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Can Hope Be Primed in Chronic Pain? A Clinical Application of Health Priming

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Can Hope Be Primed in Chronic Pain? A Clinical Application of Health Priming

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Approvals

In the judgment of the following signatories, this Dissertation meets the academic standards that have been established for the Doctor of Philosophy degree.

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ABSTRACT

It is recognized that nonintentional, automatic processing shapes physical health and well-being in critical ways. Conditioning—or priming—has been shown to influence attitude, beliefs, agency, behavior, and medical outcomes. Although expectations and beliefs correlate strongly with physical health, research in clinical application is needed, and studies on hope, as related to agency, in chronic pain are rare. The purpose of this study was to investigate whether, in a chronic pain sample (N = 154), hope could be primed via a Pain Neuroscience Educational (PNE) tutorial. A pre- and post-test intervention study consisting of two randomized parallel groups was designed to answer these research questions: What effect does a primed PNE have on hope in a chronic pain sample? Does exposure to a primed PNE affect pain at the present moment? What is the relationship between hope, stress-hardiness, and the perception of pain in this sample? After completing a pain inventory and obtaining baseline measures of hope, pain at the present moment, typical pain throughout the last year, and the trait of stress-hardiness, two parallel groups (n = 122) of chronic pain participants were exposed to either a primed or neutral condition and reassessed for hope and pain. After analyzing results, a third group (n = 32) was recruited and exposed to the primed condition but without the hardiness scale. A significant gain in hope at p = 0.001 was found in all three groups (N = 154), with medium effect sizes (Cohen's d), p = 0.05. There was no change in pain at the present moment. Statistically significant Pearson's correlations were found among hope, typical pain, and hardiness, p = 0.05. Broadly, the statistically significant elevation in hope across all groups suggests that unconscious exposure can prime or condition implicit attitudes apart from conscious goal setting, although the mechanism is unclear (i.e., tutorials and/or the Hope scale). By utilizing a novel priming method

in a chronic pain sample, this study contributes to the field of health priming and its findings advance the basis for the clinical application of nonconscious methods in health and medicine.

Keywords: Subliminal priming, placebo, hope, agency, stress-hardiness, chronic pain

DEDICATION

To Deirdre Davis Brigham, always.

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Table 1

Comparative Table of T-Test Results and Effect Size of Hope, Before and After, in Primed, Neutral and Primed Without Hardiness Groups

Group	Hope T1/T2	Mean	Mean of Hope T2-T1	T-Value	P-Value	Cohens d Effect Size
Neutral (*n*=54)	Hope T1	4.57	0.416	4.01	<0.001	0.546
	Hope T2	4.99				
Primed (*n*=68)	Hope T1	4.31	0.352	3.50	<0.001	0.425
	Hope T2	4.67				
Primed w/o Hardiness (*n*=32)	Hope T1	4.42	0.351	3.80	<0.001	0.672
	Hope T2	4.77				

CHAPTER ONE: INTRODUCTION

It is recognized that nonintentional, automatic processing shapes health and well-being in critical ways. Mindsets or beliefs have downstream effects (i.e., physiological enhancements) and can be influenced by environmental triggers or subtle cues (i.e., priming) without conscious awareness. Although nonconscious methods are believed to be more effective than conscious methods in changing beliefs and health behavior, research in clinical application is rare (Bargh, 2016; Girgis et al., 2018; Papies, 2016; Phillips & Pagnini, 2016). This investigation examines the effect of priming on hope, as linked to agency (e.g., see definition of terms), which is associated with lower morbidity, all-cause mortality, and the experience of pain (Long et al., 2020). Therefore, this investigation examined whether hope can be primed in a chronic pain sample.

This dissertation contains five chapters: an introduction, a literature review, the methodology, research findings and a concluding discussion followed by references and appendices. This chapter, the introduction, consists of the following sections and is organized in the order listed: the background and statement of the problem; the purpose of the study; guiding research questions; definition of terms; contributions to the field; limitations and delimitations of the study; overview of the literature and methods, followed by an outline of the dissertation.

Health Priming: A Call for Research

Intriguing cases led to an interest in *priming* (i.e., the process of environmental cueing) as I observed its impact on well-being and physical health. For example, when Susie was diagnosed with cardiomyopathy her ejection fraction (i.e., a measure of heart function) was so low that surgery for a pacemaker was scheduled. Shortness of breath and the fear of surgery contributed to panic attacks, so she was referred to me for counseling prior to the procedure. While our work

together alleviated her anxiety, an echocardiogram showed that there had been no change in the condition, and surgery was scheduled for the following week. Almost as an after-thought, during our last session prior to the procedure, I asked Susie to describe the room she and her husband spent the most time in. There, on the mantle, on either side of the television, were two urns: one for her mother and one for her mother-in-law. After discussing environmental cueing, Susie chose to relocate the urns, and a few days later when she arrived for the procedure her ejection fraction had improved so that she no longer needed a pacemaker. Without further intervention her cardiac function gradually normalized.

Although the basis of Susie's remarkable outcome cannot be ascertained with certainty, presenting this case at a medical conference kindled several discussions around the nature of *priming* (i.e., environmental cueing), and stimulated a desire to investigate the topic further. While it is recognized that attitudes and beliefs (i.e., *mindsets*) modulate physiological measures and well-being in significant ways (Stockdale, 2009; 2011), recent findings indicate that nonconscious (i.e., priming) interventions are more effective than conscious methods in changing mindsets and health behavior (Elgendi et al., 2018; Papies, 2016; Sheeran et al., 2013).

The psychobiological phenomenon of priming is "widely recognized as having a potent impact upon treatment outcomes in both medical and psychological interventions" (Sliwinski & Elkins, 2013, p. 1) and is believed to play a "crucial role in determining clinical outcomes" (Crum et al., 2017, p. 1). Beliefs and meanings, such as mindsets, "can be stored in memory and activated by subtle cues" (Savary et al., 2014, p. 4), profoundly impacting motivation, physical health, and will to live (Girgis et al., 2018; Jaremka et al., 2014; Levy et al., 2012; Marques et al., 2014; Wurm et al., 2013).

Although "belief systems are a robust predictor of well-being and related health outcomes" (Van Tongeren & Bernette, 2018, p. 102), and priming interventions can effectively stimulate adaptive mindsets, "most of these insights have not been translated into effective intervention tools" (Papies, 2016, p. 2). This study is, in part, a response to a collective call for action to identify effective clinical methods that can modify implicitly held beliefs and attitudes. As the loss of hope in chronic conditions has been shown to negatively affect quality of life and contribute to morbidity and mortality, this project was designed to explore whether hope can be primed in chronic pain, a population particularly vulnerable to the loss of hope (Serbic et al., 2016).

Statement of the Problem

When pain becomes chronic, structural remodeling of pain pathways in the brain contribute to its persistence, rendering it particularly challenging to treat (Kuner & Flor, 2017). Such effects are evident in phantom limb pain: A diseased limb may be amputated but the perception of pain persists in the missing limb. Likewise, spinal defects, when surgically corrected, only eliminate pain in a minority of patients, as sensitized pain pathways are operational even when the injury or structural abnormality has been corrected (Hanscom, 2017). Furthermore, glia—a set of nervous system cells—can chronically and independently send pain signals, without physiological cause (i.e., damaged tissue) (Donnelly et al., 2020). In this way, pain can become its own primary condition, arising after an injury or on its own. Over time the effectiveness of opioids and analgesics decrease, contributing to the syndrome (Kleine-Borgmann et al., 2019).

These challenges can lead to hopelessness, an identified factor contributing to disability and comorbidities in chronic conditions. In chronic pain specifically, the loss of hope is

associated with passive coping, amplified pain, increased comorbidities, and lower quality of life; whereas hope is linked to agency, pro-health behaviors, and positive outcome in chronic pain (Baliki & Apkarian, 2015; DuPont et al., 2020; France et al., 2020; Jaremka et al., 2014). Nevertheless, chronic pain is seldom studied in clinical practice (Brascher et al., 2018).

Recent findings, however, show that new learning can change not only the perception of pain, but the connectivity of the brain (Seminowicz et al., 2011). *Pain neuroscience education (PNE*), or learning about the neurobiology of pain, is a recognized treatment reimbursed by Medicare, and has been found, in some cases, to decrease the perception of pain and improve physical function (Puentedura & Flynn, 2016). In contrast, a systematic review and meta-analysis failed to show long-term benefits of PNE, due to nonadherence (Wood & Hendrick, 2020; 2018). In chronic conditions, acting in one's best interest is fundamental to lasting behavioral change. As such, the actionable quality of hope—associated with perseverance toward goals—is critical (Long et al., 2020). Even so, this author was unable to locate studies investigating the impact of PNE on hope; furthermore, "hope has rarely been considered in discussions of expectancy and the placebo response" (Eaves et al., 2016, p. 3).

Expectations about one's health have been found to be predictive of well-being and physical health (Levy, 2009; Van Tongeren & Bernette, 2018). Upending self-limiting beliefs, however, demands more than data, as learning—in the sense of drawing conclusions about one's prognosis—may occur outside of one's awareness, as expectations (i.e., belief systems or mindsets) may be "activated via unconscious exposure [i.e., priming]" (Papies, 2016, p. 22; Crum & Zuckerman, 2017). As such, nonconscious processes are considered more effective than conscious methods in changing implicit attitudes and health behavior, yet research in clinical application is scarce (Papies, 2016; Elgendi et al., 2018; Sheeran et al., 2013).

In summary, while recent findings in neuroscience show the brain can learn to change the course of pain, research is needed to develop targeted clinical interventions aimed at instilling adaptive mindsets (Zion, 2019). Therefore, this project focused on the possibility of priming hope (i.e., outside of conscious awareness) in a chronic pain population.

Historical Context & Complicating Factors

Contributing directly to morbidity and mortality are personal beliefs and attitudes, recognized in the late 1970s as key factors in the development of long-term pain. As a challenge to Cartesian dualism, a *biopsychosocial model* was proposed (Engel, 1977) and defined as a "multidimensional, dynamic interaction among physiological, psychological, and social factors that reciprocally influence each other" (Edwards, et al., 2016, p. 5). Interventions based on this model—evidenced by more than four decades of research—not only modulate pain perception and improve quality of life but reduce morbidity and mortality as well (Puentedura & Flynn, 2016).

Despite evidence to the contrary, the prevailing *biomedical model* (i.e., linear, cause and effect) attributes pain solely to injured or damaged tissue. This view about the nature of chronic pain can result in undue patient dependence on the medical system, contributing to helplessness which, in turn, is associated with passive coping, hopelessness, amplified pain, increased comorbidities and lower quality of life (Gatchel, et al., 2011; Long et al., 2020; Vanhaudenhuyse, et al., 2017).

Biobehavioral (i.e., biopsychosocial) interventions, on the other hand, are demonstrated to enhance outcome, improve well-being, and significantly reduce health costs (Wilson et al., 2019). To illustrate, in one investigation subjects with chronic back pain were trained in individual sessions to disassociate pain as a threatening condition, leading to hypoalgesia or pain

reduction (Ashar et al., 2021). Although compelling, health practitioners are increasingly time pressured and may not have the resources to teach behavioral medicine methods or communicate these in a way that addresses or inspires hope/agency. Consequently, a lack of motivation along with a high drop-out rate has proved problematic in behavioral medicine programs for chronic pain (Kerns et al., 2014; Stockdale, 2019).

Priming, on the other hand, does not require a significant time investment. Given that nonintentional, automatic processing shapes health in critical ways (Wryobeck & Chen, 2003), Crum and Zuckerman (2017) propose that priming methods be implemented in all physician/patient interactions. Yet, even in a biopsychosocial context, many health professionals are unaware of the value and efficacy of priming for better health outcomes, and such methods are seldom studied in a clinical context. To encourage utilization, research on practical, economical delivery methods is needed (Elgendi et al., 2018; Sheeran et al., 2013).

Although hope, as related to agency, is associated with pain reduction (i.e., hypoalgesia), less functional disability, pro-health behaviors, and lower morbidity and all-cause mortality, it has received less attention in chronic pain and is often incorrectly conflated with optimism (Goodin & Bulls, 2013; Long, et al., 2020).

Therefore, a primary question addressed by this project is whether such hope can be primed via a brief, written PNE tutorial. A secondary question is whether pain perception is affected by reading positively primed pain information (i.e., PNE). And lastly, this research project explored the relationship among pain, hope and the quality of stress-hardiness.

The High Cost of Losing Hope

At least twenty percent of individuals in the U.S. are reported to be suffering from unresolved, chronic pain**;** and for the majority, there is no identified cause (Jaremka et al., 2014;

Serbic et al., 2016). Unresolved pain symptoms "cost the U.S. health-care system roughly $256 billion in . . . direct costs per year" (Ewart et al., 2014, p. 977). Chronic back pain alone is considered "a major global health problem, while its treatment is hampered by a lack of efficacy and restricted safety profile of common frontline therapies" (Kleine-Borgmann et al., 2019, Abstract, para. 1).

Although chronic pain is acknowledged as "an enormous health care issue . . . its science has remained rudimentary" (Baliki & Apkarian, 2015, p. 23); and when the medical system is unable to ease suffering or identify the cause of pain, anger, frustration, and hopelessness may ensue (Kerns et al., 2014). In addition, downstream effects such as job loss and frayed familial relationships contribute to isolation and despair (Jaremka et al., 2014).

Since an increased risk of comorbidities and all-cause mortality is associated with hopelessness, there is a particular need for high fidelity, economical and time-saving methods that elevate hope. As a construct, hope has been measured in psychological and behavioral studies as a mediator of coping, recovery, and resilience (Coughlin, 2006). For example, in a longitudinal epidemiological study of more than twelve-thousand individuals, hope-fueled agency was associated with a reduction in pain, morbidities and all-cause mortality (Long et al., 2020). Consequently, this investigation examined whether hope could be primed in a chronic pain sample.

Related to agency and resilience, the trait of stress-hardiness (Kobassa, 1979) has been associated with improved immunity and cardiovascular stress response, lower inflammatory markers, and enhanced parasympathetic activation (Zerach et al., 2020), yet is seldom studied in chronic pain. Investigating the association among the trait factor of hardiness, hope and pain was an additional goal of this study.

Purpose of the Study

Considering hope's cardinal role in health and well-being, this study investigated whether hope could be primed via a brief PNE tutorial in a chronic pain sample. While hope has been defined in various ways, Long et al.'s (2020) definition—which distinguishes hope from optimism—is preferred (e.g., see definition of terms), and will be explored further in Chapter Three. The purpose of this study, then, was to examine the effect of a priming intervention on hope, related to agency, in chronic pain.

Guiding Research Questions

The objective of this research project was to examine the effect(s) of a priming intervention, modeled after PNE, on hope and the perception of pain, and to explore the relationship among hope, hardiness, and pain perception. The primary question guiding this project was: Does exposure to a positively primed Pain Neuroscience Educational (PNE) tutorial promote hope in respondents experiencing chronic pain? (Or: Can hope be primed via brief, written communication among participants experiencing chronic pain?) A second question was: Does exposure to a positively primed PNE tutorial influence the experience of pain as perceived in the present moment? The third query explored the relationship between hope and pain. For example, this project addressed the question: If hope increases, does pain in the moment decrease? This investigation also measured the trait of stress-hardiness. By evaluating hardiness in the sample population, it was possible to gauge this particular trait and examine its association to hope and pain.

Definition of Terms

Beliefs or Mindsets are a construct of implicit-theories that can be described as "transparent patterns or templates" (VanTongeren & Burnette, 2018, p. 101), or "lenses or

frames of mind that orient an individual to a particular set of associations and expectations" (Crum & Zuckerman, 2017, p. 1). Such mindsets, or attitudes, have neurobiological correlates that modulate physiology, and even outcome in medical treatment (Girgis et al., 2018).

The *biopsychosocial model* has been defined as a "multidimensional, dynamic interaction among physiological, psychological, and social factors that reciprocally influence each other" (Edwards, et al., 2016, p. 5).

Hardiness is more discreetly defined than the broad construct of resilience, which is interpreted in multiple ways by numerous researchers. Hardiness is a "multidimensional personality disposition which encompasses three basic facets: commitment, control and challenge," (Zerach et al., 2020, p. 1008) and is associated with improved immunity and cardiovascular stress response, lower inflammatory markers, enhanced parasympathetic activation, and is inversely associated with post-traumatic stress (2020).

Hope, as defined herein, is "understood to be a positive motivational state that enables people to persevere towards goals and pathways" (Long et al., 2020, p. 1). Hopefulness has been "conceptualized as a cognitive set involving both agency (i.e., the belief in one's ability to initiate and sustain actions) and pathways (i.e., the belief in one's ability to generate routes to achieve desired goals)" (Goodin & Bulls, 2013, p. 3). As such, hope is strongly linked to agency, and distinguished from optimism, in that believing the future will be good is very different from acting on one's own behalf (Long et al., 2020).

Optimism, as defined in this proposal "may be understood as a disposition towards having expectations that the future will be good (which may be with or without reasons)" (Long et al., 2020, p. 1). As noted, optimism is distinguished from *hope* in that believing the future will be good is different from acting (i.e., an expression of agency) on one's own behalf.

Pain Neuroscience Education (PNE), also known as Therapeutic Neuroscience Education, is education about the neural basis, or neurophysiology of pain and the nervous system. PNE refers to learning about the neurobiology of pain in a productive way that can contribute toward the development of positive expectations for pain reduction (Rondon-Ramos et al., 2020).

A Placebo is a mechanism which includes words and rituals, symbols, and beliefs such as the meaning an individual ascribes to their illness that produces measurable, physiological change (Benedetti, 2011; Eaves et al., 2016). The *placebo effect* has been defined as "the robust and measurable effect of three components: the body's natural ability to heal, the patient mindset, and the social context" (Shashkevich, 2017, para. 1). Likewise, the *nocebo effect* can be elicited when a disadvantageous process or outcome is suggested which produces a measurable change for the worse (Phillips & Pagnini, 2016). In general, the term placebo is used for both positive and negative effects:

> Due to their capacity to improve or worsen symptoms and well-being, placebo and nocebo effects are highly relevant not only in research but also in clinical practice. They contribute to most therapeutic effects, occur regularly in doctor-patient interactions, and are assumed to play a role in the development and maintenance of chronic pain and other diseases. (Brascher et al., 2018, Significance of Classical Conditioning, para. 4).

Priming, or conditioning, refers to the role of the subconscious and influence of the physical environment, or subtle cues, on mindsets, behavior, and physiology. Like placebos and nocebos, primes can be positive or negative, and while they generally imply a lack of awareness of the exposure or influence, in some cases the priming can be consciously determined and no less effective. In other cases, the term *subliminal priming*, indicates that the word or image has

been masked or occluded. *Supraliminal priming* also aims to influence behavior unconsciously, but the image or phrase is not occluded. Distinctions between the two are most often seen in market research, while health priming research appears to prefer the term *subliminal* under both conditions.

