of the panic was so great that Cantril and his colleagues at Princeton University's Office of Radio Research seized upon the opportunity to conduct the first investigation of wide scale public behaviors triggered by a media event (Lowery & DeFleur, 1995). What Cantril hoped to do was take the behavioral responses—which ranged from sorority sisters huddled around radios saying their tearful goodbyes to frantic calls to police stations and attempted suicides—and work backwards to identify the environmental conditions which had served as stimuli. To do so, the researchers conducted a wide-ranging study utilizing personal interviews, surveys, and content analysis of over 12,000 print pieces describing the broadcast and people's reactions to it.

According to Lowery & DeFleur (1995), the researchers from the Office of Radio Research identified four different categories of responses to the radio play:

1. Those who listened to the *War of the Worlds* but decided the reports sounded too much like science fiction storytelling and therefore did not panic.
2. Those who compared what they were hearing in the broadcast to external information, such as a published radio schedule, determined the reports were fictional and did not panic.
3. People who obtained other external information but yet still panicked because they believed the broadcast was true.
4. Those who panicked from the onset of the broadcast and therefore were uninterested in checking what they heard against internal or external searches of further information.

Even though Cantril (1940) believed strict behaviorists would not be comfortable with his conclusions due to the absence of a repetitive conditioning element (but after all, how many times does an alien invasion of the planet repeat itself!), the influence of a behaviorist approach in these categories is hard to dispute. They provide descriptions of the *external* or *environmental* conditions on that October night and explain how they may have influenced a person to act in one of these four ways. These descriptions were either of key elements of the media messages (i.e., the dramatic excellence of the performance itself, the interruption

of music programming to present “news” updates about the invasion, etc.), or the societal temperament in general (i.e., the fact that the broadcast occurred so close to Halloween, that war being salient in the minds of many listeners as Hitler’s fascist regime gained control in Germany, etc.). However, Cantril did not attempt to describe the processes that took place *within* the individual’s cognitive system to arrive at the conclusions they did and exhibit particular behaviors as a consequence.

Another behaviorist researcher, Carl Hovland, advanced the field with a prolific research career spent establishing links between external message attributes and opinion change in message recipients (Hovland, 1957; Hovland, Janis, & Kelly, 1953). Hovland’s research interests were greatly influenced by his stint in the US Army during World War II conducting experiments on how film could be used to affect audience opinion change (Lowery & DeFleur, 1995). During the two decades following the war, however, he moved from film to audiotape recordings of individuals making interpersonal arguments. In all he conducted over 50 studies as the director of the Yale Program of Research on Communication and Attitude Change. In his book *Persuasion and communication* (Hovland et al., 1953), for example, one chapter details experiments about the organization of message arguments and the ways in which varying their structure impacted opinion change. Research questions included:

- Should a persuasive message draw an explicit conclusion or should it leave the conclusion implicit and allow the audience to reach it?
- For a message to be maximally persuasive should each side of an argument be presented or only the points in favor of the position being argued for?
- If multiple points are made in an argument, should the message lead with the strongest one or save it for last?

To test these and other questions, Hovland recorded different versions of arguments on issues ranging from international politics to the benefits of higher education. He even included more mundane topics like the usefulness of woodworking as a hobby! In tightly controlled experimental conditions, college students listened to their assigned audiotape and then gave their opinions and attitudes toward the topic. Hovland and his colleagues felt that three things happen when someone changes an opinion:

1. A recommended opinion (the stimulus) is presented.
2. Assuming that the subjects have paid attention to and understood the message, the audience responds or reacts. That is, they think about their initial opinions and also about the recommended opinion.
3. The subjects will change their attitudes if incentives (rewards) for making a new response are greater than (*sic*) those for making the old response (Lowery & DeFleur, 1995, pp. 169–170).

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Once again, there was not much work designed to investigate the specifics of the second condition—the one having to do with cognitive processes like attention and comprehension (cf. Cohen, 1957). It was, indeed, *assumed* that “attention” occurred and that “thinking” took place. The mechanisms or processes involved in such internal states were just not explored by behaviorist researchers in the 1950s.

Albert Bandura is another communication researcher closely associated with behaviorism. Bandura developed a model of how people learn through observation which he initially called **social learning theory** (Sparks, 2002). Social learning theory maintained that if a person observes behaviors being performed by a physically- or socially-attractive model—and if those behaviors are rewarded—then the observer is likely to behave in similar ways in future situations as long as they physically can and are motivated to do so.

