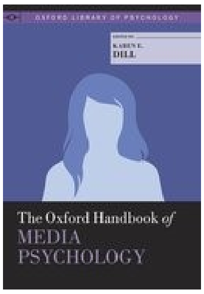

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CHAPTER

27 Media Psychophysiology: The Brain and Beyond

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Abstract

This chapter provides an overview of the effects of consuming media content spanning entertainment, news, and advertising—content that is increasingly delivered over a wide range of technological platforms (e.g., computers, televisions, smart phones)—on the psychophysiological responses of media audiences, focusing in particular on how media content affects neural responses and the ways in which those neural responses act as biological mechanisms of psychological and behavioral responses. The chapter highlights the psychophysiological approach to studying how individuals interact with media, and provides a theoretically and methodologically rich environment for advancing the scientific study of how all forms of mediated experience influence thoughts, feelings, and actions. The chapter focuses in particular on how the media psychophysiology approach has been applied to understanding media violence and persuasion, underscoring the ways in which this approach has provided a way to address questions of long-standing interest to scholars in the field.

Keywords: brain, cognition, emotion, event-related potentials, heart rate, media violence, persuasion, psychophysiology, skin conductance

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Introduction

The study of media effects—that is, how consumption of media influences psychological and behavioral responses among consumers—has a long history within the fields of psychology and communication (Bryant & Thompson, 2002). Although numerous theoretical approaches have been developed over the years, the current chapter focuses primarily on recent advances encapsulated within Lang's (2009) conceptualization of media use as consisting of a temporally dynamic interaction between the human mind and media content, defined broadly as mediated sensory information that varies in motivational significance across exposure. This conceptualization of media use moves the study of media effects forward by shifting the focus from static media effects to mental processes, embodied in neural activity, that underlie the effects of media content on individuals and provides a general framework for studying media use that can accommodate current as well as future forms of media (Lang, 2009; Lang & Ewoldsen, 2010). The psychophysiological approach is central to this theoretical perspective of media use and uniquely enables researchers to observe the activity of the mind—embodied in the brain—across time during media use, providing critical data for the development of new explanations of media effects (Bolls, Wise, & Bradley, 2012; Potter & Bolls, 2012).

Before discussing the psychophysiological study of media effects, however, it is important to first consider why scholars of human experience, even those unconcerned with media effects per se, should care about the study of media effects on brain and behavior. The simplest reason, in a nutshell, is that media use occurs on a scale that is nearly too massive to comprehend. According to the
p. 475 Advertising Age ↳ Data Center (www.adage.com/datacenter/), the top five media companies in the United States alone now earn more than $100 billion in combined annual net revenue. US media industry revenue has averaged about a 5% annual increase through the first decade of the 21st century—a decade that included several years of economic recession. Given that media industry revenue is completely dependent on audience behavior, these figures point to a huge and steadily increasing appetite for media content among the American public. This media blitzkrieg phenomenon is a relatively recent development in human history. The advent of the printing press in the 15th century represented one of the first opportunities for mediated communication on a relatively large scale (Fang, 2008). But it wasn't until the 20th century that truly massive numbers of people began to be exposed to media on a regular basis.

The story of television provides the most poignant example. First introduced in the mass market at the end of World War II, television exploded onto the American cultural landscape incredibly rapidly. By 1955, two-thirds of all homes in the United States contained a television set; by 1960, the figure was 93%. By the middle of the 1960s, television had become a part of the daily lives of virtually all Americans (Nielsen Media Research, 1998). With each annual increase in global population comes a corresponding increase in the numbers of homes containing at least one television. For example, the Nielsen Corporation reports that the number of "TV Homes" increased in virtually every one of the top 150 television markets in the United States between 2010 and 2011.

The rise in media availability has led to a culture in which media consumption is now the great American pastime. For example, the Bureau of Labor Statistics reports that in 2010 watching television accounted for around half of all time spent on leisure activities among people ages 15 and up (2011), amounting to just under 3 hours per day, every day. The next most reported category of leisure activities, "socializing and communicating," accounted for less than one-third that much time. These television use figures are likely underestimates, given that they rely on self-report. Nielsen Corporation data indicate that the average American actually watches more than 4 hours of television per day, or around 28 hours per week. At this rate, an American who lives to the age of 65 will have spent nearly 9 years of his or her life watching television. When considering that the majority of Americans also consume multiple other forms of media in addition to television, it is not an exaggeration to suggest that media consumption is the single activity that most Americans engage in most, perhaps second only to sleeping. Thus, any scholar or policymaker who believes that exposure to environmental stimuli has an important influence on behavior should be keenly interested in the study of media effects.

The scientific study of how media exposure affects media users is nearly as old as mass media itself. The first major scientific effort to study media effects occurred in the early 1930s. This effort, known as The Payne Fund Studies, consisted of a series of eight published volumes reporting the results of experiments specifically designed to test the effects of motion pictures on the attitudes and behaviors of youth (Wartella & Reeves, 1985). The popularization of different forms of mass media throughout the 20th century—film, radio, television—led to substantial concern over possible negative effects of media on individuals and society. It was during this time that specific areas of inquiry into the effects of media emerged, such as the study of the role of media in opinion change (Hovland, Janis, & Kelly, 1953) and the relationship between violent media content and aggression (Bandura, Ross, & Ross, 1963).

Early pioneers in the field used mainly self-report measures (i.e., questionnaires) to investigate how people evaluate, understand, and respond to media content. For example, Gerbner et al. made extensive use of self-report questionnaires in their effort to understand the effects of frequent viewing of violent television programs on peoples' values and perceptions of society (Gerbner & Gross, 1976). Experiments performed by early pioneers interested in the effects of persuasive and propaganda techniques in mass media relied on self-report measures of attitude change to provide evidence of effects (Lasswell, 1927/1971; Hovland, 1951). A few of the early studies attempted to directly observe behavior, as was done in Albert Bandura's experiment on media violence in which researchers observed children's play behavior after exposure to a violent film (Bandura, Ross, & Ross, 1963). An emphasis on the measurement of self-reported perceptions and observation of behavior—as illustrated by this brief review of landmark studies—was appropriate for early research on media effects that was focused on documenting relationships between media exposure and attitudinal or behavioral outcomes.

Still, measuring bodily responses as a way to gain insight into the influence of media on individuals was a small, easy to overlook, part of the very earliest formal research on media effects. One experiment p. 476 ↳ that was part of the previously mentioned Payne Fund Studies included the measurement of skin resistance and pulse rate as indices of emotional reactions to a popular film, *The Feast of Ishtar* (Dysinger & Ruckmick, 1933). This experiment was one of the earliest to illustrate the importance of understanding characteristics of both media content and the individuals who mentally process media. Yet, unfortunately the methodological insight and important conclusions resulting from this experiment were mostly ignored because of the emerging dominance of the behaviorist paradigm in psychology. Researchers working under a behaviorist paradigm in the early 20th century considered mental processes as something that could not possibly be validly measured, and moreover viewed mental processes as unnecessary to the development of psychological theories (Smith, 1996). That is, even though most scholars in the field understood that the brain must play a vital role in determining psychological and behavioral responses, they nevertheless treated the mind like a kind of "black box" whose mysteries were best left unexamined (Geiger & Newhagen, 1993).

The dominance of the behaviorist paradigm in psychology led media scholars to focus exclusively on attempting to demonstrate linkages between characteristics of media content and supposed effects of media exposure in a simple stimulus–response manner (Paisley, 1984). A stimulus–response approach to understanding media effects can be seen in early theorizing about communication, including content transmitted through media channels (Potter & Bolls, 2012). Lasswell's (1927/1971) classic definition of communication, "Who Says What to Whom in What Channel With What Effect," defined the proper focus for researchers working at this time. Shannon and Weaver (1949) elaborated on Lasswell's definition with their model of communication as a phenomenon involving a sender, message, channel, and receiver. These two early theoretical publications about the nature of communication limited the conceptualization of media effects to linkages between the stimulus (sender/message) and observable responses (the effect). Mental processes were not believed to be explicitly observable. Thus, the mind and brain, along with insights to be gained from their study, remained hidden, and researchers viewed media effects from a stimulus–response perspective. This approach to understanding media effects is illustrated in Figure 27.1.