Priming interventions aim to influence behavior outside of deliberate planning, and "refer to an increased sensitivity to certain stimuli, resulting from prior exposure to related visual or audio messages" (Eglendi et al., 2018, p. 1). Priming is the experimental manipulation in this study. Such methods are often subtle and unobtrusive, yet they activate "relevant mental representations by external, environmental stimulus" (Sheeran et al., 2013, p. 465). These representations include words and objects in the environment that can be leveraged to various effects on behavior and health (Wryobeck & Chen, 2003).

Contributions to the Field

By utilizing a novel priming method in a chronic pain sample, this study contributes to the field of health priming, and its findings advance the basis for the clinical application of nonconscious methods in health and medicine. Although fully discussed in Chapter Five, this section briefly considers a few of the ways this project contributes to priming literature.

Although nonconscious processes "profoundly affect health and well-being" (Crum & Zuckerman, 2017, p. 1), and appear to be more effective than conscious methods in changing health behavior and outcome (Elgendi et al., 2018; Sheeran et al., 2013; Wryobeck & Chen, 2003), in clinical practice they remain largely untested (Hollands, et al., 2016; Wegesin et al., 2004). Moreover, although researchers advocate that priming be implemented in all physician/patient interactions (Crum and Zuckerman, 2017), many health professionals are

unaware of the value and efficacy of priming for better health outcomes, further justifying the need for evidence-based intervention tools (Papies, 2016, p. 2; Sheeran et al., 2012).

Therefore, in response to these deficits, this study examined a feasible, targeted priming intervention in a notably hard-to-treat population, the results of which contribute to the biopsychosocial model of chronic pain treatment in unique ways. Despite its determining role in health and well-being, the role of hope in physical health, expectancy and the placebo response, is seldom studied (Eaves et al., 2016; Long et al., 2020), yet "is central to how people living with pain . . . adjust their expectations to find meaning in individual treatment narratives" (Eaves et al., 2016, p. 3). This investigation, then, contributes to the field of health priming and the psychological study of hope and its relationship to chronic pain.

Surprisingly, although pain-related beliefs "are better predictors of health-related quality of life outcomes than pain intensity outcomes" (France et al., 2020, p. 577), few studies "investigate pain patients and even less focus on clinical pain" (Brascher et al., 2018, Clinical Context, para. 1). Therefore, this study also contributes to a call for research investigating clinical pain and pain-related beliefs (France et al., 2020).

This investigation also evaluated the trait factor of stress-hardiness—characterized by the three facets of control, commitment, and challenge—which is seldom studied in chronic pain (Zerach et al., 2020). The inclusion of this distinctive measure of resilience and agency contributes to the store of knowledge and a nuanced understanding of the relationship among pain perception, hope and stress-hardiness. Furthermore, this study also allowed for a comparison of hope and hardiness outcomes, verifying the adapted Hope scale (Long et al., 2020) in assessing agency. Further details and additional facets that contribute to the literature are discussed in the concluding section of Chapter Five.

In summary, this investigation is a response to a call for clinical application in the field of health priming and a need for research in clinical pain and pain-related beliefs. It also addresses a scarcity of research in hope and chronic pain. This cross-sectional study (i.e., medical, and psychological) of hope and its relationship to chronic pain fills a need in biobehavioral health. This study also allowed for a novel comparison of hope and stress-hardiness outcomes, supporting the use of the adapted Hope scale (Long et al., 2020) in assessing hope related to agency. Therefore, this project contributes to the broad arena of biobehavioral health, chronic pain, and priming research, while its findings can inform clinical practice and serve as a stepping-stone for future research.

Delimitations/Limitations of the Study

Delimitations

Given the long-term effects of chronic pain on neural pathways, participation was limited to adults experiencing chronic pain for at least one-year, as they are more representative of the chronic pain population, as opposed to those experiencing pain for a shorter duration. To complete the online survey, a computer or cellular device was necessary, therefore a bias in terms of computer literacy is assumed. While libraries, prior to SARS-CoV2, provided computer access, these were not uniformly available in May of 2021. This delimitation (e.g., email survey) skewed the sample toward individuals with access to technology and English fluency.

Whereas Long et al.'s (2020) longitudinal investigation considered detailed medical histories, the primary focus in this study was on hope, pain perception, and the trait of stress-hardiness, not the source or type of chronic pain. Suggestions for future research could include relevant medical histories, including analgesic use, that could be correlated to hope and pain

perception, although MD Anderson found such data to be of little help in analyzing pain (MD Anderson's Brief Pain Inventory Guide).

Further, due to ethical constraints, a delimitation of this project is that it did not assess the difference in hope (i.e., pre- and post-intervention) utilizing a negative prime. The application submitted to the Institutional Review Board (IRB) for human subjects research emphasized the importance of avoiding a negative prime in terms of hopelessness and pain, while acknowledging that the Hope scale itself could act as a positive prime. Likewise, to avoid the potential harm resulting from a standard biomedical tutorial (Claessen et al., 2015), a relatively neutral adaptation on pain was used for the control group. Barring ethical considerations, future research could include a negatively primed group as did Claessen et al. (2015).

Limitations

Since hopelessness can inhibit motivation (Jaremka et al., 2014), it is possible that the self-selection process and response bias attracted individuals inclined toward hope, resulting in a group skewed toward hope. On the other hand, it is possible that high functioning individuals with chronic pain were not inclined to spend time taking the survey, biasing the sample toward more debilitated individuals.

Additionally, to control for Type 1 errors rigorous alpha levels were adopted which could have increased the likelihood of Type II errors. Each of these issues will be discussed in more detail in Chapter Five under Limitations. Future research, with a sample size of several hundred (e.g., patients in a pain clinic), could correct for some of these limitations.

Overview of the Literature

In this brief overview of the literature, findings about the influence of automatic processes in attitudinal and goal formation are contrasted with a lack of clinical research in

health priming methods. This body of literature captures the impact of unconscious processes in attitudinal change and health outcomes, and collectively, provides the necessary foundation from which to explore the rationale for investigating hope-priming in a vulnerable population, such as chronic pain. A more comprehensive literature review can be found in Chapter Two, but an overview of each section is provided below.

Memory Systems: The Priming of Memory

It is recognized that nonintentional, automatic processing affects health in critical ways (Wryobeck & Chen, 2003). Elgendi et al. (2018) argue that "the influence of subliminal priming (behavior outside of awareness) . . . can impact behavior, choices, and actions" (p. 1). Given the "limited effects of intentions on behaviour . . . novel methods . . . are needed that do not rely on conscious intentions" (Papies, 2016, p. 1). As such, *priming,* or *cueing interventions,* aim to influence behavior outside of deliberate planning.

This sensitivity (i.e., conditioning) "involves complex interactions of specialized memory systems mediated by distinct cerebral networks" (Layton & Krikorian, 2002, p. 255). Implicit and explicit memory systems are pivotal to understanding the neuroscience of conditioned responses (2002) and their relevance to biobehavioral health. By considering the nature of memory, and the physiological implications of automatic processing, the sources reviewed clarify how unconscious exposure can prime or condition health behavior apart from conscious goal setting. This section of the literature review (i.e., presented in Chapter Two) contributes to an understanding of the impact of subliminal priming on health and well-being and provides the necessary foundation from which to appreciate the need for, and the importance of, this investigation and others like it.

A Primer on Priming

Priming's relatively recent history is complex. To better appreciate the need for more research, the broad context of priming is considered, along with the limitations imposed on health priming by the sectarian nature of the field.

Although priming's influence on attitudes and behavior is undisputed by researchers, the mechanisms by which it operates, and variations in defining terms, are intensely debated. Despite rapid growth, the field is hampered by the absence of an overarching rubric, and a central, unified (i.e., standardized) vocabulary tying research sectors together. More than semantics, the problem of terminology has become a defining one in priming research, contributing to confusion (Bargh, 2016), and hindering advancement in the field (Hollands et al., 2013).

The lack of conceptual clarity among researchers, and between disciplines, makes a cross-sectional review of priming on health and well-being challenging (Hollands et al., 2013). In the literature review presented in the following chapter, these conceptual conflicts are acknowledged and addressed. This understanding provides the necessary groundwork to locate the current state of health priming research as it relates to this investigation.

Placebo, Mindset & Belief

This intriguing portion of the literature review explores how beliefs or mindsets function as potent medicinal primes, with notable downstream effects (i.e., physiological enhancements) on well-being and health (Levy, 2009; Van Tongeren & Burnette, 2018). Such mindsets, or attitudes, can become actualized by means of subtle environmental cues (Savary et al., 2014), modulating physiology, and medical treatment outcomes (Girgis et al., 2018). A thorough presentation of these conceptualizations and the supporting research (e.g., the trickle-down effects of hopelessness on physiology) anchors this project in an essential way.

Emblematic of priming in health and medicine is the placebo effect. This psychobiological phenomenon is recognized as having a profound impact upon medical and psychological outcomes (Sliwinski & Elkins, 2013), and is believed to underlie virtually every treatment effect (Crum & Zuckerman, 2017). Although priming and placebo research are two parts of the same whole, due to the general separation of the psychological and the medical, placebo research is rarely included in psychological priming studies, and vice versa (Rosen et al., 2017).

In summary, the sources cited in this section explore the connections among mindset, beliefs, and placebo research, as related to physical health, in conditioned (i.e., primed) responses. However, research investigating clinical applications is scarce, leading to the following discussion of hope and chronic pain.

Hope & Chronic Pain

This section reviews evidence supporting the current investigation, arguing the need for methods that foster hope in chronic pain populations as an essential nutriment in positive health outcomes.

Whereas hope and hopelessness are well-represented in depression literature, the role of hope, as related to agency, in physical health has received less attention (Long et al., 2020). Even so, when studied in biopsychosocial models this active form of hope has been linked to reductions in pain and less functional disability (Goodin & Bulls, 2013). The studies reviewed in this section contrast the effects of hope and hopelessness on morbidity, mortality, agency, and quality of life, particularly as seen in a chronic pain population. In Long et al.'s (2020) longitudinal study of more than 12,000 individuals, hope, linked to agency, was found to be significantly protective.

Although priming methods (i.e., nonconscious processes) "profoundly affect health and well-being" (Crum & Zuckerman, 2017, p. 1), and are purported to be more effective than conscious methods in changing health behavior and outcome (Elgendi et al., 2018; Sheeran et al., 2013; Wryobeck & Chen, 2003), in clinical practice they remain largely untested (Hollands, et al., 2016; Wegesin et al., 2004). An exception is a recent investigation using positively primed, neutral, and negatively primed questionnaires in a pain clinic. Those answering the positively primed questionnaire reported less functional disability than those responding to the neutral, or the negatively primed questionnaire (Claessen et al., 2015).

Inspiring this study, Claessen et al.'s (2015) investigation raised the possibility of priming a mindset such as hope in a chronic pain sample. Accordingly, this research project was designed to answer the primary question: Can hope be primed in chronic pain? Or, more specifically, can hope be primed among participants experiencing chronic pain via brief, written communication? To best answer this guiding question a quantitative, randomized experiment was conducted. The following section discusses the rationale for the study's design.

Overview of the Methods

A complete description of the instrument selection and methodology can be found in Chapter Three, whereas this section provides a brief overview of the methods. After discussing the study design and its rationale, the process of recruitment and participation is summarized, followed by the setting for the study, and concluding with the selection of instrumentation.

This pre-and post-test, randomized interventional study investigated whether the critical quality of hope could be primed in a chronic pain population. It also incorporated methods, scales and analytics that would contribute to a nuanced understanding of the relationship among hope, pain, and stress-hardiness. In parallel groups, approximately fifty percent of participants

were exposed to the primed intervention (i.e., hope manipulation) and fifty percent received a traditional tutorial on pain (i.e., control manipulation). Analyses were carried out in both independent groups. In the first analysis, the effect of the intervention was isolated by controlling for the baseline measure of hope and calculating the difference. In a second analysis, the outcome of pain in the present moment was assessed in the same manner.

The survey also evaluated the trait of stress-hardiness which was used to examine the association among hope, stress-hardiness, and pain. Specifically, correlational analyses compared the baseline measure of hope to the mean of hardiness and average pain throughout the year. Typical pain experienced throughout the year and the mean of hardiness were also assessed in the same manner.

The primed tutorial was modeled after PNE concepts reflecting advances in the neuroscience of pain (Ashar et al., 2021). The development of a neutral tutorial presented a challenge, as a strictly neutral tutorial (e.g., organic gardening) selects against a pain focus and would not enable an adequate comparison of the two groups as the experimental group (i.e., hope manipulation) was required to focus on pain throughout the survey. An organic gardening tutorial, by way of example, side steps that condition while introducing another variable: distraction from pain, thereby obfuscating the objective of the study. Nor could the neutral tutorial include negative pain conceptualizations and risk inducing a nocebo effect. Thus, the condition for both groups was exposure to information on pain but in somewhat different ways—one in a primed capacity and one in a relatively neutral condition. In this way, by requiring all subjects to focus on pain, results are more applicable to clinical practice, in that, patients are focused on pain when seeking treatment or participating in PNE.

This design helped the researcher answer the following questions:

What effect does exposure to a positively primed Pain Neuroscience Educational (PNE) tutorial have on the quality of hope in respondents experiencing chronic pain?

Is there an effect on the perception of pain after reading either traditional or positively primed information on pain (i.e., do pain levels fluctuate)?

What is the relationship among hope, hardiness, and the perception of pain?

Participants: Recruitment, Consent & Privacy

An ongoing criticism of research in social psychology and priming is that of inadequate sample sizes. To avoid this pitfall and draw meaningful conclusions from the data, an *a priori* power analysis was performed. Since the adapted Hope scale is a novel instrument, there was no empirical precedent upon which to calculate a sample size to ensure adequate power. Likewise, the author could not locate a similar study in extant literature to compare the hope difference and pain difference as outcomes in two randomly assigned independent, parallel groups. Therefore, to estimate the sample size, Cohen's (1988) Power Table was consulted. Assuming a medium effect size, with alpha probability of .05 and .10, it was established that each group needed either 36 or 38 participants respectively (i.e., at least 75 participants total). Despite the current SARS-CoV2 pandemic, more than 200-participants were recruited and 154 qualified.

The recruitment announcement invited adults experiencing chronic pain (e.g., chronic migraine, etc.) for at least one-year to participate in an online survey titled "understanding pain" and offered subjects the opportunity to help researchers learn more about the relationship between pain and well-being. To protect the nature of the investigation, the title of the announcement differed from that of the study, since disclosing the topic of hope could alter perception and be counter-productive in terms of subliminal priming research. Therefore, well-being was the preferred term for the announcement (see Appendix A).

To maximize participation, the web link was posted on social media and sent to email subscribers, associates, colleagues, physicians, physical therapists, and chiropractors (i.e., snowballing). Permission was granted to place cards with a QR code linking to the study in the waiting areas of a general practitioner, two private physical therapy offices, a hospital pain clinic, and two chiropractic offices. The researcher was not present so there was no interviewer bias and respondents chose when and where to participate. An incentive was a 30-minute relaxation audio available via a link that could be accessed upon qualifying to participate in the survey.

The Setting

The setting for the study was a designated website containing a link to the survey so that participants could complete the survey at a convenient time and place. The Likert scale questionnaires, instruments, and consent were developed and tested using Survey Monkey software before being embedded into the site. Participants clicked on the link provided to take the survey. Anonymity was ensured at every step: Tracking was disabled via Survey Monkey software, and no identifiers were collected at any time.

Instrumentation

Standardized scales, noted for their reliability and validity, were selected for their ability to address the research questions posed within this paper while strengthening the methodology and reducing complications. Short-form scales were preferred, and in some cases adapted, to reduce negative priming and survey completion time. Although this section presents the scales based on their qualities for inclusion, a complete discussion of instruments and their adaptations can be found in Chapter Three. A copy of each instrument can be found in Appendices C, D, E and F.

For clarity, the instruments are listed briefly, and then discussed individually, and collectively, as to their appropriateness and measurement characteristics. The primed and neutral tutorials (i.e., interventions) are discussed under the section titled, *The Neutral and Primed Tutorials*. The scales are as follows: the Five-Item Pain inventory; the Hope scale; and the Adapted Short-form Hardiness scale.

The Five-Item Pain Inventory

To establish the nature of an individual's perception of pain (i.e., severity) and its effects (i.e., interference), the first scale is an adaptation of MD Anderson's Brief Pain inventory (BPI Short-form). The BPI Short-form is a widely used, 13-item (Yes, No, numerical rating scale, and 0-10 Likert scale) self-report instrument that has been validated and shown to be reliable over time in terms of pain, as well as functional ability or disability (Correll, 2007; Jelsness-Jorgensen, et al., 2016). Its internal consistency (Chronbach alpha) ranges from .80 to .92. The test-retest reliability is highest for short-term pain and average pain ratings (.93 to .78). Test-retest reliability for current (i.e., "now") pain ratings is naturally lower (.59) due to the changing nature of pain (Cleeland, 1991).

For the purpose of this investigation, the BPI Short-form was adapted in several ways. For example, it is designed to be completed on paper and includes a diagram on which individuals are asked to shade in the areas where they experience pain. Since the area affected by pain (e.g., neck, arm, leg, etc.) was not evaluated in this investigation, this item was eliminated. Additionally, an open-ended question asking that respondents list the medications and treatments they are receiving was eliminated. Not only were these not evaluated in this project, but the item was found to be of little value in assessing pain (Cleeland, 1991).

Finally, instructions for the paper and pencil version ask participants to circle the number that best answers the question. As indicative of online surveys, individuals clicked on the number indicating the best answer rather than circling the number. Redundant questions that could unnecessarily fatigue participants were also eliminated, leaving five questions assessing current pain, typical pain throughout the year, and pain interference in three domains: general activity, walking and life enjoyment. The adapted version of the BPI Short-form—the Five-Item Pain inventory—can be found in Appendix C.

The Hope Scale

Although there are several hope/hopelessness scales from which to choose, the recently adapted Hope scale (Long et al., 2020) uniquely reflects the conceptualization of hope examined within this investigation:

> Empirical and philosophical work suggests that hope is distinct from optimism despite the continued conflation of the two terms in both popular and academic discussion. Some of the conflation may have emerged from the fact that agency and pathways are likely sources of hope, but also sources of optimism. In returning to more classical understandings of hope, hope may be distinguished from optimism in that hope may be understood as a disposition towards having an attentional focus on the possibility that the future will be good, characteristically in the face of difficulty. Optimism, on the other hand, may be understood as a disposition towards having expectations that the future will be good (which may be with or without reasons). (Long et al. 2020, p. 1.)

Therefore, in a novel adaptation, Long et al. (2020) reverse coded items derived from two other measures (Everson et al., 1996; Beck et al., 1974) to construct a scale of hope rather than hopelessness, which will be discussed further in Chapter Three. The self-report scale consists of

four statements rated from one to six (Strongly Disagree to Strongly Agree): “It is possible for me to reach goals; the future seems hopeful to me; I do expect to get what I really want; There is use in trying” (Long et al., 2020 p. 1).