Bandura was primarily interested in how people learned aggressive behaviors and much of his early experiments had school-aged subjects watch modeling stimuli consisting of media messages showing adults acting in an aggressive manner. For example, in one study Bandura and his colleagues (Bandura, Ross, & Ross, 1963) tested whether watching aggressive behaviors in a film resulted in different levels of post-viewing aggressive behaviors in research subjects than watching the same behaviors in cartoon or real-life versions of the same acts. The experimental procedure for this study was similar to many done by Bandura. First, a child subject came to the lab individually and was randomly assigned to a treatment group; they were either selected to see the live-, film-, or cartoon-version of the aggressive behavior or they were assigned to a control group and exposed to no aggressive behaviors at all. When the experiment began, the experimenter brought the subject and another adult into a testing room. The other adult was actually also one of the experimenters—a **confederate** acting as the modeling agent. Both the child and the modeling agent were seated at a table on which there were arts and crafts supplies. The experimenter showed them both how to use the supplies to make creations. After a short time, the experimenter then escorted the confederate to a table on the other side of the room. This table was covered with small toys, a small mallet, and an inflated plastic Bobo doll toy. The confederate was told, loud enough so that the child subject could hear them, that they could now only play on that side of the room. The experimenter then left the two of them—at their separate tables—alone in the room.

As a planned part of the experimental manipulation, the confederate first began playing with toys but after a short while began yelling at the Bobo doll and acting aggressively toward it—sitting on it, punching it multiple times in the nose, hitting it on the head with a mallet, throwing it up in the air and kicking it around the room—for about 10 minutes. Subjects in the film version of the experiment did not share the room with the confederate, but instead were shown a movie of an adult acting in this same aggressive way on a color TV set placed close to the arts and crafts table. Those in the cartoon version also watched the same TV set,

but the film was actually a live-action production of *Herman the Cat*, a show made especially for the experiment where “the female model costumed as a black cat similar to the many cartoon cats” appeared walking across the floor “covered with artificial grass and the walls forming the backdrop were warm, bright-colored trees, birds, and butterflies creating a fantasyland setting” (Bandura et al., 1963, p. 5). But, as you might expect, Herman the Cat also eventually beat the heck out of the Bobo doll!

After the modeling session, the child subject was led to another small room that contained a number of attractive toys and told that they could play with them. But, shortly after they became engaged with these toys, the experimenter returned and said that those toys were too nice for the subject to play with. Instead, they would have to go into yet another room and play with toys there. The goal of this step, of course, was to instigate frustration in the child. In the next room the child subject found equal numbers of nonaggressive toys like crayons and paper, cars and trucks, dolls, and plastic farm animals. There was also an assortment of aggressive toys, too. Most importantly an identical Bobo doll, a mallet and peg board, two dart guns, and a tether ball with a face drawn on it and hanging from the ceiling. The child then spent 20 minutes in this room while experimenters observed and coded their behaviors while sitting behind a one-way window.

Bandura’s findings were exactly the type that you could imagine William Harrison Short had hoped to find during the Payne Fund Studies:

Indeed, the available data suggests that, of the three experimental conditions, exposure to humans on film portraying aggression was the most influential in eliciting and shaping aggressive behavior. Subjects in this condition, in relation to the control subjects, exhibited more total aggression, more imitative aggression, and more partially imitative behavior, such as sitting on the Bobo doll and mallet aggression, and they engaged in significantly more aggressive gunplay. In addition, they performed significantly more aggressive gunplay than subjects who were exposed to the real-life aggressive models.

(Bandura et al., 1963, p. 7).

Similar to Hovland’s theory of persuasion, Bandura’s social learning theory proposed four necessary conditions if modeled behaviors were later to be imitated by a targeted individual: attention, retention, reproduction, and motivation. In other words, if learning of the modeled behaviors was going to occur, one must ensure that behavioral details are first selected from the vast array of information in the target’s environment at any one time and symbolically encoded into their cognitive system. If the students in the Bobo doll experiments had, instead of watching the model, been so focused on their arts and crafts, no learning of aggressive behavior could have occurred because none had been attended to in

the first place. But, paying attention to the behavior is not enough. Instead, said Bandura, the details of the modeled behavior must be retained in long-term memory and be accessible during appropriate situations. Furthermore, the target individual must be physically capable of reproducing the effect and have strong incentives to do so.

Bandura's research has focused primarily on investigating the impact of different variables on these four necessary conditions for social learning. With the inclusion of the concept *personal agency* (Bandura, 2006), social learning theory has transformed to social cognitive theory (Bandura, 2009). However, in the late 1950s and early 1960s, like the work of Hovland and Cantril before him, Bandura focused almost entirely on external circumstances in a noticeably behaviorist way. In fact, this focus away from closely investigating internal cognitive processes lasted well into the 1970s. Noted communications researcher Wilbur Schramm—in his edited volume entitled *The process and effects of mass communication*—stated that although much of communication took place inside our brain, researchers were forced to view that as impenetrable:

Most of the communication process is in the “black box” of the central nervous system, the contents of which we understand only vaguely. When we describe communication, we are therefore dealing with analogies and gross functions, and the test of any model [of communications] is whether it enables us to make predictions—not whether it is a true copy of what happens in the black box, a matter of which we cannot now speak with any great confidence.