This view began to change with the advent of the so-called cognitive revolution in experimental psychology, in which the strict behaviorist approach was replaced with an information-processing approach (Lachman, Lachman, & Butterfield, 1979). The cognitive revolution, along with formal development of the psychophysiological approach, have been credited with changing the paradigm for media effects research by enabling researchers to explore mental processes that intervene in determining media effects (Lang, Potter, & Bolls, 2009). These developments essentially shifted the paradigm from p. 477 ↳ one focused on stimulus–response relationships to one that investigates media effects as occurring in a more complex stimulus-intervening processes–response fashion (Potter & Bolls, 2012). Figure 27.2 illustrates this more complex and theoretically rich way of conceptualizing media effects.

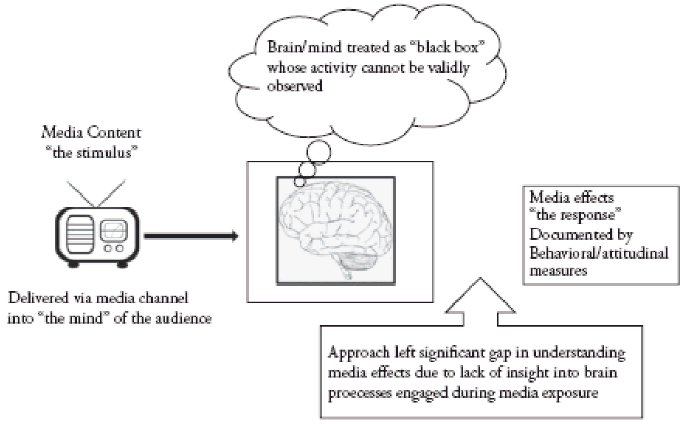

Figure 27.1 **Model depicting the stimulus-response approach to media effects research that treated brain activity as scientifically unobservable and therefore was only able to document the occurrence of effects or responses to media content without insight into how the brain processes media content.**

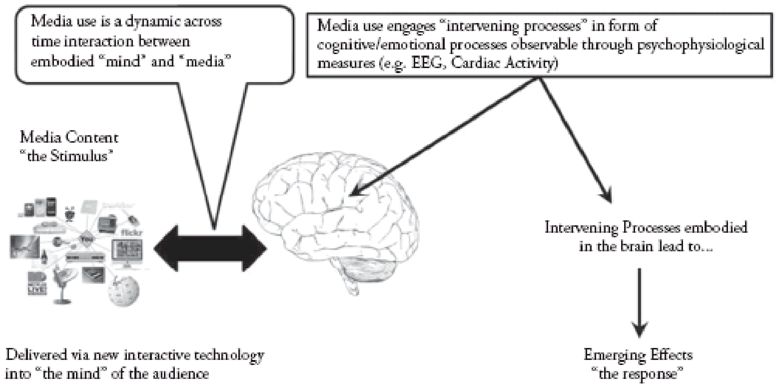

Figure 27.2 **Model Depicting the Stimulus-Intervening Processes-Response Approach to Media Effects Research.**

This approach uses psychophysiological measures to observe brain activity that act as intervening processes between exposure to media content and observable media effects.

The importance of bursting open the black box and investigating mental processes instantiated in brain activity evoked by media exposure was noted by the communication scholar Wilbur Schramm, who commented, "Most of the communication process is in the 'black box' of the central nervous system, the contents of which we understand only vaguely" (Schramm, 1971, pp. 24). It was during this stage of media effects research that researchers began to use various behavioral measures not only to gauge overt reactions to media, but also as indices of presumed, underlying cognitive operations carried out during media exposure. For example, media scholars interested in observing variation in levels of attention engaged during media exposure turned to secondary task reaction time—a measure that had gained traction in cognitive psychology—as well as time spent looking at the screen (Anderson & Burns, 1991; Basil, 1994).

In recent years, the cognitive revolution has been supplanted by another shift in focus, which we might call the "cognitive neuroscience revolution" (Sherry, 2004; Weber, Sherry, & Mathiak, 2009). This new age of media research is characterized by scholars from both media studies and psychology using various psychophysiological measures to understand not only the information processing operations engaged by media content, but also the neural underpinnings of those operations and the bodily responses they instantiate. The value of this new approach was recognized in the introduction to a special issue of the journal *Media Psychology* dedicated to the use of brain imaging in media effects research, in which it was claimed that the opportunity to observe brain activity during exposure to media content promises the potential to discover biological explanations for previously observed media effects (Anderson et al., 2006). Most broadly, cognitive neuroscience is the study of the biologic substrates of complex cognition, with a particular emphasis on the neural structures and processes that give rise to mental processes (Gazzaniga, Ivry, & Mangun, 2002). The cognitive neuroscience approach to understanding media effects is grounded in a theoretical orientation that assumes that integrating responses to media derived from cognitive, neural, and peripheral physiological levels provides a more comprehensive understanding of responses to media than can be achieved by investigating any one or two of these levels alone (Ochsner & Lieberman, 2001). The focus of this chapter is primarily on the influence of this new theoretical and methodological approach on the study of media effects.

Theoretical Approaches to Media and the Brain

 Media studies and psychology are two distinct disciplines that make unique contributions to research on ↳ how the brain processes media. Broadly, psychological scientists engage in the study of behavior, including how environmental influences and individual differences contribute to the various ways in which the brain causes behavior. In particular, social psychologists are primarily concerned with the influence of situational and environmental factors on behavior. Scholars working in media studies are primarily interested in providing insight into a wide range of mental processes engaged by media use occurring not only within traditional media—such as television and radio—but also newer, interactive digital forms of media. In this way, social psychology and media studies share a common orientation toward understanding how exposure to salient stimuli in the environment—media content, in this case—causes changes in behavior, via their effects on internal states, such as cognitions and emotions (Carnagey & Anderson, 2003). The increasing convergence between the general theoretical approach in social psychology with the specific focus on the cognitive and emotional processes engaged by media, and the larger, cross-disciplinary focus on grounding psychological and behavioral processes in brain function has led to the emergence of a new area of scholarship aptly called media psychology research (Potter & Bolls, 2012).

Media psychology research is distinct from the two disciplines that form its foundation in its entire focus on understanding—to paraphrase a famous anti-drug slogan—the brain "on" media. Psychological experiments on media effects often involve exposing participants to some form of media, and media studies includes psychology as part of its epistemological foundation. Separately, however, these two disciplines lack critical conceptual and operational components required for truly advancing knowledge of the brain "on" media. Psychological experiments that feature the effects of some form of mediated stimuli on brain and/or behavior can advance understanding of how those stimuli are processed at a basic level, but without consideration of current trends in the media industry (e.g., how various media are typically presented) and how individuals actually consume media, this research lacks the level of ecological validity necessary to truly understand the typical media consumption experience and its neural correlates. Similarly, experiments conducted in media studies must be grounded in the most current knowledge of brain structure and function so as to avoid producing very shallow, limited understanding of the influence of media on individuals and the internal (i.e., brain-based) processes that are affected by media exposure.

The specific approach to media psychology research covered in this chapter continues to advance knowledge of brain processes underlying effects of media use by uniting scientists under a common research paradigm. This paradigm combines conceptual understanding of the nature of the human brain and current knowledge of media effects and industry practices with the methodological expertise required to measure nervous system activity engaged during media use. Potter and Bolls (2012) termed this paradigm *media psychophysiology*.

Psychophysiology has emerged as a distinct paradigm within psychology with its own assumptions about the human mind and a distinct collection of measures for studying it (Cacioppo, Tassinary, & Berntson, 2007). In the broadest terms, psychophysiology is the study of the physiological and biological bases of psychological processes (Stern, Ray, & Quigley, 2001; Andreassi, 2007). Media psychophysiology extends the psychophysiological paradigm to studying how the brain processes media content. This chapter provides an overview of media psychophysiology as a paradigm for studying brain processes associated with the effects of media content and reviews relevant research by scholars working in this area. The chapter closes with considerations for future media psychophysiology research in light of continuing advancements in knowledge and measurement of brain processes as well as a constantly changing media industry and environment.

