I

IMMERSIVE VIRTUAL ENVIRONMENTS, AVATARS, AND AGENTS FOR HEALTH

Surpassing three trillion US dollars in 2014, health-care spending is at almost $10,000 per person (Centers for Medicare & Medicaid Services), and this trend is projected to accelerate in the coming decade (Keehan et al., 2015). Labor involved in health care accounts for the largest proportion of expenditures in many health systems, and scholars believe that unlocking innovation to reduce the labor-intensive nature of health care might be key to slowing this spending growth (Macdonnell & Darzi, 2013). The search for creative and effective solutions to reduce health-care expenditure is a timely task. Healthcare technology, such as m-health and e-health, aims to offer cost- and labor-effective solutions to health-care professionals through incorporating digital devices and infrastructures. For instance, a large-scale study suggested that web-based interventions for adults using computer-tailored health guidance might be more cost effective for health outcomes than traditional means of health care (Schulz et al., 2014).

There has been much anticipation of recent regarding the potential of immersive virtual environments, popularly referred to as "virtual reality," as a viable technology to be applied in everyday clinical settings and a source of self-guided health care for patients. In the 1990s, researchers and clinicians began to recognize the utility of these computer-generated environments to provide health treatment.

Since then, the application of virtual environments in health care has expanded greatly, ranging from interventions to training programs. Immersive virtual environments are being actively researched for a myriad of health-care applications, including doctor training, therapy, rehabilitation, and patient education. Building on the earlier efforts to develop efficient and effective health-care technology, this chapter introduces immersive virtual environments as another potential innovation to the existing array of health-care technology by discussing how these virtual worlds may offer a cost- and labor-effective approach to improving health care while retaining much of the advantages of traditional health-care practices. In the coming sections, this article provides an introduction to immersive virtual environments and explains their distinctive structural affordances. This article also discusses how users and other humans are represented in virtual environments and what characteristics of these representations are meaningful for health applications. Then, various health applications of virtual environments in both research and clinical settings will be reviewed. Finally, the literature will be synthesized to discuss the advantages and limitations of virtual environments for health practitioners now and in the future.

AN INTRODUCTION TO IMMERSIVE VIRTUAL ENVIRONMENTS

Immersive virtual environments (IVEs) are digital systems comprised of devices that simulate multiple layers of sensory information so that users are able to see, hear, and feel as if they are in the real world (Blascovich & Bailenson, 2011; Loomis, Blascovich, & Beall, 1999). IVEs are distinguished from other virtual environments by their ability to track users' natural physical movements and use this information to render the digital setting accordingly. A growing collection of literature demonstrates that digitally mediated multisensory experiences in IVEs can influence attitudes and behaviors that transfer into the non-mediated, physical world (see Ahn & Fox, 2016; Blascovich & Bailenson, 2011; Fox, Christy, & Vang, 2014; Yee, 2014). Novel affordances of advanced digital media such as IVEs allow individuals to go beyond passive consumption experiences provided by traditional media such as television and books. Instead, people become active participants in the mediated context.

Personal and direct experiences have greater impact on attitude and behavior change than indirect experiences (Hertwig et al., 2004; Rajecki, 1982). Direct experiences provide detailed sensory cues, which become associated and stored with existing *schemas* or mental models. These schemas are later activated and recalled when the individual encounters or thinks about similar stimuli (Barsalou, 2009). When direct experiences are mimicked with sufficient realism, schemas may also be constructed following mediated experiences (Bandura, 2001). Because the rich layers of simulated sensory information in IVEs mimic direct experiences better than traditional media or imagination (Ahn, in press; Ahn, Bailenson, & Park, 2014), virtual experiences in IVEs are likely to have a stronger impact on attitude and behavior formation than simulations where the person is less embodied and presented with environments less similar to direct experiences.

As the name implies, *immersion* is a main feature of IVEs and refers to users being surrounded or enveloped by sensory information simulated with digital devices (Heeter, 1992; Steuer, 1992). Virtual environments can differ in the level of immersion that they offer. IVEs can provide stereoscopic visual input, spatialized aural input, and tactile input, yielding a sense of perceptual depth and vivid realism. In comparison, virtual environments with lower levels of immersion, such as desktop computers, offer monoscopic visual, simple audio, and limited tactile inputs. The effect of having differing intensity of immersiveness is still being debated (Ahn et al., 2016; Fox et al., 2014; Price & Anderson, 2007; Price,

Anderson, & Rothbaum, 2008). For example, a meta-analysis (Cummings & Bailenson, 2016) reported that levels of immersion yield moderate size effects on users' perceptions of "being there" in the virtual world, and a systematic review suggested that more immersive virtual simulations may be more conducive to positive treatment outcomes for autism spectrum disorders (Miller & Bugnariu, 2016). However, because the perception of presence in virtual worlds is subjective, and not necessarily dependent on technological features, the degree of immersiveness may not be the sole driver of user experience, but rather, individual differences (Galloso, Palacios, Feijóo, & Santamaría, 2016) such as cognitive abilities (Sacau, Laarni, & Hartmann, 2008), capacity for imagination (Sas & O'Hare, 2003), and even personality (Sacau et al., 2008; Sas & O'Hare, 2003). Thus, if the individual does not or is not able to perceive differences between high versus low immersive systems, user experience may not be influenced.

Interactivity is another characteristic of IVEs that distinguishes them from traditional media—the technological capacity of the digital system to actually respond in a two-way exchange, immediately, in real-time (Rafaeli, 1988; Rice & Williams, 1984; Steuer, 1992). Although interactivity is not unique to IVEs, they tend to provide users with the most engaging and responsive stimuli that respond in real time to user actions. Interactivity allows the user to be both an observer and a participant in mediated environments, possibly leading to more potent media effects (Rafaeli, 1988; Steuer, 1992). IVEs offer interactivity in several ways that encourage greater user control, participation, and engagement by eliciting user interaction with the interface through system features (Sundar, Xu, & Bellur, 2010).

These features present a wide range of opportunities for health communication researchers and practitioners to incorporate IVEs into their health-care or health intervention programs, which will be discussed in further detail in following sections. In the past, access to IVE systems were often restricted to sophisticated laboratory and research establishments. In the early 21st century, however, the applicability of IVEs in clinical settings has become much more feasible with the rapid development of consumer-grade headsets that would allow users to experience IVEs in the comfort of their own living rooms, such as the Google Cardboard, Samsung Gear VR, Oculus Rift, and HTC Vive. As of 2016, 2.3 million US households with broadband currently own at least one such headset, and the rate of adoption is expected to increase rapidly (Parks Associates, 2016). The adoption of this novel technology has the potential to transform existing paradigms of human interaction in both mediated and non-mediated environments. The past two decades of research has also demonstrated the potential of IVEs for changing health-related attitudes and behaviors.

REPRESENTING INTERACTIONS IN IMMERSIVE VIRTUAL ENVIRONMENTS WITH AVATARS AND AGENTS

Virtual representations include both people and objects rendered in virtual environments. Representations can vary on both their physical realism, which is how much they appear similar to their manifestation in the real world, and their behavioral realism, or to what extent they act in ways consistent with the real world (Blascovich, 2002). For example, a virtual pizza high in physical realism may look good enough to eat, down to the glisten of grease atop a meaty pepperoni slice. If the pizza suddenly spoke and informed you that you would be consuming 298 calories and 12 grams of fat per slice, however, it would be low in behavioral realism.

Conceptually speaking, any form of representation that symbolizes a person can be considered an avatar, whether digital or not (Ahn et al., 2011). A name, a voice, a photo, or a top hat used in a game of Monopoly: these can all serve as a user's avatar. In digital environments,

an avatar is a representation controlled by a human user. If a representation is controlled by a computer or algorithm, it is an agent. This distinction is an important one; avatars have been shown to be more persuasive than agents (see meta-analysis by Fox, Ahn, Janssen, Yeykelis, Segovia, & Bailenson, 2015). The model of social influence in virtual environments, however, suggests this effect may be moderated by the perceived behavioral realism of virtual representations (Blascovich, 2002). Fox and colleagues (2015) also discovered that who is actually controlling a representation is less important than who people perceive to be controlling the representation. That is, if a user *thinks* another human is controlling a representation, then it is more persuasive—regardless of whether it is actually controlled by a human or a computer. This perception may be important for researchers or clinicians who are trying to persuade users to make health behavior changes, for example. If agents that are programmed to carry out the role of health-care professionals, such as nurses or therapists, are designed to behave just as realistically as their human counterparts, they may become as impactful as humans.

Both avatars and agents frequently manifest in human form within health IVEs. Over time, virtual representations of people have become significantly more complex, rendered in three dimensional forms with an extensive range of dynamic movements, photorealistic appearances, naturalistic language, and even the ability to mimic empathy when interacting with users (Blascovich & Bailenson, 2011). These *virtual humans* are designed to be high in both physical and behavioral realism. Such similarity to real people is conducive to natural interactions in the IVE, such as consulting with a virtual patient or interacting with a virtual fitness coach (Fox, 2012). Virtual humans have been used to impact a wide range of behaviors in the physical world, ranging from health monitoring (Skalski & Tamborini, 2007), helping behavior (Eastwich & Gardner, 2009), and to brand preference (Ahn & Bailenson, 2011; Fox et al., 2014). As Bandura (1977) noted, persuasive messages from interpersonal sources can have a direct impact on self-efficacy; using virtual humans to convey these messages may maximize the impact of health messages because they evoke many of the same or similar feelings as interpersonal interactions.

ADVANTAGES AND DISADVANTAGES OF USING AVATARS AND AGENTS IN HEALTH INTERVENTIONS

Both agents and avatars are viable options for incorporation in health prevention and intervention programs; the choice to use one over the other should be made after careful consideration of the benefits and costs. Avatars that are controlled by humans are likely to have stronger impacts on health behavior change in the physical world than agents that are controlled by machines. Rather than an agent providing a heavily scripted health intervention, an avatar delivering naturalistic interactions is likely to be much more effective in influencing health behaviors. Having an actual person control a virtual human may be useful in a variety of health contexts.

Avatars present many other advantages to health communication, particularly between doctors and patients. On a basic level, avatars allow users to interact with the doctor at a distance via virtual worlds, while minimizing issues or inconveniences of remote communication. For example, communicating via phone, e-mail, or text chat can strip out some nonverbal aspects. Although webcams can be useful, they are limited in that they can only portray the current physical state of the patient. Avatars allow patients to project more information than just their current state by graphically portraying descriptions and occurrences of their symptoms' evolution over time to provide a doctor with more granular details. A doctor could map a patient's history of complaints onto the patient's avatar to get a holistic, head-to-toe view of medical issues. Having all of this

information visible might facilitate diagnoses. This visibility might also be useful for doctors to explain the complex interrelations among the patient's symptoms (e.g., how a person's excess weight is causing back and knee pain) and show how these conditions might change the entire body over time.

Avatars also present users with the opportunity for an experience beyond mere exposure to mediated imagery. Users embody avatars, controlling the movements and interactions of the representation; thus, the avatar becomes a proxy for the physical self in the virtual world (Ahn, Fox, & Bailenson, 2011). As Biocca (1997) noted, during avatar embodiment "the mental model of the user's body (body schema or body image) may be influenced by the mapping of the physical body to the geometry and topology of the virtual body."

Although avatars are more persuasive than agents, there may be situations in which computer-controlled agents are a more viable option. Having human controllers positioned for each and every avatar would be effortful and costly; thus, employing a human controller may be prohibitive in a large-scale program. Although the initial development and setup of the agent might be costly, once the infrastructure is established, agents can continue to work at the same speed and efficiency without the need to eat or rest. These agents may be infinitely replicable, which would allow patients to receive equal and uniform care across all health-care facilities. Relational agents can express appropriate affect and empathy to patients (Bickmore, 2015). Recent research also indicates a potential benefit of using agents over avatars: when interacting with a virtual human during a health screening, participants were more comfortable disclosing to an agent than a human-controlled avatar (Lucas, Gratch, King, & Morency, 2014). For sensitive topics of discussion (e.g., sexual history, substance abuse), patients may prefer to interact with a computer-controlled agent rather than a human-controlled avatar for greater perceived privacy.

Individuals often judge others based on nonverbal cues such as physical appearance or behavior (Rosenberg & McCafferty, 1987; Sigelman, Sigleman, & Fowler, 1987; Todorov et al., 2005). Indeed, people are often drawn to others perceived as similar to themselves (Bailenson et al., 2008; Baumeister, 1998), or simply familiar (e.g., celebrities; Tanner & Maeng, 2012; Zajonc, 2001). Even with the knowledge from these findings, it would be difficult to apply these findings in clinical settings in the physical world because people have limited capacity to manipulate their appearances. In comparison, manipulating the appearance of a virtual human is much simpler: at the click of a button, a virtual human may be transformed into a multitude of permutations, bound only by the software's limitations.

Because virtual humans afford labor- and cost-effective means of adopting almost a limitless option of physical appearances and behaviors, they may flexibly tailor and personalize their appearance and interaction patterns for each respective patient at a fraction of the cost it would take to hire and train health-care professionals (Ahn, 2017). For example, clinicians may interact with patients in virtual worlds and create virtual humans that match the traits of each individual patient, such as ethnicity or gender. Alternatively, the virtual human could take on the physical appearance of a well-known celebrity to deliver health messages, and the perceived familiarity triggered by the virtual human may favorably impact persuasion as demonstrated in earlier studies (Tanner & Maeng, 2012).