(Schramm, 1971, pp. 24–25)

Opening the black box—the information processing approach

It is generally accepted that three primary goals of social scientific investigation are prediction, explanation, and understanding (Babbie, 2010; Sparks, 2002). Scientists predict (we often say “hypothesize”) what will happen when we bring different variables together. We see this exemplified in the extreme with the Stimulus–Response model of behaviorist work. But beyond that, most scientists also have a strong desire to know *why* things happen the way they do and to *understand* the particular sequence of events that have to transpire in order to obtain a particular effect (Sparks, 2002). Because behaviorism did such a poor job of satisfying these two aspects of the scientific undertaking, the luster of the paradigm began fading by the 1960s. Many psychologists began to believe like linguist Noam Chomsky, “defining psychology as the science of behavior was like defining physics as the science of meter reading” (attributed to Chomsky by Miller, 2003).

What was needed in order to better understand human psychology was a willingness to pry open the “black box” of the mind. Scientists felt that in order

to predict and fully explain human behavior they needed to not only identify which environmental stimuli caused predictable effects but also design methods and test hypotheses concerning the specific mental processes and mechanisms behind these S-R connections. Picking from a wide array of disciplines—not only psychology but also philosophy, linguistics, computer science, communication science and anthropology—some social scientists began moving their work in a direction which eventually became known as the *information processing approach*. In their book *Cognitive psychology and information processing: An introduction* Roy Lachman, Janet Lachman, and Earl Butterfield provide a thorough description of how each of these fields contributed to the development of information processing as a discipline in its own right (Lachman et al., 1979). They also provide a discussion of the assumptive principles held by those who began to peek inside the black box. Because many of these principles are also held by media psychology researchers who use psychophysiological methods it is important to summarize them for you here:

1. *Humans have innate capacities.* Behaviorists felt that all of human knowledge and behavior was due to conditioned learning. In contrast, those using an information processing approach believe that humans also have inherited tendencies passed on through generations via the genetic mechanisms of natural selection. There are genetics associated with external and aesthetic traits, of course: height, hair and eye color, skin pigmentation, etc. There are also innate genetic tendencies for certain diseases. The information-processing scientist, however, is more interested in the impact of innate *cognitive* abilities that have evolved in all human beings to a varying extent. And, as we will see, the fact that these abilities were selected for down through millennia when almost everything human beings encountered was real and present, certainly impacts the ways in which we interact today with things mediated through a TV or computer screen—in other words, with things *not* real and *not* present (Reeves & Nass, 1996). But, that's getting a little bit ahead of ourselves. For now, it is important to realize that a key assumption held by those using an information-processing approach is that “part of the job of explaining human cognition is to identify how innate capacities and the results of experience combine to produce human performance” (Lachman et al., 1979, p. 118).
2. *Humans are active information seekers.* Again in stark contrast to the behaviorist approach, which viewed humans as passively waiting to react as environmental stimuli acted upon them, the information processing approach “views people as hungry for information, as constantly scanning their environment in search of relevant developments” (Lachman et al., 1979, p. 118). What causes unpredictability in human behavior, of course, is that human beings are not only motivated by observable external conditions but also by internal motivations that are often unseen and therefore unrecognized by the scientific observer.

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3. *Knowledge is stored in the brain.* Humans (and other living organisms) interact with the environment through sensory organs. When reading this book, light is reflected off the page and hits your eyeball. When listening to music through headphones connected to an MP3 player, ears collect vibrations of air occurring at various frequencies. But what happens to these instances of light and sound energy after they enter into the human organism? How are they transferred into the cognitive system? Somehow the different light and shadow patterns reflected from the page become recognized as letters, words, and sentences containing meaning. The varied vibrations get turned into a recognition and appreciation of the musical notes from a favorite song. But if we were to slice open your brain while reading and listening to music we would not, of course, be flooded with waves of light and sound. Those using an information processing approach believe that the human brain first transfers these various energies into some sort of representations of reality. There are debates over what form these representations may take. Some—including Lachman et al. in the late 1970s—believe that knowledge is represented as a series of formal symbolic propositions which the brain then manipulates (Newell, 1990). Others believe that viewing cognition as strict symbol manipulation is too limiting and instead feel that knowledge is represented as a distributed network of neurons that become activated at certain times (Churchland & Sejnowski, 1992). Regardless, the fact that some sort of representation is necessary in a cognitive system is an undisputed assumption.
4. *The Brain is a knowledge manipulator.* Since Lachman et al. (1979) believed that knowledge was stored in the brain in a symbolic manner, they stated this assumption as “*The Brain is a Symbol Manipulator*” and that only a “few relatively basic symbolic computational operations, such as encoding, comparing, locating, storing, and the like, may ultimately account for human intelligence and the capacity to create knowledge, novelty, and perhaps expectations about the future” (Lachman et al., 1979 pp. 114–115). Although the computational operations may be few, evolution has fine-tuned the human cognitive system into one that is very rapid, efficient, and precise in its ability to employ them. Of course, if one takes the distributed network approach, the brain has evolved to rapidly make associations between a series of neurons located across the brain (Clark, 1997; Thelen, 1995). Regardless of how you think knowledge is represented in our brains, the assumption that evolution has fine-tuned the brain into a very rapid processor of that knowledge is central to information processing and to psychophysiology.
5. *Human beings are systems.* Social scientists using an information processing approach view the human organism as a **dynamic system**. The concept of a dynamic system is one that we will return to in more detail when discussing specific assumptions of the *psychophysiological* approach. For now, the