Media Psychophysiology: Studying the Brain "On" Media

At its core, media psychophysiology is concerned with development of theories—and formulating testable hypotheses based on those theories—concerning both the effects of media on psychological and behavioral responses and the functional organization of central and peripheral nervous system responses more generally. In that respect, media psychophysiology is much more than simply a collection of measures of physiological responses engaged during media use. Researchers working during the 1970s who produced the first sustained effort to apply physiological measures to the study of media effects made the mistake of viewing physiological measures as a tool for demonstrating stimulus–response linkages between characteristics of media content and physiological changes, rather than as indices of psychological processes instantiated in nervous system activity (Lang, Potter, Bolls, 2009; Potter & Bolls, 2012). This group of researchers—primarily led by Dolf Zillmann—searched for physiological effects of media content, p. 479 primarily erotica or ↳ violence, on a range of peripheral nervous system measures, including blood pressure, skin temperature, and heart rate as a way of observing the effect of media content on emotional arousal (Zillmann & Bryant, 1974; Zillmann, Hoyt, & Day, 1974; Zillmann, Mody, & Cantor, 1974; Cantor, Zillmann, & Einsiedel, 1978; Donnerstein & Barrett, 1978). Their work produced several interesting results concerning the effects of sexual and violent content, but psychophysiological data obtained in their experiments often failed to support predicted effects of media content on physiological responses. Looking back on these studies through the lens of the psychophysiological paradigm, we now know that their conceptualization of arousal as a unitary concept under which physiological systems should be expected to uniformly increase or decrease, along with their view of physiological measures as simply a collection of measures of physiological responses to media content, was misguided. By focusing on trying to record physiological responses as supposed effects of media exposure, researchers overlooked complexities in the mind–body–environment relationship and how physiological activity reflects psychological processes targeted at helping individuals adapt and respond to their environment. In other words, they lacked a strong research paradigm capable of providing a more accurate conceptualization of physiological measures as indicators of mental processes evoked by media use.

Media psychophysiology has emerged as a distinct paradigm for applying psychophysiological measures to the study of brain processes evoked by media use that ultimately produce the effects of media content on behavior. This approach contains a clear set of theoretical assumptions about the brain—including appropriate methods for determining the psychological meaning of brain activity—and media use. These theoretical assumptions provide a foundation for formulating testable hypotheses about how individuals process media content as well as possible effects that might emerge from media exposure. This paradigm also provides methodological guidelines that aid researchers in validly collecting and analyzing the range of psychophysiological data that can be observed during media use. We offer this paradigm and its more recent focus on directly observing brain activity through central nervous system measures—combined with peripheral nervous system measures—as the research approach most likely to produce practically valuable insight into media effects. Thus, we turn now to a brief discussion of theoretical assumptions that make media psychophysiology a distinct research paradigm.

Media psychophysiology shares with the more general psychophysiological paradigm core theoretical assumptions about the nature of the mind/brain and the manner in which physiological activity reflects underlying psychological processes. These assumptions have been discussed in detail elsewhere (Cacioppo, Tassinary, & Berntson, 2007; Potter & Bolls, 2012). Thus, we provide a brief overview of just a few of the more fundamental assumptions here.

The Brain Is Embodied

This assumption provides a starting point for how to conceptualize the brain and the entire range of mental experience. Here, mental experience is conceptualized as embodied in the brain—an organ that is connected to all the other organs through a system of afferent and efferent neurological, chemical, and muscular connections. This assumption is best summed up by the statement, "Cognition depends on the kinds of experiences that come from having a body with particular perceptual and motor capacities that are inseparably linked and that together form the matrix within which reasoning, memory, emotion, language, and all other aspects of life are meshed" (Thelan Schöner, Scheier, & Smith et al., 2001, p. 1).

Cognitive/Emotional Processes Can Be Inferred from Bodily Reactions

This assumption is the crux of the entire psychophysiological approach. The psychophysiological enterprise focuses on establishing relationships between physiological response patterns and psychological constructs (Cacioppo, Tassinary, & Berntson, 2007). Because of the assumption that mental experience is embodied in the brain and the brain is connected to the rest of the body through the nervous system, these response patterns can span multiple physiological systems across the peripheral and central branches of the nervous system. The ultimate goal is to identify valid and reliable physiological indices of psychological constructs involved in information processing (Cacioppo, Tassinary, & Berntson, 2007). A focus on physiological response patterns as indicators of psychological processes engaged when an individual interacts in a complex social environment rather than simply responses to environmental stimuli—such as media content—is what truly separates media psychophysiology as a strong research paradigm from simply a collection of measures of physiological responses.

p. 480

The Work of the Brain Happens over Time

The assumption that cognitive operations embodied in the brain unfold over time was recognized as a fundamental theoretical principle of the information processing approach that took hold during the cognitive revolution (Lachman, Lachman, & Butterfield, 1979). This assumption is carried over to the psychophysiological approach and provides part of the foundation for mapping physiological response patterns to specific psychological processes as well as the analysis of data obtained from psychophysiological measures. That is, the cognitive and affective states that people experience (e.g., as the result of external and internal stimulus events) lead to changes that occur over the course of milliseconds or seconds, and the impacts of these changes on biological and physiological systems increase and decrease along with the vagaries of cognitive and affective experience (Lang, Potter, & Bolls, 2009). Suffice it to say that temporal characteristics of both psychological processes and psychophysiological measures should guide the valid operational application of specific measures in experiments as well as the interpretation of the observed physiological activity evoked during media use.

Psychophysiological Measures Are Monstrosities

This fact was recognized early on in the development of the psychophysiological approach (Gardiner, Metcalf, & Beebe-Center, 1937/1970). It emphasizes that relationships between physiological response patterns and psychological constructs are correlational, not causal. The correlational nature of psychophysiological measures emerges from homeodynamic relationships between different physiological systems in the human organism as well as between the organism and the myriad of possible influences on physiological activity contained in the environment. Berntson and Cacioppo (2007) proposed homeodynamic regulation as an alternative to homeostasis as a way of describing regulatory mechanisms at work in helping an organism adapt and respond to environmental stimuli. Homeodynamic regulatory processes are dynamic in the sense that they do not reflect simple, rigid feedback mechanisms but are complex, with lags, limits, and feed-forward components whose functioning can vary across time as an organism proceeds through the environment. The implication of this assumption is that researchers must recognize that psychophysiological measures are under the influence of multiple, dynamic inputs whose influence on physiological activity can change according to characteristics of the environment as well as the individual. Researchers need to exercise a high degree of control over experimental design and procedures to use psychophysiological measures to investigate psychological processes associated with media use and possible media effects.

In addition to sharing the core paradigmatic assumptions contained in the general psychophysiological approach, the media psychophysiology paradigm includes a unique way of conceptualizing media content and use. There have been two broad historical perspectives in media effects research for conceptualizing media use. The hypodermic needle model was one of the earliest theoretical perspectives in media effects research and conceptualized media use as a predominantly passive activity in which exposure to media content in essence injects the effects of media into individuals (Wartella & Reeves, 1985). As researchers discovered that media effects are more complicated and nuanced than that, they moved to a conceptualization of media use as a more active phenomenon in which audience members purposefully select media content based on motivations and gratifications sought from media—an approach that became known as uses and gratifications theory (Rubin, 2009). Neither of these theoretical perspectives on media use can be explicated at a detailed enough level to take into account the nature of foundational neural processes, developed over the course of evolution to aid individuals in successfully adapting to a complex environment, that dynamically unfold across time during media selection and exposure. More recent media psychology research is beginning to identify specific ways that basic motivational processes emerging from neural activity grounded in evolutionarily old brain systems significantly influence not only the way media content is mentally processed but even the specific kinds of media content individuals are drawn to seek out (Potter et al., 2006; Lee & Lang, 2009; Leshner, Bolls, & Wise, 2011; Potter, Lee, & Rubenking, 2011; Wang, Lang, & Busemeyer, 2011). A new theoretical perspective for conceptualizing media content and media use—generally referred to as *motivated mediated message processing*—has emerged from this line of reasoning (Lang & Yegiyan, 2009). Motivated mediated message processing offers an explication of media content and use in a way that is consistent with the psychophysiological approach and provides a foundation for research focused on analyzing media effects as a phenomenon spanning cognitive/emotional, neural, and peripheral physiological levels (Lang, 2009; Potter & Bolls, 2012).

p. 481 Under the umbrella of the media psychophysiology paradigm, the motivated mediated message processing perspective provides a unique and useful conceptualization of both media content and media use to complement the theoretical assumptions and methodologies associated with the psychophysiological approach. This approach focuses on how media content affects neural responses and the ways in which those neural responses act as biological mechanisms of psychological and behavioral outcomes. Although not formally recognized as a unifying paradigm for all such research, experiments in this area clearly reflect the theoretical assumptions and methodologies identified here as the media psychophysiology paradigm. We hope that, in addition to being a useful review of recent research, this chapter supports more unified theoretical thinking among interdisciplinary researchers. We now turn to reviewing recent media psychophysiology research that is indeed revealing, in new ways, the brain "on" media.

