THE ROUTLEDGE HANDBOOK OF MEDIA USE AND WELL-BEING

International Perspectives on Theory and Research on Positive Media Effects

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Swann, Jr., W. B., Rentfrow, P. J., & Guinn, J. (2003). Self-verification: The search for coherence. In M. Leary & J. Tagney (Eds.), *Handbook of self and identity* (pp. 367–383). New York: Guilford.

Tandoc, E. C., Ferrucci, P., & Duffy, M. (2015). Facebook use, envy, and depression among college students: Is Facebooking depressing? *Computers in Human Behavior, 43*, 139–146.

Tice, D. M. (1992). Self-concept change and self-presentation: The looking glass self is also a magnifying glass. *Journal of Personality and Social Psychology, 63*, 435–451.

Toma, C. L. (2013). Feeling better but doing worse: Effects of Facebook self-presentation on implicit self-esteem and cognitive task performance. *Media Psychology, 16*, 199–220.

Toma, C. L., & Carlson, C. L. (2015). How do Facebook users think they come across in their profiles? A meta-perception approach to Facebook self-presentation. *Communication Research Reports, 32*, 93–101.

Toma, C. L., & Hancock, J. T. (2010). Looks and lies: The role of physical attractiveness in online dating self-presentation. *Communication Research, 37*, 335–351.

Toma, C. L., & Hancock, J. T. (2011). A new twist on love's labor: Self-presentation in online dating profiles. In K. B. Wright & L. M. Webb (Eds.), *Computer-mediated communication in personal relationships* (1st ed., pp. 41–55). New York: Peter Lang Publishing.

Toma, C. L., & Hancock, J. T. (2013). Self-affirmation underlies Facebook use. *Personality and Social Psychology Bulletin, 39*, 321–331. doi: 10.1177=0146167212474694

Toma, C. L., Hancock, J. T., & Ellison, N. B. (2008). Separating fact from fiction: Deceptive self-presentation in online dating profiles. *Personality and Social Psychology Bulletin, 38*, 1023–1036.

Trepte, S., & Reinecke, L. (2011). The social web as a shelter for privacy and authentic living. In S. Trepte & L. Reinecke (Eds.), *Privacy online* (pp. 61–73). Berlin: Springer.

Walther, J. B. (1996). Computer-mediated communication: Impersonal, interpersonal, and hyperpersonal interaction. *Communication Research, 23*, 3–44. doi: 10.1177/009365096023001001

Walther, J. B. (2007). Selective self-presentation in computer-mediated communication: Hyperpersonal dimensions of technology, language, and cognition. *Computers in Human Behavior, 23*, 2538–2557. doi: 10.1016/j.chb.2006.05.002

Zhao, S., Grasmuck, S., & Martin, J. (2008). Identity construction on Facebook: Digital empowerment in anchored relationships. *Computers in Human Behavior, 24*, 1816–1836. doi: 10.1016/j.chb.2008.02.012.

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FLOW EXPERIENCES AND WELL-BEING

A Media Neuroscience Perspective

René Weber, Richard Huskey, and Britney Craighead

Much of the media psychology literature focuses on the factors that undermine well-being, such as the harmful effects of media violence, racial stereotyping, sex-role stereotyping, the creation of unrealistic body-image expectations, and so on (see e.g., Bryant & Oliver, 2009; Nabi & Oliver, 2009; see also the chapters by Mastro and by Greenwood in this volume). In fact, even studies purporting to explore well-being often examine issues that actually detract from well-being, such as depression and loneliness associated with Internet use (e.g., Huang, 2010). At the same time, the chapters in this volume forcefully demonstrate that a notable number of media scholars have begun to systematically investigate media's potential to enhance well-being and to contribute to a purposeful and fulfilling life. Among the various psychological mechanisms that may connect media use and well-being, media scholars have invested significant effort in understanding how media give rise to so-called *flow* experiences (Csikszentmihalyi, 1990; Sherry, 2004a).

Flow is a specific psychological process that spans major cognitive domains such as attention, reward, emotion, and motivation. To date, media psychological research has primarily focused on describing the antecedents and consequences of flow experiences. This body of research is an important first start, but advances in testing long-theorized relationships between media content, individual differences, and flow experiences (e.g., Sherry, 2004a) are hindered by several conceptual and operational ambiguities. In an effort to better define what flow *is* and thereby improve the construct's measurement, recent work is increasingly focused on understanding how and why the human brain creates flow experiences (Weber, Tamborini, Westcott-Baker, & Kantor, 2009; Westcott-Baker & Weber, 2012).

In this chapter, we argue that it is time to move beyond mere descriptions of flow experiences. By systematically investigating the neuropsychological processes that give rise to flow states, we can advance our understanding of how media exposure contributes to flow (specifically) and well-being (more generally). Accordingly, the bulk of this chapter focuses on the phenomenon of flow experiences from a media neuroscience perspective. However, we recognize that any media effect is embedded in a larger neuropsychological context. Therefore, we conclude the chapter by broadening our focus to include more general issues related to the neuropsychological basis of pleasure, reward, and pain. But first, we turn to an overview of flow research.

A Brief History of Flow

Flow is a state of focused attention, affective sensation, and motivation resulting from an interaction between individual and environmental conditions (Nakamura & Csikszentmihalyi, 2002).

Csikszentmihalyi (1990) describes a number of characteristics specific to the flow experience. First and most important is the notion of balance; that is, the sense that one's skills are an adequate fit for the task challenge presented. Second, flow requires intense focused attention (absorption) such that few resources remain for attending to self-consciousness or monitoring the passing of time. Finally, balance and focus yield a pleasant experience that is both inherently rewarding (autotelic) and not perceived as taxing, even when the task challenge is high. Importantly, flow is not a continuous construct – it is a state. There is no smooth transition between a no-flow state and a flow state – transitions are sudden and likely due to high levels of absorption associated with the flow-inducing task. More colloquially, the flow experience is often referred to as being "in the zone."

Task challenge and individual skill are conceptualized as causal antecedents to flow experiences (Csikszentmihalyi, 1990). No-flow experiences, for instance the experience of boredom, occur when an individual's skills exceed the challenges presented. Likewise, excessive challenge paired with too little skill yields a frustrating experience. The view that flow experiences represent a "middle ground" between boredom and frustration is commonly referred to as the "channel model" of flow. While valid, this three-state model ignores other affective states that are particularly relevant to media psychologists (Westcott-Baker & Weber, 2012). Accordingly, modern conceptualizations of the model include eight different affective states that result from various combinations of challenge and skill (Nakamura & Csikszentmihalyi, 2005). Regardless, this challenge/skill balance both describes the origination of flow and explains the motivational aspects of the experience: pleasure-maximizing humans seek out flow experiences where they are challenged in a manner fitting their skills.