One particularly useful form of virtual human that maximizes this flexibility is the virtual doppelgänger that is created with digital photographs of the user so that they bear photorealistic resemblance to the self (Ahn, Fox, & Hahm, 2014; Fox & Bailenson, 2010). Because these virtual humans bear such striking similarities to the self, they lead to novel situations wherein the physical self may view the virtual self as a third person, much like looking into a mirror. The virtual doppelgänger

can be programmed to behave independently of the physical self so that a virtual human that looks like the physical self may be controlled by a third party or an algorithm (Ahn, 2015, in press; Fox & Bailenson, 2009), creating unique situations for persuasion and behavior change wherein the virtual self is used to persuade the physical self (Ahn & Bailenson, 2011; Ahn, Phua, & Shan, 2017).

Another promising form of virtual representation would be an optimal hybrid of avatars and agents that combine the advantages of both forms of virtual humans (Fan, McNeese, & Yen, 2010). For instance, Chase and colleagues (2009) discuss using a hybrid virtual representative that blends the properties of avatars and agents to serve as a teaching agent. If avatars can exert greater social influence on individuals compared to agents as confirmed by our current study, and agents offer greater controllability and are cheaper to operate and manage, hybrids may be able implement the best of both worlds.

The use of avatars and agents allow users to maximize the benefits of the novel features that IVEs have to offer in the context of health interventions. The next few sections will discuss the interplay between these novel IVE features and embodied experiences or interactions with agents in the virtual worlds and the impact they have on health related outcomes. Because desired health behaviors and outcomes can vary widely depending on the relevant health issue, each section will discuss a specific health issue and how IVEs may be applied in the context of that particular issue.

PROMOTING PHYSICAL ACTIVITY

Identification, or feelings of being similar to another, increases the likelihood that an individual will model and follow the behaviors of the entity he or she identifies with (Bandura, 1977, 2001). One known motivator of physical activity is modeling a person with whom they identify with, for instance, parents (Bois, Sarrazin, Brustad, Rouilloud, & Cury, 2005; Brustad, 1996). These findings suggest that creating a virtual human that is sufficiently similar to the users to elicit identification is likely to be successful in encouraging physical activity via modeling.

An earlier study provided empirical support by investigating the use of virtual doppelgängers to promote physical activity (Fox & Bailenson, 2009). In this study, participants were randomly assigned to three groups: one group saw a virtual doppelgänger running on a treadmill in the virtual world, another group saw a virtual human of an unfamiliar person running on a treadmill, and the final group saw a virtual doppelgänger loitering. Twenty-four hours following exposure, participants who saw a virtual doppelgänger running engaged in greater levels of physical activity during the day than those in other conditions. These results suggest that using a virtual doppelgänger is more effective than a generic virtual human in encouraging modeling behaviors, wherein the physical self is persuaded to model and follow the behaviors of the virtual self.

In the past, such studies had to be conducted in a highly controlled laboratory setting because the experimental set up required state-of-the-art digital devices. In the early 21st century, videogame consoles with tracking capabilities have gradually increased the accessibility and affordability of IVE applications that require players to use body movements to progress through the game (Biddiss & Irwin, 2010). Some studies have demonstrated that interacting with virtual humans in these *exergames* results in increased physical activity (Peng & Crouse, 2013) and weight reduction (Staino, Abraham, & Calvert, 2013). Although findings are mixed and the physical activity outcomes of exergames remain small to moderate (Baranowski et al., 2012; Peng, Crouse, & Lin, 2013), they demonstrate the possibilities of health applications within low-grade, commercially available IVEs.

The bulk of studies looking at agents and avatars have investigated the influence of virtual humans, but not all virtual representations

are required to take on human forms. Earlier, a small pilot study tested the feasibility of a desktop computer game of a virtual agent in the shape of a fish, which grew in size and sported different facial expressions depending on whether participants met physical activity goals (Lin et al., 2006). Although formal scientific designs were not incorporated in the study, all fourteen participants expressed engagement in the game over the span of 14 weeks.

More recently, researchers investigated the potential of using a computer agent linked to a physical activity monitor to promote physical activity in children (Ahn et al., 2015; Johnsen et al., 2014). Guided by the framework of social cognitive theory (Bandura, 1977, 2001), the virtual agent was a dog designed to systematically promote physical activity in children through goal setting, vicarious experiences, and positive reinforcement. Children's physical activity was measured with an activity monitor that was synchronized with each virtual dog so that each child was paired with a unique pet displayed on a television screen mounted on a kiosk. The activity monitor worn by each child updated the virtual pet automatically with physical activity data when the child stepped up to the kiosk. As children engaged in physical activity and met more physical activity goals, the virtual dog displayed the health benefits through a leaner appearance, faster response times, and more enthusiastic body movements (e.g., wagging tail, playful gestures). When compared with children in the control group who were given an identical computer system with the same goal-setting and feedback functionalities but without the virtual dog, children who interacted with the virtual dog engaged in approximately 1.09 more hours of physical activity daily than the children in the control group. Interacting with the virtual dog led children to feel confident about their abilities to set and meet physical activity goals, which strengthened their beliefs that physical activity is good for them and subsequently led to an increase in physical activity.

HEALTHY DIETARY CHOICES

Promoting food consumption presents unique challenges in children. When they are given extrinsic, rather than intrinsic, goals for healthy food consumption, children suddenly consider the healthy food item to be less preferable (Birch, Birch, Marlin, & Kramer, 1982). For example, when children were told that crackers would make them healthy, they ate fewer crackers and thought the crackers were less tasty compared to children who were given the same crackers without an extrinsic goal (Maimaran & Fishbach, 2014). This suggests that children may initially increase consumption of healthy foods to obtain extrinsic rewards but fail to continue the healthy behavior because of their decreased preference for the food items.

Taking this challenge into consideration, the virtual dog was tested again in the context of promoting fruit and vegetable consumption in children (Ahn et al., 2016). Using similar goal setting, feedback, and reinforcement features, children between the ages 7 and 13 were randomly assigned to three experimental conditions: virtual dog, computer system with similar features without the virtual dog, and no intervention control. Fruit and vegetable consumption, as well as changes in food preferences for the fruit and vegetable items were assessed over a three day period. Results indicated that children in the virtual dog condition chose to be served significantly more fruit and vegetables than those in the computer only or control conditions. Moreover, food preferences did not differ significantly across the three conditions before and after experimental treatments, suggesting that interacting with the virtual dog may have subverted children's attention on the fact that they were given extrinsic goals to consume healthy food items. Many participants indicated enjoyment regarding their interaction experience with the dog (e.g., "Fun to play with!").

Another novel affordance of avatars and agents within IVEs is that they can be used to

accurately portray past, current, and potential future health conditions. In the virtual world, time becomes a more fluid concept than in the physical world; once created, an agent or an avatar may be digitally manipulated to dynamically shift their appearances. Rather than having to exert cognitive effort to imagine oneself in a specific state, or personally experiencing the negative future health consequence, a user can experience and observe conditions on his or her own virtual body to simulate negative health consequences of unhealthy dietary choices without incurring harm to the physical body. Traditional media, such as static photos or television, are often limited to portraying only "before" and "after" scenarios, whereas the IVEs can be used to dynamically depict incremental levels of change or alternate realities depending on what health choices are made. These affordances allow virtual humans to be more potent and effective models than those used in traditional health behavior change efforts.

Individuals are likely to hold an unrealistic level of optimism in conceptualizing distant future events (Weinstein, 1980). People tend to think of the future as an isolated event, independent of past and present events, and base their forecasts of the future on plans and scenarios of success rather than on accurate past results (Kahneman & Lovallo, 1993). This biased thinking is particularly applicable to future health risks. Because negative health consequences may take some time to manifest following present behaviors, the large temporal distance is likely to encourage unrealistic and inaccurate levels of optimism in thinking about the health issue. For instance, consuming unhealthy snacks today will not immediately lead to weight gain and obesity-related issues the next day; rather, the detrimental effect of unhealthy snacking may require years to manifest. The temporal distance between the cause (unhealthy snacking) and effect (weight gain and obesity-related problems) renders this relationship abstract and opaque, leading individuals to assume an optimistic outlook for their health in the future. Consequently, this positivity bias is one major barrier to successfully communicating health risks and changing present health behaviors. Using agents and avatars in IVEs to digitally render future negative health consequences allows individuals to clearly understand the causal relationship between their present actions as well as the seriousness of the negative consequences to occur in the future.

One early study demonstrated the extent to which participants felt that the simulation of such future negative consequences using avatars in IVEs was vivid and believable. In this study (Fox, Bailenson, & Binney, 2009), participants were exposed to their self avatar eating. Afterward, they responded to some questionnaire items while seated at a computer with a bowl of chocolate candy placed on the table. For participants who experienced *presence* (i.e., they felt the environment was realistic and involving), social facilitation of eating behaviors occurred, wherein men ate more and women ate less in the presence of another person (Harrison, Taylor, & Marske, 2006; Herman, Roth, & Polivy, 2003). That is, the same social eating patterns that are observed in the physical world were replicated when participants encountered a virtual person: high-presence men ate more candy, whereas high-presence women suppressed their appetites.

Another study further explored the underlying mechanisms of virtual doppelgängers demonstrating accelerated passing of time to display the future negative health consequences of soft drink consumption (Ahn, Fox, & Hahm, 2014). Participants were exposed to an IVE showing either virtual doppelgängers or an unfamiliar agent gaining weight as a result of consuming soft drinks regularly for two years, depicted in two minutes in the virtual world. Results indicated that virtual doppelgängers were more effective than unfamiliar agents in increasing the perception of presence (i.e., participants felt as if they were in the virtual world, consuming a soft drink) as well as self-relevant

thoughts. Watching an agent that looks like the self consume soft drinks and become obese made participants feel as if he or she were truly undergoing the experience and encouraged them to think about themselves in the context of soft drink consumption. Heightened presence and self-relevant thoughts, in turn, led to increased personal relevance to the issue of soft drink consumption and obesity.

Building on these preliminary findings, a recent set of studies investigated the effect of agents in eliciting perceptions of risk imminence (i.e., "The health risk could happen very soon") and personal relevance toward the health risk (i.e., "The health risk could happen to me") in the context of soft drink consumption (Ahn, 2015). Findings suggested that when such virtual simulations are coupled with traditional platforms of health communication, such as pamphlets, this combination could yield potent effects that persist over time, even without the use of virtual doppelgängers. Participants who were exposed to health risk information on soft drink consumption through both a pamphlet and an IVE simulation of a virtual agent gaining weight as a result of regularly consuming soft drinks over time exhibited an increase in perceived risk imminence, which led to a reduction in the consumption of soft drinks, one week following exposure to experimental treatments. A follow up study then demonstrated that such virtual simulations led to greater levels of risk perceptions on soft drink consumption than strictly statistical information or static "before" and "after" pictures (Ahn, in press).

IVEs may also be used to simulate and measure eating scenarios. Accurate measurement of food choice and consumption is extremely difficult to obtain in field studies and researchers often rely on self-reports such as food diaries that have often been criticized for inaccuracy and reporting-biases (Cook, Pryer, & Shetty, 2000). Creating eating environments in IVEs allow researchers to observe food selection in a highly controlled environment, while retaining ecological validity by constructing a realistic eating environment. For instance, McBride and colleagues (2013) constructed a virtual buffet where participants could select a variety of food items in varying amounts to place on their virtual plates, following individually tailored nutrition education. Using this experimental setup, researchers were able to accurately gauge the total caloric content of the foods selected without the interference of uncontrolled variables that may have been present if they had conducted the behavioral measure at a buffet in the physical world.

USING IVES FOR THERAPEUTIC INTERVENTIONS

IVEs have also been used to complement traditional counseling and behavioral therapy. Scholars have noted that IVEs present the best of both worlds for therapy because the virtual simulation is perceived as a safer environment where patients can explore new grounds without incurring physical harm, yet retains sufficient experiential realism through vivid sensory information (Perpiña, Botella, & Baños, 2003). In addition, compared to traditional in vivo techniques that expose patients to real life situations, IVEs allow clinicians to control and tailor the exposure to the threat appropriate for each patient.

Virtual reality exposure therapy. One of the most common applications of IVEs is virtual reality exposure therapy (VRET; Parsons & Rizzo, 2008; Powers & Emmelkamp, 2008; Riva, 2005; Rothbaum, Hodges, & Kooper, 1997). Psychiatric researchers realized that IVEs could be used to treat patients who suffer from a specific anxiety or phobia (Opriş, Pintea, García-Palacios, Botella, Szamosközi, & David, 2012; Wiederhold & Bouchard, 2014). In the virtual environment, patients are gradually introduced to the negative stimulus in a virtual setting until they become desensitized or are able to cope with their fear or anxiety. Using IVEs allows the therapist to have maximal control over the introduction and intensity of the fear-inducing stimulus. VRET

has been used to treat a number of fears, including acrophobia, the fear of heights (Coelho, Santos, Silvério, & Silva, 2006); agoraphobia, the fear of open spaces (Botella et al., 2007); fear of animals, such as arachnophobia, the fear of spiders (Cote & Bouchard, 2005); aviophobia, the fear of flying (Rothbaum, Hodges, Smith, Lee, & Price, 2000); and claustrophobia, the fear of enclosed spaces (Botella, Baños, Villa, Perpiñá, & García-Palacios, 2000). Phobia treatments may be particularly useful with sensitive populations for whom in vivo therapy (i.e., in which they experience their source of fear in the physical world) is risky, such as children with autism spectrum disorders (Maskey, Lowry, Rodgers, McConachie, & Parr, 2014). Another notable benefit of VRET is that, when considering treatment, individuals suffering from phobias are far less likely to refuse VR-based therapy compared to in vivo forms of therapy (Garcia-Palacios, Botella, Hoffman, & Fabregat, 2007). The ability to generate realistic virtual humans has also driven the use of virtual reality to address social anxiety and related phobias, such as public speaking anxiety (Harris, Kemmerling, & North, 2002), and social anxiety (Anderson et al., 2013; Roy, Klinger, Legeron, Lauer, Chemin, & Nugues, 2003).