While empirical evidence supports the health promoting effects of hope, both mentally and physically, previous Hope scales (Everson et al., 1996; Beck et al., 1974) could be gauging a lack of depressive symptoms which is not the same as the actionable quality of hope and the perseverance toward goals (Long et al., 2020). Further, the chronic pain population is not classified as psychiatric which also argues for the use of this revised scale.

Therefore, Long et al.’s (2020) revised Hope scale captures a distinct aspect of hope that makes it possible to conceptualize the relationship between chronic pain and hope inspired agency, and was, therefore, the preferred Hope scale for use in this study. For ease of comparison, Appendix C includes the original negatively phrased items derived from Everson et al. (1996) and Beck et al. (1974).

The Adapted Short-form Hardiness Scale (DRS-II, Short-form)

The concept of stress resistance, or hardiness, was established by Kobasa (1979) as a protective personality trait that is stable over time. Kobasa (1979) found that—despite high scores on the Rahe and Holmes Life Event Checklist (LEC) which proved predictive of serious illness—individuals with high levels of hardiness did not become seriously ill. Since then, the concept of hardiness has been empirically demonstrated to be a moderator in illness (Gebhardt et al., 2001), and has also been found to correlate to the Big 5 Personality inventory (Kardum, et al., 2012).

Although the inverse relationship between hardiness and chronic illness is well-established in the literature, very little has been published examining the relationship between

hardiness (i.e., control, commitment, and challenge) and chronic pain (Zerach et al., 2020). Various resilience scales have been used in chronic pain, but they are frequently conflated with optimism (Goodin & Bulls, 2013); therefore, comparing and contrasting Kobassa's findings (1979) with the actionable quality of hope was a goal of this study.

Unfortunately, among hardiness scales, there is no "gold standard" (Windle et al., 2011), with various scales measuring different properties or attributes of stress-hardiness, and few having strong test-retest reliability. For example, some hardiness or resilience scales have been found to measure either an individual's ability to bounce back or seek support from outside sources, neither of which adequately captures the nature of hardiness as defined by Kobasa (1979). Yet, the DRS-II short-form (Sinclair et al., 2003), based on Bartone's (1991) earlier work, uses language that directly relates to an individual's capacity to take personal responsibility (i.e., control) despite challenges.

After reviewing a number of these scales, the DRS-II was found to have good overall internal consistency (Chronbach's alpha .83), but test-retest reliability has been difficult to establish for this instrument. However, the DRS-II is based on the Dispositional Resilience scale (DRS), which was found to have a coefficient measured at .78 across numerous populations (Bartone, 2007). The DRS, though, seems to be more relevant for language groups other than English (Bartone, 2013), so, for this investigation the DRS-II short-form is preferred (Sinclair et al. 2013).

The Short-form Hardiness scale contains 18-items, rated on a five-point scale from one (Definitely False) to six (Definitely True). This instrument evaluates six subscales: control or self-efficacy; powerlessness and/or fatalism; commitment, which is defined as being interested in and fully engaged with life; alienation, which refers to a sense of meaninglessness and isolation;

challenge, which is the "tendency to view stressors as challenges rather than threats;" and rigidity which is gauged by a lack of flexibility and resistance to change. (Sinclair et al., 2003, p. 11).

The internal reliability of the six subscales is as follows: Control (.79); Powerlessness (.93); Commitment (.79); Alienation (.88); Challenge (.77); and Rigidity (.66) (Sinclair et al., 2003, p. 13).

The ways in which the Short-form Hardiness scale was adapted for the purposes of this investigation are discussed in Chapter Three. The adapted scale and guide to interpretation can be found in Appendix E.

The Neutral and Primed Tutorials

Participants were randomized to either a control (i.e., neutral manipulation) or experimental group (i.e., hope manipulation). The experimental group (n = 68) reviewed a primed 219-word tutorial on the advances in the neuroscience of pain and the control group (n = 54) reviewed a 219-word supportively written tutorial on the nature of pain (see Appendix F). Later, a third group (n = 32) was exposed to the primed tutorial but without the hardiness scale.

In designing the primed tutorial, every effort was made to present the essential, but potentially disruptive data, in a supportive way. For some, new information, albeit positively presented, could trigger a conflict of authority with treating physicians, surgeons, or the medical system (Knowles et al., 2015). So, although pain re-education suggests that individuals can diminish pain by learning to perceive their pain in a non-threatening manner (Ashar et al. 2021), this idea was not stated to minimize conflict. As a result, the primed tutorial reflects PNE content with an emphasis on new findings in pain neuroscience, along with references for interested individuals.

Although the control group was still required to focus on pain-related content, care was taken to construct a relatively neutral tutorial to avoid the nocebo effect. Thus, the control group reviewed a 219-word tutorial on the unique nature of pain (see Appendix F).

Procedure

After qualifying (e.g., adults experiencing chronic pain for more than one year) and establishing consent, participants completed a brief demographic survey followed by the Five-Item Pain scale, the Hope scale, and the Adapted Short-form Hardiness scale, before being exposed to either the Primed or Neutral tutorials consisting of 219-words each. Upon reviewing either the primed or neutral tutorial, both groups again completed the Hope scale, and rated pain experienced at the present moment from 0-10.

The order of instrumentation was structured in such a way as to best answer the research questions. In the pre-test, participants focused on the nature of their pain immediately prior to completing the Hope scale. Since the Hope scale also assessed agency it segues into hardiness, a measurement of self-mastery. The post-test was designed to assess hope immediately after the intervention, concluding with a single-question pain assessment.

This pre-and post-intervention survey (with an experimental group and a control group) addressed these research questions:

What effect does exposure to a positively primed Pain Neuroscience Educational (PNE) tutorial have on the quality of hope in respondents experiencing chronic pain?

What do participants report on the perception of pain after reading either neutral or positively primed information on pain (i.e., do pain levels fluctuate)?

What is the relationship among hope, pain, and hardiness in this sample?

The following section delineates the procedure followed by participants and the data collection process.

Data Collection Procedures & Tools

The procedure for participants was as follows: On a designated website, www.UnderstandingPainStudy.com, participants clicked on the link provided and established qualifiers (i.e., age and chronic pain duration of at least one-year). After reading the consent form, subjects selected "continue" to agree to the terms of participation (see Appendix B). After consenting, a brief demographic survey was completed (e.g., age, gender, country of origin), and individuals were able to download a 30-minute relaxation audio using psychoacoustics as an incentive, whether completing the study or not.

After completing the above, administration of the first wave of instruments began. Participants completed the Five-Item Pain scale (see Appendix D), the four-item Hope scale (see Appendix C), and the 10-item Adapted Short-form Hardiness scale (see Appendix E). The experimental group then reviewed a primed PNE tutorial of 219-words, while the control group was exposed to a relatively neutral pain tutorial, with the same word count. See Appendix F to compare the two tutorials. After reviewing either the primed or neutral tutorial, post-test measures began. Both groups again completed the four-item Hope scale and rated the level of pain or discomfort in the present moment on a scale of 0-10.

Data collection began when target participation goals were reached. After 84-participants completed the survey using the Primed tutorial, data was collected and uploaded into Excel and IBM's Statistical Package for the Social Sciences (SPSS). The primed tutorial was then replaced with the neutral (i.e., control) tutorial. After 77-participants completed the Neutral survey, data was collected and uploaded into Excel and SPSS software. Of the 161-respondents, 122

qualified. Findings then indicated the need for a third group (n = 32). This group reviewed the primed tutorial, and all measures were equal except this group was not exposed to the Hardiness scale.

Confidentiality & Anonymity

As indicated, the survey was administered online via a link on a designated website, and no identifiers were collected ensuring anonymity throughout the process. All participants were treated equally.

The methodology is discussed in detail in Chapter Three, and the result of each corresponding measure is analyzed in Chapter Four and interpreted in Chapter Five. To summarize this section, the strengths of the investigation are sample size, randomization, standardized instrumentation adapted to the purposes of the investigation, and a unique priming method. The following and final section of this chapter concludes with an outline of the dissertation.

Chapter Outline

In this introductory chapter, the primacy of non-conscious methods in modifying implicit attitudes and beliefs affecting health and well-being was discussed. The context and statement of the problem, the significance and purpose of the study, the guiding research questions, limitations, and definitions of terms were all covered herein.

The second chapter reviews the broad literature on priming, mindset, attention bias and placebo research, as well as conflicting definitions and sectarian limitations, with a focus on health and concomitant well-being. This chapter concludes by assessing the current state of health priming research and advocates for a more inclusive framework to advance the field. It

also sets the stage for the study by examining extant literature on the effects of hope and hopelessness on physiology.

Chapter Three provides an overview of the experiment: the pre-and post-intervention design and methodology selected to best answer the research questions. The instrumentation, setting, participant recruitment, and data collection process are all clearly detailed therein.

The fourth chapter presents the findings as they relate to each research question, while the final section, Chapter Five, interprets the data accordingly. The strengths and limitations of the study are discussed in detail along with directions for future research and clinical application. The final sections of Chapter Five analyze conclusions that can be drawn from the data and how the project contributes to health priming research and biobehavioral medicine, while furthering a nuanced understanding of the relationship among hope, pain, and hardiness.

To better appreciate the need for research in clinical application, the next chapter will consider the historical context of priming, its interdisciplinary foundations and the limitations imposed on health priming by the sectarian nature of intersecting fields.

CHAPTER TWO: LITERATURE REVIEW

As thoughts, feelings and behaviors have downstream effects on physiology, and can be influenced by environmental triggers without conscious awareness (Bargh, 2016; Phillips & Pagnini, 2016), the literature reviewed in this chapter provides the necessary framework from which to evaluate the study's purpose, design, and its contribution to clinical application. To that end, this chapter offers an interdisciplinary review of priming (i.e., non-conscious methods) on well-being and concomitant physical health. Each section contributes to an overview of the current state of health priming research, supporting the need and rationale for this investigation.

To highlight the impact of subliminal priming on physical health and well-being, divergent and intersecting tracks of research are included, such as: *implicit* and *explicit memory, attention bias modification, supraliminal and subliminal priming,* and *placebo/nocebo* research, each of which will be defined herein. This understanding provides the necessary framework in which the guiding research questions are conceptualized; namely, can the critical quality of hope be primed in respondents experiencing chronic pain for at least one-year?

Running parallel to a discussion of health priming is the problem of terminology. More than semantics, the issue has become a defining one in priming research, contributing to confusion among students and researchers (Bargh, 2016). The lack of conceptual clarity among researchers, and between disciplines, is a significant factor limiting progress in the field (Hollands et al., 2013). This appears to have inhibited a cross-sectional review of priming on health and well-being, as this author could not locate such a compendium.

To appreciate the challenges of an interdisciplinary review, and in the interest of clarity, the first two sections of this chapter provide relevant foundational concepts. The first explores the nature of memory, which is fundamental to priming. The second section offers a brief history

of priming research. In these two sections, terms are defined as they arise in context, but it is the third section that addresses conflicting terminology associated with research findings leading to the rationale for the terminology used herein. The remaining sections review priming research, including key concepts such as placebo/nocebo effects, mindset, and attention bias. The literature reviewed is relevant to adults in general, but the final section focuses on disparities in health and aging that appear to be mitigated by certain priming interventions. Despite the growth of priming literature over the last two decades research investigating practical application is scarce, leading to the rationale for this project.

Consequently, every effort has been made to limit the discussion (i.e., definitions, viewpoints, examples, etc.) to closely adhere to health priming concerns. Each section compares and contrasts conflicting viewpoints, and where possible, identifies areas for further investigation. Examples are cited throughout the paper to illustrate concepts and capture the nature of the content. Unless stated otherwise, these are simplified to advance the discussion, and are not derived from a particular source. Definitions are stated as simply and briefly as possible, so as not to distract from the flow of argument. With that in mind, the literature selected reflects a wide swath of peer reviewed articles in medical, behavioral, and psychological journals. Multiple databases were used including Google and Google Scholar, PubMed, and Lesley Library. More than 150 journal articles and book chapters were determined to be relevant to this paper, and far more were reviewed. It should be noted, however, that this paper is not intended to be a complete discussion of each of the defined constructs, nor provide an exhaustive review of the literature; it is, rather, a selective, thematic review of the therapeutic potential of health priming.

How We Know: The Priming of Memory

Simply put, health education is geared toward motivating individuals to adopt patterns of behavior that improve both physical and psychosocial well-being—a subjective quality of life shown to reduce risk of morbidity and mortality. Despite such a straightforward endeavor, "recent research has shown the limited effects of intentions on behaviour, so that novel methods to facilitate behaviour change are needed that do not rely on conscious intentions" (Papies, 2016, p. 1). Since priming impacts behavior, choices, and actions, *priming,* or *cueing interventions,* aim to influence behavior outside of deliberate planning. *Priming effects*, or automatic responses, result from this conditioning.

To appreciate this sensitivity (i.e., conditioning), and how it emerges from experience, it is useful to understand two specialized memory systems: the explicit (i.e., declarative, or conscious) memory system, and the implicit (i.e., nondeclarative) system (Layton & Krikorian, 2002). *Implicit* learning occurs in the absence of conscious or deliberate awareness. Although there are several forms of implicit learning (Squire, 2004), only two will be discussed here*:* *procedural* and *emotional. Procedural* learning, often referred to as muscle memory, occurs through repetitive motor actions such as riding a bike or typing that can be acquired and eventually performed without conscious attention to the motor actions. *Emotional learning* occurs during emotive experiences, such as feelings associated with particular songs. *Explicit memory*, on the other hand, is available to conscious awareness and consists of *semantic memory*—the store of facts and knowledge—and *autobiographical memory*, a subset of episodic memory which contains the details—the who, what and when—of personal events and experience (Hine & Tsushima, 2018).

There are different models of the processes by which the learning and memories from different systems are activated, and how conflicting schemas affect behavior. Sheeran et al.

(2013) argue that such conflicts have largely overtaken what should be the primary point: the "appreciation of how nonconscious processes can promote as well as compromise health" (pp. 460-461).

Although semantic, autobiographical, procedural, and emotional memory are mediated by and operate in separate neurobiological systems they can, and do, interact. To illustrate how implicit and explicit memory are involved in a conditioned, or primed response, consider the example of biting into a lemon. After the initial experience, when exposed to photos of lemons or even the word *lemon*, one may automatically salivate. Recognition of the word requires explicit (i.e., semantic) memory, but the recollection of the sour taste is an implicit, automatic response of salivation. Simply put, exposure to the sour taste could cause a *conditioned* or *nonconscious* response to the word or an image of a lemon.

Processes such as these, that are not directed by an individual's conscious intention, are considered *automatic*. If, for example, lemons provoke an allergic response, the conditioned body memory could be aversive, and, among other things, trigger a physiological state associated with anxiety. Such conditioned associations involve implicit learning and represent *nonconscious* learning or *implicit priming* (Payne et al., 2016).

Extending the example of the lemon, previous experience and cultural influence are powerful examples of how "priming is closely related to top-down processing" (Hardin, 2018, Day 1, para. 10). *Top-down processing* is thought to occur without conscious awareness and is primed or conditioned not only by experience, but via expectations (Gaspelin & Luck, 2018). An often-cited investigation by Bornstein et al. (1987) found that frequent exposure to a stimulus resulted in a preference for that stimulus, even though the individuals were unaware of the exposure (i.e., "the exposure effect," p. 1070). Whether or not one is aware of the experience:

> once such a situated conceptualisation has been stored, activating any of its elements on later occasions can re-activate its other elements, with those elements then more likely to be enacted. In other words, an action previously performed in a certain context can be triggered automatically by a contextual cue, leading to nonconscious effects on behavior. (Papies, 2016, p. 6)

Therefore, "to promote behavioral change, it may thus be beneficial or even necessary to develop intervention strategies that allow for a change of implicit evaluations" (Vanaelst et al., 2016, Introduction, para. 1). Considering the implicit, or:

> nonintentional effects on health behaviour, such as the effects of habits, impulses, and nonconscious goals . . . through the activation of cognitive structures by specific situations . . . [i]nterventions should therefore be situated to change these effects, either by changing the critical cognitive structures (training interventions), or by . . . priming as a cueing intervention tool to activate health goals. (Papies, 2016, p. 1)

In sum, the nature of memory, and the physiological implications of automatic processing clarify an important component of this project: how unconscious exposure can prime or condition attitudes or health behavior apart from conscious goal setting. In experimental and other branches of psychology, such conditioned responses often form the basis of cueing or priming research; therefore, to aid in locating the current state of health priming research, a brief history of priming is discussed in the following section.

A Primer on Priming

Priming, then, is a form of implicit learning (Claessen et al., 2015; Sliwinski & Elkins, 2013), and has been referred to as "pre-programming of the mind" (Friedman, 2013, p. 559). Although priming techniques are often subtle and unobtrusive, they nonetheless activate

"relevant mental representations by external, environmental stimulus" (Sheeran et al., 2013, p. 465). As with placebos, these representations include words, rituals, symbols, and beliefs as well as objects that can be leveraged to various effects on behavior and health (Eaves et al., 2016; Wryobeck & Chen, 2003).

In the previous example, salivating to the idea of a lemon illustrates a conditioned, nonconscious response. That such a response could be primed to influence behavior, came to the fore in the 1950s when subliminal messages (i.e., presented for brief periods below the threshold of awareness), in movie theatres encouraged the consumption of Coca-Cola and popcorn. Despite conflicting viewpoints on whether the increase in consumption was statistically significant, two decades later the Federal Communications Commission banned subliminal advertising from television (Bergland, 2015).

However, in both marketing and psychological sectors, the study of environmental cueing is a relatively recent one. Less than one-hundred-years ago, "it was a radical thing in experimental psychology to suggest that one's experience of the outside world was determined by anything other than the stimulation 'out there'" (Bargh & Chartrand, 2000, p. 312). The early foundations of what is known today as priming, and perceptual neuroscience, can be found in the "study of visual illusions . . . [that illustrate individual differences in] perception of size, distance, and brightness" (p. 312), such as the well-known, ambiguous image of Rubin's vase. Nevertheless, for decades individual variability in perception was largely ignored (Phillips & Pagnini, 2016), and treated as "error variance" (Bargh & Chartrand, 2000, p. 313).

Eventually in the 1950s, these perceptual variations became known as *priming*. If a snapshot of a lemon was flashed below the threshold of perception during a lecture, and observers noted the rate of water consumption before and after, the process was termed as

passive priming. As an aside, priming effects in medical and psychobiological research increased in the 1950s as well, but due to the prevailing biomedical model—separating mind and body—such research is incorporated in placebo literature but does not appear to be included in priming history literature. These effects are concerned with physiology—how alterations in perception can impact measures such as heart rate, blood pressure and insulin levels—and will be further considered in the section on placebo. As such, this section concerns itself with the history of priming as presented by the cited texts.