Before doing so, however, we wish to offer two important caveats concerning this chapter. First, although numerous studies using peripheral psychophysiological measures (predominantly heart rate, skin conductance, and facial EMG) have appeared in the media psychophysiology literature since the late 1980s, several thorough reviews of this research have appeared in recent years (Ravaja, 2004; Lang, Potter, & Bolls, 2009; Potter & Bolls, 2012). Thus, the specific focus of this chapter is on reviewing research in which measures of central nervous system activity have dominated, especially electroencephalography (EEG), event-related brain potentials (ERPs), and functional magnetic resonance imaging (fMRI). Second, the current review is limited to media effects research on violence and persuasive messages encompassing public health campaigns and advertising. We do not pretend to cover all media domains in this chapter.

The Psychophysiology of Media Violence

Violence in Media

Although violence in entertainment is as old as civilization itself (think the Roman Coliseum), it was not until the advent of motion pictures and radio in the early 20th century, followed by television by the middle of that century, that the masses were exposed to entertainment media—and hence media violence—on a regular basis. Media violence has been defined as "any overt depiction of a credible threat of physical force or the actual use of such force intended to physically harm an animate being or group of beings" (National Television Violence Study, 1998, p. 41). Violence in the media might not be of great concern were there not so much of it. One of the first motion pictures to see wide distribution, *The Great Train Robbery* (Edison & Porter, 1903), depicted a gang of bandits robbing a passenger train and the posse of concerned citizens dispatched to hunt them down. The film is very short, containing only 14 scenes and lasting only 12 minutes, but involves a striking amount of violence: of the 14 scenes, fully half depict threats of violence or actual physical assaults (e.g., the telegraph operator is bound at gunpoint; several fights occur aboard the moving train; a passenger attempts to make an escape but is instantly shot down). Films such as this one set the stage for violence as a central theme in the movies, a trend still evident today. Increasingly, films rated as appropriate for younger viewers contain graphic depictions of violence. As reported by Nalkur et al. (2010), since the advent of the film ratings system in 1968, "explicit violence in R-rated films increased, while films that would previously have been rated R were increasingly assigned to PG-13" (p. 440).

Television, too, has consistently been a venue for depictions of violence, both dramatized and real. Although often excluded from major content analyses of televised violence, television news programs feature some of the heaviest doses of violence in the media (van der Molen, 2004). For example, local news broadcasts often are found to overemphasize violent crime and sensational presentations of violence (Chavez & Dorfman, 1996; Dorfman et al., 1997; Romer, Jamieson, & Aday, 2003), and violent world events constitute the most frequently covered topics on national network newscasts (Johnson, 1996; Lowry, Nio, & Leitner, 2003). This same trend is reflected in "reality-based" television programs (e.g., *COPS*, *America's Most Wanted*), which give the impression that violence and murder are commonplace. According to one study (Oliver, 1994), although murder accounts for only 0.2% of the crimes reported by the FBI, fully 50% of the crimes shown on programs like these are murders. This overemphasis on televised violence has a major impact on public perceptions of the dangerousness of society, leading people to believe that violent crime rates are much higher than they actually are (see Bushman & Anderson, 2001; Lowry et al., 2003).

The newest forms of media, video games and the Internet, are continuing this long-established trend for violence as a content staple. p. 482 An overwhelming majority of children age 8 to 18 play video games ↳ daily or weekly; approximately 60% of all children are playing a video game at any given time of day or night (Kaiser Family Foundation, 2010). As with other forms of media, many of the most popular video games contain explicitly violent themes. For example, sales data from 2010 and 2011 indicate that half of the 10 best-selling games in each year contained explicitly violent themes.

Scientists have many reasons for being interested in understanding effects of media violence. Perhaps chief among these is that research consistently has shown that exposure to environmental cues associated with violence is a reliable predictor of increased aggression (Bandura, Ross, & Ross, 1961; Berkowitz & LePage, 1967; Berkowitz, 1989; Anderson, Benjamin, & Bartholow, 1998; Bartholow et al., 2005). Thus, it follows that media depictions of violence could facilitate aggressive responses (Carnagey & Anderson, 2003). The next section first considers psychophysiological studies aimed at understanding potential effects of media violence on processes relevant for aggression, and then turns to other recent work investigating media violence effects on cognitive and affective information processing more generally.

Psychophysiological Studies of Media Violence Effects

As noted, early psychophysiological research on media violence was focused on attempting to understand effects of media violence on "arousal" (Zillmann & Bryant, 1974; Zillmann et al., 1974a, b; Cantor et al., 1978; Donnerstein & Barrett, 1978). In large part such studies were designed to test aspects of various arousal theories of aggression, which posit that exposure to "exciting" media content (e.g., violence, sex) increases arousal, and that this arousal takes time to dissipate. If provoked while in such an aroused state, an individual is likely to misattribute the source of the arousal to the provocation, prompting a retaliatory response (Zillmann, 1983). Unfortunately, the results of such studies were rarely straightforward, owing largely to the fact that, as later theorists described in detail (Cacioppo & Tassinary, 1990), arousal is not a single or simple construct, and there is rarely—if ever—a one-to-one relationship between the psychological construct of arousal and physiological responses thought to represent it. Therefore, contemporary research has turned away from this early focus on a potential causal role of media violence on simple arousal, and focuses instead on understanding the ways in which psychophysiological measures can contribute to building and testing broad theories of media violence effects (Carnagey & Anderson, 2003; Carnagey, Anderson, & Bartholow, 2007).

One such theory that has received considerable attention in the media violence literature is desensitization (see Brockmyer, this volume), an idea that—somewhat ironically, given earlier research on arousal theory—posits a role for *reduced* arousal following media violence exposure as a causal factor in aggression-related responses. Research has shown that exposure to media violence initially produces fear, disgust, and other avoidance-related motivational states (Cantor, 1998). According to desensitization theory, repeated exposure to violence, whether in the media or in life, results in habituation of the initially negative cognitive, emotional, and physiological responses people experience when they see blood and gore (Rule & Ferguson, 1986; Funk et al., 2004), which in theory can produce more calloused attitudes toward violence and, ultimately, increased aggression. Numerous studies have provided evidence for the basic premise that media violence can produce desensitization to violence, in that individuals exposed to violent media content are less physiologically aroused by subsequent depictions of actual violence (Lazarus et al., 1962; Cline, Croft, & Courrier, 1973; Thomas et al., 1977; Thomas, 1982; Linz, Donnerstein, & Adams, 1989; Carnagey, Anderson, & Bushman, 2007), and are less empathic toward the pain and suffering of others (Bushman & Anderson, 2009) than are participants initially exposed to nonviolent media.

However, it was not until relatively recently that researchers directly addressed the question of whether desensitization as a result of media violence exposure could be a pathway to increased aggressiveness. In an initial study, Bartholow, Bushman, and Sestir (2006) recorded ERPs—electrical activity in the brain elicited by stimulus and response events, corresponding to various information-processing operations (Fabiani, Gratton, & Federmeier, 2007)—from a group of participants varying in their history of video game violence exposure (VVE) while they viewed a series of evaluatively neutral (e.g., a towel lying on a table), violent (e.g., a main holding a gun in another man's mouth), and negative but nonviolent (e.g., a rotting dog corpse) images. The amplitude of the P300 component of the ERP elicited by emotionally evocative images has been linked to the extent to which the contents of the images activates relevant underlying motivational propensities (e.g., to approach or avoid) (Nieuwenhuis, Aston-Jones, & Cohen, 2005).
p. 483 Thus, and based on the idea that repeated exposure to violent video games would ↳ lead to desensitization to depictions of real violence, Bartholow et al. hypothesized that high-VVE participants would show reduced P300 responses to violent images than would their low-VVE peers. Consistent with this prediction, the P300 response elicited by violent pictures was significantly smaller among high-VVE participants than low-VVE participants, but responses to negative nonviolent images did not differ between the groups (Fig. 27.3). These findings suggest that violence-related images elicit less avoidance/withdrawal motivation among high-VVE individuals, consistent with the tenets of desensitization theory (Bailey, West, & Anderson, 2011).