One of the earliest clinical applications of VRET was to treat patients with body dysmorphia and eating disorders (Ferrer-García & Guitiérrez-Maldonado, 2012). Body image disturbances, wherein patients fail to accept their body as their own, lie at the core of many eating disorders, such as anorexia or bulimia (Stice & Shaw, 2002). This disturbance arises from the disconnect between the body image that the patients appraise and perceive of their body, and their actual physical appearance. Traditional therapy struggles to counter such cognitive biases, because the biased processing of information occurs almost automatically and as a result is real for patients (Williamson, 1990). Attempts to convince patients that their judgment of their body is biased are likely to produce strong psychological reactance (Dillard & Shen, 2005; Vitousek, Watson, & Wilson, 1998). Avatars and agents in IVEs allow patients to have complete control of their virtual body while clinicians guide them toward closing the gap between their perceived, virtual, and physical bodies (Perpiña, Botella, & Baños, 2002). Through creating and interacting with their avatars, patients are also able to view their body consciously as a third person. One study found that adding an IVE component to traditional behavioral treatments for body image disturbances better improved patient outcomes in their attitudes, thoughts, emotions, and behavior related to their body and physical appearance than the traditional behavioral treatment alone, both at post-treatment and at a one-year follow-up (Marco, Perpiña, & Botella, 2013).

IVEs are also being actively tested as a therapy tool to complement traditional counseling and behavioral therapy for eating disorders. Scholars have noted that IVEs present the best of both worlds for therapy because the virtual simulation is perceived as a "safe" environment where patients can confidently explore new grounds without incurring physical harm, yet retains sufficient experiential realism through vivid sensory information (Perpiña, Botella, & Baños, 2003; Riva, 2005). A randomized controlled trial of morbidly obese patients who underwent IVE treatment in addition to traditional treatments based on cognitive-behavioral approaches yielded greater likelihood of maintenance of the results of treatment at the 12-month follow-up, compared to patients who did not receive the IVE component (Cesa et al., 2013).

Due to the nascence of the field, and the complexity of the problem, further research is still needed to develop a standardized form of treatment that incorporates virtual experiences as a part of the formal treatment process for eating disorders and body image disturbances. Riva and his team have made substantial contributions to this effort by creating a protocol for body image rescripting, which includes 14 one-hour sessions led by a therapist

(Riva, Gaggioli, & Dakanalis, 2013) to present patients with a comprehensive treatment plan that includes therapist-guided virtual simulations of critical situations that patients can experience from both a first-person and a third-person perspective. This encouraged patients to interpret and discuss their problems from both subjective and objective standpoints.

VRET has also been employed in the treatment of post-traumatic stress disorder (PTSD; McLay et al., 2014; Rothbaum, Ruef, Litz, Han, & Hodges, 2003; Rizzo, Rger, Gahm, Difede, & Rothbaum, 2009). For example, in the treatment of combat-related PTSD, VEs are used to simulate battle environments, including the sights (e.g., jungle clearings, desert scenes, or inside helicopters), sounds (including gunfire, bombs, planes, others' voices), and even haptic experiences (such as vibrations from an explosion). Veterans are gradually exposed to more vivid and stressful cues in the virtual environment over time, which can be used to facilitate desensitization or to evoke suppressed memories. Coping mechanisms can be practiced during or following the experience. In this way, veterans can learn to manage stressful triggers, such as loud noises, in the safety of a clinical setting. A meta-analysis of VRET also revealed another possible advantage, finding that veterans in treatment for PTSD seem less resistant to VRET compared to other forms of therapy (Gonçalves, Pedrozo, Coutinho, Figueira, & Ventura, 2012).

Another area of treatment that virtual environments researchers are currently exploring is addiction. Virtual reality has been used to test how relevant cues stimulate cravings for substances such as alcohol and tobacco (Baumann & Sayette, 2006; Cho et al., 2008). Cognitive behavioral therapy techniques are then incorporated alongside the cue exposure therapy so that individuals learn to cope with their cravings in a variety of contexts to maximize self-efficacy. These cue exposure techniques have been used to address problematic behaviors such as smoking (Pericot-Valverde, Secades-Villa, Gutiérrez-Maldonado, & García-Rodríguez, 2014) and gambling (Giroux, Faucher-Gravel, St-Hilaire, Boudreault, Jacques, & Bouchard, 2013).

PHYSICAL THERAPY, REHABILITATION, AND APPLICATIONS

Another increasingly common application is the use of virtual reality therapy in physical rehabilitation (Riva, 2014; Schultheis & Rizzo, 2001; Sveistrup et al., 2003; Weiss, Keshner, & Levin, 2014). Virtual environments have two features that uniquely facilitate physical rehabilitation: the ability to capture and review one's physical behavior three-dimensionally, thus enabling examination of one's progress and failures and the ability to see one's own avatar rendered in real time from a third-person point of view (Bailenson, Patel, Nielsen, Bajscy, Jung, & Kurillo, 2008). Additionally, virtual environments can be used to safely re-create real environments that might be challenges for those who have suffered an injury (e.g., crossing a busy intersection). VEs have been used to help stroke victims regain a sense of balance while walking (Deutsch & Mirelman, 2007) and help children with cerebral palsy develop muscular coordination (Bryanton, Bossé, Brien, McLean, McCormick, & Sveistrup, 2006).

Avatars and agents may provide assistance to populations with various disabilities who need rehabilitation work but find it difficult to regularly visit clinical settings. Preliminary evidence points to the potential of using IVE or videogame systems to aid rehabilitation programs, for example, patients recovering after knee surgery (Lee et al., 2016) and stroke patients (Corbetta, Imeri, & Gatti, 2015). Although these studies are preliminary, scholars commend the ease of use with virtual environments that allow patients to engage in highly repetitive rehabilitation sessions in the comfort of their own homes without the burden of personal trainers. Furthermore, Corbetta, Imeri, and Gatti (2015) note that because virtual environments mimic physical

interactions better than more traditional media channels, they are more effective in encouraging rehabilitation exercises than television or video format training.

TREATMENT FOR AUTISTIC SPECTRUM DISORDERS

Because IVEs are able to reproduce sensory-rich experiences, individuals likely expend less cognitive energy to construct mental imageries during a virtual experience. This digital assistance in mental imagery construction would be helpful in instances where individuals lack the schema to base their mental imagery on. For example, earlier research suggested that participants who are inherently less likely to engage in mentally taking the perspective of another person may receive greater assistance in understanding the other person by virtually experiencing that person's perspective through IVEs than participants who are inherently more likely to engage in perspective taking (Ahn, Le, & Bailenson, 2013).

Similarly, scholars and practitioners who work with individuals on the autism spectrum disorder have begun to test IVE experiences that may help their patients (Irish, 2013; Lorenzo, Pomares, & Lledó, 2013). Exposure to virtual experiences is particularly relevant for these individuals because difficulty in taking the perspective of another person and using imagination to construct mental imageries are major characteristics of individuals with autistic spectrum disorders (Jordan, 2003; Wing & Gould, 1979). Because IVEs allow individuals to "step into the shoes" of another person through avatar embodiment from the first-person perspective, so that he or she may see, hear, and feel as the other person would, this offers a wide range of training and therapeutic opportunities to hone social cognitive skills, such as reading social cues or understanding different perspectives (Ahn et al., 2013). The fact that social situations constructed in IVEs may be repeated an infinite number of times for the patient without incurring training and personnel costs is another advantage for clinicians. In addition, the virtual environment is a safe place for patients to experiment and readjust their responses, allowing patients to be bolder in their level of engagement and exploration in IVEs than in real life situations (Standen & Brown, 2005).

A growing number of small-scale pilot studies confirm IVEs' potential as a cost- and labor-effective tool for training social skills in individuals with autistic spectrum disorders in both children (Herrera et al., 2008; Ke & Im, 2013; Lorenzo et al., 2016) and high-functioning adults (Kandalaft et al., 2013; Parsons & Mitchell, 2002). A pilot study also demonstrated potential long-term benefits of IVE training by showing that participants with high-functioning autistic spectrum disorder who received job interview training via virtual simulations secured more competitive job positions six months following treatment than participants who did not receive this training (Smith et al., 2015).

IVES AS HEALTH TEACHING AND TRAINING ENVIRONMENTS

Due to their high levels of realism and interactivity, IVEs have been incorporated in medical training for many years (Mantovani, Castelnuovo, Gaggioli, & Riva, 2003; Riva, 2014). Virtual three-dimensional models of the human body have become popular interactive tools for teaching medical students, nurses, and doctors elements of anatomy and physiology. Rather than put patients at risk, medical students and doctors can practice new techniques using virtual environments (de Ribaupierre, Kapralos, Haji, Stroulia, Dubrowski, & Eagleson, 2014; Riva, 2014). Not only are IVEs safer, they can also be used to simulate challenging conditions that are infrequently encountered in regular practice: the surgeon is then prepared for even the rarest complexities.

IVEs have also been used to teach medical personnel communication and decision-

making skills. Traditional training techniques often involved actors and physical setups, which can be inconvenient or limiting. Several IVEs have been built for practitioners to develop and practice patient-provider interaction skills with diverse populations (Johnsen et al., 2006; Kenny, Rizzo, Parsons, Gratch, & Swartout, 2007). IVEs are capable of rendering a wide variety of scenarios and contexts to practice efficient decision making in highly stressful situations, including complex injuries; triage in an overflowing ER; and on-site management at a large-scale disaster, like a highway pileup (de Leo et al., 2003; Freeman, Thompson, Allely, Sobel, & Stansfield, 2000).

IVEs may also be a helpful tool in educating the public about abstract scientific concepts (Persky & McBride, 2009). For example, Kaphingst and colleagues (2009) created an educational virtual world where participants learned about genomic concepts such as preventative steps for increased genetic risk for health problems or diseases. To learn these concepts, participants could either actively search for the knowledge or passively listen to a lecture on genomic concepts. Interestingly, although participants who were active in the IVE simulation were more motivated to engage in learning, comprehension of the information provided was higher for participants who passively listened to the lecture. Although this was a small-scale pilot study, these findings suggest that interactivity in IVEs may not always lead to positive outcomes in the education context.

DISCUSSION OF THE LITERATURE

By producing simulations that closely mimic non-mediated sensory experiences, IVEs offer novel opportunities for health researchers and practitioners. Although IVEs may not completely replace current treatment regimens, these highly immersive and interactive platforms have the potential to complement and enhance traditional health intervention programs. Embodying avatars and interacting with computer agents, patients are able to freely experiment with a variety of simulated scenarios that are sufficiently real, without incurring social and physical costs. Traditional in vivo treatments are often rejected by patients because they can be overbearing; however, patients may explore virtual environments at their own pace, while still comforted by the fact that they are physically located at the clinician's office. The confidence that patients gain within a virtual world is likely to facilitate the progress of treatment.

Because the physical and behavioral characteristics of virtual humans can be easily manipulated, virtual doppelgängers may be created to create simulations wherein the virtual self is employed to persuade the physical self. The simulations can be a straightforward replica of a real world event or a fantastical situation, which transcends the temporal and spatial boundaries of the physical world. Because time and space are relatively fluid concepts in the virtual space, negative future health consequences may be vividly depicted on the self's virtual doppelgänger to demonstrate that health risks are personally relevant and can be imminent. Not only can these simulations be minutely tailored to meet each individual user's needs, but patients can also repeat the simulations infinitely without expending further resources. Optimally, patients should be actively involved in the creation of the simulations to maximize the benefits of hyper-tailored health interventions using IVEs.

Furthermore, patients are able to enter these simulations from the first-person perspective and step into the virtual shoes of another person, seeing, hearing, and feeling as that person would. The sensory-rich experience that mimics direct experiences yields greater impact on attitudes and behaviors than indirect experiences (e.g., print message, mental imagery) and presents the potential of IVEs in treating mental impairments that make it difficult for patients to understand others' perspectives. The enhanced ability to take the

perspective of another person through IVEs would also be useful in training healthy persons to better understand and empathize with the problems and issues that patients go through on a daily basis.

Based on such novel features, a growing number of studies point to the utility of IVEs in a variety of health contexts for both children and adults, including the promotion of physical activity, healthy food choices, exposure therapy, physical therapy for rehabilitation, and autistic spectrum disorder. Although the findings are mostly preliminary and the generalizability of the findings is limited at this point, these are efforts to supplement current health practices with creative approaches to treat and maintain individual health. In addition, much work needs to be done to develop appropriate content to match the rapid development of consumer-grade IVE systems. Nevertheless, IVE technologies are advancing at an unprecedented speed, and we may soon witness virtual experiences and interactions with avatars and agents becoming a new norm of clinical treatments.

Although IVEs offer many advantages for health researchers and practitioners, like any method, they have drawbacks. First, despite rapidly decreasing costs of IVE systems and the media attention on the development of affordable and accessible consumer-grade IVE devices, quality virtual content can take considerable financial and human resources to design, develop, and implement. As with any other communication platform, a sophisticated device (hardware) would be meaningless without access to appropriate content (software). Thus, a clinician or health practitioners may be unpleasantly surprised to find that purchasing the state-of-the-art IVE device may be as useful as a computer without any software installed on it.