While passive priming refers to a lack of awareness of the exposure, this term was largely replaced as distinctions were made between *subliminal* and *supraliminal priming* which are discussed in the following section. In the 1970s a novel series of experiments showed that priming could alter one's views of, or assumptions about, other people outside of intentional awareness (Fatemi, 2016). Findings in the following decades paved the way for the current distinctions between implicit and explicit memory (Bargh & Chartrand, 2000). But it wasn't until the 1990s that priming research began to probe behavioral and motivational effects in a systemic way (2000).

In market research, and within various branches of psychology—applied, cognitive and experimental, to name a few—a variety of priming or conditioning methods have been evaluated. Although it is beyond the scope of this paper to deconstruct priming methodologies, the few examples that follow illustrate how closely related they can be, and why it is not always necessary to many health investigations to distinguish the technique.

Semantic and *visual priming* refer to words and visual cues, respectively (Friedman, 2013). *Context priming* "is said to occur when a word is used to accelerate the processing of stimuli that are likely to occur within the given context" (Elgendi et al., 2018), such as when

"table" triggers the word "chair." *Evaluative conditioning* is often used to prime implicit attitudes and refers to pairing a positive stimulus to a negative one to reduce the negative effect of the aversive stimulus (Claessen et al., 2015). For example, in one evaluative conditioning study images of obesity were paired with various types of snacks to determine the effect on food choice (Sheeran, et al., 2013). *Conceptual priming* can be somewhat difficult to distinguish from *mindset priming*, as both can refer to stereotypes that may influence non-conscious goals (Friedman, 2013). For example, participants might be exposed to either optimistic or depressing scenes, and then asked to complete a problem-solving question. *Sequential priming* probes the connection between two different concepts. In such a case, participants might be exposed, for example, to either harsh or kind facial expressions, and then probed for how generously they might behave under certain conditions (Bargh & Chartrand, 2000; Friedman, 2013). And lastly, *repetition priming* "refers to the change in responding to a word or an object as a result of a previous encounter with that same item" (Henik & Carr, 2002, Inhibition).

Apart from the priming techniques mentioned above, there are further distinctions in the literature, but as the various methods (e.g., semantic, mindset, sequential) are seldom distinguished in biopsychological research, they will not be considered here. Rather, in many priming studies the specific conditioning method (e.g., evaluative, or conceptual, etc.) is not labeled but simply referred to as *priming*. Most importantly, for the purpose of this paper, what all of these methods "have in common is a concern with the unintended consequences of an environmental event on subsequent thoughts, feelings, goals, and behaviors" (Bargh & Chartrand, 2000, p. 317). For clarity, and to adhere to a standard that can apply across all research sectors, priming is the preferred term herein.

In the last two decades, pioneering work on priming has been advanced by research in mindsets and creativity (Bargh, 2016; Moskowitz, 2009; Friedman, 2013), which will be considered in the section on mindsets. Organizational psychology, too, has contributed findings on the use of primes such as "photographs, music, artifacts and scents . . . [to] promote desired behaviors that are aligned with organizational strategy" (Friedman, 2013, p. 561). Although the majority of psychological research in priming has reportedly been for marketing purposes (Karremans et al., 2006), the robust findings therein contributed to a growing interest in priming for health (Smarandescu & Shimp, 2015).

Given that priming effects can interact with autobiographical memory, it is understandable that priming opportunities—particularly when concerning health—should be selected based on the characteristics and needs of the individual (Hine & Tsushima, 2018; Sliwinski & Elkins, 2013). Bearing this out, in many investigations, a null effect is found when the goal or prime is not syntonic with the individual's predisposition, or value system (Sheeran et al., 2012). For example, individuals who are not hungry are less influenced by food related primes (Bargh, 2016). As in operant conditioning, "persuasive messages can motivate behavior change, but only if people are receptive" (Kang et al., 2018, Abstract, para. 2). This is one reason some find priming unsuitable to large scale interventions (e.g., populations); while others, such as Papies (2016), advocate priming to encourage healthy food selection and exercise in communities at large.

A review of priming's relatively recent history also reveals the complexity and variability of personal processes, such as memory and perception, that may affect one's sensitivity to a prime. Although priming's potential to influence behavior is undisputed by researchers, the

mechanisms by which it operates, and variations in defining terms are intensely debated, as the next section will show.

A Defining Problem: Variations in Terminology

Having considered a brief history of priming, and the nature of memory, it is important to note that various disciplines, and even experts within a discipline, define the nuances of priming in various ways. This understanding establishes a framework for the preferred terminology herein and provides the necessary groundwork to explore priming in a more inclusive, and interdisciplinary manner. For example, in cognitive and experimental psychology *automaticity research* involves the study of the way individuals may automatically perceive themselves, others, situations and events, whereas *priming research* is "more concerned with effects of the current situational context and how these environmental features cause the average individual to think, feel, and behave differently than otherwise" (Bargh & Chartrand, 2000, p. 312).

Despite this distinction, automaticity and priming techniques are often applied interchangeably for practical reasons. As a result, even Bargh and Chartrand (2000) acknowledge that "automatic processing is . . . a grab-bag of the various types of processing that are considered *not conscious*" (p. 314). Furthermore, the term nonconscious priming generally applies to participants who are unaware of the effects of a prime, but there are exceptions. Moskowitz & Gesundheit (2009), for example, caution that while implicit priming can occur without awareness, it can also occur "despite awareness of some component(s) of the process" (p. 207). Since implicit priming may, therefore, occur through both nonconscious and conscious components, for the purpose of this paper the term priming is preferred, but is not distinguished from automaticity.

There is significant disagreement over what constitutes a *subliminal* or *supraliminal* prime. Using an example from Cohn et al. (2014), an individual exposed to the word *cancer* may decline the offer of a cigarette—in which case, the word "cancer" could, by some, be considered subliminal, while others argue that because the prime was not flashed below the threshold of awareness it is *supraliminal* (i.e., above the threshold of awareness). To illustrate the disagreement, in one well-publicized case, investment bankers were offered money if a coin toss resulted in more heads than tails (2014). The experimental group, having been uniquely primed by discussing their identity as bank employees, was found to have cheated significantly more on the coin toss than the control group who had simply chatted about their hobbies. According to Bargh (2016), "whenever the participant can accurately report afterwards on the experimental hypothesis, this is not 'priming' as the term has been used in psychology over the past 40 years" (p. 49). Since the bankers were unaware of the prime (e.g., conversation) and its effect on cheating, the prime and its portended effects could be considered *subliminal*, or outside the realm of consciousness.

Others disagree, arguing that if an individual is aware of the prime at all, but not its purported effects, it is still considered to be a *supraliminal* prime (Friedman, 2013; Elgendi et al., 2018). This means the person cannot be aware even of "the presence of the priming stimuli" (Bargh, 2016, p. 49) for the prime to be considered subliminal. According to Bargh, this definition is problematic for several reasons:

> it is not the historical definition of 'unconscious' as used by Darwin, Freud, and others, to whom it meant effects of (supraliminal) stimuli of which the person was not aware; it is overly restrictive and implies (alas, to many younger students and researchers in our field) that as long as a person is consciously aware of the primes they are also aware of

> and intend any influence of the primes (because these are other qualities traditionally associated with 'conscious' processing, and worst of all, it conflates 'unconscious' with 'processing very weak and brief stimuli' and of 'conscious' with 'processing strong and long lasting stimuli' . . . in many priming studies, for example, individuals are consciously aware of the prime, but are nonetheless unaware of the ways in which the prime affects their subsequent cognition, affect, or behavior. (Bargh, 2016, p. 49)

Emblematic of the interplay between the subliminal and supraliminal, "some studies showed that placebo hypoalgesia and nocebo hyperalgesia that had been conditioned with supraliminally presented cues (i.e., explicit conditioning) can be activated by subliminally presented cues" (Brascher et al., 2018, Significance of Classical Conditioning, para. 2).

Yet, Bargh (2016) also argues that in *subliminal priming* the prime must be very brief, immediately masked (i.e., hidden), and followed by a screening for awareness of the prime. Such research can be particularly complex, gauged through electroencephalographic and eye movement tracking, along with other computer assisted programs, where words are occluded (i.e., masked), and input is flashed outside of the visual field (Elgendi et al., 2018; Friedman, 2013). Cognitive psychology studies, for example, "often include very short experimental observation periods (milliseconds) to understand the impact of a brief exposure on an individual's decision-making when exposed to a subsequent stimulus" (Elgendi et al., 2018, p. 2). It should be noted, though, that the goal in masking—to reduce conscious awareness of primes (Bussche et al., 2013)—is often to study the role of the subconscious or isolate a particular feature of the subliminal process:

> One point of criticism regarding prevalent models concerns the classification of physiological processes into being either conscious or unconscious. Evidence suggests

> that it is conceivable that most, if not all, bodily functions, including perception and behavior, have 'unconscious' (i.e., outside a person's awareness; cf., e.g., blindsight and implicit operant conditioning and 'conscious' (i.e., verbally represented) portions. (Bascher et al., 2018, Significance of Classical Conditioning, para. 4).

Understandably then, not all priming investigations make use of this structure. Health priming is not always concerned with isolating a particular aspect of the unconscious, and so it may be argued that the greater effect, the better. Consider, for example, that adjustments in micro-environments, such as workplaces, have been shown to influence health behavior, and even outcome (Friedman, 2013), in which there is little point in occluding the prime, or making it brief. Environmental and organizational priming research, for example, has contributed to a *choice architecture* (e.g., design that supports the decisions or choices being made in a particular context), that leverages the environment—including web design—for marketing purposes or health and well-being choice promotion (Thorndike et al., 2012; Shafir et al., 2012; Thaler et al., 2012).

The effects extend to healthcare architecture. For example, when abstract art was replaced with photographic art, there was a significant reduction in white coat hypertension (Harper et al., 2017; Hollands, 2016). Therefore, the distinction between the two types of priming—subliminal and supraliminal, as described above—has become blurred, and *subliminal* is frequently used in both contexts. As a result, many advocate that research "on implicit conditioning should be expanded and diversified," by more inclusive classification of "physiological processes into being either conscious or unconscious" (Brascher et al., 2016, Significance of Classical Conditioning, para 4).

Conflicting definitions and standards are indicative of the recent emergence of health priming and the lack of an established framework to contextualize appropriate terms and conditions according to the category, or goal, of the research. In fact, some environmental health priming research is not even referenced as priming (Thorndike et al., 2012), perhaps due to the associated arguments. Yet, studies using a variety of health-related primes, both explicit (i.e., indicating that one is aware of either the nature of the research or of the potential effects of the prime) and implicit, have documented effects on blood pressure, blood sugar, and even memory (Wegesin et al., 2004). In health priming, therefore, such distinctions may hold less relevance than in other sectors such as experimental and applied psychology.

Bearing this out, Friedman (201) explains that environmental cues can help achieve a synchronous alignment between conscious and unconscious motivation, for greater effect. In fact, multiple studies show that by deliberately increasing the strength of a prime at the conscious level, attitude, and performance improved, exceeding subliminal priming, conscious attitudinal, and goal setting (Friedman, 2013; Moskowitz, 2009). Similarly, in some cases conscious and unconscious primes have demonstrated "identical perceptual strength . . . but the effects for conscious trials were significantly stronger" (Bussche et al., 2013, p. 1). By way of example, in research on social anxiety, only individuals consciously aware of the prime benefited from the intervention (Maoz et al., 2013). In another investigation, null results were found when priming was subliminally presented, but not when consciously presented (Akram et al., 2018). Papies (2016) argues that the emphasis in priming should simply be on processes other than those requiring an intentional focus, regardless of whether one is aware of the prime or not.

Two more conceptual conflicts must be acknowledged briefly before concluding this section. When defining top-down processing in the previous section, it was assumed that the

term was consistently used in the same way by all; when, in fact, this too, represents a revolving door depending on the researcher. Gaspelin and Luck (2017) complain about the inconsistency of critical terminology within priming research, noting that top-down mechanisms (i.e., responses conditioned by context, experience, and expectations) have been conflated with *voluntary* or *intentional*, and even *volitional*. Sheeran et al. conflate these ideas in precisely this manner, stating that bottom-up processing can lead to relatively effortless, "automatic bottom-up control" (Sheeran et al., 2013, p. 462). Since the literature references 'automatic' processing both ways (top-down and bottom-up) it:

> highlights a broad problem in attention capture [i.e., priming] research: The terms used to describe attentional control are often poorly defined, and much current debate seems to be related to the meaning of words. To move forward . . . we must agree on what terms such as 'top-down' and 'bottom-up' actually mean. (Gaspelin & Luck, 2018, p. 1)

Using an analogy of the color blue, Gaspelin and Luck (2018) argue that if two groups disagree on what the color means the debate will continue forever until a common definition of blue is agreed upon. It was tempting to overlook the debate entirely; the author of this paper found conflicting definitions, and multiple instances of the terms being used in contrary contexts, but as the two constructs (*top-down* and *bottom-up processing*—referring most often to sensory input) are so commonly referenced in psychological priming investigations, inclusion is warranted. However, since the terms seldom appear in psychobiological investigations, and rather than burden this paper unnecessarily, they will not be referenced further. The point at hand is the consensus that—whatever the phrase—priming is a response of automaticity, requiring less conscious processing than strictly cognitive methods.

A final point of dissention is that not all researchers agree that "implicit measures reveal the same processes," (Blair et al., 2001, Discussion of Experiments 4 and 5, para. 3). Put another way, while research on nonconscious processing has taken on significant importance and made great gains, the mechanisms involved in implicit and explicit processing are debated. Sheeran et al. (2013) argue that the time and energy lost in debate could better focus on interventions targeting implicit processes to "maximize behavior change efforts" (p. 468), concluding that implicit attitudes are important predictors of health behaviors and should be investigated as interventions. In line with Sheeran et al. (2013), Shashkevich (2017) posits that the focus should be on interventions, that "deliberately harness [the prime, or the placebo effect] to improve health care" (para. 5).

Therefore, studying the effects of explicit and implicit primes, in tandem with any placebo elements (discussed in the following section), is well within the bounds of clinical research aiming for a therapeutic application. With that in mind, this paper rests from further references to problematic terminology. So, it stands: a call for clarity among researchers, and across disciplines, would do much to advance the field and the interpretation of results. In the meantime, dissecting the meaning of key terms prior to evaluating a stated conclusion in priming research is critical.

In sum, Hollands et al. (2013) argue that the lack of conceptual clarity, as indicated throughout this section, is a limiting factor in advancing priming research. To study the impact of priming on physical health and concomitant well-being a researcher must bridge, not only the varying vocabulary of different disciplines, but also reach beneath the surface to comprehend the various ways researchers, often within the same field, use key concepts, which affect interpretation. What researchers appear to agree on, though, is the power of priming, in that,

"once activated, a primed goal operates like a conscious goal" (Friedman, 2013, p. 549). Harnessing that potential are studies documenting physiological change in response to environmental cues, both explicit and implicit. Rather than argue for definitions the focus is to investigate priming's effects on physical health, attitudes, and well-being. Therefore, unless otherwise indicated, priming refers to the implicit or explicit utilization of primes, whether one is aware of the effects, be it attitudinal, behavioral, or physiological.

Since gains in priming research have been slow to trickle down into the psychophysiological model, only recently gaining traction in the health sciences (Elgendi et al., 2018), the intersection of priming and health can be explored via the placebo response, covered in the next section.

Placebo and Nocebo: To Deceive or Not to Deceive

While priming in psychological research, as mentioned in the previous section, can involve eye tracking and electroencephalogram (EEG), in medical arenas functional magnetic resonance imaging (fMRI), positron emission tomography (PET), serological measures, and neural imaging studies, to name a few, investigate the placebo effect. A *placebo* is a chemically inactive mechanism—which includes beliefs such as the meaning an individual ascribes to their illness as well as the social context—that produce measurable, physiological change (Eaves et al., 2016; Shashkevich, 2017). Likewise, the *nocebo effect* can be elicited when a disadvantageous process or outcome is suggested which produces a measurable change for the worse (Phillips & Pagnini, 2016).

Most often, both the positive and negative effects are collectively termed *placebo*. Placebo responses "are catalyzed by and pertain to a broad range of human experience, from changes in the meaning an individual ascribes to their illness to evolutionarily patterned and

deeply embodied responses to conditioned action (such as the taking of a pill)," (Eaves et al., 2016, p. 2). Their power is so well-documented that famed placebo researcher, Fabrizio Benedetti, writes:

> Placebos are not inert substances, as thus far believed. They are made of words and rituals, symbols, and meanings, and all these elements are active in shaping the patient's brain . . . The placebo [is the] administration within a set of sensory and social stimuli that tell the patient that a beneficial treatment is being given. (Benedetti et al., 2011, p. 339)

In a biomedical context, priming and placebo research are two parts of the same whole, and research can include both overlapping constructs in various applications (Rosen et al., 2017). Due to the general separation of psychological and medical research, however, placebo research is seldom integrated in psychological priming studies. Yet, this psychobiological phenomenon is inclusive of words, symbols, beliefs and other recognized primes. Crum et al. (2017) argue that in everyday medical practice psychological forces of healing—which by definition include environmental cues—underlie virtually every treatment effect.

Consider, for example, Parkinson's disease. In Benedetti's lab at the University of Turin, when a patient is primed with an active pharmaceutical that is then withdrawn, and substituted with saline (i.e., placebo), the treatment response is equally effective (Benedetti et al., 2011). Typically, such investigations are geared toward establishing a purely psychological disposition, or isolating the results of a medication; therefore, placebo related effects need to be as controlled as possible. Thus, the goal in most medical research is to correct for the placebo effect, as in most psychological research it is to obscure the prime.

This poses a tangle for health priming research. Sliwinski and Elkins (2013) argue that, although research studies attempt to minimize placebo and/or priming effects, "in clinical practice there may be significant benefits in enhancing placebo effects" (p. 1). This recognition reflects a dichotomy in health priming for two reasons. For one, most of the priming/placebo literature reflects research rather than a clinical perspective; and second, deception in clinical practice is unethical. Standard disclosure and consent forms, required in research with human subjects, can pose unique problems, as well. Priming researcher, Ellen Langer, for example, often couples an implied salutary effect (i.e., placebo)—or even a nocebo effect in some cases—with an explicit or implicit prime for added effect (Fatemi, 2016; Payne et al., 2016). Yet, verbiage on a consent form can be a double-edged sword. Langer argues that when subjects sign a form acknowledging, for example, that there are no known benefits from participating in a particular research project, it is, in effect a nocebo (Gierson, 2014).