definition provided by Miller (1973) will suffice: “A system is a set of interacting units with relationships among them” (p. 68). Information processing conceptualizes any single behavior (or thought . . . or emotion . . . or memory) as the result of a whole multitude of interactions amongst and between components of different systems within and outside of the individual. Consider again the task of reading the words on this page. But, this time, let’s be more specific and think about what is going on as you read and understand a single word, say:

BALL

Your eyes represent an access point to a complex *visual system* where light energy is transduced into bioelectrical energy at the cellular level (Kandel, Schwartz, & Jessell, 2000). Then it is transmitted along a string of neurons—a *neural system*—connecting your optic nerve to a very specific location in the brain known as the visual cortex. To decipher the squiggly lines on the page as the word “BALL” (as opposed to say GXPZ, or even other squiggly lines like ||◊■) requires more interaction within another system—this time among brain cells in the visual cortex. Interestingly, investigation of this particular brain system by cognitive neuroscientists (James, James, Jobard, Wong, & Gauthier, 2005) shows that even though vision is involved in both tasks, different identifiable parts of the visual cortex are activated when processing a word unit (“BALL”) compared to processing individual letters appearing alone (“B”). Why? Different tasks necessitate the interaction of different units . . . the involvement of different systems. As we think more closely about reading the word “BALL” off the page, we recognize even more systems that are involved with this simple task. After recognizing “BALL” as a word unit, you likely create a mental image of a ball, for example. What units interact to constitute this process? Why might some readers imagine a baseball, others a football, and still others a rugby ball? What systems are at work as you recall the time when you and a group of friends played volleyball at the beach last summer? Or as you experience mixed emotions; remembering the happiness of that day while also realizing you haven’t seen those friends for a long time? Meaning-making, exemplar generation, personal memory, emotion . . . they all are viewed by scientists using an information-processing approach as the outcomes of systems interacting with each other. Recognize how this is a magnitude greater in complexity than the traditional behaviorist view of the world from the 1950s, where action resulted from a connection between two nodes—stimulus and response. To one viewing the world from an information-processing standpoint, this increase in complexity seems appropriate. For although science strives for the simplest explanation of a single phenomenon (a concept known as **parsimony**), we are also after as thorough and complete an explanation

as can be teased apart. The notion of the brain as an unknowable “black box” will not be enough! One of the tasks for the information-processing psychologist, then, is to develop models that generate testable hypotheses about how a particular system behaves and interacts with others. A model, in the scientific sense, is an attempt to break down larger experiences into their composite parts (Shoemaker, Tankard, & Lasorsa, 2004), which brings us to the sixth principle underlying those using an information-processing approach.

6. *Systems are divisible and take time to complete.* As the example with the word “BALL” illustrated, an information-processing researcher often begins the task of understanding a cognitive phenomenon by breaking it down into a list of steps—or subprocesses—necessary to realize an end state. Each of these subprocesses can then be explored individually along with, of course, the ways they interact as a system. A further important component within the information-processing paradigm, however, is the idea that each of these subprocesses takes time (Posner, 1978). To contrast information processing with behaviorism again, the importance of time elapsing was never recognized by behaviorists “[b]ecause they were uninterested in internal events, it stands to reason that they would not think of speed as an index of occurrence of events inside the head” (Lachman et al., 1979, p. 119). However, as we will see in Chapter 7, **Secondary Task Reaction Time (STRT)** measures have become instrumental in understanding many of the subprocesses that make up encoding of mediated information. Psychophysiological recording also relies heavily on the concept of time. In fact, just like the STRT measure, time is sometimes exactly what a psychophysiological records. One way of quantifying cardiac activity, for example, is by counting the number of milliseconds (1/1000th of a second) between peaks in the waveform created by the electrical signals generated by the heart. As we’ll learn in Chapter 4, this waveform is called an *electrocardiogram* and the time between peaks is the *inter-beat interval*. In other instances, time can be used to identify meaningful psychophysiological responses. For example, suppose you wonder if the appearance of a close-up video image of a police officer firing their pistol in a cop episodic drama, and the accompanying sound, increases viewer arousal. You could answer this question by measuring skin conductance activity off the hands of viewers as they watched the cop show to see if it increased in response to the firing of the pistol. But, what duration of time will you use to determine whether an increase in skin conductance was *in response* to the pistol as opposed to something else? How long does an evoked skin conductance response take to manifest itself? Defining this will have an impact on the conclusions you draw. We’ll discuss the answers to these questions further in Chapter 5 but remember that cognitive processes take time, and just how long they do take is an important consideration in developing theories of media psychology.