Researchers and clinicians must also keep in mind that individual use in the home or other uncontrolled environments are likely to feature any number of contextual issues, from spatial constraints to limited system processing to distractions. It is possible that these factors constrain or interfere with users' experiences, thus limiting users' attention, immersion, or perceptions of realism within the IVE. Very few research studies have examined whether treatments that have been effective in controlled virtual reality lab environments are as effective with lower-quality versions or in natural or uncontrolled settings.

Second, developing an effective IVE simulation requires specific expertise. One downside to the rapid diffusion of technologies and lowered barriers of adoption is that many people assume that simply having ideas for content and then hiring programmers who can generate the content is sufficient. Researchers and practitioners rarely consider the necessity of hiring experts in usability and user experience (UX) design in addition to programmers. Given the complexity of IVEs, this is an essential developmental role. Another error is that users themselves are conspicuously missing from the design process. Researchers map out content, have someone build said content, and then test said content without involving users earlier in the process. As a result, many health-oriented apps and video games are poorly designed, and low-quality IVE simulations are similarly inevitable. It is important for practitioners to assess potential users' needs and requirements, develop multiple alternatives, generate prototypes, and evaluate these prototypes before the first line of code is even written. User-centered and evidence-centered design is necessary for virtual applications to be engaging and effective.

Third, like most technologies, IVEs have some accessibility issues that may limit the individuals who can use certain setups. Currently, most virtual experiences heavily rely on visual stimuli. Those with vision difficulties or impairments, such as colorblindness or blurred vision, may have difficulties. Stereoblindness is a vision issue that is often undetected but may have a significant impact on whether or not a user perceives a virtual environment as three dimensional. Some studies indicate that

even users with healthy vision may experience visual fatigue if immersed too long.

Another problem is *cybersickness* or simulator sickness. Some users, particularly those susceptible to light-based stimuli, may experience dizziness, light-headedness, and nausea after spending time in VEs, particularly if they are fully immersive (Keshavarz, Hecht, & Lawson, 2014). Several studies have demonstrated that beyond individual sensitivities (e.g., susceptibility to motion sickness, history of migraines), the type of technology, its level of sophistication, and the time spent immersed may also play a role in whether users experience cybersickness while immersed (Keshavarz et al., 2014; Stanney, Hale, Nahmens, & Kennedy, 2003). For example, *lag*, or the time delay between the user's actual motions and the updating of the visual scene, may cause illness in VR users. One longitudinal study, however, has demonstrated that cybersickness tends to decrease over time as participants become more familiar with the experience of immersion (Bailenson & Yee, 2006).

Finally, the findings from many of the studies reported in this chapter should be interpreted with caution for several reasons. The bulk of the research on IVEs, avatars, and agents present preliminary data with small sample sizes using convenience samples, tested in a highly controlled environment. Many IVE studies also lack sound methodological practices, such as randomization, blind assessment, and true controls (McCann et al., 2014). Furthermore, few studies have assessed limited longitudinal effects, so there is little known about the change in effects over time or following repeated exposure. Also, partly due to the nascence of the field, replication efforts both within and across reported studies are difficult to find. Thus, despite the promise and potential that IVEs hold for the future of health campaigns and treatments, further research and development will be imperative in the development of effective communication strategies and treatment plans that incorporate IVEs. Ethical issues are underexplored as well, despite potential problems that could arise with the blurred boundary between the virtual and the physical identities, when both may either look or behave in similar ways.

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Sun Joo Ahn and Jesse Fox

INOCULATION THEORY APPLIED IN HEALTH AND RISK MESSAGING

THE ORIGINS OF INOCULATION THEORY

Although it traces its origin to ancient Greek rhetoric, inoculation theory scholars attribute the inspiration for the theory to the seminal work of Lumsdaine and Janis (1953) on two-sided messages (see Ivanov, 2012; Pfau, 1992) and the "unanticipated finding" (Pfau, 1992, p. 27) evidencing the effectiveness of these messages in conferring resistance to subsequent attitudinal challenges. Lumsdaine and Janis attributed the success of two-sided messages, which present arguments from both sides of the issue, to their inoculating function as suggested in the authors' report:

> But if the initial communication is, instead, a two-sided one it will already have taken into account both the positive and negative arguments and still reached the positive conclusion. When the listener is then subsequently exposed to the presentation of opposing arguments in the counterpropaganda, he is less likely to be influenced by them. He is not only familiar with the opposing point of view, but has been led to the positive conclusion in a context in which the negative arguments were in evidence. In effect, he has been given an advance basis for ignoring or discounting the opposing communication and, thus "**inoculated**", he will tend to retain the positive conclusion.
> (p. 318, bold added for emphasis)

Indeed, it is the *inoculating* function of two-sided messages that inspired McGuire to propose the original core mechanisms of the theory (McGuire, 1964). His work has stimulated five and a half decades of vigorous

programmatic research on inoculation-elicited resistance (Compton, 2013). During that time, the original theoretical mechanisms—threat and counterarguing—proposed by McGuire (1964) as responsible for the generated resistance process have been tested (e.g., Ivanov, Pfau, & Parker, 2009b), challenged (e.g., Banas & Rains, 2010), nuanced (e.g., Miller et al., 2013), and complemented (e.g., Pfau et al., 2003).

In addition, inoculation theory, "the grandparent theory of resistance to attitude change" (Eagly & Chaiken, 1993, p. 561), has been applied to numerous communication contexts including commercial (e.g., Ivanov, Pfau, & Parker, 2009c; Pfau, 1992), instruction/education (e.g., Compton & Pfau, 2008), interpersonal (e.g., Sutton, 2011), political (e.g., Compton & Ivanov, 2013), corporate (e.g., Dillingham & Ivanov, 2015); public relations (e.g., Wan & Pfau, 2004), cross-cultural (e.g., Ivanov, Parker, Miller, & Pfau, 2012b), health (e.g., Parker, Ivanov, & Compton, 2012) and risk (e.g., Ivanov et al., 2016). Each of these efforts, both theoretical and contextual, has contributed to our understanding of the resistance-based processes unleashed by inoculation, which, in turn, has enriched our knowledge base relied upon in designing effective inoculation-based message strategies.

This chapter first discusses inoculation's boundaries and the theory's original mechanisms, testing, and logic as offered by its original author, William McGuire. It then addresses additional complementing and/or competing variables associated with the inoculation-based process(es) of resistance derived from four decades of inoculation research since McGuire's original work. The theoretical discussion is followed by brief summaries of the theory's application into several communication contexts. Consistent with the topics in this volume, the primary contextual focus is on the design and processing of effective inoculation messages applicable in health and risk communication situations. In addition to summarizing the inoculation work in these areas, through an example, this chapter provides a recommendation on how to design an effective inoculation message. Although the example will be specific to the context of health and risk communication, it is nevertheless applicable in any context consistent with the theory's message efficacy. The chapter concludes with a brief discussion about inoculation's future after considering some of its limitations.

BOUNDARY CONDITIONS

Like most theories, inoculation is not without boundary conditions. Some of these are theoretical (e.g., initial attitude) while others are practical (e.g., involvement). Furthermore, some hold multiple roles in the inoculation process (e.g., involvement as boundary condition, moderator, and mediator). This chapter focuses on the most relevant boundary conditions of the theory: initial attitudes, involvement, and cross-protection (blanket or umbrella protection).

Initial Attitudes. Consistent with the medical (or biological) inoculation analogy, McGuire believed that inoculation should be used to protect healthy (previously unchallenged) beliefs (1964). Medical (or biological) inoculations are used to *protect* healthy individuals from succumbing to a viral infection. As Ivanov and colleagues pointed out, "McGuire's (1964) use of the biological analogy was not merely stylistic, it was explanatory" (Ivanov et al., 2015, p. 220). As such, attitudinal inoculation should be used to *protect* individuals with healthy (or established) attitudes from succumbing to a counter-attitudinal challenge. Thus, the boundary condition here-imposed by the medical (or biological) analogy suggests that the attitude in place must be *healthy* (already established) for inoculation to be an appropriate strategy. Consequently, the application of inoculation is theoretically (or analogically) limited to *protecting* already-established attitudes (beliefs, behaviors, values, etc.). That is not to suggest that this strategy

is ineffective as an approach to change or shape attitudes. In fact, studies have shown that inoculation messages can have a desired effect when used for individuals with neutral and opposed (or *unhealthy*) attitudes as well (Ivanov et al., 2017; Wood, 2007). However, in such cases, inoculation simply functions as a two-sided attitude *formation* or attitude *change* persuasive strategy, rather than as a preemptive attitude *protection* resistance strategy (Ivanov et al., 2017). If rigidly bound to the medical (or biological) analogy, inoculation is a preemptive attitude protection strategy, which requires that the attitude is established before it can be protected.

Involvement. Pfau and colleagues believed that "involvement holds the key to inoculation's terrain" (1997, p. 210). In their study, these authors discovered that inoculation works best with moderately-involving issues. They reasoned that low-involving issues would fail to generate a threat—the requisite component of inoculation (Compton & Pfau, 2005)—because people will not care enough about these issues to be properly motivated to protect them. On the other hand, highly-involving issues should be so important to the individuals that they would not necessitate additional motivation. Given the high importance of the issue, these individuals have prior (or inherent) motivation to defend the issue and likely have already prepared their defenses in anticipation of attitudinal challenge. Thus, according to Pfau and colleagues (1997), inoculation would have the greatest contribution to resistance with moderately-involving issues. However, although the results of Banas and Rains' (2010) meta-analysis showed patterns consistent with Pfau et al.'s findings, the results were not statistically significant; thus no curvilinear relationship for involvement was detected. Banas and Rains speculated that their findings could be influenced by a lack of power associated with the test performed. Alternatively, they suggested, the lack of significant findings could be the result of how involvement has been operationalized in previous inoculation studies, which mainly has consisted of embedding involvement in the topic rather than experimentally manipulating it in the messages. As a result, the notion that issue involvement creates a boundary condition for inoculation has to be considered with reservation.

Cross-Protection. One of inoculation's main advantages, further discussed in the next section, is the ability to motivate individuals to defend their attitudes (McGuire, 1964). The motivation ensures that individuals do not solely rely on the content of the inoculation message for protection against forthcoming attitudinal challenges. Instead, motivated individuals go a step further by identifying new challenges they proceed to refute and by increasing their ability, via counter-attitudinal practice, to defend against challenges not previously encountered. Stated differently, inoculation forms an umbrella (or blanket) of protection against all arguments within an issue domain (Banas & Rains, 2010; Compton & Pfau, 2005; McGuire, 1964).

Recently, however, Parker and colleagues (2012, 2016) argued that the umbrella (or blanket) of protection may span much wider than originally thought. The authors suggested that inoculation used to protect a single attitude may provide cross-protection for different but related attitudes, as well. The support for their prediction comes from the use of vaccinations in medical settings where a vaccine used to generate protection against one virus can create protection against multiple viruses (Clemens et al., 1988). The results of a few recent studies provided early support for this prediction (Ivanov et al., 2015; Parker et al., 2012; Parker, Rains, & Ivanov, 2016), thus extending the boundaries of the theory.

This section of the chapter identified the terrain in which inoculation operates. The next section focuses on the mechanisms that drive the inoculation-elicited process of resistance.

ORIGINAL MECHANISMS, PROCESSES, TESTING, AND LOGIC

The inspirational work of Lumsdaine and Janis (1953) demonstrated that two-sided messages can be effective in protecting attitudinal slippage against subsequent counter-attitudinal challenges. However, the mechanisms responsible for the effectiveness of the inoculating message, as proposed by these authors, significantly differed from that of McGuire. Lumsdaine and Janis attributed the success of the two-sided messages in part to the credibility of the source as two-sided message recipients "may be more impressed by the communication and less inclined to distrust the arguments as coming from a biased source if the communicator makes it clear that he has taken the negative arguments into account" (p. 317). In addition, by attributing the fortification of the attitude to careful message scrutiny and deliberation in which the pro-attitudinal arguments have outperformed the counter-attitudinal ones (Petty & Cacioppo, 1986), Lumsdaine and Janis suggested that prior encounters with the counter-attitudinal challenges would lead to "ignoring or discounting the opposing communication" (p. 318). As such, while Lumsdaine and Janis suggested that the message elicits careful content processing in the attitude fortification stage, they also suggested a more heuristic defense process that relied on discounting or ignoring, rather than engaging, the assailing attitudinal challenges.

McGuire (1961, 1964, 1970), conversely, suspected that the defense process of inoculated individuals is much more active than suggested by Lumsdaine and Janis (1953). For an answer regarding the process of attitudinal inoculation-based resistance, he turned to the medical analogy derived from human immunization. McGuire reasoned that the same way healthy people are inoculated from viruses, individuals with established attitudes (beliefs, values, opinions, intentions, behaviors, etc.; henceforth, for convenience, referred to as attitudes) could be inoculated from forthcoming attitudinal challenges. More specifically, just as the introduction of a weakened form of a virus shocks the body into producing antibodies capable of fighting off the viral agent when encountered, McGuire believed that a weakened from of counter-attitudinal arguments can provide a "shock value" (1961, p. 185) in the form of realization that the attitude in place is indeed vulnerable. The shock should motivate the individual to shore up the attitude in place and thus render the individual better prepared and more resistant to forthcoming challenges. An important key to the process was the introduction of weakened counter-attitudinal arguments; but how weak should they be? Drawing again from the medical (or biological) analogy, he reasoned that, akin to vaccines, the arguments needed to be strong enough to provide a shock to the system, but not so strong as to overwhelm it. As a result, McGuire's "use of the biological analogy was not merely stylistic, it was explanatory" (Ivanov et al., 2015, p. 220; but also Compton, 2013; Compton & Pfau, 2005).