Flow experiences are characterized as essential for living a purposeful and fulfilling life (Csikszentmihalyi, 1997), and an expansive body of research has used flow theory to investigate people's everyday lived experiences (Csikszentmihalyi, 1990). Sherry (2004a) argued that flow states can likewise be elicited by media exposure and can serve as a motivator for subsequent media use. According to Sherry, flow occurs when individuals have sufficient cognitive abilities to respond to various cognitive challenges associated with the processing and comprehension of media content. Media content that requires few cognitive resources (e.g., television sitcoms) is unlikely to result in flow, as audience skill greatly exceeds the cognitive resources required (Csikszentmihalyi & Kubey, 2007; but cf. Sherry, 2004a). Instead, flow resulting from media use is thought to occur during more cognitively demanding media use – for instance, following a complex narrative with moral conflicts and emotional shifts (Nabi & Green, 2015) or playing a video game in which players need to control the virtual environment and must continuously respond to dynamic and novel situations while maintaining an active mental representation of the game's goals and objectives. A body of experimental research using video games as stimuli corroborates this view (Jin, 2011, 2012; Keller & Bless, 2008; Rheinberg & Vollmeyer, 2003; Schmierbach, Chung, Wu, & Kim, 2014).

Epistemological Foundation

Before specifying what media and flow research gains by adding a media neuroscience perspective, it is first helpful to give an overview of an important (and somewhat recent) development among communication scholars. A decade ago, Sherry noted that:

> consideration of our biological selves has never been a major force in our field because the philosophical biases present at the inception of the field have left us mired in an ontology that only considers the nurture (environmental learning) portion of the human experience. (Sherry, 2004b, p. 85)

As a way forward, he called on communication scholars to broaden the scope of their theorizing by considering the dynamic interaction between the biological and environmental factors that shape human behavior. While a majority of communication scholars still privilege a learning perspective (see Floyd, 2014), recent scholarship in communication science conceptualizes the relationship between media user and media content as a dynamic process that occurs over time and at multiple levels (e.g., chemical, neural, psychological, behavioral, sociocultural; see Lang, 2013, 2014; Lang & Ewoldsen, 2013; Lang, Potter, & Bolls, 2008; Sherry, 2015; Weber, Sherry, & Mathiak, 2008). Cognitive processes such as attention, memory, reward, emotion, and so on are often specified as psychological mechanisms that are implicated in communication behavior. But a longstanding limitation of theories that posit cognitive mechanisms for communication processes is that they tend to treat the brain as an unknowable black box (Geiger & Newhagen, 1993). This is a real problem. By failing to consider how cognitive communication processes supervene on brain states, our theories essentially specify software without ever bothering to check for hardware compatibility. The neurophysiological perspective in mass communication research (Weber et al., 2008) argues that the latest developments in cognitive neuroscience can help resolve this issue. Theories of communication should be questioned if they fail to: (1) conform to well evidenced understandings of mind/brain function, (2) explain communication phenomena at multiple levels, and (3) generate falsifiable predictions that explain a reasonable amount of variance.

Our epistemological position is thus incremental and not revolutionary (and we should be skeptical of revolutionary arguments; see, for example, Miller & Berger, 1978). Media psychological research can benefit from increased theoretical specificity, and a growing body of evidence demonstrates that a media neuroscience perspective does help us increase theoretical specificity (for an extended discussion, see Weber, Eden, Huskey, Mangus, & Falk, 2015). Adopting a media neuroscience perspective recognizes the power of new methods to instigate important advances in theory and knowledge (Greenwald, 2012; Kuhn, 2000) and, as has been demonstrated in the larger field of cognitive psychology, neuroscience has the potential to assist in theory falsification (White & Poldrack, 2013).

The last two decades have seen rapid advances in neuroscientific knowledge, and much of this knowledge is based on using brain-imaging methodologies to uncover insights into the mind/brain (Smith, 2012). As evidenced by exemplary studies in three recent special issues in communication and media psychology journals (Afifi & Floyd, 2014; Weber, 2015a, 2015b), communication scholars are beginning to use brain imaging for theory testing. Therefore, adding a media neuroscience perspective to traditional investigations of flow as a consequence of media exposure is neither new nor revolutionary – it is simply the continuation of a trend towards a process-oriented and multilevel investigation of a media exposure phenomenon that has already started.

The Synchronization Theory of Flow

We now turn to the neuropsychological processes that are likely involved in creating a flow experience. As a fair warning, the ideas presented here are technical at places. We have tried to summarize the most important premises of our arguments as concisely as possible (for more details see Weber et al., 2009), but some operational specificity is necessary, because it is this specificity of neuropsychological processes that allows for risky tests of theoretical predictions which, if supported, lead to knowledge increase (for an extended discussion, see Weber, Mangus, & Huskey, 2015b).

Despite a vast empirical literature, there is still considerable conceptual ambiguity about what exactly constitutes flow, how flow is measured, and what the consequences are of flow. The synchronization theory of flow (sync theory; Weber et al., 2009) was motivated by the ambiguities inherent in the larger body of flow research and attempts to specify the neuropsychological processes that likely give rise to flow experiences. While others have attempted to explain the neurophysiological basis of flow (Dietrich, 2004), such accounts feature important limitations based on recent developments in the cognitive neurosciences (see Weber et al., 2009). Therefore, to our knowledge sync theory is the only available theory that specifies the neuropsychological processes of flow experiences. The theory is comprised of five central premises based on empirical evidence that is widely accepted in the neuroscientific community.

(1) *Brains are oscillating systems*: Brains are dynamic biological systems with an energy source (cell metabolism) and can be characterized as systems that oscillate at various frequencies (Ward, 2003). Neural networks oscillating at the same frequency are said to be in sync (Sherry, 2015; Strogatz, 2003) and network synchronization is central to the communication of information between neural networks (Başar, Başar-Eroglu, Karakşs, & Schürmann, 1999; Buzsáki, 2006; von der Malsburg & Schneider, 1986).

(2) *Synchronized systems are energy efficient*: Oscillating systems (neural networks) in a synchronized state operate at a lower energetic level compared to oscillating systems in a non-synchronized state (Strogatz, 2003). As with all biological entities, brains try to accomplish their function with the minimum amount of required energy. Thus, brains have an inherent tendency towards network synchronization, as this is an energetically optimized state (Laufs et al., 2003). This energetic efficiency is well supported by both computational modeling (Torrealdea, Sarasola, D'Anjou, Moujahid, & de Mendizábal, 2009) and empirical data (Bullmore & Sporns, 2012; Laufs et al., 2003).

(3) *Brain states are discrete*: Cognitive states, and the neural network configurations that enable these states, are discrete. Neural networks cannot be more or less in sync (Haken, 2006) just as individuals cannot be more or less in flow. Shifts between unsynchronized and synchronized states are known as phase transitions (Sole, 2011). Phase transitions between states happen rapidly (Strogatz, 2003), occur at a critical point, and follow power-law (Hesse & Gross, 2014; Massobrio, Arcangelis, Pasquale, Jensen, & Plenz, 2015) or near power-law (Priesemann et al., 2014) dynamics (but see Touboul & Destexhe, 2010). Importantly, there is increasing agreement that the dynamic coupling of neural systems gives rise to unique brain states that correspond to specific cognitive outputs (Davison et al., 2015). These differences between brain states may account for the subjective characteristics that distinguish flow from other states.