7. *Science should work on issues that are applicable to everyday life.* It may seem unnecessary to even state this principle in a book for *media* psychology researchers—after all, people all over the world interact with some form of mediated communication on a regular basis. But three decades after Lachman et al. (1979) it is still worth mentioning this standard for those new to the field—as well as a reminder for those of us who have been at it for some time. A guiding principle *from the very beginning* of the information-processing tradition of enquiry was the desire to understand how the brain worked while processing everyday events. There are two ways this principle can be applied in modern research. The first is to remember that fruitfulness is secondary to naturalness. In academic circles, the term *fruitfulness* means the ability of one’s research area to generate future studies and publications. However, generating studies and publishing academic articles that test slight variations among independent variables should not be the *raison d’être* of the media psychology researcher if those variations are not ones meaningfully encountered in everyday life. This guideline can be easily forgotten, particularly with increasingly powerful computer technology that allows us to easily make the smallest of experimental variations to our media stimuli. Add to this the fact that—as we hope to demonstrate in the pages that follow—collecting and analyzing psychophysiological data is also becoming easier all the time, and it becomes all the more tempting to conduct study after study just because you can. Remember the goal is to understand and explain cognition and emotion associated with the everyday phenomenon of media processing, not just to complete another study and obtain statistically significant results.

While the rapid advancement of computer hardware and software makes it difficult to abide by this principle in one sense, it can also make it easier in another. When researchers first began using psychophysiological measures to explore the processing of media, the equipment was large and bulky, the protocols intrusive and unnatural. Inherent in this seventh principle is a desire, when possible, to explore how media are processed in everyday life *outside* of the laboratory. As we will see in Chapter 6, with new ambulatory psychophysiological measurement devices this is becoming increasingly more possible, less intrusive to the participant, and less expensive for the researcher.

The second debut of physiology in media research

By the early 1960s it became clear that the discipline of psychology was making a dramatic shift, abandoning the doctrine of behaviorism in favor of these principles of information processing (Miller, 2003). The communication discipline did not rapidly follow suit. In fact, 20 years after psychologists began taking up the information systems approach, **Steven Chaffee** (1980) criticized the field by explaining that it had been stuck for too long in what he referred to as “the two-variable model.” He described it using recognizably behaviorist language in an essay originally published in the book *Communication research—a half-century appraisal*:

The two-variable model consists of a measure or manipulation of variation in exposure to media content (independent variable) and an observation of change in some aspect of thought or behavior (dependent variable) that is empirically linked in a systematic statistical fashion to the independent variable.

(pp. 88–89)

Interestingly, it is in these studies from the 1970s, employing the “two-variable model,” where we see the second appearance of physiological indices employed by communication researchers (Donnerstein & Barrett, 1978; Donnerstein & Hallam, 1978; Zillmann, 1971). However, these studies did little more than use the measures to demonstrate Stimulus-Response linkages between media variables and physiological changes. **Dolf Zillmann** (1971), for example, used physiological measures in a pretest to identify movie stimuli for later use in a test of **Excitation-Transfer Theory**. In the pretest, 12 male subjects watched segments of six films while their skin temperature, heart rate and blood pressure were measured. The six film clips were “selected on intuitive grounds” as examples of three conditions: Neutral, Aggressive, and Erotic (Zillmann, 1971, p. 423). However, when the physiological data were analyzed and interpreted for each of the films, with an eye toward selection of the final three for use in the Excitation-Transfer experiment,

[t]he choice of the three most appropriate experimental films was clearly determined by the results obtained . . . [w]ith the exception that a negligibly greater drop in skin temperature was produced by [the chosen aggressive film] than by [the chosen erotic film], the differences between all physiological indices of excitation are in the proper direction. The differentiation in the critical indices of mean blood pressure and sympathetic activation was highly significant. *The three eliminated films either had major deficiencies or were not advantageous.*

(Zillmann, 1971, pp. 426–427, emphasis added)

The priority in this particular pretest was to identify film clips that elevated physiological arousal so they could later be used to test the effect of transferring residual arousal to another task—the lynchpin of the excitation transfer approach. Certainly for that, Zillmann’s interpretation served a purpose. But it is difficult to read that excerpt without recognizing the behaviorists’ influence—the films selected on intuitive grounds were supposed to elicit specific physiological responses in a classic S-R manner. Those that were thought to be arousing should increase all measures above those that were not. Those that did not follow the expected patterns were eliminated as “not advantageous,” or were explained in a caveat—the erotic film had shown greater arousal effects than the aggressive film in all measures *except* skin temperature (which goes down during high sympathetic nervous system arousal).