McGuire (1961, 1964, 1970), McGuire and Papageorgis (1962), and Papageorgis and McGuire (1961) identified two key mechanisms that are responsible for the effectiveness of inoculation messages: threat and counterarguing. Threat, as McGuire (1964) believed, provides the motivation for individuals to defend their attitudes. The defense process consists of individuals enhancing their ability to counterargue conflicting viewpoints through counterarguing practice. This counterarguing practice, according to McGuire (1964), is motivated by threat, supported by the material (content) presented in the inoculation message, and aided by the exemplification of an effective counterarguing exercise offered in the message. Thus, in short, inoculation elicits threat, which motivates counterarguing, which in turn generates greater attitudinal resistance.

Threat. In McGuire's work, threat—the shock value of the message—was generated by presenting individuals with weakened counter-arguments displaying the potential vulnerability of the attitude. Hence, threat represented a realization of attitudinal vulnerability (Compton & Pfau, 2005). In McGuire's (e.g., McGuire, 1961) initial work, threat was ostensibly generated simply due to the presentation of weakened counter-attitudinal arguments. McGuire termed this implicitly generated shock value as "inherent threat" (McGuire, 1970, p. 63). In his subsequent work (e.g., McGuire & Papageorgis, 1962), he introduced an explicit form of threat as well by using a forewarning in the message. The forewarning, rather explicitly, instructed individuals that their attitudes were vulnerable to forthcoming challenges. Consequently, the combination of explicit and implicit (or inherent) threat, McGuire believed, was responsible for unlocking defense motivation in the individual, which was pivotal in inspiring defense building and practice. As such, McGuire believed that threat is a "requisite construct within the process of inoculation" (Miller et al., 2013, p. 128; but also see Compton & Pfau, 2005). More contemporary inoculation scholars agree with McGuire's assessment of threat's importance in inoculation-based resistance (Compton, 2013; Compton & Pfau, 2005; Ivanov et al., 2012b; Miller et al., 2013; Pfau, 1995); this sentiment was punctuated by Pfau's assertion that threat is "the most distinguished feature of inoculation" (1997, p. 137).

Without threat, the effect of inoculation would be limited to the one prescribed by Lumsdaine and Janis (1953). To remind, these authors believed that the inoculating success of two-sided messages rests, in part, with the familiarity of the forthcoming counter-attitudinal arguments, due to their prior encounter in the two-sided message. In that context, the individual would be more likely to ignore or discount the assailing challenge as one that has already been dealt with and overcome. Thus, the effectiveness of inoculation messages would be limited to scenarios in which the individual faces the *same* counter-attitudinal arguments previously encountered. However, the effect would be much less pronounced, if at all present, when the counter-attitudinal arguments are *novel* i.e., have not been faced before. McGuire (1964) argued that threat motivates individuals to shore up their defenses and not only rely on the counter-attitudinal arguments previously encountered in the inoculation message. To show that inoculation's threat-generated motivation, rather than content, is primarily responsible for the effectiveness of inoculation messages, McGuire (1964) rendered inoculated individuals to either the same counter-attitudinal challenges encountered in the inoculation message or a set of different ones. His general findings and conclusions, supported by a recent meta-analysis (Banas & Rains, 2010), confirmed McGuire's suspicion as no appreciable difference in the effectiveness of inoculation was discovered based on whether attacks featured the *same* or *novel* content. Thus, it seems, the motivation generated by threat, rather than the content of the inoculation message, is largely responsible for the effectiveness of inoculation. This finding has practical significance as well because it suggests that in order to use inoculation messages, one does not have to counter all possible arguments on the issue at hand because inoculation creates an umbrella protection that is capable of "safeguarding against both those counterarguments addressed . . . [by the inoculation message] . . . and those not addressed" (Pfau, 1995, p. 101; also see Banas & Rains, 2010).

Yet, in spite of its ascribed importance, threat remained a primitive construct until the late 1970s when a scale to directly measure threat was developed (Burgoon, Cohen, Miller, & Montgomery, 1978). Numerous subsequent inoculation studies have confirmed the role of threat in the process of resistance (e.g., Ivanov et al., 2012b; Miller et al., 2013; Pfau

et al., 2004); however, a recent meta-analysis by Banas and Rains (2010) failed to validate these findings even though the results were in the expected direction. The authors speculated that low power of the test might be responsible for the results. Another possible reason for this inconsistency may be tied to the measure used to assess the presence of threat. A closer examination of previous inoculation studies assessing threat suggests a limited range of threat scores clustered around the midpoint (Compton, 2013). The question inoculation scholars are presently attempting to answer is whether this result is an artifact of the measure (i.e., lack of sensitivity) or the ability of scholars to enhance the level of generated threat. For example, Pfau and colleagues (2010) incorporated components of vested interest (Crano & Prislin, 1995) in their attempt to portray the threat as more "personally relevant" (p. 4). Their attempt was not successful as their enhanced threat manipulation (M = 3.39) was statistically undifferentiated from the regular threat manipulation (M = 3.41) on a seven-point scale. Based on an earlier work by Burgoon and colleagues (1976), Ivanov and colleagues (2013b) manipulated threat by varying the certainty with which the attack is likely to occur. Although the authors had some manipulation success, they were still unable to raise the level of threat beyond the midpoint on a seven-point scale (highest M = 3.88). Finally, Miller and colleagues (2013), borrowing from the theory of psychological reactance (Brehm, 1966), manipulated threat as a restriction to the freedom of individuals to hold the desired attitudes. Although the study was successful in manipulating threat, the highest level of generated threat did not reach the midpoint mark (M = 3.88) on the seven-point traditional scale.

Threat may indeed be a requisite for inoculation-based resistance (Compton & Pfau, 2005; but see Banas & Rains, 2010); however, scholars have much work to do to better understand how to significantly manipulate and better assess this variable. If threat motivates defense preparation (Compton, 2009; Ivanov et al., 2009b; McGuire, 1964), then enhancing threat may be an important factor in eliciting significant motivation.

Yet, the relationship between threat and motivation in the inoculation-elicited resistance is theoretical. The notion that enhanced threat leads to greater motivation is assumed, but unconfirmed. For example, Compton and Ivanov acknowledged this limitation in their study suggesting the "assumption is that threat . . . elicits motivation to engage in resistance processes, such as counterarguing . . .; however, [they] did not measure motivation in this study" (2012, p. 11). Thus, even though motivation seems to be identified as a key mediator of generated resistance, motivation has never been explicitly established nor incorporated into the inoculation model. Its presence has been inferred by inoculation scholars as being elicited by threat and contributing to defense bolstering. For example, McGuire suggested that "any extrinsic *threat* . . . *should increase* . . . *motivation* to assimilate the material and hence enhance its immunizing effectiveness." (McGuire, 1964, p. 210, italics added for emphasis). Compton added that ". . . *both inherent and explicit threat affects motivation* to attend to the information presented in inoculation messages" (Compton, 2009, italics added for emphasis). Ivanov and colleagues stated that "the *threat* element *warns* the individual *about the vulnerability* of the attitude currently in place. This realized *vulnerability acts as a motivator* for the individual to seek out information that would strengthen his or her current attitude" (Ivanov et al., 2009b, p. 48, italics added for emphasis). Thus, motivation is implicitly assumed to be the catalyst for defense bolstering, but could motivation be generated independent of threat? How much of the variance in motivation is explained by threat compared to other mechanisms (e.g., anger, involvement, etc.)?

Threat continues to be a focal point in inoculation research (see Compton, 2013). However, much more remains to be learned

about this variable and its interaction with motivation and other components of the inoculation-based process of resistance.

Counterarguing. The second original mechanism of inoculation-elicited resistance, according to McGuire (1964), is counterarguing. Consistent with the biological analogy, counterarguing against opposing counterattitudinal challenges is analogous to a human body fending off a viral infection by producing antibodies. Compton defines this concept as a process that includes "the collective generation of counterarguments and refutations, [and] post-inoculation pretreatments" (2013, p. 222). McGuire believed that inoculation messages generate threat, which in turn motivates the process of defense bolstering, which he believed to be in the form of counterarguing. As such, McGuire's vision of inoculation differs from that of Lumsdaine and Janis (1953). McGuire, believed that motivated counterarguing of opposing viewpoints is the mediating process of inoculation resistance, rather than the discounting or ignoring of opposing arguments or viewpoints. This process, according to inoculation scholars (e.g., Pfau et al., 2004), was generally assumed to be an *intra*personal or internal "subvocal, psychological process" (Brandt, 1979, p. 324). However, more recent work has suggested that the process of counterarguing may also be *inter*personal as inoculated individuals may turn to others within their social networks, seeking attitudinal reassurance or practicing attitudinal advocacy (Compton & Pfau, 2004, 2009; Ivanov et al., 2012a, 2015).

Unlike threat, which remained as a primitive term in McGuire's studies, counterarguing received a single assessment as participants were asked to list all of the arguments that came to mind in favor of the belief (see Papageorgis & McGuire, 1961). The quality of the arguments were subsequently rated by a trained outside professional; however, no differences were discovered between the inoculation and control groups, thus failing to confirm the process of inoculation as envisioned by McGuire. Smith suggested that "McGuire provided no evidence that his motivational and informational pretreatments . . . increased the ability and willingness of people to counterargue persuasive attacks" (1982, pp. 294–295). Compton and Pfau (2005) also conceded that the evidence on counterarguing was not as definitive, which is consistent with studies discovering inoculation-generated resistance in absence of significant counterarguing effect (e.g., Compton & Ivanov, 2012). Ivanov, Parker, and Dillingham attributed the equivocality of the findings, at least in part, to the methods used to capture counterarguing (2013a). After pointing out the strengths and weaknesses of several techniques used in measuring counterarguing, the authors suggested using a combination of measures to capture counterarguing by pointing to successful studies that have applied this approach (Banas & Bessarabova, 2009; Miller et al., 2013).

While, as suggested by Compton and Pfau (2005), the evidence may not be definitive, that is not to suggest that evidence of counterarguing mediating the inoculation process or resistance is lacking (e.g., Pfau et al., 2005). In fact, a significant number of studies have found support for McGuire's theoretical mechanisms regardless whether counterarguing was treated and assessed as a subvocal (e.g., Ivanov et al., 2009a; Pfau et al., 1997, 2001, 2004) or a vocal (e.g., Ivanov et al., 2015) process.

Treating counterarguing as a vocal, in addition to a subvocal, process, a relative novelty in inoculation research, was first suggested in Compton and Pfau's (2009) seminal article on inoculation and word of mouth communication. In their theoretical essay, the authors proposed that inoculated individuals, in addition to engaging in the process of subvocal counterarguing as prescribed by McGuire (1964), may also engage in conversations with other individuals for the purpose of reassuring their current position on the topic and/or advocating their position to others. Empirical tests by Ivanov and colleagues (2012a, 2015)

have subsequently confirmed the reassurance and advocacy functions of post-inoculation word-of-mouth communication, termed as post-inoculation talk (PIT) (Ivanov et al., 2012a, 2015). As a collection, their findings showed that PIT, boosted by inoculation-elicited threat and anger, enhanced attitudinal resistance. A study by Dillingham and Ivanov (2016) partitioned the effects of vocal and subvocal counterarguing and added an additional dependent variable, attitude certainty. The subsequent results revealed a more nuanced interplay between these processes (vocal vs. subvocal counterarguing) and variables (attitude vs. attitude certainty) than originally conceptualized. The process of subvocal counterarguing, when decoupled from vocal counterarguing by restricting the participants from engaging in PIT, yielded familiar findings i.e., inoculation worked in generating attitudinal resistance. However, inconsistent with previous findings (e.g., Pfau et al., 2004), inoculation had no effect on attitudinal certainty. The addition of the vocal (PIT) to the subvocal process of counterarguing, while having no appreciable impact on attitudinal resistance, did have a positive impact on attitudinal certainty. As a result, the authors concluded that, while subvocal counterarguing may be responsible for generating attitudinal resistance, PIT plays an important role in the process of inoculation-elicited resistance by bolstering the certainty with which the attitudes are held, possibly as function of reassurance. An additional benefit of vocal counterarguing or PIT is the ability of the message to be diffused over social networks to individuals not exposed to the original inoculation; thus submitting others to messages of reassurance and/or advocacy. Hence, the effect of PIT in the inoculation process may be quite significant. Yet, while PIT seems to have a positive inoculative effect on the original message recipients, the impact of PIT on those receiving the inoculation message via social diffusion remains unknown and in need for more systematic research.

In general, inoculation works. Over 50 years of research has provided an overall support for the inoculation-elicited process of resistance mediated by the variables—threat and counterarguing—identified by its original author (but see Banas & Rains, 2010). Yet, subsequent inoculation scholarship has identified additional variables (moderating and mediating) impacting the inoculation process of resistance. The next section addresses some of the most relevant complementing and/or competing variables associated with the inoculation-based process(es).

COMPLEMENTING AND/OR COMPETING PROCESSES: MEDIATORS, MODERATORS, AND OUTCOMES

While agreeing with the role of the original mechanisms in the inoculation process, Insko (1967) suspected that this process, as conceptualized by McGuire, is incomplete. He intuitively believed that additional mechanisms yet to be uncovered complicated the resistance process inspired by inoculation. Decades of research has confirmed Insko's intuition as additional moderating and mediating variables have been added to the inoculation process of resistance. This section briefly attends to some of the most relevant variables in this process including involvement, self-efficacy, attitude accessibility, associative networks, attitude certainty, affect, message source, gender, modality, message type, and outcomes.