In the second half of the study, participants completed a competitive game in which they were given the chance to deliver blasts of noxious noise to an ostensible opponent. The intensity of noise blasts set by participants constitutes an often-used and externally valid laboratory measure of aggression (Carlson, Marcus-Newhall, & Miller, 1989; Bushman, 1995; Anderson & Bushman, 1997; Giancola & Chermack, 1998; Anderson, Lindsay, & Bushman, 1999; Bartholow & Anderson, 2002). Bartholow et al. (2006) found that participants high in VVE generally set louder noise blasts for their ostensible opponents than did low-VVE participants. Moreover, and consistent with the desensitization hypothesis, there was a strong, negative correlation between the levels of noise punishment participants set for their opponents and the size of their brain responses to violent images measured in the first part of the study. That is, participants with smaller P300 responses to violence—a hypothesized neural indication of desensitization—tended to blast their opponents with louder noise during the reaction-time task.

Although Bartholow et al.'s (2006) findings were generally consistent with desensitization theory, that study suffered from a major limitation because it was correlational in nature—participants were preselected on the basis of their self-reported history of video game violence exposure, rather than being randomly assigned to violent or nonviolent game exposure conditions (see also Bailey et al., 2011). Thus, it could be that their media violence history did not cause them to become desensitized, but that individuals with small brain responses to violence (caused by unknown factors) simply tend to play a lot of violent video games. To address this
p. 484 limitation, Engelhardt, Bartholow, Kerr, and Bushman (2011) recruited ↳ male and female participants varying in VVE and randomly assigned them to play either a violent or nonviolent video game in the lab for 25 minutes before completing the picture-viewing and aggression tasks used in Bartholow et al. (2006). Figure 27.4 shows the ERP data from that study. Inspection of Figure 27.4 indicates that, consistent with what Bartholow et al. (2006) found, high-VVE individuals showed smaller P300 responses to violence compared with their low-VVE peers. However, of greater interest is that, among low-VVE participants, those who had just played a violent video game in the lab showed smaller P300 responses to violence than did their counterparts who had just played a nonviolent game. This finding indicates that a brief exposure to video game violence caused acute desensitization to violence, which cannot be attributed to preexisting differences in neural responses. Also of interest is the finding that high-VVE participants showed reduced P300 amplitude to violence regardless of the game played in the lab, suggesting that these individuals had already been desensitized and another brief exposure to video game violence did not further desensitize them (i.e., a floor effect). Finally, Engelhardt et al. found that among those low in VVE, the size of the P300 elicited by violent pictures significantly mediated the effect of the video game exposure manipulation (violent or nonviolent) on aggressive behavior during the reaction-time task (intensity and duration of noise blasts). These data are the first to show that acute desensitization to violence can be a mechanism through which aggression can increase following exposure to video game violence.

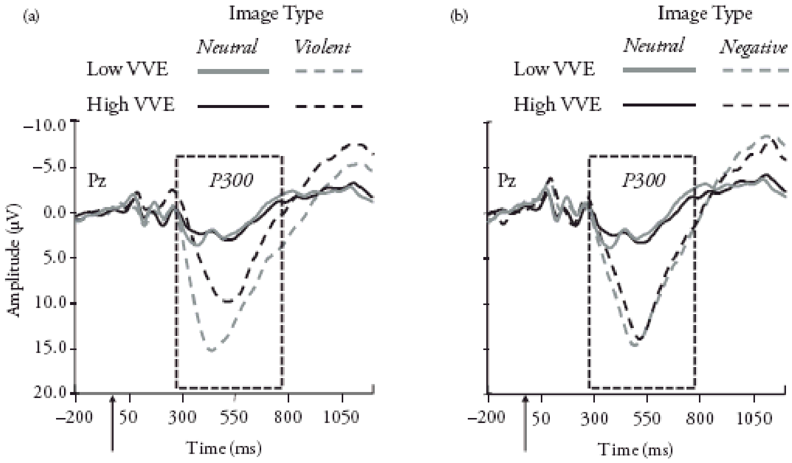

Figure 27.3 **A. Related brain potentials waveforms recorded from a midline parietal scalp location (electrode Pz) elicited by images of real violence (*dashed lines*) and evaluatively neutral images (*solid lines*) among participants high and low in previous video game violence exposure (VVE). The vertical arrow at time zero on the time line indicates picture onset. The P300 is the large, positive dip in the waveform peaking around 450 ms following picture onset. Low-VVE participants showed a larger P300 response to violent images than did high-VVE participants. B. Related brain potentials waveforms recorded from electrode Pz by images depicting very negative (but not violent) scenes. VVE level had no effect on the amplitude of the P300 elicited by negative, nonviolent images.**

Adapted from Bartholow, B. D., Bushman, B. J., & Sestir, M. A. (2006). Chronic violent video game exposure and desensitization: Behavioral and event-related brain potential data. *Journal of Experimental Social Psychology*, 42 , 532–539.

A complimentary approach used in recent research aimed at understanding how media violence exposure could affect aggression has been to investigate the neural structures and circuits that are engaged when playing violent compared to nonviolent video games. One of the first such studies (of which we are aware) was conducted by Weber, Ritterfeld, and Mathiak (2006), who used fMRI to investigate neural structures that increase and decrease in activation during violent video game play. These authors recorded fMRI while participants played a violent video game, and afterward coded each game scene in terms of its content. Of interest, Weber et al. found a negative linear relationship between the potential for violence in a scene and the blood oxygen level dependent (BOLD) signal change in both the rostral anterior cingulate cortex (rACC) and the amygdala, structures implicated in affect/emotion-related processing. Similarly, Kelly, Grinband, and Hirsch (2007) found that repeated exposure to violent movie clips, but not to equally p. 485 arousing nonviolent movie clips ↳ (e.g., fearful scenes), led to diminished response in a network of neural areas, such as right-lateral orbitofrontal cortex and amygdala, which has been associated with decreased control over reactive aggression (Goyer et al., 1994; Raine et al., 1998). Kelly et al. also reported a significant association between the magnitude of this diminished neural response to violence and scores on a self-reported reactive aggression scale (Bartholow et al., 2006; Engelhardt et al., 2011). Although far from definitive, these findings suggest that violent media exposure could produce acute (or chronic) desensitization to violence by reducing the extent to which the emotional impact of violence is elaborated in the brain, which could weaken control over impulsive aggressive responses.

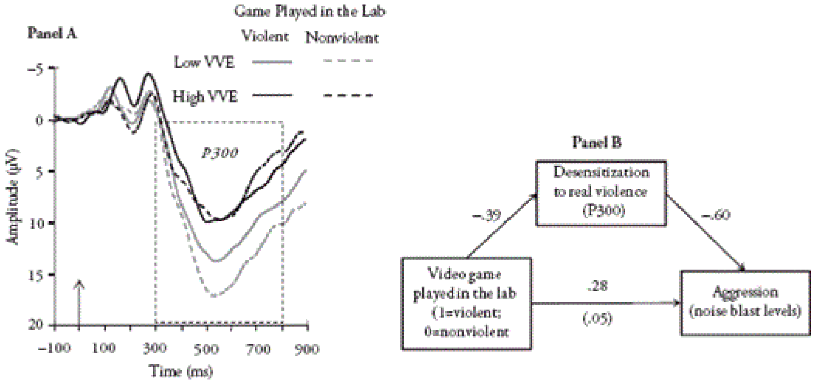

Figure 27.4 **A. Related brain potentials waveforms recorded from a midline parietal scalp location (electrode Pz) elicited by images of real violence as a function of type of video game played in the lab and previous video game violence exposure. The vertical arrow at time zero on the time line indicates picture onset. The P300 is the large, positive dip in the waveform peaking around 500 ms following picture onset. B. Schematic showing the mediating effect of desensitization to real-life violence (P300) on the increase in aggression that occurs after playing a violent relative to a nonviolent video game. The standardized coefficient in parentheses is the effect of game condition on aggression when P300 amplitudes are included in the regression model. The bootstrapping method (Shrout & Bolger, 2002) indicated a significant indirect effect, i.e., the effect of game condition on aggression via P300 amplitude.**

Adapted from Engelhardt, C. R., Bartholow, B. D., Kerr, G. T. & Bushman, B. J. (2011). This is your brain on violent video games: Neural desensitization to violence predicts increased aggression following violent video game exposure. *Journal of Experimental Social Psychology*, 47, 1033–1036.