Zillmann and his students similarly used physiological measures to confirm that specific experimental conditions generated arousal either in pretest situations (Zillmann & Bryant, 1974; Zillmann, Mody, & Cantor, 1974) or as dependent variables in main experiments (Cantor, Zillmann, & Einsiedel, 1978; Zillmann, Hoyt, & Day, 1974). In these studies, like with Zillmann (1971), the focus was on finding an “effect” of certain stimuli (different types of media stimuli, negative provocation by a research confederate, etc.) on physiological systems—primarily the arousal system (Lang, Potter, & Bolls, 2009). These studies then attempted to show that such arousal activation influenced subsequent behaviors, such as presumably delivering electric shocks to a provoking confederate.

Sometimes during this “second wave” of physiological measurement in media research physiological dependent variables did not act as expected *and* subsequent behaviors did not cleanly match. **Edward Donnerstein**, for example, explored the influence of an anger manipulation and the subsequent viewing of an erotic film on the aggressive responses of male subjects toward either a male or female research confederate (Donnerstein & Barrett, 1978). The study used physiological variables to index arousal levels at various points during the experimental procedure. Subjects first came to the lab and met a confederate posing as another subject. The actual subject was told that the nature of the research was to determine the effect of stress on learning and physiological response. They were always “randomly” selected by the primary researcher to do the first cognitive task, prior to which their blood pressure was recorded. The cognitive task was to spend five minutes writing an essay about a specific current event. The subject was told that essay would then be judged by the other participant (the confederate), who would communicate an assessment about the essay’s quality by administering up to 10 short (half-second) electric shocks to the subject as well as providing a written critique. The feedback was, of course, predetermined to be either harsh (receiving nine shocks) or mild (receiving one shock) to manipulate the subject’s level of anger. Following the shocks and the reading of a written evaluation of the essay, the subject’s blood pressure was taken again.

Then it was the confederate’s turn to perform a task, which the actual subject was told was to learn a list of nonsense word pairs. While the confederate was “learning” them, the subject was told to watch a film to pass the time and was randomly assigned to view either an excerpt of a nature film or a black-and-white erotic film. The subject’s blood pressure was again recorded after viewing the film.

Finally, the subject was given a list of nonsense words to administer to the confederate who was supposed to respond with the correct matched pair. If correct, the subject could award the confederate any number of points—redeemable for money at the completion of the study. If incorrect, the subject was told to administer an electric shock to the confederate at a level of intensity and duration they thought appropriate. The primary researcher told the subject whether the confederate’s answer was correct or incorrect. The number of incorrect responses was also predetermined, of course.

Results were more complicated than the authors had expected. Mean blood pressure and systolic blood pressure were used as indices of physiological arousal in the male subjects. Both measures increased in angered subjects after they saw the erotic film—as Donnerstein hypothesized. But unexpectedly, this physiological response occurred *only in subjects who were paired with female confederates*. Those who interacted with male confederates showed a *decrease* in mean and systolic blood pressure immediately following the erotic film. Further baffling was that the angered subjects behaved less aggressively (e.g., gave shorter and less intense shocks) than those who had shown less physiological arousal—a finding completely contradictory to the expectations of the Excitation-Transfer Theory being employed (Donnerstein & Barrett, 1978).

So, in the decade of the 1970s, communication researchers who had tried to include physiological measures in their methodological toolbox found themselves faced with perplexing issues. To begin with, when compared to the paper-and-pencil measures often used in the discipline to collect self-report data, physiological measures seemed both expensive and daunting (Gale & Smith, 1980). Furthermore, there were many known methodological and design problems associated with blood pressure (Stern, Ray & Davis, 1980), the primary measure being employed by communications researchers at the time (Cantor, Zillmann, & Einsiedel, 1978; Donnerstein & Barrett, 1978; Donnerstein & Hallam, 1978; Zillmann & Bryant, 1974; Zillmann, Hoyt, & Day, 1974; Zillmann, Mody, & Cantor, 1974). This expense and aggravation was coupled with the even more bothersome fact that the results being obtained did not conform to the predictions of S-R behaviorism—neither those where the arousing media variables were the stimulus and recorded physiological activity the response *nor* those when physiological arousal was conceptualized as the stimulus and the subsequent behavior (as predicted by Excitation-Transfer Theory) the response. So, just as they had 40 years earlier, physiological measures were placed back onto the shelf by media psychology researchers and not taken down again for some time.