So, is deception necessary in placebo research? Benedetti (2016) argues that the placebo effect demands unconscious or subliminal buy-in to be effective, as opposed to willful and intentional usage. Others disagree. Based on numerous investigations, Sliwinski and Elkins (2013) contend that a placebo, or nocebo effect, can be achieved without deception. Recent research has explored the potential for placebos in reducing the required dose of a medication—lowering costs and inhibiting harmful side effects (Doering & Rief, 2012). Through a conditioned response, placebo-controlled dose reduction (PCDR), also termed dose-extending placebos, subjects have successfully been able to significantly reduce prescription medication when knowingly alternating a placebo with the active medication. Results have been impressive: reducing immunosuppressants in renal transplant (Kirchhof et al., 2018), and successfully reducing opioids by utilizing "open-label dose-extending placebos" (Belcher et al., 2019,

Abstract, para. 1). In view of compelling evidence, Colloca and Howick (2018) argue that not only is deception unnecessary to produce effects, but that "at least some of the ethical barriers to their clinical use [can be bypassed] . . . Future large scale, pragmatic trials should investigate the potential of open-label and dose-extending placebos to improve outcomes and reduce side effects" (p. 15).

Crum et al. argue that while a randomized clinical trial is considered the gold standard in medicine, what the current model:

> obscures is that, in the practice of medicine, the psychological and social elements underlying placebo effects remain an influence in active treatment. Indeed, medical diagnoses and treatments are never isolated from patient mindsets . . . Rather than being incidental to treatment, these psychological and social elements play crucial roles in determining clinical outcomes. (Crum, 2017, p. 1)

Likewise, placebo researcher, Kaptchuk, finds a placebo does not have to be delivered below the threshold of awareness to have an effect, and is operational in patient encounters, knowingly or unknowingly (Feinberg, 2013). The suggestive implications in hypnosis and guided imagery, when aligned with a patient's purpose or goal, are considered by some to be a type of nondeceptive placebo (2013). Contextual effects, then, need not be entirely unconscious to be effective (Kaplan & Epstein, 2012).

An example like PCDR, above, speaks to the potential value of marrying a conscious goal to a prime, in a deliberate, intentional way. Although perhaps rare in research circles, the idea of coupling a prime and a conscious goal may hold health benefits. Even Benedetti acknowledges that the study of the "placebo effect can actually be viewed as a melting pot of concepts and ideas for neuroscience. Indeed, there exists not a single but many placebo effects,

with different mechanisms and in different systems, medical conditions, and therapeutic interventions" (Benedetti et al., 2011, p. 1).

Widening the net may capture more therapeutic benefits, expanding the practical application of priming and placebo with "far reaching consequences for health and well-being" (Fatemi, 2016, p. xix). Likewise, Sliwinski and Elkins (2013) argue that "if treatment outcomes are improved due to placebo effects, then it is in the client's best interest if his or her therapist attempts to maximize these effects" (p. 3). Although the fabric of our medical system is threaded with Cartesian dualism, the call for a more integrated approach "to health that merges our thoughts and emotions, [through] . . . context is paramount, in particular for its priming effect" (Phillips & Pagnini, 2016, p. 174). Unfortunately, placebo research is seldom referenced in priming literature, which reduces the health priming knowledge base—if such a thing existed—considerably.

The sources cited in this section explore the connections between priming and placebo research, as related to health, in conditioned responses. While the mechanism behind the effects may be debated, their power is not. Throughout the literature, placebo is used just like a prime—knowingly and unknowingly, consciously, and non-consciously—depending upon the preference of the researcher, and the goal of the study. Although correcting for the prime (i.e., placebo) might be standard procedure, it may not be necessary in investigations designed for clinical application (Crum, 2017). While this paper does not attempt to discuss the complexities of placebo research, it acknowledges the limited scope pertaining to clinical use. With that in mind, a cueing intervention is gaining traction in both research and clinical practice that may open unique opportunities for health priming research. This will be considered in the following section.

Attention Bias Modification

When introducing the question of priming and its potential impact on health and well-being, this paper emphasized that an individual's response to a prime or placebo was dependent on the goal or desire of the person (Cristea et al., 2016). Meta-analyses underscore the value of a personalized approach, "revealing stronger behavior priming effects when the primes correspond to an important or currently active goal of the individual" (Bargh, 2016, p. 49; Friedman, 2013). A spate of recent findings in models that seek to retrain implicit responses (i.e., ingrained habitual responses) to achieve an active goal, are intriguing.

Of these, *Attention Bias Modification* (ABM), based on principles of operant conditioning, holds potential for health goals and behavior. Attention biases have been described as unconscious processes that cause individuals to automatically focus their attention on certain cues in their environment (Zhang et al., 2018). Techniques using environmental cueing or priming to inhibit temptation, or strengthen a long-term goal, consciously or unconsciously, have been referred to as ABM (Moskowitz, 2009; Wryobeck & Chen, 2003; Papies, 2016; Sheeran et al., 2013).

The treatment goal in ABM is to affect implicit cognition by reducing one's attention to an alluring, but undesirable stimulus, thereby weakening a previously conditioned response (Sheeran et al., 2013). This is believed to occur by "attempting to change which cognitive structures get activated by specific situations" (Papies, 2016, p. 9), and by improving working memory, a construct that refers to executive abilities, semantic access, and cognitive control functions (Sheeran et al., 2013). In addictions, for example, an undesirable stimulus can harness one's attention, increasing the likelihood of succumbing (Field et al., 2014). In disrupting the automatic focus, meta-analyses have found ABM to be effective in the treatment of substance

disorders (Cristea et al., 2016), dietary change (Zhang et al., 2018), insomnia (Akram et al., 2018), and sleep quality (Milkins et al., 2016); while similar methods are reportedly used to boost measures of mood, quality of life, as well as strength and stamina in aging (Akram et al., 2018; Lancee et al., 2017).

To illustrate, not long after reading a journal article on ABM, a client contacted me for help with alcohol use after his oncologist warned that it would inhibit the efficacy of chemotherapy. Aside from some binge drinking in college, Mark did not over drink. But since his doctor's prohibition, alcohol use increased. Each day he and his wife would have one last drink before pouring the remainder down the sink. The next day, Mark would drive to the liquor store for another "last drink," and the cycle continued.

After discussing ABM methods, a series of cues were devised to interrupt the pattern. For example, in the front seat of his car, where he would put the liquor, Mark placed a copy of his favorite inspirational biography. On the island in the kitchen, where the bottle was typically set, he added a flowering plant. Mark also purchased new glassware to be used only for sparkling water, or nonalcoholic beverage. In the pantry, below eye level, he pasted a magazine picture of a very ill elderly man and added a picture of a wine bottle. At eye level, he placed a picture of a healthy figure running on the beach and to this was added an appealing photo of sparkling water. Other ABM examples considered were red and green dots—since we are culturally conditioned to respond to red (i.e., stop) and green (i.e., go), to attach to desirable and undesirable substances (Thorndike et al., 2012). Mark felt this was unnecessary since the sparkling water was already in a green bottle, and he no longer had alcohol in the house. Other adjustments were made to his routine, but these illustrate how Mark's goal was coupled with explicit priming. The first week

after making these adjustments he only purchased and drank alcohol on two occasions. Two-months later he reported he had only imbibed three or four times on social occasions.

Admittedly, this is a simple case, but it speaks to the topic question in interesting ways. It appears that Mark's motivation, and personal participation in the ABM process, were key factors in his success. In sophisticated ABM investigations the prime is often obscured, as in computerized models, but research in clinical application is less common. That Mark's collaboration on the cueing would be considered explicit does not change the fact that, once in place, the symbols chosen "require[d] minimal conscious engagement" (Holland et al., 2016, Discussion, para. 2). Since goals and motivations are indicators of what we notice or pay attention to in any given environment, not everyone would be expected to respond similarly to the same stimulus, and so a self-selection process seems reasonable (Bargh, 2016). Although Field et al. (2014) found insufficient evidence to use ABM in addiction, others disagree. For example, after reviewing:

> several attentional bias programs, including the alcohol attention control training program . . . [Cox et al] reported that the attention bias program is efficacious for re-training attentional bias, reducing craving, and enhancing self-efficacy and perceived self-control in a sample of harmful drinkers. (Zhang et al., 2018, pp. 1-2)

Papies (2016) posits that priming via ABM can be suitable for larger scale applications within communities, such as grocery stores and markets, "to improve the nonconscious regulation of health behavior" (p. 6). Although not termed "ABM," a choice architecture study at Massachusetts General Hospital, red and green labels were attached to healthy and non-healthy foods, prompting a significant uptick in the consumption of healthy food (Thorndike et al., 2012). The effects extend to health architecture, including hospital design which has been shown

to influence patient outcome including recovery rates (Rappleye, 2017). Might similar strategies—art and design—be employed in the homes of individuals recovering from surgery, or those with chronic conditions? Although there is a growing body of evidence supporting health architecture, a search did not uncover similar research-based findings for home use, which could be pursued in another project.

Without arguing for large scale applications, Bargh (2016) contends that the effectiveness of priming interventions depend upon which goals and outcomes are important to the individual (2016). By way of example, in one investigation, individuals who felt their self-worth threatened by certain primes—feeling shamed by negative messaging around weight or diet—were able to ignore the prime toward healthy eating. Later, these individuals, when primed via compassion meditation, responded more positively—without shame—to health behavior messaging (Kang et al., 2018). Although the authors conclude that meditation training, as a conditioning process, can affect attitude and subsequently behavior, Sheeran et al. (2012) reports that many findings in attentional bias related to behavioral change are suggestive rather than conclusive, but its effect on implicit motivation is pronounced. In either case, the suggestion that motivation can be impacted by priming is key, which may offer a less effortful path to desired change.

Despite ABM documentation in anxiety, depression, and addiction research, "few studies have assessed the impact of evaluative conditioning [used in ABM] on health-related attitudes and behavior" (Sheeran et al., p. 463). Further, considering the lack of cross-sectional dialogue among disciplines, it would be challenging to make a comprehensive assessment. For example, placebo work and investigations in choice architecture (Thorndike et al., 2012) do not appear to be referenced in ABM literature—and ABM literature is not necessarily included in priming or placebo—likely due to variations in terms, and long-standing disciplinary divisions.

In concluding this discussion, weighted evidence suggests that the methodology can be effective in promoting implicit motivation in health behaviors, most notably when the prime supports a valued goal. Given "that situational cues play a crucial role in health behaviour" (Papies, 2016, p. 4), ABM offers untapped potential for future research. Although priming interventions have been shown to influence mindsets (e.g., attitudes), none of these studies appear to be included in the priming meta-analyses covered thus far. With that in mind, the following section explores how mindset functions as placebo—a potent medicinal prime.

Mindset As Medicine

Positive traits and states (i.e., inclusive of mindsets) associated with greater overall health and lower all-cause mortality are not fixed in time, but malleable (DuPont, 2020), shown to impact decision making and activate health goals (Sheeran et al., 2013). The downstream effects of mindsets on well-being and physical health (Van Tongeren & Burnette, 2018; Levy, 2009), has recently captivated the attention of researchers and lay persons alike.

Simply put, mindsets incorporate beliefs and "organize the way people ascribe meaning to events" (Van Tongeren & Burnette, 2018, p. 101) which can be activated by subtle environmental cues impacting outcome in medical treatment (Girgis et al., 2018; Savary et al., 2014). Whether or not one's beliefs are grounded in fact has little bearing on the physiological effects. Crum & Zuckerman (2017) argue that beliefs or mindsets:

> are not inconsequential . . . [but] . . . profoundly affect health and well-being . . . Research shows that mindset or expectations to heal, similar to placebos, can trigger specific neurobiological correlates including the immune, cardiovascular, and neuroendocrine systems. In fact, placebos are driven in large part by the mindset that the pill is effective. Although less widely studied growth mindsets are also proving to be

> critical in health care. In one study involving . . . adolescents with type 1 diabetes, those who believed that their health could be changed had lower mean hemoglobin A1C . . . [While more] research is needed, what is clear is that instilling a growth mindset in patients about their belief in the capacity to change is an important precursor to health and healing . . . (p. 1)

For good or for ill, expectations about health have been found to be "self-fulfilling prophecies" (Levy, 2009, p. 334). Considering that priming cuts both ways—as in the placebo and nocebo effect discussed previously—effects can be pronounced. For example, when participants rated a series of health-related words, they later reported an increased number of health problems (Bargh & Chartrand, 2000). In another cueing study, when participants were instructed to develop colds while primed with videos of people sneezing and coughing laboratory evidence indicated immune system activation as typically seen in a viral pattern, although no virus had been introduced (Fatemi, 2016). And recently, the act of DNA testing alone elicited a nocebo effect, inducing physiological change (Lynam, 2018). Since placebo can be a "device for changing mindsets" (Phillips & Pagnini, 2016, p. 179), there is reason to promote placebo-driven primes that allow people to influence the "context of their own illness" (p. 179).

In testament to these findings, a longitudinal clinical trial at Stanford University (2020) is currently recruiting patients to investigate the effect of mindset on cancer (Zion et al. 2019). Developing evidence-based strategies to facilitate a constructive view of a medical condition could be lifesaving. Petrie et al. (2018) explain that:

> [t]he patient's illness model strongly influences how the individual copes with his or her condition and studies have shown that illness perceptions are related to a range [of] health

> outcomes, including functioning, the use of health care, adherence to treatment, and even mortality. (p. 37)

That mindsets can affect physiological processes is intriguing, but that such appear malleable, argues for targeted interventions aimed at instilling adaptive mindsets (Zion, 2019) and overturning harmful stereotypes. By way of example, Crum et al. (2013) found associated physical effects based on whether one believed stress to be enhancing or debilitating. Similarly, Van Tongeren and Burnette (2018) note that positive mindsets could be cultivated with attendant improvements in well-being, concomitant to physical health.

Belief systems "therefore may be strengthened or minimized, by the patient's broader mindsets about the nature of health and his or her ability and efficacy to change" (Crum & Zuckerman, 2017, p. 1). An interesting example can be found in a randomized, double-blind study that used three different priming questionnaires when probing for pain in a chronic pain population. Those answering a positively phrased questionnaire reported less functional disability than either the neutral, or the negatively primed (Claessen et al., 2015).

Similarly, the riveting effects of catastrophic news and eye-popping headlines exerts its own toll on mind and body. The widespread media coverage of the SARS-CoV2 pandemic is concerning to health psychologists, as the amount and type of media exposure has been found to operate as a prime, significantly impacting emotional well-being and physical health over time (Garfin, Silver & Holman, 2020). Whether through subtle societal cues, or attention-grabbing headlines, positive and negative primes have been shown to reduce and increase anxiety, respectively (Gibbons, 2009).

Likewise, when highly stressed individuals were primed with information about the upside of stress—such as "stress is energizing"—both immunity and cognitive function

improved (Crum & Zuckerman, 2017). The opportunity to reduce stress and/or depression via priming may have far reaching effects on health. Some of the most well-publicized priming research, geared toward health and well-being, is led by Ellen Langer, revealing that even "small increases in control of one's surroundings [are] associated with increases in longevity" (Fatemi, 2016, p. xviii). Novel approaches to priming, instituted by Langer, have been shown to influence biomarkers such as weight, blood sugar, viral loading, and visual acuity. For example, in Type 2 diabetes, manipulating the perception of time—by using clocks that ran either fast or slow while participants completed simple tasks—found that blood sugar levels follow perceived rather than actual time (Grierson, 2014; Park et al., 2016).

In one creative investigation, overweight chambermaids instructed to interpret their work as "exercise" rather than "labor," not only lost weight but blood pressure dropped an average of ten percent; while the control group—who were not primed—had no change (Crum & Langer, 2007; Crum & Liebowitz, 2017; Spiegel, 2008). All of which suggests that manipulating the "context of a situation may supply much promise to maintaining and improving our health" (Phillips & Pagnini, p. 173):

> Although more research is needed on the value and limitations of such mindsets for specific diseases, what is clear is that simply being more thoughtful about the words used in diagnoses and recommendations may be just as important as the treatment delivered. (Crum & Zuckerman, 2017, p. 1)

As promising as such evidence may be, Hollands et al. (2016) argue that while interventions targeting non-conscious processes may be more effective than conscious methods in changing health behavior, they remain largely untested due to the "lack of a practicable conceptual framework that can be applied to better describe and assess these interventions"

(Abstract). Arguing for more than a conceptual framework, Papies champions a paradigm shift. Contending that low compliance in achieving health related goals, "points to significant nonintentional influences on behavior," she advocates retiring the theory of planned behavior altogether in order "to increase the focus on automatic processes" (Papies, 2016, p. 3).

While it is beyond the scope of this paper to discuss the mechanisms involved—particularly, as new findings continue to be debated (Dionigi, 2015; Levy, 2009), this section addressed the research project directly by reviewing the downstream effects of mindsets. Although more research is needed, the cited literature illustrates how mindsets, and/or placebo, function as primes, promoting or hindering physical health and well-being.

These concepts are broadly applicable throughout the lifespan. Although aging is not a disease, Niraula et al. (2017) contend that an increase in lifespan is insufficient unless accompanied by good health. Therefore, the next section offers an overview of priming effects related to aging.

Embodied Stereotypes in Health & Aging

The measurable effects of mindset on aging are illustrated in multiple investigations linking primes to healthier food selection and an increase in exercise (Hine & Tsushima, 2018; Hollands et al., 2016). As discussed in the previous section, mindsets or stereotypes can be reinforced throughout life, assimilated unconsciously and "activated automatically by subtle contextual cues" (Marques et al., 2014, p. 399). Particularly compelling is a spate of research linking attitude more strongly to longevity than any other factor (McLachlan, 2020). Functional and serological measures—once considered to be influenced only by physical interventions such as diet and exercise and set apart from attitudes and beliefs—reveal the direct effects of subtle attitudes and beliefs on biomarkers of aging (Phillips & Pagnini, 2016).

Of these subtle influences, self-perception (i.e., self-concept) has been shown to have a measurable effect on the aging process. In a study of more than a thousand individuals, strong correlations were found between negative self-perceptions of aging and poor physical health (Sargent-Cox et al., 2012). Meta-analyses reveal that negative age stereotypes are associated with a decline in physical function and health (Levy et al., 2012; Levy, 2009; Levy, Slade & Kasl, 2002; Meisner, 2012). In a review of the literature, Levy et al. (2018) conclude that "considerable research has found that positive age beliefs predict better cognitive performance, whereas negative age beliefs predict worse cognitive performance" (Introduction, para. 2).