(4) *Brains are functionally organized*: While some brain regions are selectively recruited for just one cognitive process (Kanwisher, 2010), the evidence discussed above demonstrates that the brain exhibits characteristics of a complex system where cognitive processes result from an interaction between multiple neural systems. From a complex systems perspective (for an extended discussion, see Bassett & Gazzaniga, 2011), different neural structures perform computational tasks by following a set of simple rules. These structures can work together, or even exert influence over another, and the combined output of this joint computation is thought to be greater than the sum of the individual parts; an idea known as emergence. Therefore, if a task conceptually requires cognitive process A, and cognitive process A has been identified as resulting from the neural synchronization of regions X, Y, and Z, then we would expect that tasks eliciting cognitive process A necessarily leads to the network synchronization of regions X, Y, and Z (see, for example, Friston, 2011).

(5) *Brains are hierarchically organized*: Brains have a hierarchical architecture where higher-order cognitive states emerge from lower-order cognitive processes (Bassett & Gazzaniga, 2011). As just one example, lower-order neural networks for the recognition of an object's shape, size, orientation, color, and so on synchronize to create higher-order visual perceptions (Eckhorn et al., 1988; Gray & Singer, 1989). This synchronization between hierarchically organized neural networks is thought to be involved in the cognitive subprocesses (attention, memory, and so on) that ultimately facilitate the subjective conscious experience (Dennett, 1991).

Sync theory integrates these five basic premises with the phenomenological aspects of flow to develop a series of falsifiable predictions. As is characteristic of any theory, the predictions presented below

are hypothetical, but specific and accessible for empirical testing with reliable and valid measurement instruments (Weber, Mangus, & Huskey, 2015).

Pulling It All Together

At this point, it may help to summarize the phenomenological aspects of flow as described earlier in this chapter. Flow experiences (a) are a rewarding state of focused attention that (b) emerge suddenly (c) as the result of a balance between an individual's skill and the task's challenge, where (d) even difficult tasks are not perceived as taxing. If premises 1–3 account for phenomena (b), emergence, and (d), energetic consumption, premises 4–5 account for phenomenon (a), attention and reward, and if (c), challenge/skill balance, is the causal antecedent of flow experiences, then sync theory argues:

> In the media context, flow is a discrete, energetically optimized, and gratifying experience resulting from the synchronization of attentional and reward networks under condition of balance between challenge and skill. Flow can be understood as synchronization of a complex, natural system. Synchronization is an organizing and energetically cheap principle in oscillating natural systems. Organization, energetic optimization, and – as a result – balance in a synchronized cognitive system manifests [emerges] as pleasurable experience. (Weber et al., 2009, p. 412)

The Neural Basis of Flow

Sync theory specifically argues that attentional and reward networks should be recruited and synchronized when creating a flow experience. These networks can be further subdivided. For instance, attention consists of alerting, orienting, and executive processes (Posner, Inhoff, Friedrich, & Cohen, 1987). The relevant attentional structures identified in sync theory include frontal and parietal cortical regions (alerting; the process of becoming aware of a stimulus) as well as the superior and inferior parietal lobes, the frontal eye fields, and the superior colliculus (orienting; allocating attentional resources to a stimulus). Prefrontal regions (executive; goal directed processing) are also thought to contribute to flow experiences.

Similarly, sync theory distinguishes between two types of reward, anticipatory and consummatory (Lang, 2009; Pinel, 2005), and argues that both are relevant for flow experiences. Anticipatory reward is when a specific action is expected to result in a rewarding outcome and is associated with neural activation in the basal ganglia, specifically the thalamus and striatum. By comparison, consummatory reward is the pleasure experienced during a rewarding outcome and is associated with activity in the putamen, caudate nucleus, and a number of prefrontal structures (although, the striatum and thalamus may also be implicated in consummatory reward; see Frackowiak et al., 2003). In what follows, we review nascent research investigating the neural basis of flow experiences and highlight circumstances where empirical findings overlap with sync theory's hypotheses.

To date, just a handful of studies have put sync theory's hypotheses to an empirical test. One of the first had participants play a video game while undergoing fMRI scanning (Klasen, Weber, Kircher, Mathiak, & Mathiak, 2012). The game data were then content-analyzed to create events that corresponded to subjective descriptors of the flow experience (i.e., balance between task challenge and individual skill, concentration, control, clear goals). Consistent with synchronization theory, results showed neural activation in structures associated with attention (visual cortices), reward (thalamus), error monitoring (anterior cingulate cortex; ACC), and motor stimulation (somatosensory and premotor cortices).

A different approach experimentally manipulated affective states by varying the difficulty of a mental arithmetic paradigm while participants underwent fMRI scanning (Ulrich, Keller, Hoenig, Waller, & Grön, 2013). In the boredom condition, participants were given simple addition problems whereas the overload condition featured difficult questions that became more complex if participant accuracy surpassed a certain threshold. In the flow condition, a balance between task challenge and individual skill was achieved by dynamically adjusting question difficulty depending on the participants' performance. During the flow condition, increased regional cerebral blood flow (rCBF) was observed in the inferior frontal gyrus (IFG; an executive attention structure), which the authors interpret as being associated with adaptation to task demands. Increased rCBF was also observed in the putamen, a region in the dopaminergic system thought to be associated with consummatory reward. This finding is consistent with sync theory predictions as well as previous work showing that dopaminergic receptor availability in the striatum and putamen is positively correlated with the ability to experience flow (de Manzano et al., 2013).

Ulrich and colleagues also found rCBF decreases in regions typically associated with the default mode network (i.e., medial prefrontal cortex, MPFC, amygdala, and hippocampus). This result is interpreted as a disengagement of self-referential processing, which may correspond to a diminished sense of self-consciousness – a characteristic experience attributed to flow. However, this reverse-inference is somewhat difficult to interpret given that structures in the default mode network commonly deactivate in response to a variety of cognitive tasks (e.g., Raichle et al., 2001). A second issue is that solving arithmetic problems differs substantially from media experiences and the sort of activities commonly thought to result in flow. Coupled with the relatively sparse neural activations observed (especially considering that the data were not corrected for multiple comparisons), it is difficult to discern the extent to which their procedure elicited flow.

The most recent work in this area has experimentally manipulated flow using video game stimuli while imaging neural activation. Yoshida et al. (2014) had participants play a modified version of Tetris while conducting functional near-infrared spectroscopy. Tetris bricks fell very slowly in the boredom condition whereas the bricks fell at a dynamic rate (adjusted for player skill) during the flow condition. Results showed greater levels of oxygenated hemoglobin in the dorsolateral prefrontal cortex (DLPFC) during flow compared to boredom. The DLPFC is part of executive (top-down) control networks and is commonly implicated in studies of top-down attention (Raz & Buhle, 2006) as well as the reward-dependent modulation of working memory (Kennerley & Wallis, 2009). Similarly, preliminary electroencephalogram data demonstrate increased medial-frontal activity during flow relative to conditions of boredom and frustration (Castellar, 2015).

Lastly, a recent functional magnetic resonance imaging (fMRI) experiment had subjects free-play a first-person shooter video game while responding to a secondary distractor task (Weber, Alicea, Huskey, & Mathiak, 2014). Particularly relevant for the criticality assumption central to sync theory, the results showed a nonlinear increase in functional connectivity among subcortical structures (e.g., thalamus) with executive attention structures (e.g., superior frontal gyrus, middle frontal gyrus) as distraction decreased below a critical threshold. Taken together, these studies suggest that regions associated with executive attention are recruited during flow experiences.