In addition to contributing to theories underlying effects of media violence exposure on aggressive behavior, researchers have used the media psychophysiology approach to better understand how exposure to media violence might influence a broad array of cognitive and affective processes. One such approach reflects what is known as skills transfer. The possibility that skills acquired during training in computer-based tasks or games could transfer to untrained behaviors has intrigued researchers for years (Fabiani et al., 1989; Frederickson & White, 1989; Gopher, Weil, & Bareket, 1994). Recently, Green et al. have reported findings suggesting that long-term experience with so-called “action” video games, most of which contain violent themes, might lead to enhancement in certain cognitive skills, particularly those related to the scope of attention (Green & Bavelier, 2003, 2006, 2007; Dye, Green, & Bavelier, 2009a,b), and that some such effects can occur after relatively short-term training (e.g., 30 hours over the course of 1 month) (Green & Bavelier, 2007). For example, Green and Bavelier (2003) reported that, in comparison to nongamers, self-reported action video game players showed a broader scope of visual selective attention on a range of tasks (see also Dye et al., 2009b).

Although such effects have been lauded as demonstrating the benefits of extended exposure to violent video games (as a counterpoint to the oft-cited harmful effects of such exposure) (Anderson et al., 2010), an expanded scope of visual attention can be detrimental in some contexts. For example, if the goal of a particular task involves controlling attention so as to avoid the influence of peripheral distracters, then an expanded scope of visual attention can actually impede task performance. For example, in the flanker task (Eriksen & Eriksen, 1974; Eriksen & Schultz, 1979), widely used to assess attention and executive control, participants’ goal is to categorize a centrally presented target stimulus flanked by to-be-ignored distracter stimuli (i.e., the flankers). The measure of primary interest is generally the flanker compatibility effect in reaction time, representing the extent to which participants can ignore the flankers and focus their attention on the target. The results of a number of previous studies (Green & Bavelier, 2003; Dye et al., 2009b) show that action game players experience larger flanker compatibility effects than do nongamers, indicating that gamers have greater difficulty controlling attention in the presence of visual distracters (but see Green & Bavelier, 2007, for an alternative interpretation). Such a result is unsurprising given the demands of many action/violent games to direct attention broadly, but could indicate difficulties in the development and maintenance of self-regulatory cognitive control abilities, a core feature of which is the control of attention (Friedman & Miyake, 2004; Miyake & Friedman, 2012).

Indeed, West et al. have conducted a series of studies showing that extended exposure to violent video games is associated with some specific deficits in cognitive control processes relying on control of attention. For example, Bailey, West, and Anderson (2010) used behavioral and ERP measures to investigate the influence of violent game exposure on proactive and reactive cognitive control. As described by those authors (and others; see Braver, Gray, & Burgess, 2007), “proactive control represents a future-oriented form of control that serves to optimize task preparation; reactive control represents a just-in-time form of control that serves to resolve conflict within a trial” (Bailey et al., 2010, p. 1005). Bailey et al. found that both behavioral and neural indices of proactive control were attenuated in participants with considerable violent game experience relative to those with little such experience. Specifically, the amplitude of frontal negativities in the ERP measured on high-conflict trials (i.e., those requiring cognitive control) was smaller among high-VVE compared with low-VVE participants, complimenting a reduced ability among high-VVE participants to adapt to conflict on a trial-to-trial basis as revealed in patterns of behavioral responses. In contrast, measures of reactive control did not differ for high- and low-VVE participants. Taken together, these findings suggest that video game experience may selectively interfere with proactive cognitive control processes that help to maintain goal-directed, self-regulatory cognition and action.

 Another approach to studying video game effects on cognition involves measuring cognitive performance and its neural correlates, immediately following an acute exposure to one type of game or another. For example, Wang et al. (2009) had groups of adolescents (n = 22 each) play a violent (first-person shooter) or nonviolent (car racing) video game for 30 minutes before completing a counting Stroop and an emotional Stroop task, during which their brain activity was assessed using fMRI. In contrast with the nonviolent game group, participants who had played the violent game showed less activation in areas of dorsolateral prefrontal cortex (DLPFC), areas typically associated with cognitive control during performance of cognitively demanding tasks such as the Stroop (MacDonald et al., 2000; Kerns et al., 2004). Moreover, participants exposed to the violent game showed weaker functional coupling between left DLPFC and dorsal ACC, also suggesting less efficient engagement of a network of areas important for cognitive control (Botvinick et al., 2001; Kerns et al., 2004).

Other, suggestive evidence of cognitive control difficulties following acute violent game exposure has come from recent studies by Engelhardt and Bartholow (2011, 2012). For example, Engelhardt and Bartholow (2011) had participants play a violent or nonviolent video game (or no game) before completing a flanker task. Results indicated that participants who had played a violent game for 30 minutes made more errors identifying targets on incompatible flanker trials (i.e., those requiring attention control) than did participants who hadn't played a video game before the flanker task. In contrast, accuracy was not significantly affected by exposure to a nonviolent game. In a follow-up experiment, Engelhardt and Bartholow (2012) again randomly assigned participants to play either a violent or nonviolent video game, after which participants completed a different cognitive control task, the spatial Stroop task (Lu & Proctor, 1995), which requires participants to respond to targets on the basis of their physical orientation while ignoring their spatial location. Consistent with Bailey et al.'s (2010) findings among high-relative to low-VVE participants, Engelhardt and Bartholow (2012) found that the amplitude of the medial frontal negativity (i.e., the N2 component) in the ERP elicited on high-conflict trials was attenuated following violent relative to nonviolent game exposure. Interestingly, trait physical aggressiveness (Buss & Perry, 1992) differentially moderated the N2 and frontal slow wave components following violent and nonviolent game play. Specifically, whereas N2 amplitude increased (i.e., increased conflict) as a function of increasing levels of trait aggression following violent game play, N2 amplitude and trait aggression were uncorrelated following nonviolent game play. Conversely, frontal slow wave amplitude (implementation of proactive control) increased along with increasing levels of trait aggression following nonviolent game play, but was unaffected by trait aggression following violent game play. Although very preliminary, this pattern of results suggests that interaction with violent and nonviolent media differentially affects reactive and proactive cognitive control functions for individuals high versus low in trait aggressiveness. More research is needed to determine what, if any, implications such findings have for understanding the influence of video game violence on aggression (see also Bailey et al., 2010).

Summary

Although the literature on the psychophysiology of media violence remains quite small, recent work paints something of a mixed picture in terms of potentially beneficial and harmful effects of exposure. Some studies indicate that repeatedly playing violent "action" video games can lead to increases in the scope of visual attention (Green & Bavelier, 2003, 2007; Dye et al., 2009a) and decreases in overall response speed (Dye et al., 2009b). However, such findings should be interpreted with caution, especially given evidence that these effects can actually be detrimental to performance in contexts in which controlling and focusing attention are important (Dye et al., 2009b; Wang et al., 2009; Bailey et al., 2010; Engelhardt & Bartholow, 2011, 2012). Moreover, recent ERP and fMRI evidence suggests that both acute and repeated exposure to violent video games is associated with decreases in activation of neural circuits underlying some forms of cognitive control (Wang et al., 2009; Bailey et al., 2010; Engelhardt & Bartholow, 2012). Future work should be directed at not only continuing to document such effects and their limitations, but to better understand the mechanisms by which playing violent video games influences neurocognitive processes underlying cognitive control, as well as the implications of such effects for regulating social behaviors, such as aggression.