The third time's a charm: psychophysiological approaches to media

Not nearly as much time passed before physiological measures were again employed in the media lab . . . but it was still more than a decade after Chaffee (1980) had encouraged the field to move beyond two-variable studies and begin embracing the exploration of “psychological *processes* that intervene between media exposure and its effects” (p. 89, emphasis added) that they received widespread attention. It came in the form of another overview of the discipline, this one a two-issue special collection of essays in the *Journal of Communication* designed to be “a collective reconnaissance of communication scholarship and its future” (Levy & Gurevitch, 1993, p. 4). One of the essays, by Seth Geiger and John Newhagen, claimed that the information-processing view was still largely ignored by the field:

Inquiry in individual-level mass media effects has been limited by conceptualizing the human processor as an impenetrable “black box” with unknowable processes taking place between message reception and the traditional outcomes of learning, attitudes, or behaviors. Instead, we see these component processes as both important outcomes and predictors in their own right. In short, the perennial black box of mass media effects can be better illuminated by examining the black box of human information processing that goes on within it.

(Geiger & Newhagen, 1993, p. 42)

Still, they went on to review recent publications in which media scholars were beginning to develop models of how the human cognitive system processes media by harnessing tools developed by psychologists over the three decades since behaviorism’s initial wane. For example, some work focused on a central principle in information processing, that cognition takes time (Posner, 1978), and measured either secondary task reaction time (STRT) (Geiger & Reeves, 1993; Reeves, Newhagen, Maibach, Basil, & Kurz, 1991) or response latency (Newhagen & Reeves, 1992)—which quantifies the amount of time it takes a person to respond to questions about a previously seen media message (Cameron & Frieske, 1994). The common researcher across many of these studies, **Byron Reeves**, was also a key figure in the re-introduction of physiological measures to media psychology. As we will see, his studies using brain waves (EEG) were the first to truly bring a *psychophysiological* perspective to media psychology.

There is a key concept in psychophysiology known as the **orienting response** (OR) which is a momentary increase in attention to what’s going on in the environment—we will spend more time on the OR in Chapter 4. But, for now, one of the ways that an OR can be identified physiologically is with a momentary change in the bioelectrical signals emitted by your brain. So, if electrodes were put on your scalp and the signal amplified about 20,000 times, the very small electrical signals your brain was generating could be seen on a computer screen. Actually, what would be seen is a very complex waveform . . . a very messy squiggly line. This waveform is actually the summation of many different waveforms oscillating at particular frequencies. Waveforms oscillating at two distinct frequency ranges are of interest when it comes to attention: they are arbitrarily named **alpha waves** and **beta waves**. When you experience an orienting response and momentarily pay more attention to what is in your environment, the waves oscillating in the beta range increase in amplitude and those oscillating in the alpha range decrease. Knowing this, Reeves and his colleagues (Reeves, Thorson, Rothschild, McDonald, Hirsch, & Goldstein, 1985) were interested in using EEG measures to determine which aspects of media caused ORs in viewers. They recorded EEG from 26 right-handed females while they watched two 30-minute sitcoms containing commercials. Another group of 57 women watched the same two sitcoms without having their physiology data

recorded but instead completing only memory tests after the programs. The first sitcom was included as part of the procedure to essentially allow the physiology subjects to become used to having four EEG sensors attached to specific locations on the top of their head, plus two others on their earlobes to act as comparison locations (see Chapter 4).

Reeves et al. (1985) placed nine advertisements in the sitcoms across three commercial breaks. They collected the brain wave signals 128 times each second and then extracted the portions of the complex waveform that were in the alpha frequency range of 8–13 Hz. To analyze the data they began by graphing the strength of the alpha waves each half-second for each commercial, averaged across the 26 subjects. Then, they looked extremely closely at the ads themselves, a half-second at a time. For each 500ms they coded whether there was movement of actors or objects on the screen and if the camera cut between two different shots. This fine-grained inspection of both the media stimuli and the physiological response was different from other work at the time that looked at brain waves during ad processing but averaged the physiological measure across much longer time periods (Appel, Weinstein, & Weinstein, 1979; Weinstein, Appel, & Weinstein, 1980; Weinstein, Drozdenko, & Weinstein, 1984). By looking across such a small time window Reeves et al. (1985) were able to conclude that “attention *reacts* to the stimulus. Rapid alpha drops and habituation are likely involuntary reactions to visual stimuli, although the magnitude of drop and the length of recovery may be variable and related to interest in content” (Reeves et al., 1985, p. 252, emphasis in original).

Annie Lang, a student of Reeves at the University of Wisconsin, determined that the same visual structural features Reeves et al. (1985) had shown caused alpha blocking also elicited the predicted pattern of cardiac deceleration associated with the orienting response (Lang, 1990). The impact of Lang demonstrating that heart rate can be used as a physiological correlate with the allocation of cognitive resources to the processing of media cannot be overstated. The comparative ease with which heart rate could be collected, coupled with the related lack of invasiveness experienced by the subject, has led to numerous studies which vary aspects of the television message and use heart rate to determine the resulting impact on cognition. Another early study (Lang, Geiger, Strickwerda, & Sumner, 1993) used cardiac deceleration to investigate whether people pay more attention to a television message during the few seconds following a change of the picture on the screen—which they called, at the time, a “cut.” They showed 12 different segments of television to 58 college students. They also recorded the heart rates of a subset of them, synchronizing that with the television presentation. The results of the physiological analyses show that, indeed, on average a person’s heart rate slows down following a cut. Furthermore, they showed that there is no difference in the extent of deceleration depending on whether the cut was between two related images (i.e., a cut from one camera shot to another within the same scene) or two unrelated ones (i.e., a cut from a shot of a car in a commercial to a shot

of a news anchor at a desk). But, interestingly, there were differences between related and unrelated cuts in other information-processing dependent measures that A. Lang et al. (1993) collected. For example, subjects were not only faster to respond to STRT tones that occurred in the audio track shortly after related cuts compared to unrelated ones but their memory for the content was better as well.