These studies represent an important first step in understanding the neurological basis of flow, and their findings generally correspond with the structural predictions offered by synchronization theory. Moreover, the prefrontal neural activation results highlight the importance of executive attention and working memory, cognitive processes that were less emphasized in the original formulation of synchronization theory. While future research should focus on investigating the extent to which these cognitive processes are recruited during flow experience, there is still a pressing need to test the synchronization assumption of sync theory. As of this writing, no brain-imaging study has examined if the attentional and reward network activations observed during flow are independent effects, or represent the neural synchronization of these networks. Our lab is currently collecting data that will test exactly this issue.

What To Do with Sync Theory?

The previous sections provide some technical detail on the central assumptions and conclusions of synchronization theory. However, even if synchronization theory's predictions are supported, the implications for media psychological research on flow may not be intuitively clear. This brief section attempts to provide some guidance, with two examples that should demonstrate how exactly sync theory can advance media psychological research on flow and well-being.

Improvements in measurement. A principal methodological issue is that flow is generally assessed using self-report measures. Unfortunately, there are at least 13 different scales for measuring flow, and these measures are not uniformly applied in the literature (Novak, Hoffman, & Yung, 2000). One of the most commonly used tools to measure flow is the experience sampling method (ESM; Massimini & Carli, 1988). The ESM relies upon random emission of stimuli to beepers which signal participants to fill out a form asking about their current activities and feelings. Unfortunately, these self-report measures of flow suffer from several limitations. First, distractions from beepers and pop-up windows are sure to disrupt the highly focused experience of flow. As a result, these measures merely catalogue the activities associated with flow experiences while providing little detail on when exactly flow was experienced or what specific conditions resulted in flow. More generally, these measures are particularly susceptible to well-known issues associated with self-report data (Nisbett & Ross, 1980). If flow is characterized by focused attention to the task at hand and a diminished sense of temporal and self-awareness, it is quite unlikely that self-report measures accurately assess flow experiences. Researchers have attempted to overcome these issues by applying multilevel modeling analyses (e.g., Schmidt, Shernoff, & Csikszentmihalyi, 2007). Unfortunately, sophisticated statistics do not make self-report data more valid.

If task difficulty and individual skill are causal antecedents of flow experiences, then media studies on flow must consider how difficulty varies between different types of media and during media exposure. Along this line of reasoning, Sherry (2004a) has argued that the contribution of formal features (e.g., cuts, camera angles) and content (e.g., narrative complexity) should jointly determine the difficulty of different media stimuli. Unfortunately, it is all but impossible to test the combined effect of moment-by-moment changes in a media stimulus and individual differences in cognitive ability on flow experiences by using self-report data. In the most basic sense, the neuropsychological conceptualization provided by sync theory offers a solution to this dilemma. Examining how momentary changes in a stimulus modulate synchronization between attentional and reward networks is a first-step in understanding the dynamic, over-time, and temporally granular contribution of media features to flow experiences.

Brain-as-predictor. Another promising area for flow research capitalizes on recent advances that move beyond merely correlating neural activity with psychological processes. Known as the brain-as-predictor approach (Berkman & Falk, 2013), it involves media neuroscientists using neural responses in well-validated brain structures to predict perceptual and behavioral outcomes in independent samples (for methodological details, see Falk, Cascio, & Coronel, 2015). Once the neural correlates of flow are established, it may be possible to use brain activity during flow experiences to assess how variation in media content interacts with individual differences in cognitive ability to predict population-level popularity and enjoyment (e.g., Boksem & Smidts, 2015). While flow is linked with media enjoyment and well-being, it has also been posited as an antecedent to media addiction (see below). Brain-as-predictor approaches might be particularly useful for distinguishing the circumstances where media use results in either enjoyment and well-being, or addiction.

Neuropsychology of Pleasure, Reward, and Pain

Lastly, we widen our focus to examine how pleasure and pain influence reward circuits in the brain that ultimately promote or prohibit flow. This section first provides a broad view of the neuropsychology of pleasure, pain, and reward: topics which easily fill entire books (e.g., Kahneman, Diener, & Schwarz, 1999). Pleasure and pain are generally treated as discrete categories, yet neuropsychological evidence suggests that they may more aptly be described as two sides of the same coin. As we will demonstrate, pleasure is associated with well-being but excessive unregulated pleasure may have degenerative effects on well-being, including addiction. Next we explore how pleasure, pain, and reward contribute to higher-order cognitive processes such as flow and video game addiction. Finally, we conclude by examining how cognitive control governs these processes.

Pleasure and Reward

Pleasure is the subjective state of happiness one feels in response to something that is deemed enjoyable (Esch & Stefano, 2004). Broadly, pleasure is a positive emotion that (1) motivates individuals to seek out survival-enhancing objects (Lang, 2009) and (2) has been shown to improve cognitive functioning, concentration, and memory (Esch & Stefano, 2004). With that said, pleasure and reward are distinct cognitive processes. Reward is a multifaceted construct composed of liking, wanting, and learning whereas pleasure is a liking reaction to a reward (Berridge & Kringelbach, 2008). And, as discussed above, a distinction can be made between anticipatory and consummatory reward. Here we discuss the neural machinery that enables these processes.

Focusing first on consummatory reward, the striatum has been identified as the main site of pleasurable experience of rewards (Baldo & Kelley, 2007; Fliessbach et al., 2007; Frackowiak et al., 2003). The striatum is part of the basal ganglia, a component of the brain's limbic system. Anatomically, the reward system consists of the ventral tegmental area (VTA), which projects the neurotransmitter dopamine to the limbic system, specifically to the shell of the nucleus accumbens, and to the prefrontal cortex (Vetulani, 2001). Dopaminergic neurotransmission increases in the nucleus accumbens during naturally rewarding behaviors such as eating, drinking, and sexual activity (Vetulani, 2001).

Dopamine has long been considered a pleasure neurotransmitter, but recent research suggests a more complicated function (Berridge & Kringelbach, 2008). In fact, compelling evidence suggests that in addition to being involved in hedonic pleasure (consummatory reward), dopamine is also involved in learning and anticipatory reward (Baldo & Kelley, 2007; Banich, 2004; Berke, 2003; Frackowiak et al., 2003) and in facilitating enduring changes in motivation (Berridge & Kringelbach, 2008). However, it is unclear whether dopamine release is necessary to *cause* learning, as animal research demonstrates that reward learning still occurs in mice that completely lack dopamine (Hnasko, Sotak, & Palmiter, 2005).

In some circumstances, reward anticipation can be almost as pleasurable as the reward itself (Vetulani, 2001). Dopamine neurons in the mesolimbic reward system do not respond exclusively to pleasure. These neurons are also activated by predictive, motivational, and attentional properties, including goal-directed behavior (Carelli, 2004), processes involved in anticipatory reward.