The Psychophysiology of Persuasion

Some of the earliest research on media effects investigated persuasive effects of media content. This area of research has grown p. 487 significantly since the early work of Hovland (1951) and Lasswell ↳ (1927), coinciding with the exponential growth of media content aimed at persuading target audiences. Leading advertisers, such as AT&T and American Express, now spend more than $1 billion annually on this practice (see www.adage.com/datacenter/). At an estimated $2.6 billion, the 2012 election in the United States is predicted to shatter previous records for spending on political advertising (see www.adage.com). Arguably, advertising is the most pervasive form of media content, as savvy advertisers have moved beyond traditional ad placements (e.g., commercial breaks in television and radio programming) to placing their messages into entertainment content and social media channels, as well as attempting to push messages virally over the Internet (Sissors & Baron, 2010). Current advertising practice views any screen, mobile or traditional, as a potentially valuable communication channel through which persuasive media content can be delivered.

The effects of persuasive media content have implications not only for every business engaged in marketing products through advertising, but also for politicians seeking personal advancement and nonprofit organizations dedicated to achieving social change. This clearly means that research on the effects of persuasive messages can have important implications for economic activity, public health, and the shape of the democratic political process. Research in this area has been applied to both promoting the interests of organizations engaged in persuasive media campaigns as well as at making individuals more resistant to and critical of persuasive media messages (Perloff, 2008).

Before reviewing some of the recent experiments investigating how the brain processes persuasive media content, it is important to note an interesting recent development that makes this a unique area of media effects research. Although research on the effects of other forms of media content primarily has been confined to the academic community, both academics and media industry professionals are extensively engaged in conducting research on the effects of persuasive media content. Proprietary research firms as well as research departments housed in advertising agencies began to expand over the last half of the 20th century and continue to conduct extensive research directed at making clients' advertisements more persuasive. One of the first applications of psychophysiological measures in the study of persuasive media content was conducted by Herbert Krugman, director of public opinion research at General Electric. Krugman used EEG in an attempt to identify brain activity reflective of increased attention paid to advertisements (Krugman, 1971). More recently, one proprietary research company, Sands Research (www.sandsresearch.com), has begun an annual practice of publicizing their research on Super Bowl advertisements in which they use EEG and other psychophysiological and self-report measures to identify the most effective Super Bowl advertisement of the year. Although psychophysiological measures have historically been part of the toolbox that advertising industry researchers use in conducting their work, a renewed interest in EEG and the more recent application fMRI in advertising research has led to the development of a specialized area termed neuromarketing (Du Plessis, 2011). Several published articles have critiqued the value, validity, and ethical implications of neuromarketing research (Kenning, 2008; Marci, 2008; Nairn & Fine, 2008). Further, because of the fact that the majority of neuromarketing research is proprietary and therefore not subject to a peer review process (or even accessible to anyone except paying clients), we cannot say whether or not researchers conducting this work are following the media psychophysiology research paradigm presented in this chapter. This aside, neuromarketing represents an interesting, explicit attempt to conduct research on brain mechanisms underlying the effects of persuasive media content. Readers interested in learning more about neuromarketing can find numerous relevant advertising industry web sites and blogs, neuromarketing company web pages, and recent books discussing the implications of neuroscience for advertising, such as *The Branded Mind* (Du Plessis, 2011). We now turn to a brief review of the peer reviewed published research adopting a psychophysiological approach to studying how the brain processes persuasive media content.

Research using psychophysiological measures to study how the brain processes persuasive media content has a history that mirrors the more general history of psychophysiology and media effects research. A number of early experiments produced promising results in terms of the ability to index mental processes that might underlie persuasion. For instance, Krugman's (1971) work identified specific patterns in the EEG signal recorded from frontal cortex that were significantly associated with attending to and remembering commercials. Other researchers used skin conductance recorded during exposure to advertisements in an attempt to p. 488 predict product purchase intentions (Hopkins & Fletcher, 1994). These early efforts were primarily directed at attempting ↳ to establish psychophysiological measures as effective tools for applied advertising copy testing, in the tradition of the stimulus–response paradigm referred to earlier in this chapter, rather than generating deep insight into brain processes engaged during exposure to persuasive media messages. The shift toward research with the latter goal occurred in the 1980s, with researchers who adopted the stronger psychophysiological theoretical approach previously reviewed.

A pioneering experiment in that vein was conducted by Reeves et al. (1985), who used EEG to study the interaction between features of television advertisements and attention. In one experiment, they identified alpha blocking, a decrease in activity in the alpha frequency band of the EEG signal, recorded from frontal cortical regions, as a physiological indicator of increases in orienting attention to scene changes occurring in a television advertisement. This experiment involved exposing participants to nine advertisements placed in televised sitcoms that were spread across three commercial breaks. The EEG signal was averaged over each half-second over the course of each advertisement. This experiment was one of the first in media psychophysiology to use such a fine-grained, intra-stimulus data analysis, matching each half-second of recorded data to specific features occurring within the advertisements. This analysis yielded the first significant theoretical insight into the degree to which attention quickly reacts to rapidly occurring and changing content within television advertisements. Thus, early on, researchers working under a media psychophysiology paradigm realized the value of using psychophysiological measures to not only index brain processes unfolding over the entire course of a segment of media content, but also to examine momentary yet potentially critical processes evoked at specific time points within a message. Subsequent work using measures of cardiac activity replicated the result that scene changes within television advertisements automatically orient attention toward the advertisement (Lang, 1990). Taken together, these two early experiments offer insight into both central and peripheral nervous system activity underlying processes related to attention during exposure to advertisements.

A large number of psychophysiological studies have used peripheral nervous system measures to index brain processes theorized to unfold during exposure to persuasive media content. Specifically, heart rate has been used primarily as an indicator of cognitive resources allocated to encoding information from the message, skin conductance has been used to index arousal, facial EMG has been used to index the valence of emotional responses, and more recently, the startle eye blink response has been used to index the extent to which media content is perceived to be aversive (Potter & Bolls, 2012). Experiments in this area have primarily focused on investigating how advertising content affects motivational and emotional responses. For instance, in a recent experiment Leshner et al. exposed participants to antitobacco advertisements varying in the extent to which they featured disgust-eliciting visual images (Leshner, Bolls, & Wise, 2011). This study revealed specific patterns of cardiac acceleration and an associated decrease in corrugator facial muscle activity (reflecting expression of negative affect), which researchers interpreted as reflecting defensive withdrawal of attention from the message, gradually resulting in a decrease in the intensity of negative emotional responding. In a recent study of political advertising (Bradley, Angelini, & Lee, 2007), the startle eye blink response was recorded along with skin conductance during exposure to negative and positive political advertisements. The results of this experiment revealed that while negatively toned ads evoke intense levels of aversive motivational responses, they are better remembered than positive ads. Potter et al. (2006) recorded corrugator EMG activity as an indicator of negative emotional responding during exposure to advertisements embedded in different types of entertainment programs. Their findings revealed that the content in which commercials are embedded significantly impacts the intensity of emotional responding they elicit.

Although experiments conducted with peripheral measures clearly do not shed light on the anatomical makeup and specific functioning of neural networks involved in how the brain processes persuasive media content, this brief review clearly indicates that such studies have produced valuable insight into general cognitive and emotional processes embodied in the brain that unfold across time while individuals are exposed to persuasive content. Peripheral nervous system measures have historically been the most accessible for researchers wishing to conduct research on the psychophysiology of persuasive media content, and therefore such studies represent the majority of efforts to produce knowledge of persuasive media effects. This historical trend is changing, however, as more researchers embrace a neuroscience perspective under the media psychophysiology paradigm and central nervous system measures that directly index brain processes become more accessible to media effects researchers.

 A majority of research on persuasive media content conducted under this newer neuroscience perspective has relied on EEG to directly index brain activity theorized to be important to understanding how individuals process persuasive media messages. A strong argument for the validity of the EEG in advertising research, particularly when used in combination with other psychophysiological measures, was recently made by Ohme Matukin, and Pacula-Lesniak (2011). Their work integrating EEG and eye tracking provided evidence concerning the ability to detect frontal neural activity reflecting positive and negative emotional responding that is sensitive to the focus of visual attention directed to specific elements of interactive advertisements. This line of research is typical of one area of focus in neuroscience-based research on persuasive media content, in that the primary objective is to illustrate that central nervous system measures like EEG are sensitive to very specific variations in advertisement content. Along this line, Ohme et al. provided further evidence of the effectiveness of EEG in this context by applying it to identifying which of three Sony television ads were most effective at eliciting activity in frontal cortex that could be tied to favorable reactions to ads (Ohme et al., 2010). This study relied on a theoretical model positing that left hemisphere dominance reflects brain processes underlying a favorable shift in attitudes toward an advertised brand (Silberstein & Nield, 2008), a specific application of a more general theory proposing that left-frontal EEG asymmetry reflects favorable, approach-motivated responses to stimuli (Harmon-Jones, 2003; Harmon-Jones & Harmon-Jones, 2011). Advertising researchers have also turned to ERP components of the EEG signal in developing insight into brain activity underlying effective advertising. The P3a event-related potential was recently used to indicate the degree to which brand logos presented in interactive advertising evoke an automatic increase in attention (Treleaven-Hassard et al., 2010). Research designed to identify specific patterns of brain activity underlying mental processes leading to persuasion during advertising exposure is clearly going to be a growing part of advertising research (Perrachione & Perrachione, 2008).