Now, if the pattern surrounding the use of physiology by media scholars was to repeat itself yet again, the publication of this handful of studies would have been the end of the line for another decade or so. But, the third time was the charm! Lang published an edited book a short time later entitled *Measuring psychological responses to media* (Lang, 1994b). Two of the chapters in it focused directly on the proper measurement and interpretation of bodily responses to mediated messages (Hopkins & Fletcher, 1994; Lang, 1994c) while three others discussed physiological measures as examples of larger topics such as experimental design (Reeves & Geiger, 1994), data analysis (Watt, 1994), and setting up a laboratory space (Lang, 1994a). More importantly for the continued utilization of physiology within the field was the book's framing of "explanations of how specific psychological measures could be used to assess the mental processing of mediated messages" (Lang, Bradley, Chung, & Lee, 2003, p. 651). With the widespread distribution of Lang's methods book, and more importantly the theoretical stance it took, the separation from the behaviorist tradition in the field of media psychology moved toward completion. This has been demonstrated by a noteworthy increase in the number of journal articles in the field utilizing the information processing approach in the decade following its publication (Lang et al., 2003). Lane and Harrington (2009) express disappointment in the fact that less than 5 percent of those publications utilize psychophysiological measures. While their point is well taken—*future* media research should strongly consider the added insights psychophysiology can provide to their research endeavors (that's the reasoning behind this book, after all!)—it is also possible to view the field since 1993 in a more optimistic light. Placing the number of studies employing physiological measures within the entire arch of communications research presents a quite encouraging picture. As you have seen during this brief history of mass communication research, there are very few examples of physiology being measured between the years 1910 and 1990. However, Figure 1.2 shows the number of publications in major communication journals between 1995 and 2009 utilizing psychophysiological measures. The increase is obvious, as is the fact that more and more investigators across the world are setting up media research labs containing physiological measurement equipment. Why the change? What has happened to create an environment where physiological measures are accepted as useful?

The primary difference is a separation from viewing bodily measures as *responses* in the classic behaviorist sense. Instead, media researchers are increasingly operating under what has been called the S-I-R paradigm, where the middle letter

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stands for the importance of psychological processes which *Intervene* between the external world of the stimulus and the observable response (Donchin, 1979; Donchin & Israel, 1980; Porges, Ackles, & Truax, 1983). In other words, the data obtained when measuring bioelectrical signals from various bodily systems in today's media laboratory are interpreted using the basic assumptions of *psychophysiology* . . . assumptions which make up the first topic of Chapter 2.

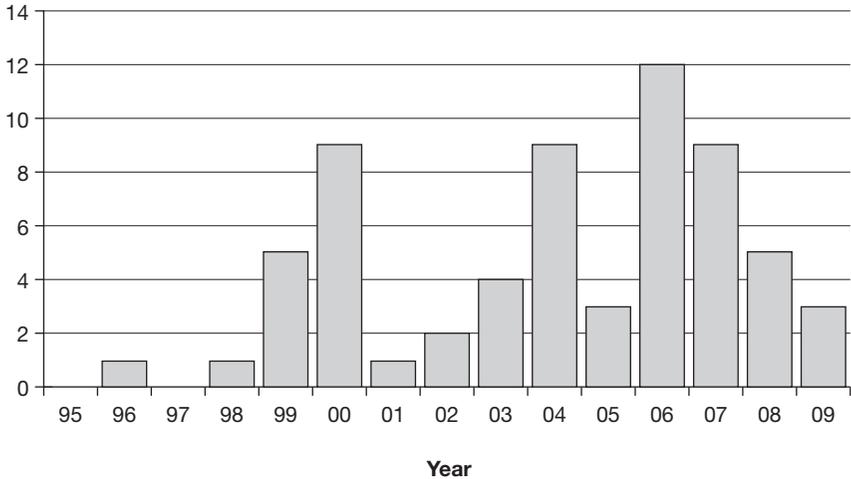


FIGURE 1.2 Number of peer-reviewed journal articles using or substantially mentioning psychophysiological measures published in *Communication Research*, *Human Communication Research*, *Journal of Advertising*, *Journal of Broadcasting & Electronic Media*, *Journal of Communication*, and *Media Psychology*.

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