Anticipatory and consummatory reward share common neural mechanisms. Subcortical structures such as the VTA and the limbic system play an important role in processing reward-related information. Anticipatory and consummatory reward are both vital to goal-directed behavior (Miller & Cohen, 2001). Behaviors are often separated in time from the rewards they produce – being able to anticipate a reward, even when it is separated from a behavior, is useful for reward learning and for planning future behavior. When a behavior is met with success (i.e., when the reward is consumed), connections between the PFC and other neurons associated with the behavior are strengthened. This leads to reinforcement of the behavior.

Pleasure and Pain: Two Sides of the Same Coin?

In our everyday experience, we feel pleasure and pain as distinct emotional states. However, these emotions share common physiological foundations (Berridge, 1999). Pleasure is an important component of motivation, which drives individuals to seek out naturally rewarding stimuli (Esch & Stefano, 2004). However, too much unregulated pleasure can have detrimental effects (Berridge & Kringelbach, 2008; Naqvi & Bechara, 2010). For instance, exogenous drugs hijack the reward system, increasing dopaminergic transmission in the nucleus accumbens (Vetulani, 2001), which can lead to conditions that detract from well-being, such as chemical and behavioral addiction. By examining the neuroscience of addiction, we see that the same neural structures involved in pleasurable experiences are also implicated in pain.

Just as the nucleus accumbens regulates dopamine that modulates pleasant experience, this structure is also implicated in pain. Low dopamine levels in the nucleus accumbens can contribute to painful experiences. The neurotransmitter acetylcholine counteracts dopamine and leads to feelings of satiety, which can cause cessation of behavior (Hoebel, Rada, Mark, & Pothos, 1999). This leads someone to stop eating when they are full. Yet, an imbalance in this process can also lead to reduced motivation. If dopamine levels fall below normal and acetylcholine levels are relatively high in the nucleus accumbens, individuals experience a loss of reinforcement, which can lead to painful aversive states such as depression. Conversely, exogenous drugs (e.g., cocaine, methamphetamine) increase dopamine release in the nucleus accumbens and lead to a state of hyper-reinforcement (too much pleasure). Prolonged hyper-reinforcement is associated with negative outcomes such as abnormal cognition and paranoia (Hoebel et al., 1999).

This line of research suggests that pleasure, pain, and reward employ common neural circuits. At first glance, this may seem to complicate attempts to understand the neural basis of media enjoyment. These difficulties can be overcome by remembering that the brain is a hierarchically organized system where complex cognitive processes result from the dynamic interaction between multiple neural subsystems. To help clarify this point, consider the distinction between flow (pleasure) and video game addiction (pain).

Flow and video game addiction share similar behavioral components, including high engagement and the experience of subjective time loss (Hull, Williams, & Griffiths, 2013). This observation has led some to hypothesize that flow is an antecedent to video game addiction (Chou & Ting, 2003; Gentile, 2009; Hull et al., 2013). There is, however, limited support for this hypothesis. A study of Taiwanese gamers found that those who have experienced flow in the past are more likely to be addicted to video games (Chou & Ting, 2003). However, it is important to note that experiencing flow in the past and being categorized as a currently addicted player does not demonstrate a causal relationship. Presumably, the surveyed gamers have also experienced other psychological states prior to their categorization as addicted players. Similarly, a survey examined nine components of the flow experience and found that video game addiction was positively correlated with a distorted sense of time and negatively correlated with general happiness levels (Hull et al., 2013). The authors interpreted these findings as evidence that flow-inducing behaviors lead to addictive behaviors. Taken together, these results suggest that flow and addiction do share key features (high engagement and time loss). But again, these studies do not provide strong evidence that other components of flow predict addictive behavior. While the majority of gamers report that they have experienced flow during game play (Wood & Griffiths, 2007), few gamers experience addiction (Festl, Sharkow, & Quandt, 2012). Neuroscientific investigations into addiction help clarify what distinguishes addiction from flow.

Self-regulation of behavior is dependent on a balance between activation in the prefrontal cortex and subcortical regions in the brain, including the limbic system (Heatherton & Wagner, 2011). Self-regulation of behavior requires top-down control (cognitive control) from the prefrontal cortex;

however, some stimuli may evoke a strong impulse, which then tips the balance in favor of bottom-up control from the subcortical regions and increases the likelihood that an individual will fail to self-regulate behavior (Heatherton & Wagner, 2011). Failure of self-regulation contributes to addiction. Addiction is associated with bottom-up processing from subcortical areas and a lack of cognitive control, whereas flow is a rewarding experience associated with focused attention that may help individuals achieve various goal-directed behaviors. Next we briefly discuss the neural correlates of cognitive control and the importance of cognitive control in achieving goal-directed behavior.

Cognitive Control

Balance theories of behavioral regulation can be best understood within the broader context of cognitive control (Miller & Cohen, 2001). Cognitive control allows individuals to coordinate lower-level sensory and motor processes in order to enact goal-directed behaviors. A key aspect of cognitive control is the ability of an individual to act on a weaker, task-relevant response when simultaneously confronted with a stronger, task-irrelevant response. Cognitive control requires a great deal of coordination. As an example, imagine an individual playing a particularly challenging level of the puzzle game *Portal*. To beat the level, this player must maintain a cognitive representation of the goal (successfully plan an escape and navigate through the game area). The player must maintain a cognitive representation of the goal while ignoring task-irrelevant information (e.g., avoiding interaction with salient but useless objects). While developing the new skills required for solving the novel challenges presented by the particular game level, the player must also inhibit other responses. This may include overriding well-practiced (and therefore automatic) game moves in favor of incipient, task-relevant behaviors that will help achieve the goal of beating the particular (and novel) level. Miller and Cohen write that:

> the PFC [prefrontal cortex] exhibits the properties required to support a role in cognitive control: sustained activity that is robust to interference; multimodal convergence and integration of behaviorally relevant information; feedback pathways that can exert biasing influences on other structures throughout the brain; and ongoing plasticity that is adaptive to the demands of new tasks. (Miller & Cohen, 2001, p. 182)

Indeed, this summary of cognitive control suggests a perfect mechanism for dealing with the challenges presented by interactive media such as video games.

Concluding Remarks

A neuropsychological understanding of flow, pleasure, and reward enhances our understanding of how exactly media exposure can translate into individual well-being. Importantly, a neuropsychological perspective indicates that pleasure and pain are not discrete states. Instead, they fall along a continuum and share much of the underlying neurological architecture. Accordingly, well-being and ill-being as media effects are not discrete states. Each is enabled by similar neural structures and both share similar neuropsychological processes. Thus, from a media neuroscience perspective it is difficult to understand why, in the past, media psychology has explored only one side of this continuum by focusing on the facets of media that detract from well-being. We hope that this chapter demonstrates what can be gained by conceptualizing media psychological processes from a media neuroscience perspective, and that it helps media psychologists to widen their traditional research focus. At the same time, we hope that our readers recognize that adopting a media neuroscience perspective requires considerable theoretical and operational specificity. Without this specificity, there is little hope for resolving conceptually ambiguous constructs such as flow or media addiction (see Weber, Eden, et al., 2015; Weber, Mangus, & Huskey, 2015) and improving their predictive potential for individual well-being.