As witnessed thus far, terms such as beliefs, self-perception, mindset, and stereotypes are used somewhat interchangeably depending on the context, disciplinary division, and preference of the researcher. When stereotypes become embodied, they are knowingly or unknowingly applied to oneself as self-perceptions that can predict functional health over time (Levy et al., 2000; Levy, 2009; Sargent-Cox et al., 2012). Emphasizing the impact of priming, these implicit expectations are believed to operate psychologically, behaviorally, and physiologically (Levy, 2009). Although seemingly subtle, such embedded mindsets have been found to have profound effects, directly impacting even the will to live (Marques et al., 2014). Negative age stereotyping can unknowingly (i.e., non-consciously) develop when young, contributing to a significant elevation of cardiovascular events in following decades (Levy et al., 2009). Levy et al. (2014) explain:

> when individuals recognize through environmental cues that they have entered old-age, the age stereotypes that were applied to others acquire personal resonance, and thus become self-perceptions of aging, which can be activated by subsequent exposure to these cues; in turn, physical outcomes can then be impacted. (p. 4)

It appears, then, that "when older individuals apply negative age stereotypes to themselves, they can adversely influence a wide range of outcomes" (Levy et al., 2009, p. 1). Negative age beliefs may lead to a higher subjective age, which has been shown to correlate with cognitive impairments and even dementia (Stephan et al., 2018). Such negative self-concepts may result in chronic activation of the autonomic nervous system with far-reaching effects including morbidity and mortality (Levy et al., 2000; 2009; Moser et al., 2011):

> Mounting evidence points to a causal link between the primed profile of the aged brain and vulnerability to secondary insults, including infections and psychological stress. Conversely, psychological stress may also induce aging-like sensitization of microglia and increase reactivity to secondary challenges. (Niraula et al., 2017, p. 1)

Adding to the weight of evidence, a meta-analysis revealed that negative priming affected health behaviors of older individuals (Meisner, 2012). When faced with a health threat, the belief that aging is associated with physical losses reduced health supporting behaviors (Wurm, et al., 2013).

Turning to positive expectations, Wurm et al. (2013) cite a cluster of studies that strongly associate positive self-perceptions with health and life satisfaction. A positive age mindset has been shown to promote longevity and have a protective effect on multiple physiological factors including the cardiovascular stress response and recovery from severe disability (Levy et al., 2014; Levy et al., 2012; Levy et al., 2009). Longitudinal data from three studies following nearly 13,000 people for 20 years found a lower subjective age to be correlated to increased lifespan (Stephen et al., 2018). Specifically, positive self-beliefs associated with the aging process have been found to promote memory (Wryobeck & Chen, 2003) and protect against dementia, even among carriers of the APOE4 gene variant associated with an increased risk of Alzheimer's

disease (Levy et al., 2018). So compelling are the findings, researchers concluded that negative age beliefs are an independent risk factor for dementia (Levy, et al., 2019).

Once embedded, though, are negative age beliefs malleable? To answer that question, using pre-and post-physical and psychological measures, Levy et al. (2014) primed one-hundred older individuals with either positive or negative age-related concepts over a period of several weeks. Utilizing a masked intervention (i.e., words flashed below the threshold of awareness, such as spry, wise or frail) and mental imagery (e.g., imagine a healthy senior), among those positively primed, not only did their self-perception of aging improve significantly, but the measurable gains in physical function—strength, gait, balance, speed of walking—were greater than "the outcome of a six-month exercise program" (2014, pp. 11, 12).

Explicit priming was also effective. An intriguing series of studies demonstrate that mental imagery (i.e., a willful and intentional process) was effective in altering implicit gender stereotypes (Blair et al., 2001). Subsequently, Levy et al. (2014) successfully applied the method to overturning age-related biases. Addressing the potential, further investigations support the claim that the harmful effects of negative age stereotyping can be overcome—and survival outcomes improved—by subtly priming one's environment (Marques et al., 2014). As a result, Pagnini et al. (2019) argue that aging can be, at least partially, mentally construed.

For example, when the environment of seniors was primed to recollect a time of vitality and effectiveness, vision, hearing, and cognitive function improved. Conversely, a negative correlation was found among those who remained fixated on the past and longevity (Fatemi, 2016). Pagnini et al. (2019) emphasize the importance of studies like these that promote:

> a change in perspective about ageing, from the narrow biomedical perspective to a more open and mindful idea based on the psychology of possibility, [which] can actually

> improve older adults' well-being. Challenging the dominant biomedical view, and properly communicating it through various channels, will lead to change mindsets and stereotypes related to the ageing condition. (p. 7)

Contrary to the prevailing biomedical model, aging does not appear to follow a fixed, linear path, but operates as a multifaceted dynamic responsive to priming. Unfortunately, when it comes to priming, as in life, susceptibility to the negativity bias (i.e., a survival mechanism that promotes attention to danger, or negativity) appears to be pronounced. Attention toward words, symbols, or images, even when subliminally presented, appears weighted toward the negative (Nasrallah et al., 2009). If such findings can be generalized, it presents a worrisome prospect considering the bias in certain societies toward aging and argues for more research on how to efficiently overcome socio-culturally entrenched beliefs. It is noteworthy that the average age of chronic pain participants in the study reviewed in this paper was 45-54, an age where counteracting the downstream effects of hopelessness can be pivotal.

Criticism in the arena of mindset and aging most notably appears in reference to a famous study, in which participants, after being negatively primed to age stereotypes, walked slower when exiting the laboratory (Bargh et al., 1996). In an attempt to replicate the original findings, Doyen and Klein (2012) noted the same slow pace after being negatively primed—but only when experimenters believed participants would walk slower. The authors suggest:

> that both priming and experimenters' expectations are instrumental in explaining the walking speed effect. Further, debriefing was suggestive of awareness of the primes. We conclude that unconscious behavioral priming is real, while real, involves mechanisms different from those typically assumed to cause the effect. (Abstract section, para. 1)

Aside from the intriguing response to researchers' expectations, Doyen and Klein's (2012) investigation illustrates that there is little debate among experts as to whether priming is "real," but the contention is on the mechanisms involved. Their concluding statements (2012) regarding whether there was an awareness of the prime, harks back to arguments as to what constitutes subliminal priming. Studies like Doyen and Klein's (2012) shine a light on the purpose of most priming research: exploring the influence of the subconscious (i.e., distinguishing effects below the threshold of awareness) and the mechanics of priming—rather than exploring methods in clinical application which is a primary focus of the study presented in this dissertation.

Nevertheless, Doyen and Klein's (2012) conclusion indicates that mindset priming can be effective even when one is aware of the prime. Three brief examples bear this out. When groups were implicitly and explicitly primed with positive age stereotypes, Levy et al. (2014) found the most notable improvement in the implicitly primed group. Likewise, in a randomized trial statistically significant improvements in physical function and positive self-perception of aging were achieved through both implicit and explicit priming, but the effect of implicit priming was greater (2014). On the other hand, when comparing subliminal (i.e., below the threshold of awareness) with spoken or written words in influencing behavior, Falk et al. (2010; 2011) found the explicit method (e.g., spoken or written) to be more effective.

Considering the evidence, priming offers untapped potential to assist an aging population, but there is a considerable need for intervention studies "to support effective strategy use in older adults with serious illness" (Wurm et al., 2013, p. 1088). Successful studies of this nature are often conducted in institutional environments or costly specialized settings (Pagnini, et al., 2019). Even Langer's most compelling health priming interventions involved secluding

participants in a completely different environment for at least several days and is not easily replicated (Baltzell & McCarthy, 2016). The paucity of research employing feasible priming methods in aging is surprising yet points to the need for studies like the one presented in this paper (Wegesin et al., 2004).

In summary, a reduction in birth rates in Western cultures and an increased lifespan has contributed to a rising elderly population with "significant health and socio-economic implications" (Niraula et al., 2017, p. 2). There is, therefore, a critical need for interventions that contribute to active aging, and increased functionality. Since negative self-perception of aging is a risk factor in morbidity and mortality, this section examined how such embodied stereotypes, or mindsets, can be disentangled via subtle cognitive manipulations, with attending physical gains.

The average age of chronic pain participants in this study was 45-54, indicating the need for priming methods that attenuate states such as hopelessness, that contribute to comorbidities in a middle-aged population. Further research, investigating methods designed to increase agency and positive self-perception, is warranted (Moser et al., 2011). The challenges and the opportunities therein, are discussed in the concluding paragraphs.

Conclusion

Lasting behavioral change requires evidence-based interventions that foster a change of implicit evaluations (Vanalest et al., 2016). Of these, priming has emerged as a dynamic intervention to recalibrate implicit attitudes and activate health goals (2016; Papies, 2016). Although the downstream effects (i.e., physiological enhancements) of positive mindsets and self-efficacy beliefs are well-documented, there is a great need for studies with a clinical application (Sheeran et al., 2013).

However, given the sectarian nature of health priming research, a cross-sectional review is challenging, but necessary to advance clinical application. Even in the face of robust findings results are not widely distributed across disciplines. For example, Harvard University's choice architecture study (Thorndike et al., 2012) utilized standard ABM priming methods, but it is not classified as such, nor does choice architecture appear in ABM searches. Likewise, there is little placebo work in priming research, no doubt due to its biomedical foundations. And vice versa. As a result, important findings are stacked into discrete silos, laden by defining debates within disciplines. The net effect is a reduction of the fullness of a remarkable field of opportunity.

Cross-sectional dialogue is further hampered by the absence of an overarching rubric, and a central, unified (i.e., standardized) vocabulary tying research sectors together. Without such an integrated framework, the field of health priming could flounder. Indeed, it is hard to imagine any field of discovery gaining significant traction without a standardized vocabulary. Should such a framework be established, and definitions be ratified, cross-categorical research could be integrated across disciplines permitting the field to flourish.

It is perhaps for these very reasons that the "effect of primes (i.e., incidental cues) on human behavior has become controversial" (Payne et al., 2016, p. 1269). The need for larger sample sizes is an ongoing criticism of social psychology's research, including that on primes (Freedland, 2020). While well-founded in some cases, it should be noted that due to disciplinary divisions, such conclusions do not appear to take into consideration the wide body of placebo work (e.g., PCDR), choice architecture (Shafir et al., 2012), as well as mindset, and attitudinal investigations spanning continents and decades (Levy, 2009). No doubt the wide variations in terminology, and lack of cohesion among research circles, are challenges to an inclusive, interdisciplinary analysis.

While it is beyond the scope of this chapter to debate these issues further, the consensus of evidence across disciplines is that "automatic response triumphs over . . . conscious effort" (Wryobeck & Chen, 2003, p. 106; Vanalest et al., 2016). Although the mechanisms are debated, it is agreed that priming impacts health in profound ways (Sheeran et al., 2013). In the aggregate, findings indicate that not only do expectations affect clinical results and physiology (Sliwinski & Elkins, 2013; Friedman, 2013), but the subtle cueing of environmental features can measurably impact "behavior, choices and actions" (Elgendi et al., 2018, p. 1). In sum, a "convergence of study results describe how mindsets can affect the body" (Phillips & Pagnini, 2016, p. 179); so, while various disciplines in psychology and medicine may differ over defining constructs, the broader literature showcases the impact of nonconscious methods on health behavior with striking physiological effects (Crum & Zuckerman, 2017; Papies, 2016).

In the high-stakes world of healthcare, priming can be a time saving and cost-effective tool to advance well-being, as relatively small primes in one's surroundings are associated with health and longevity (Fatemi, 2016). Harnessing that potential is yet to be seen. Although our understanding of nonconscious processes that affect beliefs and behavior "has strongly increased over the past decades" (Papies, 2016, p. 2), authors in all sectors cite concern over the lack of practical research for clinical use. Capitalizing on the untapped potential, Sheeran et al. (2013) urge: "Research on nonconscious processes holds significant potential that can and should be developed by health psychologists" (Conclusions section, para. 1).

How might this potential be realized? One possibility is through awareness—and choice. Choice has been shown to be crucial to well-being (Fatemi, 2016), but one must first become aware that there is a choice. Restoring the heuristic—the power of discovery—to the individual by allowing them to explore their beliefs, and participate in constructing relevant primes, is one

answer. But is it possible for individuals to achieve a more dynamic and flexible view of aging, mindsets, and self-efficacy beliefs process by personally choosing, and utilizing subtle cues? The available data from studies using conditioning (Wryobeck & Chen, 2003) and open-label placebo (Belcher et al., 2019) suggest this may be the case. Scaffolding priming methods to promote health, as in ABM, and using imagery to inculcate positive expectations and reduce harmful stereotypes, are further methods to consider.

Since placebo can efficiently change mindsets, there is reason to promote placebo-driven primes that allow people to become a "'guardian' of one's own health" (Phillips & Pagnini, 2016, p. 179). Although seemingly subtle, such embedded mindsets have been found to have profound effects, directly impacting even the will to live (Marques et al., 2014). Therefore, Crum and Zuckerman (2017) propose that priming methods be implemented at the primary care level in all physician/patient interactions.

Scaffolding priming methods in healthcare can include visual, verbal, and written materials. Brief exposure to a primed health questionnaire in a chronic pain sample, resulting in an improvement in quality of life, suggests that it is possible and practical (Claessen et al., 2015). Claessen et al.'s (2015) study, coupled with the strong need for clinical application, inspired this research project. Further inspiration came from Long et al.'s (2020) longitudinal study on hope. When related to agency, hope was associated with hypoalgesia, a reduced risk of chronic illness, lower all-cause mortality (Long et al., 2020) and enhanced motivation (Jaremka et al., 2014).

Although "a positive attitude is probably the first step needed to engage individuals with chronic musculoskeletal (MSK) pain in self-management strategies," it is rarely researched in clinical application (Rondon-Ramos et al., 2020, p. 2). In contrast, a hopeless or "malignant mindset can cast a shadow over the lived experience of the patient" (Zion et al., 2019, p. 3),

interfering in actively managing one's own medical care and healthcare goals. But mindsets are malleable with "significant downstream impacts" (Zion et al., 2019, p. 2). How, then, to condition the actionable quality of hope, despite the psychological and social burden of chronic pain? Likewise, it appears that hope, too, as related to agency, is seldom studied in chronic pain (Eaves et al., 2016; France et al., 2020; Long et al., 2020), and there is little extant literature on priming hope, particularly in chronic pain (Katsimigos et al., 2021).

To contribute to the literature, therefore, this investigation addressed the following: Could a positively primed pain tutorial have a salutary effect on hope, as related to agency? In other words, can hope be primed in chronic pain? Since pain is recognized "as a multidimensional phenomenon that incorporates sensory, affective, behavioral, and physiological levels that can all be accessed on aware and unaware levels" (Brascher et al., 2018, Significance of Classical Conditioning, para. 4), does hope impact the perception of pain? Further, the trait of stress-hardiness has been associated with greater resistance to illness but has been rarely studied in trauma and pain (France et al., 2020). Is hardiness related to hope and/or pain? If so, what is the relationship among hope, the adaptive state of hardiness, and pain? To best address these guiding questions a pre- post-test experimental design (i.e., randomized intervention study) was utilized and is outlined in the following chapter.

CHAPTER THREE: METHODS & PROCEDURES

This pre- and post-test intervention study, with two randomized parallel groups, was designed to explore whether hope can be primed in individuals with chronic pain. This chapter presents an overview of the design, as well as the rationale for the methods and instruments selected. The process for participant recruitment, the setting, privacy procedures and descriptive statistics of the sample are also given, before concluding with a review of the delimitations and limitations of the study, and a chapter summary.

Overview of the Methods

When testing whether a practice, substance or idea makes a difference in results or outcome measures, experimental designs (i.e., intervention studies) are generally preferred (Creswell, 2012). As the goal of the research was to investigate the effect of a primed PNE tutorial on hope and pain, an experimental, pre-and post-test intervention was conducted to determine whether the critical quality of hope could be primed in a chronic pain population. Although PNE is coded for reimbursement via Medicare, the researcher was unable to locate studies investigating its impact on hope. Further, there is little extant literature on priming hope, particularly in chronic pain (Eaves et al., 2016; Long et al., 2020), making a quantitative investigation the design of choice. Not only did this method allow for a clear assessment of effects (i.e., versus qualitative approaches), the design also eliminated the risk of investigator bias and/or influence by administering all scales anonymously via a web link.

Although Claessen's (2015) study on priming in chronic pain utilized positive, neutral, and negative primes in three respective groups, in this study, even the neutral tutorial was written in a supportive way to avoid a negative prime (e.g., increasing distress), as indicated in the application to the Institutional Review Board (IRB).

To evaluate the intervention's effect on hope and pain, two parallel, independent groups were surveyed via web-based software (i.e., Survey Monkey). All participants completed the Five-Item Pain inventory, the Hope scale, and the Adapted Hardiness scale. Approximately fifty percent of participants received the hope manipulation (i.e., primed PNE tutorial), and fifty-percent received a more neutral pain educational tutorial, forming a control group. After reviewing either the primed or neutral tutorial, both groups again completed the four-item Hope scale and rated pain at the present moment on a scale from 0 – 10. For a copy of each instrument, please see Appendices C, D and E respectively. After data collection for these two parallel groups were completed (n = 122), a third group (n = 32) was added to investigate whether the hardiness scale functioned as a prime (i.e., elevated hope).

Three analyses were carried out in the Primed and Neutral groups. In the first analysis, the effect of the intervention was isolated by controlling for the baseline measure of hope and calculating the difference. In a second analysis, the outcome of pain was assessed in the same manner. These analyses allowed the researcher to carry out two different types of comparisons: (a) pre- and post-test (i.e., intervention) measurements, and (b) two distinct groups (e.g., a primed manipulation vs. a control manipulation). As a result, it was possible to detect whether the intervention had an impact on hope and/or pain.

The survey also collected additional information on pain and stress-hardiness, not only to characterize this significant factor in the subject sample, but to perform a correlational analysis to examine the associations among stress-hardiness, typical pain throughout the last year, and hope.

This design was selected to address the following research questions: Does exposure to a positively primed Pain Neuroscience Educational (PNE) tutorial promote hope in respondents

experiencing chronic pain? Does exposure to a primed PNE tutorial influence the experience of pain as perceived in the present moment? And, does hope impact pain, as perceived at the present moment? This inquiry also measured the trait factor of stress-hardiness in participants, which allowed the researcher to examine the relationship among hardiness, pain perception and the experience of hope.

Instrumentation

Standardized scales, noted for their reliability and validity, were selected for their potential to address the research questions while strengthening the methodology. Short-form scales were preferred, and in some cases adapted, to reduce negative priming and survey completion time. The scales selected are as follows: the Five-Item Pain inventory, the Hope scale, and the Adapted Short-form Hardiness scale. A copy of each instrument, with instructions and scoring, can be found in the Appendices. The primed intervention and neutral tutorial are discussed under the section titled, The Neutral and Primed Tutorials. For clarity, the instruments are first discussed individually and then collectively, as to their appropriateness and measurement characteristics.

The Five-Item Pain Inventory

To establish the nature of an individual's perception of pain (i.e., severity) and its effects (i.e., interference), the first scale administered to participants in this study is the Five-Item Pain inventory, based on the Brief Pain inventory (BPI) Short-form developed by MD Anderson Cancer Center, and widely used in pain treatment centers. The original BPI Short-form is a 13-item (Yes, No, numerical rating scale and 0-10 Likert scale) self-report instrument that has been validated and shown to be reliable over time in terms of pain, as well as functional ability or disability (Correll, 2007; Jelsness-Jorgensen, et al., 2016). Its internal consistency as measured

by Chronbach's alpha, ranges from .80 to .92. The test-retest reliability is highest for short-term pain and typical pain ratings (.93 to .78). Test-retest reliability for current (i.e., "now") pain ratings is lower (.59) due to the changing nature of pain (Cleeland, 1991).