Involvement. Issue involvement plays a significant role in the process of inoculation-generated resistance as it can moderate, mediate, and function independently of the inoculation process. Defined as the salience or importance for the receiver of an attitude object (Pfau et al., 1997), issue involvement may impact the effectiveness of inoculation. Pfau and colleagues (1997) discovered that moderate levels of issue involvement may

produce most pronounced inoculation effects; yet these findings have not received meta-analytic support (Banas & Rains, 2010).

In a different study, Pfau et al. (2010) examined the effects of alternative types of involvement (outcome-relevant, value-relevant, and impression-relevant). They hypothesized that outcome-relevant involvement, which they likened to issue involvement, would confer resistance by influencing the original mechanisms of inoculation-based resistance, threat and counterarguing. In contrast, the authors expected that value-relevant (i.e., an attitude integrally connected to the person's values) and impression-relevant involvement (i.e., a desire to express socially-supported attitudes by significant others) would bypass the original inoculation mechanisms and generate resistance independent of threat and counterarguing (Pfau et al., 2010). No statistically significant results were discovered for impression-relevant involvement, but both outcome-relevant and value-relevant involvement impacted resistance by bypassing threat and counterarguing. These findings are consistent with the earlier work of Pfau and colleagues (1997) who also discovered issue involvement to impact resistance independent of the traditional inoculation mechanism at each level of involvement: high, moderate, and low. In addition to the independent influence on resistance, moderate level of issue (or outcome-relevant) involvement also impacted threat and counterarguing as hypothesized in the Pfau and colleagues' (2010) study. Thus, involvement seems to play a significant role in the process of resistance independently and by moderating the effect of inoculation.

Issue involvement also mediates the inoculation-elicited process of resistance. In their study, Pfau and colleagues (2004) discovered that inoculation generated threat, which elicited involvement. The elicited involvement then strengthened attitudinal certainty and accessibility and increased counterarguing level. In turn, counterarguing and attitude accessibility directly and certainty indirectly (through attitude accessibility), impacted resistance.

In conclusion, issue involvement has an instrumental role in the process of inoculation-generated resistance. Initial level of involvement, in general, seems to impact the process of resistance independently of the traditional inoculation processes; however, at moderate levels, it also has a direct positive impact on threat and counterarguing. Issue involvement is also elicited by the inoculation message and, as such, it increases the level of resistance via counterarguing, attitude certainty, and attitude accessibility.

Self-Efficacy. Similar to issue involvement, self-efficacy also plays multiple roles in the inoculation-elicited process of resistance as a moderator and mediator (Compton, 2013). In general, self-efficacy is expected to lower the level of experienced threat as increase in self-efficacy should increase the confidence of the individuals in their abilities to defend the challenged attitude (Pfau et al., 2001). Yet the first study to measure self-efficacy (Pfau et al., 2001) did not discover any definitive impact of self-efficacy on threat. However, it did show self-efficacy to be positively related to happiness and anger, both of which enhanced resistance (2001).

Additional studies tested self-efficacy as a product of inoculation and discovered that inoculation can enhance self-efficacy (Farchi & Gidron, 2010; Ivanov et al., 2016; Jackson et al., 2015; Pfau et al., 2009); however, none of these studies directly assessed the impact of elicited self-efficacy on the attitudes. Thus, much more remains to be learned about the mediating role of self-efficacy in the process of inoculation-elicited resistance.

Attitude Accessibility, Certainty, and Associative Networks. Roskos-Ewoldsen and Fazio (1997) suggested that beliefs that are more readily accessible from memory are more salient and more likely to be considered when confronting an issue. Inoculation

enhances the accessibility of these beliefs (Pfau et al., 2003, 2004) and accessibility in turn enhances resistance (Pfau et al., 2004). This process works independently of the original mechanisms of the theory—threat and counterarguing—as well as collaboratively through threat, as threat increases attitude accessibility, which leads to greater resistance (Pfau et al., 2004).

The certainty with which individuals hold the attitude also plays an important role in the inoculation process of resistance (Pfau et al., 2004, 2005). Inoculation treatments directly boost attitudinal certainty, which in turn enhances resistance (Pfau et al., 2004, 2005). In addition, certainty can be boosted by threat and elicited involvement and can impact resistance both directly and indirectly by enhancing attitude accessibility (Pfau et al., 2004).

Besides bolstering attitude accessibility and certainty, inoculation modifies the structure of individuals' associative networks by adding additional nodes and increasing the number of linkages among nodes (Pfau et al., 2005; but see Pfau et al., 2009). The associative network structures consist of affective and cognitive nodes located in long-term memory that are connected by associative pathways (or linkages). More complex structures consist of more interconnected nodes and, as such, are less vulnerable to challenges (2005). As Pfau and colleagues (2005) discovered, inoculation has the ability to enhance individuals' associative networks, which increases resistance.

Affect. For many years, inoculation theory was considered to elicit primarily a cognitive process of resistance (Compton & Pfau, 2005). Recent inoculation scholarship has recognized the importance of affect in the process of inoculation-elicited resistance (e.g., Compton & Ivanov, 2014; Ivanov et al., 2012a, 2012b; Miller et al., 2013). For example, studies have shown that inoculation can elicit anger (e.g., Ivanov et al., 2012a) or happiness (Pfau et al., 2001), both of which had a positive impact on resistance. But, inoculation can also impact emotions, such as enhancing pride (Pfau et al., 2006) or reducing fear (Pfau et al., 2009). The precise moderating, mediating, and outcome roles specific emotions and moods play in the inoculation process of resistance is not yet clear. Much remains to be learned about the impact of affect on the process of inoculation.

Message Source and Gender. The message source plays a relevant role in the inoculation process. An and Pfau (2004) discovered that more positive perceptions of the credibility of the inoculation source leads to more effective inoculation. Thus, the credibility of the source can moderate the effectiveness of the inoculation message. In addition, a source can have a mediating role in the inoculation process. Miller and colleagues (2013), using the principles of psychological reactance, were able to use inoculation to elicit reactance against the source of the attack message, which lead to greater source derogation. Pfau and Kenski (1990), on the other hand, provided evidence that inoculation may be capable of protecting a message source i.e., the character of a political candidate.

Stone (1969), for the most part, did not find significant difference in the effect of inoculation messages based on gender. What he did find were females to be more influenced by the source of the message compared to males, a finding confirmed by Pfau and Kenski (1990).

Message Type. Over the years, inoculation researchers have tested different types of messages designed to maximize the inoculation's effectiveness (Ivanov, 2012). For example, Banas and Miller (2013) successfully employed fact-based and logic-based inoculation messages. The fact-based inoculation treatments provided specific refutations of factual claims, while the logic-based messages refuted the reasoning process used in the counterarguments. Pfau and colleagues (2001), on the other hand, used cognitive, affective-happiness, and affective-anger messages to generate resistance.

The cognitive messages used arguments, facts, and evidence. The affective-happiness and affective-anger messages relied on content that emphasized either how the desired goal would be facilitated by protecting the present attitude (affective-happiness messages) or how the goal attainment would be obstructed by the counter-attitudinal challenges and challengers (affective-anger messages). All of the different message types showed promise; however, Pfau and colleagues suggested that "resistance is optimized when the refutational preemption component of inoculation messages feature arguments supported by hard evidence in addition to the use of affect triggers which signal that goals may be thwarted" (2009, p. 93).

More recent research has also considered the role of psychological reactance in the message effectiveness. Szabo and Pfau (2001) discovered that inoculation messages can produce reactance, thus recent inoculation studies have added language and postscripts at the end of the inoculation message to ensure that receivers' freedom of choice is not restricted by the message (e.g., Miller et al., 2013). Furthermore, Miller and colleagues structured the inoculation messages in a manner that elicited reactance against the counter-attitudinal challengers, thus increasing inoculation's effectiveness (2013; also Niederdeppe, Heley, & Berry, 2015).

Modality. Although inoculation researchers have tinkered with the message content and structure, the effectiveness of the message has persisted (Ivanov, 2012). Its robust nature also crosses different communication modalities (e.g., Banas & Miller, 2013). To date, inoculation messages have been primarily presented in video (e.g., Nabi, 2003; Pfau, Van Bockern, & Kang, 1992) or print format (e.g., Ivanov et al., 2009b; Miller et al., 2013). Pfau and colleagues (2000) conducted a direct comparison of inoculation's effectiveness presented in both modes and found the effects to be undifferentiated. Dillingham and Ivanov (in press) found similar results when manipulating the modality of the attack message. Inoculation was equally effective regardless of whether the attack was in a print or video format, thus illustrating the robustness of inoculation across different communication modalities.

Perhaps the greatest test of inoculation's robustness was conducted by Banas and Miller (2013) who diluted the effects of the short print-based inoculation messages by using additional inoculation messages to forewarn participants of the effects of inoculation messages. In essence, they inoculate participants against the effects of inoculation, or metainoculation as termed by the authors. Subsequently, they presented participants with a 40-minute attack video supported by music, narration, and imagery in addition to the impressive length. Yet, inoculation messages still generated attitude protection, thus highlighting the robust nature of this message strategy.

Outcomes. The target outcomes of inoculation messages have varied and included established beliefs (e.g., McGuire, 1964), attitudes (e.g., Ivanov et al., 2009b), values (Bernard, Maio, & Olson, 2003), and behavioral intentions (e.g., Pfau et al., 2001). However, as previously discussed, inoculation has targeted a number of additional outcomes that play a role in the inoculation process such as self-efficacy, attitude accessibility, and attitude certainty, to name a few.

Overall, inoculation-elicited resistance is intricate and complex. Some processes are consistent, others complement (e.g., attitude certainty), and yet others compete (e.g., attitude accessibility) with McGuire's originally identified process mechanisms: threat and counterarguing. Whereas inoculation research has increased our understanding of these processes, many questions and unknowns still remain. Throughout all of the research, one theme, however, has persisted. Inoculation works (see Banas & Rains, 2010). It is a robust strategy, which success has warranted application of inoculation in multiple contexts reviewed in the next section.

CONTEXTUAL APPLICATION OF INOCULATION

As summarized in the introduction of this chapter, inoculation has been applied in numerous contexts, mostly with success. This section briefly addresses the most relevant contexts in which inoculation has been applied outside of health and risk and then proceeds to provide a more detailed account of inoculation's success in the health and risk communication context. The reporting of different studies under specific contexts below is meant to be instructive rather than definitive. Numerous studies are cross-contextual, thus fitting well in multiple contexts.

Relevant Application Contexts Outside of Health and Risk Communication.

Political Communication. One of the contexts that has benefited most from inoculation research is that of political communication. As Compton and Ivanov suggested, "[I]n some ways, political campaign practitioners were quicker to realize the potential of inoculation in political campaign settings than inoculation and political campaign scholars were" (2013, p. 256). As a political consultant, Jim Innocenzi has previously stated, "[I]noculation and pre-emption are what win campaigns" (as cited in Ehrenhalt, 1985, p. 2E). Practitioners' experience and intuition were quickly followed by empirical support derived from controlled experimental designs. Pfau and Burgoon (1988) were the first to provide evidence that inoculation can blunt the impact of political attacks and their sources on voter intentions, as well as deflect the content of an attack. In general, inoculation has been shown to be an effective preemptive political campaign strategy when used to protect the candidate's image and issue position (Pfau & Burgoon, 1988; Pfau et al., 1990) or when used to protect the position of a specific political issue (Pfau et al., 2006, 2008).

Commercial Communication. Marketing and advertising scholars were quick to realize the value of inoculation and systematically test its efficacy in the commercial communication context (Bither, Dolich, & Nell, 1971; Hunt, 1973; Sawyer, 1973; Szybillo & Heslin, 1973). As a result, inoculation has been demonstrated to be effective in protecting attitudes toward brands (Pfau, 1992) as well as countries as tourist (Ivanov et al., 2017) and manufacturing (Ivanov et al., 2009c) destinations from slippage. In addition, Compton and Pfau (2004) successfully incorporated inoculation as a resistance strategy against credit card marketing promotions aimed at college students. In a different study, Bechwati and Siegal (2005) were able to show that inoculation can aid the product prechoice process that results in lower product returns. In addition, inoculation scholars have proposed that inoculation may be able to protect buyers from experiencing postpurchase remorse (Ivanov, Parker, & Compton, 2011) and recommended inoculation as a viable strategy for protecting the positive images of celebrities and corporations (Ivanov & Parker, 2011).

Corporate Communication. Haigh and Pfau (2006) illustrated the positive impact inoculation can have on internal corporate communication. As their study's results showed, inoculation may be an effective strategy in strengthening organizational identity, commitment, and organizational citizenship behaviors. On the other hand, Dillingham and Ivanov (in press) tested the efficacy of inoculation in an external corporate communicative setting. By focusing on the problem of unanticipated widespread sell-offs of securities motivated by a financial crisis, Dillingham and Ivanov were able to use inoculation strategy to fortify the "stay in the market" beliefs of individuals.

Public Relations. Burgoon, Pfau, and Birk (1995) believed that issue-advocacy campaigns used by organizations serve an inoculating

function by protecting pro-organizational attitudes. Their findings supported this belief. Wan and Pfau (2004), on the other hand, successfully applied inoculation in the context of pre-crisis communication. More specifically, the authors were able to show that inoculation protected pro-organizational attitudes from slippage following an organizational crisis. Wigley and Pfau (2010) found similar results showing the ability of inoculation, used as a pre-crises treatment message strategy, to protect the reputation of an organization in the aftermath of a crisis.