References

Afifi, T., & Floyd, K. (2014). Biology and physiology in communication [Special Issue]. *Communication Monographs, 82*(1). doi: 10.1080/19312458.2014.999755

Baldo, B. A., & Kelley, A. E. (2007). Discrete neurochemical coding of distinguishable motivational processes: Insights from nucleus accumbens control of feeding. *Psychopharmacology, 191*(3), 439–459. doi: 10.1007/s00213-007-0741-z

Banich, M. T. (2004). *Cognitive neuroscience and neuropsychology.* Boston, MA: Houghton Mifflin.

Başar, E., Başar-Eroglu, C., Karakşs, S., & Schürmann, M. (1999). Oscillatory brain theory: A new trend in neuroscience. *IEEE Engineering in Medicine and Biology, 18*(3), 56–66. doi: 10.1109/51.765190

Bassett, D. S., & Gazzaniga, M. S. (2011). Understanding complexity in the human brain. *Trends in Cognitive Sciences, 15*(5), 200–209. doi: 10.1016/j.tics.2011.03.006

Berke, J. D. (2003). Drugs of abuse in compulsive drug use and relapse. In J. Q. Wang (Ed.), *Drugs of abuse: Neurological reviews and protocols* (pp. 75–101). Totowa, NJ: Humana Press.

Berkman, E. T., & Falk, E. B. (2013). Beyond brain mapping: Using the brain to predict real-world outcomes. *Current Directions in Psychological Science, 22*(1), 45–55. doi: 10.1177/0963721412469394

Berridge, K. C. (1999). Pleasure, pain, desire, and dread: Hidden core processes of emotion. In D. Kahneman, E. Diener, & N. Schwarz (Eds.), *Well-being: The foundations of hedonic psychology* (pp. 525–557). New York: Russell Sage Foundation.

Berridge, K. C., & Kringelbach, M. L. (2008). Affective neuroscience of pleasure: Reward in humans and animals. *Psychopharmacology, 199*(3), 457–480. doi: 10.1007/s00213-008-1099-6

Boksem, M. A. S., & Smidts, A. (2015). Brain responses to movie-trailers predict individual preferences for movies and their population-wide commercial success. *Journal of Marketing Research.* Advance online publication. doi: 10.1509/jmr.13.0572

Bryant, J., & Oliver, M. B. (Eds.) (2009). *Media effects: Advances in theory and research* (3rd ed.). New York: Routledge.

Bullmore, E., & Sporns, O. (2012). The economy of brain network organization. *Nature Reviews Neuroscience, 13*(5), 336–349. doi: 10.1038/nrn3214

Buzsáki, G. (2006). *Rhythms of the brain.* New York: Oxford University Press.

Carelli, R. M. (2004). Nucleus accumbens cell firing and rapid dopamine signaling during goal-directed behaviors in rats. *Neuropharmacology, 47*, 180–189. doi: 10.1016/j.neuropharm.2004.07.017

Castellar, E. N. (2015). Attentional control mechanisms and subjective flow experience during game play: An EEG study. Paper presented at the annual conference of the International Communication Association, San Juan, Puerto Rico.

Chou, T.-J., & Ting, C.-C. (2003). The role of flow experience in cyber-game addiction. *Cyberpsychology & Behavior: The Impact of the Internet, Multimedia and Virtual Reality on Behavior and Society, 6*(6), 663–675. doi: 10.1089/109493103322725469

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience.* New York: HarperCollins Publishers.

Csikszentmihalyi, M. (1997). *Finding flow. The psychology of engagement with everyday life.* New York: Basic Books.

Csikszentmihalyi, M., & Kubey, R. (2007). Television and the rest of life: A systematic comparison of subjective experience. *The Public Opinion Quarterly, 45*(3), 317–328. doi: 10.1086/268667

Davison, E. N., Schlesinger, K. J., Bassett, D. S., Lynall, M.-E., Miller, M. B., Grafton, S. T., & Carlson, J. M. (2015). Brain network adaptability across task states. *PLoS Computational Biology, 11*(1), e1004029. doi: 10.1371/journal.pcbi.1004029

de Manzano, Ö., Cervenka, S., Jucaite, A., Hellenäs, O., Farde, L., & Ullén, F. (2013). Individual differences in the proneness to have flow experiences are linked to dopamine D2-receptor availability in the dorsal striatum. *NeuroImage, 67*(15), 1–6. doi: 10.1016/j.neuroimage.2012.10.072

Dennett, D. C. (1991). *Consciousness Explained.* Boston, MA: Little, Brown & Company.

Dietrich, A. (2004). Neurocognitive mechanisms underlying the experience of flow. *Consciousness and Cognition, 13*(4), 746–761. doi: 10.1016/j.concog.2004.07.002

Eckhorn, R., Bauer, R., Jordan, W., Brosch, M., Kruse, W., Munk, M., & Reitboeck, H. J. (1988). Coherent oscillations: A mechanism of feature linking in the visual cortex? *Biological Cybernetics, 60*(2), 121–130. doi: 10.1007/BF00202899

Esch, T., & Stefano, G. B. (2004). The neurobiology of pleasure reward processes, addiction and their health implications. *Neuroendocrinology Letters, 25*(4), 235–251.

Falk, E. B., Cascio, C. N., & Coronel, J. (2015). Neural prediction of communication-relevant outcomes. *Communication Methods and Measures, 9*(1–2), 30–54. doi: 10.1080/19312458.2014.999750

Festl, R., Scharkow, M., & Quandt, T. (2013). Problematic computer game use among adolescents, younger and older adults. *Addiction, 108*(3), 592–599. doi: 10.1111/add.12016

Fliessbach, K., Weber, B., Trautner, P., Dohmen, T., Sunde, U., Elger, C.E., & Falk, A. (2007). Social comparison affects reward-related brain activity in the human ventral striatum. *Science, 318*(5854), 1305–1308. doi: 10.1126/science.1145876

Floyd, K. (2014). Humans are people, too: Nurturing an appreciation for nature in communication research. *Review of Communication Research, 2*(1), 1–29. doi: 10.12840/issn.2255-4165.2014.02.01.001

Frackowiak, R., Friston, K., Frith, C., Dolan, R., Price, C., Zeki, S., . . . & Penny, W. D. (2003). Brain systems mediating reward. In R. Frakowiak et al. (Eds.), *Human Brain Function* (pp. 445–470). San Diego, CA: Academic Press.

Friston, K. J. (2011). Functional and effective connectivity: A review. *Brain Connectivity, 1*(1), 13–36. doi: 10.1089/brain.2011.0008

Geiger, S., & Newhagen, J. (1993). Revealing the black box: Information processing and media effects. *Journal of Communication, 43*(4), 42–50. doi: 10.1111/j.1460-2466.1993.tb01303.x

Gentile, D. (2009). Pathological video-game use among youth ages 8 to 18: A national study. *Psychological Science, 20*(5), 594–602. doi: 10.1111/j.1467-9280.2009.02340.x

Gray, C. M., & Singer, W. (1989). Stimulus-specific neuronal oscillations in orientation columns of cat visual cortex. *Proceedings of the National Academy of Science, 86*(5), 1698–1702.