In addition to its validity and reliability, this pain scale was selected to gauge the severity of pain and examine any post-intervention effect. It was adapted for the purpose of this study in several ways. For example, in the paper and pencil version participants circle the number that best answers the question; however, in the online adaptation, individuals clicked on the number indicating the best answer. Additionally, the standard paper and pencil version includes a diagram on which individuals shade in the areas where they experience pain. Since the area affected by pain (e.g., neck, arm, leg, etc.) was not being evaluated in this investigation, this item was eliminated from the survey. Likewise, an open-ended question asking that respondents list their medications and pain treatments was also excluded, as these were not being assessed in this study.

Redundant questions that could unnecessarily fatigue participants were also removed, leaving five questions assessing current pain, typical pain throughout the last year, and pain interference in three domains: general activity, walking and life enjoyment. Although even shorter pain scales have been utilized effectively (France et al., 2020) it was determined that the Five-Item Pain inventory was not so long that participants would feel fatigued but comprehensive enough to allow for reflection on the nature of pain and its effect(s) on daily life.

The adapted version of the BPI Short-form—The Five-Item Pain inventory—can be found in Appendix D.

The Hope Scale

Although there are other hope/hopelessness scales from which to choose (Beck et al., 1974; Everson et al., 1996), Long et al.'s (2020) adaptation uniquely reflects the conceptualization of hope, as distinguished from optimism, pertinent to this investigation. Evidence supporting the relationship between optimism and the experience of chronic pain is a relatively recent one. According to Goodin & Bulls (2013), prior to the year 2000, research focused primarily on negative psychological constructs, as opposed to positive traits and states. Although there are multiple dimensions to optimism which are yet to be fully understood, in the aggregate, dispositional optimism has been found to be a significant predictor of diverse physical health outcomes (Scheier & Carver, 2018), contributing to reduced pain sensitivity and enhanced physical recovery (Goodin & Bulls, 2013). Recently, functional neuroimaging studies indicate that the cortical regions responsible for pain processing are also involved in generating optimism, supporting a possible neuroprotective relationship between optimism and the sensory experience of pain (2013).

An impediment to evaluating the effects of hope and/or optimism is that the two are frequently conflated (Goodin & Bulls, 2013). For example, individuals scoring high on optimism have been found to use approach rather than avoidant coping strategies when faced with setbacks, as exhibited by determination and commitment toward a desired goal (2013). This relates more directly to agency (i.e., hope), in contrast to optimism, which relates to "generalized outcome expectancies" (2013, p. 2) "that the future will be good (which may be with or without reasons)" (Long et al., 2020, p. 2). Positive expectations are not necessarily accompanied by acting on one's behalf, or perseverance in the face of obstacles (2020). For example, while nurturing positive beliefs about one's future (i.e., optimism) has been shown to facilitate

contentment, it has also been associated with poor achievement (Kappes & Oettingen, 2011), and lack of preparedness against risks (Tenney et al., 2015).

Although it seems obvious that positive thinking is quite different than acting in one's best interest, optimism and hope are frequently conflated in the literature (Long et al., 2020). It is possible, then, that the approach coping facet of optimism (Goodin & Bulls, 2013) relates more strongly with hope, as related to agency, and stress-hardiness, than positive expectations for the future. Conceivably, extant research purportedly evaluating optimism may have been, in fact, evaluating hope. In recognition of these disparities, Long et al. (2020) reverse coded items derived from Everson et al. (1996) and Beck et al.'s (1974) measures to construct a scale of hope rather than hopelessness. The self-report scale consists of four statements rated on a six-point scale from one (Strongly Disagree) to six (Strongly Agree). Long et al. (2020) explain:

> We reverse-coded the scale to construct a hope instead of hopelessness scale for three reasons. First, HRS [Health and Retirement Study] is not a clinical or psychiatric population, and as a result, levels of 'hopelessness' were relatively low. Even in the tertile with the highest hopelessness scores, the median response was to slightly disagree with all four items. Second, reverse wording of the questions strongly aligned with a widely accepted, empirical conceptualization of hope as a positive motivational state directing perseverance towards goals and pathways . . . As a result, we reverse-coded the four items and then averaged them together to construct our hope scale (e.g., It is possible for me to reach goals; the future seems hopeful to me; I do expect to get what I really want; There is use in trying, etc.). (Long et al., 2020, p. 1)

While empirical evidence supports the health promoting effects of hope—both mentally and physically—some Hope scales (Everson et al., 1996; Beck et al., 1974) could be gauging a

lack of depressive symptoms rather than the actionable effect of hope on agency, or perseverance toward goals (Long et al., 2020). As noted, the chronic pain population is not necessarily a psychiatric one, which further argues for the use of this revised scale.

Seeing that the adapted Hope scale (Long et al., 2020) captures this distinct aspect of hope it was the preferred measure in this study. For ease of comparison, Appendix C includes the original items derived from Everson et al. (1996) and Beck et al. (1974) along with the revised scale used in this investigation.

The Short-form Hardiness Scale

The concept of stress resistance, or hardiness, as a protective personality trait that is stable over time was established by Kobasa (1979). While high numbers on the Rahe and Holmes Life Event Checklist proved predictive of serious illness, individuals scoring high in hardiness did not become seriously ill. Hardiness is more discreetly defined than the broad construct of resilience, which is conceptualized in multiple ways by numerous researchers (Zerach et al., 2020). Stress-hardiness encompasses three interrelated domains, colloquially known as the three C's for: control—a sense of self-mastery, commitment—to the self, connection with others, and an ability to find meaning in life, and challenge—seeing change as an opportunity rather than a threat.

Although the construct has been empirically demonstrated to be a moderator in illness (Gebhardt et al., 2001), the relationship between stress-hardiness and chronic pain is seldom studied (Zerach et al., 2020). Exploring and clarifying this relationship was a goal of this study. Unfortunately, among hardiness scales, there is no gold standard (Windle et al., 2011), as instruments measure varying properties or attributes of stress-hardiness, and few have strong test-retest reliability. For example, some hardiness or resilience scales have been found to

measure either an individual's ability to bounce back or seek support from outside sources, neither of which adequately captures the nature of hardiness as defined by Kobasa (1979). In contrast, the Short-form Hardiness scale (Sinclair et al., 2003), based on Bartone's (1991) earlier work, captures an individual's capacity to take personal responsibility (i.e., control) despite challenges, as indicated by the three domains of control, commitment, and challenge.

Chronbach's alpha, or coefficient alpha, measures the reliability of a particular instrument when items are scored as continuous variables; ratings above .70 indicate an instrument's ability to accurately assess what it claims to measure. After reviewing a number of hardiness scales, the Short-form Hardiness scale was found to have good overall internal consistency (Chronbach alpha = .83), but test-retest reliability across various populations has been difficult to establish for this instrument (Sinclair et al. 2013). However, since it is based on the Dispositional Resilience scale (DRS), which has a coefficient alpha of .78 across numerous populations (Bartone, 2007), it was selected for this study, as the DRS is more relevant for language groups other than English (Bartone, 2013).

The Short-form Hardiness scale contains 18-items, rated on a five-point scale from one (Definitely False) to six (Definitely True). This instrument evaluates six subscales: control or self-efficacy; powerlessness and/or fatalism; commitment, which is defined as being interested in and fully engaged with life; alienation, which refers to a sense of meaninglessness and isolation; challenge, which is the "tendency to view stressors as challenges rather than threats;" and rigidity which is gauged by a lack of flexibility and resistance to change. (Sinclair et al., 2003, p. 11).

The internal reliability (i.e., Chronbach's alpha) of each the six subscales is as follows: Control (.79); Powerlessness (.93); Commitment (.79); Alienation (.88); Challenge (.77); and Rigidity (.66) (Sinclair et al., 2003, p. 13).

For the purpose of this investigation, two items on the hardiness scale were reverse coded to avoid a negative prime (Brascher et al., 2018). For example, the statement, "Sometimes, life seems meaningless to me" was replaced with, "Despite challenges, life seems meaningful to me." The statement, "I often feel alienated from the people around me," was changed to, "I often feel connected to the people around me." The Hardiness scale Short-form was also abbreviated by eliminating non-scored items (i.e., fillers) and redundant items to reduce unnecessary survey fatigue. The facets measured by the survey remain intact; for example, of the ten items, three measure the facet of commitment, three examine control, and two evaluate challenge. The two alienation measures were reverse coded to evaluate connection, as mentioned above. The Adapted Hardiness scale can be seen in Appendix E.

The Neutral & Primed Tutorials

The primed 219-word PNE tutorial (see Appendix F) was modeled after PNE concepts reflecting advances in the neuroscience of pain (Ashar et al., 2021). In designing the primed tutorial, every effort was made to present the essential, but potentially disruptive data, in a supportive way (Knowles et al., 2015). Even so, it was conceivable that the primed PNE could have created conflict for some (see Appendix F). Although viewing the medical system as a final authority on pain reduction increases the risk of hopelessness, being confronted with a different perspective could lead to feelings of disillusionment, and/or anger, either at the authority (i.e., conflict of authority), or the source of the conflicting information (Stockdale, 2019). Since the

effect of a positively primed PNE was unknown, this possibility was acknowledged in the IRB application.

The experimental, hope-manipulation group (n = 68) reviewed the primed tutorial. Later, when findings were analyzed and it was determined that both groups (i.e., primed and neutral) were similar in all respects, a third group was recruited (n = 32) and exposed to the hope manipulation, but without the hardiness scale in case the positively worded instrument served as a prime. Therefore, 100-participants were exposed to the primed tutorial (i.e., 68 in the original group and 32 in the primed without hardiness group).

The control group (n = 54), on the other hand, reviewed a relatively neutral, 219-word tutorial on pain which was supportively written to avoid the nocebo effect (Brascher et al., 2018) (See Appendix F). The development of a neutral tutorial presented a challenge, as a strictly neutral topic (e.g., organic gardening) selects against a pain focus and would not enable an adequate comparison of the two groups as the experimental group (i.e., hope manipulation) was required to focus on pain throughout the survey. An organic gardening tutorial, by way of example, side steps that condition, limiting the analysis of any potential effect of the primed intervention. It also introduces another variable: distraction from pain, thereby obfuscating the objective of the study. Nor could the neutral tutorial include negative pain conceptualizations and risk inducing a nocebo effect. Thus, both groups were exposed to information on pain but in somewhat different ways—one in a primed capacity and one in a relatively neutral condition. In this condition, by requiring all subjects to focus on pain (N = 154), results are more applicable to clinical practice or participating in PNE.

Participants: Recruitment, Consent & Privacy

According to Freedland (2020) most pilot studies are underpowered, yielding null results and “halting work on promising and unpromising interventions alike” (2020, p. 851). To avoid this pitfall and draw meaningful conclusions from the data, an a priori power analysis was performed during the planning stages of this study.

Typically, the standard deviation between groups is necessary to estimate a sample size for adequate power. Since the adapted Hope scale is a novel instrument—used once in an epidemiological study (Long et al., 2020) of 12,998 people, correlating hope with physical function, pain, and morbidity—there was no empirical precedent upon which to calculate a sample size to ensure adequate power. Without an available precedent to compare the hope difference and pain difference as outcomes in the experimental and control groups, Cohen’s (1988) Power Table was consulted. Assuming a medium effect size, with alpha probability of .05 and .10, it was established that each group needed either 36 or 38 participants respectively (i.e., at least 75 participants total, and upwards of 200 total assuming a small effect size). Initially, 168 were recruited and 122 qualified. Later, a third arm was recruited. In total, more than 200 participated and 154 qualified (e.g., incomplete surveys were eliminated).

Upon approval by the IRB, the survey and website were constructed according to design principles shown to increase participation and accurate test-taking (Oppenheimer et al., 2012; Regmi et al., 2016). The web page provided clear and easy to understand information about the study, an embedded link to the survey, and a button to download the relaxation audio gift. As noted previously, the title of the website and recruitment announcement differed from that of the study, since disclosing the topic of hope could alter perception and be counterproductive (see Appendix A). Recruitment of adults experiencing chronic pain for at least one-year, began in May and concluded in July of 2021.

To maximize participation, the web link was posted on social media and sent to email subscribers, associates, colleagues, physicians, physical therapists, and chiropractors so that interested and qualified individuals could anonymously take the survey (i.e., snowballing). Numerous online facilitators of pain groups were contacted but permission to post was denied by all. Although medical clinics have limited the use of in-office brochures due to SARS-CoV-2, permission was granted to place cards with a QR code linking to the study in the waiting areas of a general practitioner, two private physical therapy offices, a hospital pain clinic, and two chiropractic offices. The researcher was not present so there was no interviewer bias, and respondents chose when and where to participate.

As an incentive a 30-minute relaxation audio was offered to participants. To ensure anonymity, the audio was embedded on the website and configured in such a way that it could be downloaded without being tracked, and available regardless of survey completion. To further protect participants and ensure anonymity, the survey was administered online, and no identifiers or email addresses were collected. The software, Survey Monkey, allowed the researcher to deselect the capturing of email addresses, which was enabled and tested prior to recruitment to ensure anonymity throughout data collection. In other words, personal data were not collected at any point in the process so that survey responses could not be identified with any personal information. The deidentified survey responses will be stored in an Excel file for 5-years and then deleted.

An informed consent was provided prior to taking the survey (see Appendix B). To ensure anonymity, signatures were rendered unnecessary as participants were unable to move forward in the survey without indicating consent by clicking “next.” As required by the IRB, the informed consent stated that individuals may stop their participation at any point; additionally,

by eliminating the presence of an administrator there was no pressure to continue if taking the survey became uncomfortable.

Although it routinely happens during medical visits, answering questions about one's experience of pain could be distressing. Specific efforts were taken to reduce this type of stress. For example, questions about pain were kept to a minimum by reducing MD Anderson's 13-item Short-form Pain inventory to five-questions (see Appendix D). Likewise, an abbreviated version of The Short-form Hardiness scale was reduced to ten items and reverse coded to further minimize stress and negative priming. Further, every effort was made to present pain information in a non-threatening way in both tutorials (see Appendix F).

During this process, only two respondents contacted the researcher with questions. Via email, one individual reported difficulty answering the survey questions as they inquired about pain in the present, yet her experience with chronic pain was in the past. The response given was that the experience of chronic pain needed to be current to participate. A second respondent left a voice message stating she had completed the survey and asked that I return her call to discuss the study, which I did. Even though these two participants identified themselves to the researcher, no identifying information connected survey results to the individuals.

The Setting

The setting for the study was a designated website, so that participants could privately complete the survey at a convenient time and place. A link to the survey was embedded in the web page and the Likert scale questionnaires, instruments, and consent were tested for clarity and ease of use by friends and family members of the researcher, prior to data collection. As indicated in the above section, the survey was administered online, and the data collection

process ensured anonymity at every step. No email addresses were captured by the system, and the process was equal for all.

Since identifiers were not collected the researcher was unable to contact participants with a summary of results. However, all participants were invited to contact the researcher via email or phone to discuss any part of the study.

Survey Participants

Eligibility was established by indicating the participant was at least 18-years of age and had experienced chronic pain for a minimum of one-year. The web page introducing the survey stated these two requirements, and after clicking "take survey," participants indicated consent and then clicked "yes" or "no" to the two qualifiers (i.e., at least 18-years of age and whether they have experienced chronic pain for at least one-year). 163-respondents were randomized to either a primed or neutral survey group. Of these, 41 either did not meet the requirement for chronic pain and/or had incomplete responses; therefore, all corresponding data for these 41-respondents was eliminated. Of the 122 remaining qualified respondents, 54 and 68-individuals participated in the neutral and primed group, respectively. After analyzing results, the decision was made to recruit a third group. After securing permission from the IRB, and following procedures outlined in this chapter, 41 additional respondents were recruited. Of these, nine were eliminated as they either did not meet the requirement for chronic pain or had incomplete responses. The rationale for this third group of 32-participants will be discussed in the following chapter; however, all processes and methods are as described here.

Age range options for participants to click on were: 1 (18-24); 2 (25-34); 3 (35-44); 4 (45-54); 5 (55-64); 6 (65-74); 7 (75 and up). The mean age of the 68-participants in the Primed

group was 4.98, indicating the 45-54 age group. The average age of the 54 qualified respondents in the Neutral group was 4.74, indicating the same 45-54 age group.

Gender and Country of Origin were not listed with multiple choice options, so participants wrote in their selection. In the Primed group of 68-participants, 53 were Female, 14 were Male and one was listed as "a gender." Out of 54 qualified respondents in the Neutral group, two chose not to answer, one listed "nonbinary," nine wrote in male and 42 female, including "cisgender" and "female assigned at birth."

64-participants in the Primed group listed the United States as their country of origin, one the United Kingdom, one Israel, one South Africa and one Brazil. In the Neutral group, two chose not to answer, one respondent was from Canada, one from Guyana and the remaining 50 indicated the United States as their country of origin.

The typical pain rating throughout the last year for the Primed group was 6.17, rated on a scale from 0 to 10. In the Neutral group, the typical pain throughout the past year was 5.57 in a range of 1-10.

As befitting randomization, the two groups are well-matched in age, gender, country of origin, and the level of typical pain experienced throughout the last year.

Procedure

The procedure for participants was as follows: On the designated website, www.UnderstandingPainStudy.com, participants clicked on the link provided and established qualifiers (i.e., age and chronic pain duration of at least one-year). After reading the consent form, participants selected "continue" to agree to the terms of participation (see Appendix B). After consenting, a brief demographic survey was completed (e.g., age, gender, country of

origin), and individuals could download an incentive gift, a 30-minute relaxation audio using psychoacoustics.

After completing the above section, administration of the first wave of instruments began. Participants completed the Five-Item Pain inventory (see Appendix D), the four-item Hope scale (see Appendix C), and the 10-item Adapted Hardiness scale (see Appendix E).

The experimental group reviewed a primed PNE tutorial of 219-words, while the control group was exposed to a relatively neutral pain tutorial, with the same word count. See Appendix F to compare the two tutorials. After reviewing either the primed or traditional tutorial, post-test measures began. Participants completed the four-item Hope scale again and rated the level of pain or discomfort in the present moment on a scale of 0-10.

Data Collection Procedures & Tools

Data collection began when target participation goals were reached. After 84-participants completed the survey using the Primed tutorial, data was collected and uploaded into Excel and IBM Statistical Package for the Social Sciences (SPSS). The Primed tutorial was then replaced with the Neutral (i.e., control) tutorial. After 77-participants completed the neutral survey, data was collected and uploaded into Excel and SPSS software.

In SPSS, incomplete questionnaires, and unqualified participants (e.g., did not have chronic pain for more than one-year) were eliminated from both datasets. The result was that 68 and 54 qualified participants completed the primed and neutral surveys, respectively. One participant in the Primed group skipped a hardiness item “Life is Meaningful,” so 999 was entered into SPSS to identify missing data. In this case, since only the single hardiness item was skipped, data from this individual was included. There were no other incomplete cells or items in the data set of 122-participants.