One of the more theoretically interesting lines of research in the psychophysiology of persuasion focuses on discovering the neural networks that are active during exposure to media content. For instance, Morris et al. (2009) used fMRI to observe activity in emotional networks in the brain during exposure to television advertisements. These authors found that variation in bilateral activation in the inferior frontal gyri and middle temporal gyri represented the valence dimension (pleasantness–unpleasantness) of emotional experience, while activity in the right superior temporal gyrus and right middle frontal gyrus distinguished feelings associated with the arousal or intensity of emotional experience elicited by advertisements. Other experimental work has focused on investigating brain activity reflective of increasing or decreasing support for a political candidate. For example, Kato et al. (2009) used fMRI to scan brain regions during exposure to political advertising and then correlated the observed hemodynamic activity with self-reported increase or decrease in support for the political candidate portrayed. The results indicated that increased activation in the medial prefrontal cortex correlated with increased support for a candidate while increased activation in the dorsolateral prefrontal cortex correlated with decreased support. In an interesting cross-cultural experiment, Faulk et al. (2009) explored neural mechanisms underlying the subjective experience of being persuaded. Their experiment included both an American and a Korean sample exposed to both text- and video-based advertisements. They identified a consistent neural network across cultures and stimuli in which increased activity in the dorsal medial prefrontal cortex, posterior superior temporal sulcus, temporal pole, and ventral lateral prefrontal cortex correlated with self-reports of feeling persuaded.

Although intriguing, such work is best considered preliminary to more theoretically informed investigations of the cognitive neuroscience of persuasive media, given that identifying neural regions that appear active during certain kinds of persuasive appeals and (in some cases) how this activity correlates with self-reported phenomenological experience does not necessarily translate into discovery of the neural basis of persuasion or advertising effectiveness. For example, what does it mean, in terms of understanding the psychological phenomenon of persuasion, that activity in dorsomedial prefrontal cortex, post superior temporal sulcus, temporal pole, and ventrolateral prefrontal cortex correlates with self-reported persuasion? Still, such work suggests avenues for future research in which the specific features of media appeals that best lead to attitude change can be linked to specific neural structures underlying basic neurocognitive and affective processes, which in turn can be linked with behavior.

p. 490 There is a small but growing body of research utilizing EEG and fMRI to specifically explore brain ↳ activity evoked by specific features of persuasive media content. One general feature of advertising that has been investigated is whether the advertisement primarily uses a logical or emotional appeal. For example, Cook et al. (2011) recorded EEG while participants were exposed to print advertisements that varied according to using a logical or emotion-based strategy to persuade. Distinct patterns of brain activity were found for these two different kinds of advertisements, with ads presenting a logical argument evoking greater activity in orbitofrontal, anterior cingulate, and hippocampal regions compared with ads focusing on emotion. Brain activity evoked specifically in response to the presence of experts in advertisements also has been investigated. Klucharev, Smidts, and Fernandez (2008) found that effects of celebrities in ads appear to influence memory through variation in activity in the medial temporal lobe. In an experiment investigating antidrug abuse public health messages, Langleben et al. (2009) used fMRI to scan participants' brain activity during exposure to televised antidrug messages varying in message sensation value. Whereas messages coded as high on sensation value evoked greater activation primarily in the occipital cortex, messages coded as low in sensation value evoked greater prefrontal and temporal activation, a pattern also associated with messages being better recognized. This pattern of findings suggests that prefrontal and temporal activation underlies increased message recognition, and that low sensation value messages may be more effective than high sensation value messages.

Summary

Research conducted under the psychophysiological paradigm has provided tremendous insight into brain mechanisms underlying the processing of persuasive media content, in part because brain networks associated with very important subprocesses involved in persuasion have been identified. Consideration of the studies reviewed above suggests several conclusions. First, increased left frontal cortical activity is particularly involved in attitude change during exposure to persuasive messages, a finding consistent with theory linking relative left-frontal cortical activation to approach motivation (Harmon-Jones, 2003; Harmon-Jones & Harmon-Jones, 2011). Second, brain areas like the hippocampus and temporal lobes that are generally viewed to be part of the brain's memory network also are at work in forming memory representations of advertisements. Third, the available evidence suggests that processing persuasive media content involves extensive brain networks that underlie cognitive and emotional responses. This is not surprising given the complexity of media content in general and advertisements in particular. That being said, it does appear particularly promising that very specific features of advertisements evoke distinguishable patterns of brain activity (Klucharev et al., 2008; Langleben et al. 2009; Cook et al., 2011). Future research in this area is bound to provide valuable insight into the psychophysiology of persuasion as well as implications for advertising in society. The advertising industry is jumping at neuroscience as a way to probe inside the mind of the consumer, with the ultimate goal of increasing industry profits. A more socially sustainable outcome of such work could be advancing research that examines how public health messages intended to persuade people to make healthier decisions are processed, as well as studies targeted toward understanding brain activity underlying potentially harmful effects of advertising.

Conclusions and Future Directions

Relative to its predecessors, the field of media psychophysiology is still very young. Still, a few tentative conclusions can be drawn on the basis of extant evidence. First, augmenting traditional behavioral and self-report measures with measures of neural responses to media holds significant promise to advance understanding of how people perceive and are influenced by media. However, researchers need to beware of the potential pitfalls of this exciting new approach, such as the use of psychophysiological measures (especially neural measures) as an end unto themselves. For example, simply demonstrating that exposure to a certain category of media content produces activation in a given collection of neural structures provides very little in the way of advancing understanding of media effects or how media affects behavioral outcomes that we ultimately wish to explain. After all, we as psychological and media scientists have known for a long time that cognition, emotion, and behavior all stem from the brain. At a very basic level, psychophysiological measures suffer from the same limitations as any other measures in terms of requiring validation as indices of particular psychological processes of interest. Thus, researchers interested in using a media psychophysiological approach need to use their extant knowledge of experimental design and behavioral science to ground their investigations. As Cacioppo et al. aptly summarized the issue some years ago, “just because you're imaging the brain doesn't mean you can stop using your head” (Cacioppo et al., 2003, p. 650).

p. 491 Second, just as Lewin (1935) advised decades ago when attempting to account for behavior, it is becoming increasingly clear that researchers need to focus on both elements of the classic Person × Situation formula when attempting to understand media effects. That is, although some broad generalities certainly exist, not all individuals will process or respond to media content in the same ways. Rather than treating this variability simply as noise in the data, researchers should endeavor to identify stable individual difference factors that can reliably predict how various media will differentially affect neurophysiological and behavioral outcomes.

The future of media psychophysiology is intimately bound up with the ever-changing landscape of media vehicles and trends in media usage. Given the increasing influence of social media (e.g., Facebook, Twitter) on the lives of many people, media psychophysiology scholars will need to devote more attention to studying these forms of media and how they might differ from more traditional forms. Similarly, with the explosion in the use of small, portable media vehicles (e.g., smart phones), media can now be literally anywhere and everywhere a person finds themselves. This near-constant exposure to media has important and as-yet ill-understood implications for a vast array of social phenomena, including not only persuasion but basic dynamics of interpersonal interaction and cognition. Finally, the field will also change according to trends in psychophysiological measurement and meaning. What should never change, however, is the understanding that a solid scientific foundation, based in conceptual and theoretical models that are just as sophisticated and cutting-edge as the technologies used to study them, is required to adequately investigate the complex brain–behavior relationships that media psychophysiologists seek to understand.

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