Greenwald, A. G. (2012). There is nothing so theoretical as a good method. *Perspectives on Psychological Science, 7*(2), 99–108. doi: 10.1177/1745691611434210

Haken, H. (2006). Synergetics of brain function. *International Journal of Psychophysiology, 60*(2), 110–124. doi: 10.1016/j.ijpsycho.2005.12.006

Heatherton, T. F., & Wagner, D. D. (2011). Cognitive neuroscience of self-regulation failure. *Trends in Cognitive Sciences, 15*(3), 132–139. doi: 10.1016/j.tics.2010.12.005

Hesse, J., & Gross, T. (2014). Self-organized criticality as a fundamental property of neural systems. *Frontiers in Systems Neuroscience, 8*(166), 1–14. doi: 10.3389/fnsys.2014.00166

Hnasko, T. S., Sotak, B. N., & Palmiter, R. D. (2005). Morphine reward in dopamine-deficient mice. *Nature, 438*(7069), 854–857. doi: 10.1038/nature04172

Hoebel, B. G., Rada, P. V., Mark, G. P., & Pothos, E. N. (1999). Neural systems for reinforcement and inhibition of behavior: Relevance to eating, addiction, and depression. In D. Kahneman, E. Diener, & N. Schwarz (Eds.), *Well-being: The foundations of hedonic psychology* (pp. 558–574). New York: Russell Sage Foundation.

Huang, C. (2010). Internet use and psychological well-being: A meta-analysis. *Cyberpsychology, Behavior and Social Networking, 13*(3), 241–249. doi: 10.1089/cyber.2009.0217

Hull, D. C., Williams, G. A., & Griffiths, M. D. (2013). Video game characteristics, happiness and flow as predictors of addiction among video game players: A pilot study. *Journal of Behavioral Addictions, 2*(3), 145–152. doi: 10.1556/JBA.2.2013.005

Jin, S.-A. A. (2011). "I feel present. Therefore, I experience flow": A structural equation modeling approach to flow and presence in video games. *Journal of Broadcasting & Electronic Media, 55*(1), 114–136. doi: 10.1080/08838151.2011.546248

Jin, S.-A. A. (2012). "Toward integrative models of flow": Effects of performance, skill, challenge, playfulness, and presence on flow in video games. *Journal of Broadcasting & Electronic Media, 56*(2), 169–186. doi: 10.1080/08838151.2012.678516

Kahneman, D., Diener, E., & Schwarz, N. (1999). *Well-being: The foundations of hedonic psychology*. New York: Russell Sage Foundation.

Kanwisher, N. (2010). Functional specificity in the human brain: A window into the functional architecture of the mind. *Proceedings of the National Academy of Sciences of the United States of America, 107*(25), 11163–11170. doi: 10.1073/pnas.1005062107

Keller, J., & Bless, H. (2008). Flow and regulatory compatibility: An experimental approach to the flow model of intrinsic motivation. *Personality & Social Psychology Bulletin, 34*(2), 196–209. doi: 10.1177/0146167207310026

Kennerley, S. W., & Wallis, J. D. (2009). Reward-dependent modulation of working memory in lateral prefrontal cortex. *The Journal of Neuroscience, 29*(10), 3259–3270. doi: 10.1523/JNEUROSCI.5353-08.2009

Klasen, M., Weber, R., Kircher, T. T. J., Mathiak, K. A., & Mathiak, K. (2012). Neural contributions to flow experience during video game playing. *Social Cognitive and Affective Neuroscience, 7*(4), 485–495. doi: 10.1093/scan/nsr021

Kuhn, T. S. (2000). What are scientific revolutions? In J. Conan & J. Haugeland (Eds.), *The road since structure* (pp. 13–32). Chicago, IL: The University of Chicago Press.

Lang, A. (2009). The limited capacity model of motivated mediated message processing. In R. L. Nabi & M. B. Oliver (Eds.), *The SAGE handbook of media processes and effects* (pp. 193–204). Thousand Oaks, CA: SAGE.

Lang, A. (2013). Discipline in crisis? The shifting paradigm of mass communication research. *Communication Theory, 23*(1), 10–24. doi: 10.1111/comt.12000

Lang, A. (2014). Dynamic human-centered communication systems theory. *The Information Society: An International Journal, 30*(1), 60–70. doi: 10.1080/01972243.2013.856364

Lang, A., & Ewoldsen, D. R. (2013). Beyond effects: Conceptualizing communication as dynamic, complex, nonlinear, and fundamental. In S. Allan (Ed.), *Rethinking communication: Keywords in communication research* (pp. 109–120). New York: Hampton Press.

Lang, A., Potter, R. F., & Bolls, P. (2008). Where psychophysiology meets the media: Taking the effects out of mass media research. In J. Bryant & M. B. Oliver (Eds.), *Media Effects: Advances in Theory and Research* (3rd ed., pp. 185–206). New York: Routledge.

Laufs, H., Kleinschmidt, A., Beyerle, A., Eger, E., Salek-Haddadi, A., Preibisch, C., & Krakow, K. (2003). EEG-correlated fMRI of human alpha activity. *NeuroImage, 19*(4), 1463–1476. doi: 10.1016/S1053-8119(03)00286-6

Massimini, F., & Carli, M. (1988). The systematic assessment of flow in everyday life. In M. Csikszentmihalyi & I. S. Csikszentmihalyi (Eds.), *Optimal experience: Psychological studies of flow in consciousness* (pp. 266–287). New York: Cambridge University Press.

Massobrio, P., de Arcangelis, L., Pasquale, V., Jensen, H. J., & Plenz, D. (2015). Criticality as a signature of healthy neural systems. *Frontiers in Systems Neuroscience, 9*(22), 1–3. doi: 10.1038/nphys1803

Miller, E. K., & Cohen, J. D. (2001). An integrative theory of prefrontal cortex function. *Annual Review of Neuroscience, 24*, 167–202. doi: 10.1146/annurev.neuro.24.1.167

Miller, G. R., & Berger, C. R. (1978). On keeping the faith in matters scientific. *Western Journal of Speech Communication, 42*(1), 44–57. doi: 10.1080/10570317809373921

Nabi, R., & Green, M. (2015). The role of a narrative's emotional flow in promoting persuasive outcomes. *Media Psychology, 18*(2), 137–162. doi: 10.1080/15213269.2014.912585

Nabi, R., & Oliver, M. B. (Eds.) (2009). *The SAGE handbook of media processes and effects*. Thousand Oaks, CA: SAGE.

Nakamura, J., & Csikszentmihalyi, M. (2002). The concept of flow. In C. R. Snyder and S. J. Lopez (Eds.), *Handbook of positive psychology* (pp. 89–105). New York: Oxford University Press.

Naqvi, N. H., & Bechara, A. (2010). The insula and drug addiction: An interoceptive view of pleasure, urges, and decision-making. *Brain Structure and Function, 214*(5–6), 435–450. doi: 10.1007/s00429-010-0268-7

Nisbett, R. E., & Ross, L. (1980). *Human inference: Strategies and shortcomings of social judgment*. Englewood Cliffs, NJ: Prentice-Hall.

Novak, T. P., Hoffman, D. L., & Yung, Y.-F. (2000). Measuring the customer experience in online environments: A structural modeling approach. *Marketing Science, 19*(1), 22–42. doi: 10.1287/mksc.19.1.22.15184

Pinel, J. P. J. (2005). *Biopsychology*. Boston, MA: Allyn & Bacon.