Interpersonal Communication. Interpersonal communication is an understudied context in inoculation research, but one full of promise. For example, Sutton (2011) focused on interpersonal relationships and the ability of inoculation to combat the effects of improperly coping with jealousy. Inoculation did not augment the experience of jealousy, but it did improve the likelihood that individuals would use a positive jealousy expression strategy when encountering a jealousy provoking stimuli (Sutton, 2011).

Cross-Cultural Communication. Ivanov and colleagues (2012b) investigated the impact of culture on the effectiveness of the inoculation process. Their results were encouraging. Although culture moderated the process and effectiveness of inoculation, this strategy was still capable of protecting established attitudes even when implemented in a culture with values and message-processing patterns incongruent with the structure and content of the inoculation message.

Instructional/Educational Communication. One of the first ventures of inoculation in the area of instructional and educational communication context was rather unsuccessful. Compton and Pfau (2008) tested whether inoculation could protect students' attitudes against pro-plagiarism arguments. While the results were disappointing, the potential for inoculation in this context remains to be significant as inoculation is perfectly positioned to aid the development of successful instructional and training messages and strategies (e.g., Kingsley Westerman, Margolis, & Kowalski-Trakofler, 2011).

Relevant Application Contexts in Health and Risk Communication. From a health and risk communication perspective, as previously suggested, inoculation may be used as a persuasive strategy of change/restoration (i.e., a curative function) or attitude/behavior formation (Ivanov et al., 2017; Wood, 2007). It may also simultaneously serve multiple functions, that is, curative and preventive (Ivanov et al., 2017). For example, regardless of the initial belief valence (i.e., supportive, neutral, or opposing), Ivanov and colleagues (2016) successfully used inoculation to enhance the general public belief about the ability of the U.S. government to prevent and minimize the effect of politically-motivated acts of violence. The inoculation treatment successfully withstood the presentation of a simulated attack on a U.S. airliner. In addition, inoculation was effective in generating a "blanket of protection" that extended over beliefs about the government's ability to deal with national crises in general. Perhaps just as importantly, inoculation lowered the intensity of experienced fear elicited by the threat of violent attacks, as well as strengthened the perceived ability of individuals to cope with the outcome of a crisis. In a different study, irrespective of initial attitudinal valence, Blervacq (2010) was able to use inoculation to boost individual's physical activity.

Yet, the preponderance of accumulated knowledge on inoculation's effectiveness in the area of health and risk communication is focused on the preventive function of an inoculation message strategy designed to "enhance the resistance of healthy attitudes and behaviors in danger of slippage" (Ivanov, 2012, p. 77). Indeed, McGuire's successful original testing of the theoretical mechanisms em-

ployed the protection of health-related beliefs such as regular dental hygiene as well as annual health checkups and tuberculosis screenings (McGuire, 1964). His original work has been subsequently extended to a number of other risk- and health-related beliefs, attitudes, and behaviors.

Smoking Prevention. The extant inoculation research has demonstrated the ability of inoculation to impact smoking initiation (Compton, 2013; Ivanov, 2012). For example, Pfau and colleagues (1992) discovered that inoculation may be able to protect at risk adolescents with low self-esteem from succumbing to the pressure to smoke with some effects lasting over 20 weeks (Pfau & Van Bockern, 1994). Banerjee and Greene (2006, 2007) discovered similar inoculative effects for adolescents participating in the researchers' anti-smoking intervention workshops.

Drinking. Duryea (1982, 1983), Duryea, Ransom, and English (1990) suggested that inoculation may be a successful strategy to employ in preventive alcohol education. As Godbold and Pfau (2000) discovered, inoculation messages with normative focus were able to provide more accurate estimations on the part of adolescents regarding how many of their peers were consuming alcohol, thus providing a firmer base aiding the ability to withstand pressures to consume alcohol. In a separate study, Parker and colleagues (2012) found indirect cross-protection effects on college students' negative attitudes toward binge drinking. More specifically, in attempting to protect the positive attitudes toward condom use with inoculation, the researchers also discovered more pronounced negative attitudes toward binge-drinking, ostensibly as a result of the relatedness between these two risky behaviors (2012).

Unprotected Sex. As previously suggested, Parker and colleagues (2012) investigated the possibility of using inoculation as a strategy in protecting the attitudes of college students toward condom use. The results showed that inoculation messages led to greater level of experienced threat and greater production of counterarguments. In addition, inoculation contributed to more negative attitudes toward the counter-attitudinal attacks (or pressures) and more positive attitudes toward condom use.

Vaccination. In a recent study, Wong and Harrison (2014), and Wong (2016) investigated the efficacy of inoculation in protecting the positive attitudes toward HPV vaccination. Their results were encouraging. Not only did they discover inoculation messages targeting HPV vaccination to protect the attitudes toward HPV vaccination from challenges, but they also discovered that inoculation messages communicating the import of vaccination practices in general may also provide protection of pro-HPV vaccination beliefs against challenges. This finding is both theoretically and practically significant as it provides further evidence of the ability of inoculation to afford an umbrella (or blanket) protection over multiple attitudes within an issue domain.

Health-Related Policy. Besides showing efficacy in protecting specific risk and health-related attitudes and behavioral intentions, inoculation may have the ability to influence health-related policy as well. For example, in numerous studies (e.g., Miller et al., 2013; Pfau et al., 1997, 2005), inoculation has been shown to be effective in protecting attitudes in support of the government's restriction of: gambling, TV violence, sale and distribution of hand guns, and legalization of marijuana.

In a recent study, Niederdeppe, Heley, and Barry (2015) tested the efficacy of inoculation in generating support for policies designed to reduce cigarette use, obesity, and painkiller addiction against the impact of industry anti-policy messages. The results were very encouraging as the inoculation messages were not only effective immediately after being delivered,

but also outperformed narrative messages when the effect was assessed after a week. In general, inoculation may be an effective strategy that could assist health-related policy promotion.

Other Risk and Health-Related Topics. In addition to the above topics, inoculation may have the ability to protect other risk- and health-related attitudes, behaviors, or policies. For example, addiction intervention research is presently underway testing the efficacy of inoculation-based strategies in protecting recently sober individuals from relapsing. Another contemporary study is attempting to discover whether inoculation can guard against persuasive messages suggesting some erroneous positive outcomes of indoor bed tanning.

However, inoculation is not limited to the above topics. Matusitz and Breen have suggested that inoculation may be used as a strategy for preventing youth from joining gangs (Breen & Matusitz, 2008) or as a strategy for reducing recidivism in criminal prison inmates (Matusitz & Breen, 2013). Rosenberg (2004) argued that inoculation could be an effective strategy in preventing increased verbal aggression in schools. Additional promising areas for application of inoculation-based strategies may include the promotion and protection of healthy eating habits, as well as positive attitudes (and behaviors) toward mammograms, colonoscopies, breastfeeding, and regular exercise, just to name a few. As Ivanov suggested, the "application of the strategy [is] boundless" in the health and risk communication context (2012, p. 77).

INOCULATION MESSAGE DESIGN

Prior to discussing how to effectively design inoculation messages for application in the aforementioned contexts, two important message considerations warrant attention. First, inoculation messages are not immune to the dangers of *inadvertently* eliciting the process of psychological reactance (Ivanov, 2012). As mentioned earlier in this chapter, in a study testing the efficacy of inoculation antismoking messages, Szabo and Pfau (2001) demonstrated that inoculation messages, if not carefully constructed, can generate psychological reactance against the treatment message itself, which may have a counterproductive effect on the message's effectiveness. A possible cue for how to combat this negative outcome comes from the message design template used by Miller and colleagues (2013) who *purposely* generated reactance targeting the attack, rather than the inoculation messages and messengers. To ensure that their treatment messages did not generate psychological reactance toward the inoculation message and source, the authors used a restoration postscript (see Miller et al., 2007) designed to restore the freedoms of the message receivers in making their own decisions on whether to adopt the messages or suggestions contained in the inoculation treatments.

Inoculation messages could also be used to preempt the occurrence of psychological reactance in pro-health persuasive messages. For example, Richards and Banas (2015) showed how campaigners may be able to inoculate individuals from the negative effect that psychological reactance has on the assimilation of message content promoting healthy behaviors. In their study, by combating the self-generated cognitions of individuals responsible for psychological reactance, inoculation messages were able to lower the intention of individuals to consume alcohol.

The second consideration is that of booster messages. Consistent with the medical (biological) analogy, the effectiveness of inoculation messages dissipates over time (Ivanov, 2012), whether as a result of message (Stiff & Mongeau, 2003) or motivation (Insko, 1967) decay. A medical remedy for this erosion of effectiveness is to use booster shots after a period of time from the initial inoculation. McGuire (1961) suggested that attitudinal inoculation messages may also benefit from

booster shots. The results, however, are somewhat equivocal. Pfau and colleagues (2004) discovered that booster messages delivered approximately a week to three weeks after the treatment were able to sustain the process of counterarguing for more than six weeks. In a different study, boosters were applied 70 days after the presentation of the treatment message with minimal effectiveness (Pfau et al., 1992). Pfau suggested that the main factors contributing to the effectiveness of booster messages are proper timing (Pfau et al., 2004) and treatment-message consistency (Pfau, 1995). Pfau believed that the booster message should match the treatment message for it to be effective. The latter assumption was challenged by Compton and Pfau (2005) as well as Ivanov and colleagues (2009a) who suggested that other forms of boosters (e.g., weakened attacks, forewarnings, etc.) may prove to be more effective in sustaining the effectiveness of inoculation.

Discovering the proper timing in which to introduce boosters continues to draw scholarly interest. In a recent study, Ivanov and colleagues (2016) demonstrated that offering a booster two weeks after the presentation of a treatment message and four weeks in advance of the attack message did not produce appreciable boosting effect. Yet, following up the initial booster with a second one two weeks later did enhance the inoculation effect. What was not clear from the Ivanov et al. study is whether the boosted effect was a result of better timing or application of multiple boosters.

The study also tested the potential of attack messages to serve a boosting function by rendering the threat to the attitude real, a suggestion previously introduced by Ivanov and colleagues (2009a). The results showed that attack messages do not have boosting power, at least not in their full force. Ivanov and colleagues (2016), consistent with Compton and Pfau (2005), suggested that weakened attacks may better serve a boosting function. They also wondered whether booster messages in the form of forewarnings may be effective in extending the efficacy of inoculation messages.

The efficacy of boosters continues to intrigue and frustrate inoculation scholars. As Ivanov and Colleagues (2016) submitted, much more needs to be learned about the best way to structure and time booster messages. A new study testing different booster message forms, length, and timing is currently underway.

CONTEXTUAL CONSIDERATIONS AND FORMATIVE RESEARCH

Inoculation messages have to account for the contextual constraints faced in the environment in which they are applied. For example, the message-processing capabilities of the target audience have to be taken into consideration during the message design. As a result, the target audience's reading grade level should not be exceeded in the message (e.g., Miller et al., 2013) and the modality used to disseminate the message should be considered. Younger audiences may be more receptive to video message delivery (e.g., Pfau et al., 1992) compared to college students who may be equally receptive to video and print (e.g., Pfau et al., 2000).

Research has also shown that the base of the attitude that target audiences hold may impact the effectiveness of the inoculation message (Ivanov et al., 2009b). According to the findings by Ivanov and colleagues, if the base of the held attitude is predominantly affective (e.g., I do not smoke because it is disgusting), as opposed to cognitive (e.g., I do not smoke because it is detrimental to my health), inoculation messages that feature affect-laden content matching—rather than mismatching—the inoculation treatment to the base of the attitude should generate greater resistance. The reverse is the case for attitudes with a predominantly cognitive base. However, Ivanov et al.'s (2012c) research findings demonstrated that in cases where the attitudinal challenges are repeated, inoculation messages featuring both affective and cognitive content

may be just as effective as the matched attitude base/inoculation treatment combination, which, in turn, may alleviate the need to assess the base of the targeted attitude. Thus, in these situations, which should constitute the majority of occurrences, as seldom are attitudinal or behavioral challenges singular in nature, the design of inoculation messages should follow Pfau and colleagues' recommendation of using "arguments supported by hard evidence in addition to the use of affect triggers which signal that goals may be thwarted," (2009, p. 93).

Another important component in effective inoculation message design is conducting a sound formative research, which can inform the message designer of, among other things, the: primary attitudinal (or behavioral) challenges in need of refutation; base of the attitude; target audience characteristics, such as message processing capabilities, motivation, and modality preferences; source(s) of potential attitudinal (or behavioral) challenges; and context in which the challenges are likely to take place. In addition, before implementing an inoculation-based strategy, the inoculation messages should be thoroughly pretested and augmented, if necessary, based on the pretest feedback and/or results.

MESSAGE COMPONENTS AND DESIGN

The first component in the inoculation message is the explicit forewarning. To remind, explicit forewarning is not required in inoculation messages, as threat could be generated implicitly with the presentations of weakened opposing arguments in the refutational preemption component of the message (e.g., Ivanov et al., 2016). Studies using inoculation simultaneously as a resistance (e.g., preventive) and persuasive (e.g., curative) strategy may choose to omit the explicit forewarning for pragmatic reasons. For example, informing young adolescents that the negative attitudes toward smoking are likely to face challenges may seem like a good practice with adolescents who indeed have negative attitudes toward smoking; however, those who have positive attitudes toward smoking would not find the forewarning of such challenges, which are consistent with their present attitudes, to be very diagnostic or relevant. Nevertheless, Ivanov and colleagues (2017) found the use of explicit forwarding not to have an adverse effect on target audience members with opposing attitudes; thus, there does not seem to be a pertinent need to omit the explicit forwarding from the inoculation message when applied to audiences with diverse initial attitudes.