Posner, M., Inhoff, A. W., Friedrich, F. J., & Cohen, A. (1987). Isolating attentional systems: A cognitive-anatomical analysis. *Psychobiology, 15*(2), 107–121. doi: 10.1080/15213269.2014.912585

Priesemann, V., Wibral, M., Valderrama, M., Pröpper, R., Le Van Quyen, M., Geisel, T., . . . & Munk, M. H. J. (2014). Spike avalanches in vivo suggest a driven, slightly subcritical brain state. *Frontiers in Systems Neuroscience, 8*(108), 1–17. doi: 10.3389/fnsys.2014.00108

Raichle, M. E., MacLeod, A. M., Snyder, A. Z., Powers, W. J., Gusnard, D. A., & Shulman, G. L. (2001). A default mode of brain function. *Proceedings of the National Academy of Sciences of the United States of America, 98*(2), 676–682. doi: 10.1073/pnas.98.2.676

Raz, A., & Buhle, J. (2006). Typologies of attentional networks. *Nature Reviews. Neuroscience, 7*, 367–379. doi: 10.1038/nrn1903

Rheinberg, F., & Vollmeyer, R. (2003). Flow-Erleben in einem Computerspiel unter experimentell variierten Bedingungen [Flow experience in a computer game under experimentally manipulated conditions]. *Zeitschrift Für Psychologie, 211*(4), 161–170. doi: 10.1026//0044-3409.211.4.161

Schmidt, J. A., Shernoff, D. J., & Csikszentmihalyi, M. (2007). Individual and situational factors related to the experience of flow in adolescence: A multilevel approach. In A. D. Ong & M. H. M. van Dulmen (Eds.), *The Oxford handbook of methods in positive psychology* (pp. 542–588). New York: Oxford University Press.

Schmierbach, M., Chung, M.-Y., Wu, M., & Kim, K. (2014). No one likes to lose. *Journal of Media Psychology, 26*(3), 105–110. doi: 10.1027/1864-1105/a000120

Sherry, J. (2004a). Flow and media enjoyment. *Communication Theory, 14*(4), 328–347. doi: 10.1111/j.1468-2885.2004.tb00318.x

Sherry, J. (2004b). Media effects theory and the nature/nurture debate: A historical overview and directions for future research. *Media Psychology, 6*(1), 83–109. doi: 10.1207/s1532785xmep0601_4

Sherry, J. (2015). The complexity paradigm for studying human communication: A summary and integration of two fields. *Review of Communication Research, 3*(1), 22–54. doi: 10.12840/issn.2255-4165.2015.03.01.007

Smith, K. (2012). fMRI 2.0.: Functional magnetic resonance imaging is growing from showy adolescence into a workhorse of brain imaging. *Nature, 484*(7392), 24–26. doi: 10.1038/484024a

Sole, R. V. (2011). *Phase transition*. Princeton, NJ: Princeton University Press.

Strogatz, S. (2003). *Sync: The emerging science of spontaneous order*. New York: Hyperion.

Torrealdea, F. J., Sarasola, C., D'Anjou, A., Moujahid, A., & de Mendizábal, N. V. (2009). Energy efficiency of information transmission by electrically coupled neurons. *BioSystems, 97*(1), 60–71. doi: 10.1016/j.biosystems.2009.04.004

Touboul, J., & Destexhe, A. (2010). Can power-law scaling and neuronal avalanches arise from stochastic dynamics? *PLoS ONE, 5*(2), 1–14. doi: 10.1371/journal.pone.0008982

Ulrich, M., Keller, J., Hoenig, K., Waller, C., & Grön, G. (2013). Neural correlates of experimentally induced flow experiences. *NeuroImage*. doi: 10.1016/j.neuroimage.2013.08.019

Vetulani, J. (2001). Drug addiction. Part II. Neurobiology of addiction. *Polish Journal of Pharmacology, 53*(4), 303–318.

von der Malsburg, C., & Schneider, W. (1986). A neural cocktail-party processor. *Biological Cybernetics, 54*(1), 29–40. doi: 10.1007/BF00337113

Ward, L.M. (2003). Synchronous neural oscillations and cognitive processes. *Trends in Cognitive Sciences, 7*(12), 553–559. doi: 10.1016/j.tics.2003.10.012

Weber, R. (2015a). Biology and brains: Methodological innovations in communication science [Introduction: Special Issue]. *Communication Methods and Measures, 9*(1–2).

Weber, R. (2015b). Brain, mind, and media: Neuroscience meets media psychology [Editorial: Special Issue]. *Journal of Media Psychology, 27*(3), 89–92.

Weber, R., Alicea, B., Huskey, R., & Mathiak, K. (2014). The dynamics of attention in video game environments: A functional magnetic resonance imaging study. Paper presented at the annual conference of the International Communication Association, Seattle, WA.

Weber, R., Eden, A., Huskey, R., Mangus, J. M., & Falk, E. (2015). Bridging media psychology and cognitive neuroscience: Challenges and opportunities. *Journal of Media Psychology, 27*(3), 146–156.

Weber, R., Mangus, J. M., & Huskey, R. (2015). Brain imaging in communication research: A practical guide to understanding and evaluating fMRI studies. *Communication Methods and Measures, 9*(1–2), 5–29. doi: 10.1080/19312458.2014.999754

Weber, R., Sherry, J., & Mathiak, K. (2008). The neurophysiological perspective in mass communication research: Theoretical rationale, methods, and applications. In M. J. Beatty, J. C. Mccroskey, & K. Floyd (Eds.), *Biological dimensions of communication: Perspectives, methods, and research* (pp. 41–71). Cresskill, NJ: Hampton Press.

Weber, R., Tamborini, R., Westcott-Baker, A., & Kantor, B. (2009). Theorizing flow and media enjoyment as cognitive synchronization of attentional and reward networks. *Communication Theory, 19*(4), 397–422. doi: 10.1111/j.1468-2885.2009.01352.x

Westcott-Baker, A., & Weber, R. (2012). The synchronization theory of flow: Consequences of a limited capacity for attention and consciousness. In J. Gackenbach (Ed.), *Video game play and consciousness* (pp. 125–148). Hauppauge, NY: Nova Science Publishers.

White, C. N., & Poldrack, R. A. (2013). Using fMRI to constrain theories of cognition. *Perspectives on Psychological Science, 8*(1), 79–83. doi: 10.1177/1745691612469029

Wood, R. T. A., & Griffiths, M. D. (2007). Time loss whilst playing video games: Is there a relationship to addictive behaviours? *International Journal of Mental Health and Addiction, 5*(2), 141–149. doi: 10.1007/s11469-006-9048-2

Yoshida, K., Sawamura, D., Inagaki, Y., Ogawa, K., Ikoma, K., & Sakai, S. (2014). Brain activity during the flow experience: A functional near-infrared spectroscopy study. *Neuroscience Letters, 573*(24), 30–34. doi: 10.1016/j.neulet.2014.05.011

PART III

Moderators

Intervening Factors Determining the Risks and Benefits of Media Use