The explicit forewarning alerts the message recipients to the vulnerability of their current attitude or behavior. It informs the target audience members that challenges to the current attitudes or behaviors are not only possible, but likely. It instructs them that complacency can lead to undesirable attitudinal or behavioral change by telling the audience members that others like themselves have already yielded to these highly persuasive challenges. It then proceeds to provide support for this claim. Finally, it asks the target audience members whether they feel prepared to effectively defend their attitudes or behaviors by suggesting that others like themselves who felt prepared, did indeed succumb to the impending challenges. The following excerpt from the Parker et al. (2012) study designed to protect the positive beliefs toward condom use provides an example of explicit forewarning:

> . . . recent research shows that there is more pressure than ever before for college students not to use condoms. This research proves that college students are often succumbing to the pressure not to use condoms; in fact, many young people like you who think they should use condoms are often persuaded by sexual partners not to use this form of protection . . . Are you prepared to resist these persuasive appeals potentially orchestrated and practiced by your current or future partners? How about resisting

> these appeals when coming from your friends or perhaps fraternity brothers or sisters? The results of current research show that you may not be as prepared to defend your beliefs as you may think you are.

As could be noticed from the above forewarning, multiple sources of potential challenges were identified, which was a direct result of formative research. In addition, no specific time or location in regard to when and where these challenges may occur were identified in the forewarning. The location and timing were left as more general because formative research indicated the challenges can occur at different locations, at different days of the week, and at different times of the day.

The second component of the inoculation message is the refutational preemption. This component of the message begins with a presentation of arguments on the opposite side of the issue, but presented in a weakened format. Traditionally, these arguments are presented as single sentences (e.g., Ivanov et al., 2012a) or paragraphs (e.g., Parker et al., 2012) and rely on anecdotes, testimonials, and/or dubious evidence grounded in questionable logic. The following is an excerpt from the Parker et al. (2012) aforementioned study:

> One of the appeals used to persuade you to stop using condoms states that you are no more at risk for a sexually transmitted disease such as HIV . . . : "If we were at a high risk for contracting HIV, then how come this is not something that is made a big deal on college campuses . . . I don't have HIV and I don't use condoms during sex. Actually, none of my friends do and we are all fine . . . We are young, so we are at lower risk . . . So, as I said, you are not any better off wearing a condom."

The questionable logic of the opposing argument is then refuted in the rebuttal using strong evidence, fact, and/or statistics designed to overwhelm the opposing claims as the following excerpt from the Parker et al. (2012) study illustrates:

> This testimonial is as ignorant and dubious as it gets. The fact is young people in the United States are at persistent risk for HIV infection . . . According to the Centers for Disease Control and Prevention, since 1991, AIDS has been the sixth leading cause of death in the United States among 15- to 24-year-olds. In fact, half of all new HIV infections in the United States occur in people who are under 25 years old; thousands of college students acquire new HIV infections each year. Most new HIV cases in younger people are transmitted through unprotected sex . . . In fact, research published in the *Sexually Transmitted Diseases* journal shows that using a condom during intercourse to protect against HIV transmission is 10,000 times safer than not using a condom! . . .

The format of the refutational preemption component has traditionally incorporated the presentation and refutation of two (e.g., Ivanov et al., 2009b) to three (Parker et al., 2012) of the most relevant oppositional arguments, although there is currently no evidence to suggest what may be the most optimal number of refuted arguments. A research study systematically testing the efficacy of inoculation messages using different numbers of refuted arguments is currently underway.

The concluding paragraph of the inoculation message has traditionally included a final warning and a call to action as the following excerpt from the Parker et al. (2012) study illustrates:

> When condoms are not used during every sexual intercourse, you risk transmitting a sexually transmitted disease

> and HIV/AIDS, which can permanently damage your life and seriously impede your goals, not to mention your health. Don't risk your health or end up with a baby before you are ready; wear a condom every time you have sexual intercourse!

However, recent research has started to question this approach. As discussed earlier in this section, inoculation messages are not immune to creating psychological reactance. Using what may be perceived by the target audience as highly controlling or commanding language contained in the last sentence of the final paragraph accentuated by an exclamation mark, may potentially lead to undesirable message results i.e., the generation of reactance toward the inoculation message. Some of the most recent research has taken a different approach to concluding the inoculation message. Take for example the inoculation message ending in the Ivanov and colleagues (2016) study, which focused on strengthening and protecting the beliefs in government agencies' ability to prevent and/or minimize the effect of terrorist attacks. The call to action in their study is still present, but more autonomy is given to the message recipient to make up his or her own mind on the issue. Below is an excerpt from the referenced study:

> So, as you reflect on your beliefs about DHS and our government's ability to prevent and minimize the effects of terrorist attacks, please bear in mind the current success and relentless preparedness described here. No institutions in the world are better prepared for these challenges than DHS and our government. Of course, what you choose to believe is up to you; but at least now, you have an accurate understanding of the situation.

As can be seen above, there is no usage of an exclamation mark and the message receiver is reminded that he or she is free to choose what to believe. Thus, carefully structuring the call to action as to avoid generating reactance against the inoculation message itself may be a more effective way to conclude the inoculation message and ensure its efficacy.

LIMITATIONS OF INOCULATION-BASED STRATEGIES

Inoculation is by no means a perfect strategy. As with most strategies, it has drawbacks that should be considered. Some of these drawbacks are perceptual (e.g., the danger of making counterarguments salient), while other are indeed substantive (e.g., the ability of inoculation to generate reactance, the impact of metainoculation, and the relatively small effect sizes). This section will note some of these concerns.

Danger or Making Counterarguments Salient. A common concern with using inoculation messages is rooted in their two-sided nature. Inoculation messages provide opposing arguments, thus making the very existence of these counterarguments salient to message receivers. As a result, practitioners may fear that the introduction of counterarguments may destabilize the attitude in absence of an attack, by highlighting its vulnerability (see Dillingham & Ivanov, in press). However, recent studies have shown that inoculation does not produce attitudinal harm in the absence of an attack (Dillingham & Ivanov, in press; Ivanov et al., 2017; Wigley & Pfau, 2010). Instead, studies have found inoculation messages to have a strengthening attitudinal effect in the absence of an attack, rather than compromising the attitude (Ivanov et al., 2017; Wigley & Pfau, 2010). Thus, the danger of making counterarguments salient to message receivers does not seem to present a major strategic concern.

Ability of Inoculation to Generate Reactance. Inoculation messages are ca-

pable of generating psychological reactance (Brehm, 1966) that can obstruct, rather than facilitate, inoculation message acceptance. As previous research has shown (Szabo & Pfau, 2001), if not designed with care and accounting for the potential threat of eliciting reactance, inoculation messages are indeed capable of generating unintended reactance against the inoculation message itself. Thus, it is imperative that inoculation messages are designed using language that does not restrict the perceived freedoms of message receivers to self-determine. As the example in this chapter demonstrates, this can be accomplished by avoiding the use of controlling language, embedding restoration postscripts at the end of the message, and pre-testing the messages (see Ivanov et al., 2016; Miller et al., 2013).

On the other hand, as aforementioned, inoculation could be used strategically to effectively elicit reactance targeted at the attacking source and/or message and thus enhance resistance to attitudinal pressures (Miller et al., 2013). In addition, inoculation could be used to preempt the experience of message reactance and thus facilitate persuasion, or message acceptance, in situations when persuasion, rather than resistance, is the goal (Richards & Banas, 2015).

Inoculation messages are capable of creating reactance that can thwart, rather than facilitate, the intended communication goal. However, careful message design can avoid the negative effect of undesired elicitation of psychological reactance. In addition, inoculation can also be used to exploit the positive outcomes of psychological reactance.

The Impact of Metainoculation. In a very innovative study, Banas and Miller (2013) introduced an antidote to inoculation in the form of metainoculation. In their study, the authors *preempted* the preemptive strategy of inoculation by cuing individuals to the purpose of inoculation messages and how they work in an effort to prepare these individuals to counter the effects of inoculation. The metainoculation strategy worked, as it lessened the effect of the subsequent inoculation messages, thus helping facilitate, rather than reduce, persuasion.

Consequently, metainoculation can inhibit the full effect of inoculation messages. However, the authors also noted that although the inoculation effect was compromised by the metainoculation message that preceded the presentation of the inoculation message, the effect was not nullified. The results indicated that inoculated individuals who were pretreated with a metainoculation message were more resistant to conspiracy theory propaganda messages compared to individuals who received neither the metainoculation nor the inoculation messages.

As a result of the above, two important takeaway points need to be stated. First, although the inoculation's effectiveness may be diluted, its effect does not appear to be eliminated by metainoculation. Thus, inoculation messages could be successful even in situations when preempted by metainoculation. Second, Banas and Miller (2013) attributed the success of metainoculation to heuristic processing. The authors used loaded terms to prime individuals by suggesting that they should avoid being manipulated like "sheep" by the inoculation messages and instead, should be "independent thinker[s]" who should make "up their own mind[s]" (Banas & Miller, 2013, p. 199). As a result, metainoculation seems to produce similar outcomes as psychological reactance. More specifically, with metainoculation, message receivers may perceive the freedoms to make up their own minds as being restricted by the inoculation message. As such, using the same aforementioned strategies to combat psychological reactance may help facilitate resistance and blunt the effect of metainoculation.

Relatively Small Effect Sizes. The effect sizes of inoculation messages could be classified as small. More specifically, Banas and Rains's (2010) meta-analysis produced a mean effect size of $d = .43$. According to Cohen

(1988), this would be a small magnitude effect, with moderate effects starting at d = .50. Hence, the small inoculation effect sizes could generate hesitance on the part of risk and health message strategists in regards to using this strategy. However, Banas and Rains suggest that the effect sizes of inoculation messages should be considered in context (2010). As these authors explain, in health campaigns aimed at increasing young adults' resistance from engaging in unhealthy behaviors, even small increases in likelihood of resisting the risky persuasive appeals are of "great value" (Banas & Rains, 2010, p. 302).

As mentioned in this chapter, an ongoing inoculation-based intervention study is presently exploring the efficacy of the strategy in protecting recently sober addicts living in a recovery home from experiencing relapse. Prior to honoring the recovery home's request to perform the inoculation-based intervention, the researchers, in the spirit of full disclosure, forewarned the home's management that any positive effects experienced were likely to be modest. The response from the home's management was instructive and poignant, as it suggested that even if one person was saved, the strategy would have been a success and well-worth the effort and investment, thus reiterating Pfau and colleagues' assertion that in "the context of resistance research . . . small effect sizes are common *and* are meaningful" (Pfau, Haigh, Sims, & Wigley, 2007, p. 212, emphasis in original).

CONCLUSION AND THE FUTURE OF INOCULATION RESEARCH

More than ten years have passed since Compton and Pfau declared that inoculation is a theory "at maturity" (2005, p. 97), thus leading Miller and colleagues to suggest that:

> . . . we may be tempted to conclude the theoretical basis of inoculation is settled, its contribution to resistance research exhausted, and its potential for further development minimal. On the contrary, Compton and Pfau (2005) have noted that while some may dismiss inoculation as "antiquated theory," it continues to grow in its theoretical development and application, and it is by no means ready for retirement.
> (2013, pp. 127–128)

Indeed, according to Miller and colleagues, inoculation has emerged as the "most consistent and reliable method for conferring resistance to persuasion" over the past 50 years (2013, p. 126). As this chapter illustrated, inoculation theory is heavily informed by our understanding of the principles of social influence, persuasion, and message processing, which provide the basis for understanding the inoculation-elicited process of resistance. For example, the mechanisms of inoculation are very consistent with the predictions of the elaboration likelihood model (ELM; Petty & Cacioppo, 1986). In accordance with the ELM, inoculation generates biased message processing as the explicit forewarning, and issue importance (i.e., issue involvement) motivates individuals to engage in anticipatory counterarguing i.e., accumulate information and arguments that help support their message position as well as help counterargue opposing views (Petty & Cacioppo, 1986). Thus, not surprisingly, inoculation researchers are consistently introducing different theories and theoretical concepts in their testing of the inoculation mechanisms with the goal of not only better understanding the inoculation process of resistance, but informing more effective message design. In addition to this research being theoretically rewarding, the real pragmatic value rests in the application of these advancements in numerous contexts such as those exemplified in this chapter.

As Compton and Pfau have suggested, inoculation "theory continues to inform cutting-edge and exciting scholarship, adding nuance to our understanding of persuasion theory and offering practical applications"

(2005, p. 136). Indeed, current research continues to apply the theory in new contexts by testing and retesting its logic and pushing the theoretical boundaries in new and exciting areas such as cross-protection, post-inoculation talk (PIT), and two-sided message persuasion. This groundbreaking research has shown inoculation to be a more robust strategy than McGuire ever imagined. Putting all of the advancements together, we are discovering that, via social diffusion (PIT), an inoculation message may spread its influence far beyond the reach of the specific medium disseminating the message while concomitantly protecting not only the target attitude or behavior, but related ones as well; doing so irrespective of the target's attitudinal valance at the transmission of the inoculation message.

The future of inoculation scholarship is bright and inspiring. Its theoretical advancement and contextual application perhaps is only limited by our imagination. The vigorous research that has underlined the vibrancy of the theory over the years, and especially in recent history, will only serve to secure its place as the most vital theory of resistance to influence.

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