After descriptive statistics were completed, mean scores were calculated on the Five-Item Pain inventory, the Hope scale, and the Adapted Hardiness scale. The difference between pre- and post-test measures on hope and pain in the present were calculated and evaluated for statistical significance. Paired tests, both parametric and non-parametric were conducted and correlational analyses among hope, pain and hardiness were performed. The analysis of each and corresponding measures, will be discussed in the following chapter. The delimitations and limitations of this study are discussed in the following section.

Delimitations/Limitations of the Study

Although chronic pain is defined as ongoing for at least six-months, this study limits participation to adults experiencing chronic pain for at least one-year, ruling out the experience of those whose pain is of a shorter duration. Further, completion of the online survey required access to a computer or cellular device. While libraries, prior to SARS-CoV2 provided computer access, these were not fully available at the time individuals took the online survey, therefore the sample is skewed toward English speaking individuals with access to technology.

Medical histories were not included in this study, as the perception of chronic pain and its relationship to hope was the primary focus, versus the type of chronic pain and comorbidities. Suggestions for future research could include relevant medical histories that could be analyzed and correlated to hope and pain perception; however, MD Anderson found such data to be of little help in analyzing pain (MD Anderson's Brief Pain Inventory Guide).

A future investigation could assess and control for short-term versus chronic use of analgesics, which could potentially impact outcome. In this investigation, however, pain medication was not assessed as participants self-identified as suffering chronic pain, indicating that—with or without medication—the pain condition had not been successfully treated but was

intractable or on-going. Furthermore, although a diagnosis of chronic pain is established at six-months duration, participation required at least one-year of chronic pain. Presumably by then pain pathways would be sensitized and operational even if the underlying cause was treated, contributing to the identification with "chronic" pain. The perception, then, of chronic pain and its relationship to hope was the focus regardless of analgesic use.

Moreover, this investigation did not assess the difference in hope utilizing a negatively primed chronic pain group, as did Claessen (2016). In general, standard biomedical questionnaires and tutorials are considered to be potential negative primes (2016), and since the control tutorial attempted to be neutral, it was constructed to err on the positive to avoid harm. Therefore, a delimitation of this study is that the neutral tutorial could also have functioned as a positive prime. Future research could include a negatively primed tutorial (2016) for comparison.

While every effort was made to avoid a negative prime in terms of hopelessness or pain, it was acknowledged in the IRB application that the Hope scale could function as a positive prime. Rather than risking a nocebo effect (i.e., negative prime,), and because of the unique attributes of Long et al.'s (2020) revised scale (e.g., discussed in the instrumentation section), the positively worded instrument was preferred. Therefore, as discussed in Chapter Five, the positive Hope scale may have had an effect beyond the intervention itself.

In a similar way, the Adapted Hardiness scale, could have primed individuals toward hope. Although the hope difference was not correlated with hardiness, to correct for the possibility that it served as a prime, a third group was recruited (n = 32), and this scale removed. The results will be discussed in the following chapter, but it appears that the Adapted Hardiness scale did not function as a prime.

Limitations

It should be assumed that "systematic differences may be present between subjects who choose to respond to a survey compared to those who do not" (Oppenheimer et al., 2012, Bias, para. 3). Due to the effect of hopelessness on motivation (Jaremka et al., 2014), it is possible that the self-selection process and a response bias could incline individuals toward hope and openness to taking the survey, resulting in a group skewed toward hope.

On the other hand, it could be that high functioning individuals with chronic pain were not inclined to spend time taking the survey biasing the sample toward more debilitated individuals. A larger sample could also enable adequate power allowing for multiple groups (e.g., negative prime, neutral, etc.) and reflect a greater age range.

Summary

This chapter presented an overview of the study design, methodology, and rationale for each as related to the primary research questions. The strengths of this investigation are sample size, randomization, relatively standardized instrumentation, and a unique priming method. A pre- and post-test experimental design (i.e., intervention study) consisting of two randomized parallel groups, was selected to best answer the primary research questions, and contribute to a nuanced understanding of the relationship among chronic pain, stress-hardiness, and hope. The process for participant recruitment, the setting, privacy procedures and descriptive statistics of the sample were also covered in this chapter, before concluding with a review of the delimitations and limitations of the study.

In brief, the researcher designed a website incorporating survey software in an embedded click-to-answer, pre- and post-test survey, tested for ease of use across multiple devices (e.g., cell phones, tablets, computers). All procedures and methods ensured anonymity throughout the process. The validity and reliability, and any adaptations, of each instrument were also presented

in this chapter. The order of instrumentation was structured to best answer the research questions. In the pre-test, participants of both groups respond to questions about the nature of their pain and its effect on daily activities immediately prior to completing the Hope scale. A measurement of self-mastery, the Adapted Hardiness scale follows the Hope scale. After the Hardiness scale, 84-respondents were exposed to the hope manipulation, and 79-respondents to the control manipulation. Post-test measures assessed hope again and rated and pain in the present moment. Of the 163-respondents, 122 qualified participants completed the survey. After analyzing results, a third group of 41was recruited, 32 qualified and completed a primed survey without the Hardiness scale.

Data for all three groups was uploaded to Excel and SPSS for analysis. A detailed description of the process and the findings is discussed in the following chapter.

CHAPTER FOUR: RESULTS

This study examined whether a primed tutorial could raise hope in a chronic pain sample. A pre-test and post-test, hope manipulation v. control manipulation (i.e., experimental design), was selected to answer the guiding research questions. Chapter Three detailed the methods and processes utilized as participants completed a survey incorporating the Hope scale, the Five-Item Pain inventory, and the Adapted Hardiness scale prior to reviewing either a primed or neutral tutorial on pain. Following the intervention, participants completed the Hope scale again and rated pain at the present moment on a scale of 0-10. This chapter describes the procedures used to analyze data that address the guiding research questions and concludes with a summary of key findings.

Data Analysis Procedures

A power analysis was performed during the planning stages of this study to create a sampling goal so that a medium effect size would be captured by Cohen's d with alpha probability set at 0.05. A post-hoc power analysis confirmed that the sample size ($N = 154$) provided sufficient statistical power in tests within and between subjects at 0.972 and 1.0, respectively, to detect a medium effect, $p = 0.05$ (Cohen, 1988; Lenth, 2001).

Version 27 of the Statistical Package for the Social Sciences, or SPSS, developed by IBM, was used for each analysis. A brief description of, and the rationale for selecting, each test statistic, is presented in this chapter with a focus on how the analysis answers the research questions.

The data consists of survey results of pre-test and post-measures of hope and pain at the present moment, level of typical pain experienced throughout the past year, and the trait of stress-hardiness. The analysis is organized by test-statistic, beginning with descriptive statistics

that calculate measures of central tendency for facets of pain and overall hardiness and any tendency toward skewness or kurtosis as measured by Shapiro-Wilk.

To answer the first three research questions (i.e., whether exposure to a positively primed PNE tutorial promotes hope, influences the perception of pain at the present moment, and whether hope impacts the experience of pain), paired tests were performed to establish whether the intervention had an effect and if the effect reached the level of statistical significance. Inferential statistics—in this case paired t-tests (i.e., dependent sample t-test) and Wilcoxon Signed-Rank Tests—address these questions. By calculating the difference between the means of the dependent variables of hope and pain the results are compared and examined for statistical significance. After determining that the difference in hope scores reached statistical significance, a complementary test—Cohen's d—was used to calculate the size or magnitude of the effect. Benchmarks established by Cohen (1988) for this purpose are discussed in that section.

The next inferential statistic explores the trait of stress-hardiness in this sample, investigating the relationship among this factor, pain perception, and the experience of hope. To examine the strength or magnitude of a relationship between two continuous variables, and whether its direction is positive or negative, a value between -1 and +1 is calculated, known as the correlation coefficient. In this study, a bivariate correlation—Pearson's Correlation Coefficient—calculated the strength of the relationship between hope and pain at the present moment (before and after), between hardiness and hope, and between typical pain experienced throughout the past year and hardiness.

Therefore, each test statistic helps answer the guiding research questions. In this chapter, descriptive statistics are presented first, followed by parametric and nonparametric paired tests, and concludes with correlational analyses. Since this is a pre-and post-test intervention study

utilizing two parallel groups, any given test statistic will be analyzed and immediately contrasted with the other group for clarity of comparison, and to best answer the guiding questions. In all analyses, the Primed group data are summarized first and then compared with the Neutral (i.e., control) group. Therefore, to compare and contrast findings, this chapter is organized by the particular analysis being conducted rather than presenting the full data analysis for the Primed and Neutral groups in two different sections.

Sample Description

The recruitment announcement invited adults experiencing chronic pain (e.g., chronic migraine, etc.) for at least one-year to participate in an online survey titled "understanding pain." The web link was posted on social media and sent to email subscribers, associates, colleagues, physicians, physical therapists, and chiropractors (i.e., snowballing). Permission was granted to place cards with a QR code linking to the study in the waiting areas of a general practitioner, two private physical therapy offices, a hospital pain clinic, and two chiropractic offices. An incentive was a 30-minute relaxation audio available via a link that could be accessed upon qualifying to participate.

In the initial analysis, out of 161 respondents 122 met the inclusion criteria and completed all measures. A third group was later recruited (n = 32) which, for clarity, will be discussed at the relevant juncture. Of the 122 initial subjects, 54 and 68-individuals were randomly assigned to two interventions, the Primed tutorial group, and the Neutral tutorial group, respectively. Age, gender, country of origin, and typical pain experienced throughout the year are summarized below for each group.

Age

The age range options on the survey were: 1 (18-24); 2 (25-34); 3 (35-44); 4 (45-54); 5 (55-64); 6 (65-74); 7 (75 and up). The mean age category of the 68 qualified respondents in the Primed group is 4.98, corresponding to the 45-54 age group. This is similar to the mean age (i.e., 4.74) of the 54 qualified respondents in the Neutral group, placing them in the same 45-54 age group.

Gender and Country of Origin

Gender and country of origin were write-in items (i.e., not multiple choice). In the Primed group of 68-participants, 53 were female, 14 were male and one was listed as "a gender." 64 participants listed their country of origin as the United States, one the United Kingdom, one Israel, one South Africa, and one indicated Brazil. Out of 54 qualified respondents in the Neutral group, nine indicated gender as male, 42 wrote in female, two chose not to answer, and one listed "nonbinary." Fifty indicated the United States as their country of origin, two chose not to answer, one wrote in Canada, and one Guyana.

Mean of Typical Pain & Hardiness

The Five-item Pain inventory assessed pain in five areas. The pre-test and post-test variable (i.e., dependent variable) was pain experienced at the present moment. On the other hand, the typical pain rating throughout the year was assessed as an independent variable prior to the intervention, with 0 being no pain at all and 10 being the highest ever. The mean of typical pain rating (i.e., throughout the last year) for the Primed group was 6.17, and the mean of typical pain for the Neutral group was 5.57.

Hardiness was scored as the mean of ten items on a five-point scale with one being false, and five being true. Mean hardiness is 3.87 for the Primed group and 4.00 for the Neutral group.

Both skewness and kurtosis describe the shape of a distribution, with values between -1.0 and 1.0 representative of a normal curve. Skewness assesses the symmetry of the distribution while kurtosis describes the impact of outliers and whether the distribution is too peaked or too flat.

The Primed sample did not appear skewed on either variable, as the mean of typical pain throughout the year and the mean of hardiness are -0.398 and -0.625 respectively. Kurtosis was not significant as the means of typical pain and of hardiness are -0.041 and -0.167 accordingly.

Similarly, the Neutral group reflects a normal distribution for typical pain with skewness of 0.084, which is not greater than 1.0 and not less than -1.0. Hardiness, however, was skewed outside the value of -1.0 at -1.052, and kurtosis was somewhat elevated at 1.08 (i.e., leptokurtic) resulting in a peaked distribution. Therefore, the tendency toward hardiness in this group is somewhat more pronounced than in the Primed group.

Summary of Descriptive Characteristics

The majority of participants in the Primed (n = 68) and Neutral (n = 54) groups were female (i.e., approximately 80%), between 45-54 years of age, listing the United States as country of origin (98%). The independent variables of typical pain throughout the year and hardiness were comparatively assessed as they describe each group's distribution. The mean hardiness score is 3.87 for the Primed group and 4.00 for the Neutral group. Subjects rated typical pain experienced throughout the past year at five-to-six in a range of 0-10. Both samples reflect a relatively normal distribution on the experience of typical pain, and both groups tend toward higher levels of stress hardiness, the trait being more pronounced in the Neutral group. In both groups, the highest-rated value on the ten-item Adapted Hardiness scale is "life seems

meaningful to me," and the lowest score in both samples was "stressful life events are opportunities to grow."

Therefore, Primed (n = 68) and Neutral (n = 54) groups exhibited homogeneity in terms of age, gender, country of origin, typical pain, and hardiness profile, indicating successful randomization. There were no significant outliers, and most data approximated the normal distribution, although for the Neutral group the trait of hardiness was skewed at -1.052, and kurtosis was somewhat elevated at 1.08 (i.e., leptokurtic) reflecting a greater tendency toward hardiness than seen in the Primed group.

To compare the outcome measures of pain (i.e., at the present moment) and hope, before and after the intervention, paired t-tests, and the Wilcoxon Signed-Rank Test were performed and are discussed below, while correlations between hardiness, hope, and pain will be discussed in the section on correlations.

Normality Assumptions & Paired Tests

To answer the primary guiding research questions, (i.e., can hope be primed, does hope influence the perception of pain at the present moment, and does hope impact the experience of pain?), it was necessary to establish whether the intervention had an effect. In brief, prior to the intervention, participants completed the Hope scale, the Five-Item Pain inventory, and the Adapted Hardiness scale. The hope measure is the mean of four items, rated on a scale from one to six, and the pain scale is a five-item self-report measure assessing pain from 0-10. Baseline evaluations for hope and pain at the present moment (i.e., discomfort now) were performed prior to and following the intervention as a post-test evaluation. As noted previously, the pre-test also included a ten-item, five-point scale assessing stress hardiness.

A paired t-test compares the mean scores of two items or dependent variables that are measured twice as in the case of before and after testing. Since the data set contains two measurements, pre-test and post-test for every participant, a paired test was the appropriate test statistic. Paired tests are available for both parametric and nonparametric data. The parametric paired t-test (i.e., dependent sample t-test) procedure makes several assumptions about the differences between two paired sets of values (e.g., pre-test and post-test outcomes); namely, the sample must be random, the dependent variable continuous, the difference in the means approximates a normal distribution, and outcomes do not contain significant outliers.

The normality assumption of a t-test assumes that the means of the different samples are normally distributed (i.e., not that the population is normally distributed), so the findings are statistically more likely to extend to a broader population. In general, when non-normal distributions contain a sufficient number of samples the assumption of the t-test requirement is considered to be satisfied. However, it is argued that this assumption only applies in samples over 300, and even then, cannot be presumed (Kim & Park, 2019; Mohd & Khairani, 2020). At 122, the sample is considered to be of medium size, as it is greater than 50 but less than 300 (Mohd & Khairani, 2020). Although the sample population in this study, by some standards, could be considered large enough to rely on paired t-test data alone, to ratify and clarify findings as much as possible, a test of normality was also performed.

While t-tests are robust even when used in score distributions that violate normality, additional test-statistics were performed to further evaluate the data. The Shapiro-Wilk test of skewness and kurtosis is recommended for samples of less than 300 (Mohd & Khairani, 2020), and was set at the .001 level to detect even subtle deviations. In the Primed group, skewness is

minimal at 0.157, while kurtosis is elevated at 3.041. On the other hand, skewness and kurtosis in the Neutral group were 2.089 and 8.127, respectively.

Although George and Mallery (2010) define skewness and kurtosis as within +/-2, Hair et al. (2010) finds +/- 7 an acceptable range for kurtosis. Statistician Nicholas Cox (2010) argues that varying values are not only misleading, but that stringent limits for skewness and kurtosis may distort results, "impart[ing] bias to estimation and, in extreme cases, imply[ing] that no sample could bear exact witness to its parent distribution" (p. 482). Cox finds "kurtosis . . . even more enigmatic [than skewness]: some authors write of kurtosis as peakedness and some write of it as tail weight, but the skeptical interpretation that kurtosis is whatever kurtosis measures is the only totally safe story" (p. 483).

Even so, Mohd and Khairani (2020) argue that when normality is assumed rather than established, "interpretation and inference may not be reliable," (p. 689). Therefore, in an abundance of caution this paper assumes a level of kurtosis according to testing via Shapiro-Wilk. According to the +/- 2 limit for skewness, with a stringent setting at the .001 level, the Neutral sample is slightly skewed. Kurtosis, however, is high at +/-8. In a review of the literature, Mohd and Khairani (2020) note that "normality is important when skewness or outliers affect correlation or significant value statistical analysis," while kurtosis may "not have much effect on most statistical analysis" (p. 691).

In summary, t-tests are robust measures even when normality in score distributions has been violated. Nevertheless, the Shapiro-Wilk test for skewness and kurtosis was performed in both data sets. In the Primed group, skewness was minimal at 0.157, while kurtosis was elevated at 3.041. On the other hand, skewness and kurtosis in the Neutral group were 2.089 and 8.127,

respectively. Since normality cannot be assured, both parametric and nonparametric paired tests were conducted; the findings are discussed below, beginning with the Primed group.

Paired T-Tests: The Primed Group

After establishing a baseline for scores of hope and pain, 68-subjects were exposed to a primed pain tutorial (i.e., the hope manipulation), and again took the four-item Hope scale and rated pain at the present moment (i.e., now). A before and after measurement of each participant was taken on a scale where 6 = high hope and 1 = low hope, and 0-10 indicated the level of pain experienced at the present moment. Accordingly, a paired t-test was performed to calculate the difference between the means of the dependent variables of hope and pain at the present moment, before and after the intervention.

Before the intervention the mean of hope was 4.319 (HopeT1) and after was 4.672 (HopeT2). The mean of pain at the present moment (i.e., pain now), before the intervention, was 6.0 and after 5.89. The differences in the mean of hope (i.e., HopeT1, HopeT2), before and after, and discomfort at the present moment, before and after, can be seen in the paired sample t-tests in Table 1. The difference in the mean scores of hope, before and after the intervention, is significant at the 0.001 level, while the difference in pain was not statistically significant, p = 0.57.

After determining that the difference in hope scores reached statistical significance, Cohen's d was used to calculate the size or magnitude of the effect. Benchmarks established by Cohen (1988) for this purpose are reported as small (.2), medium (.5), and large (.8) effect sizes. Since the post-test score for hope (i.e., HopeT2) is greater, subtracting it from the pre-test score (i.e., HopeT1) yields a positive value for Cohen's d, as the point estimate indicates a medium effect size at 0.425.

Wilcoxon Signed-Rank Test: Primed Group

Although parametric tests have greater power, that is, greater ability to detect differences, nonparametric tests are not dependent upon assumptions of normality and were performed as complementary measures considering the slight skewness and kurtosis of the control group (Kim & Park, 2019). The Wilcoxon Signed-Rank Test compares the sum of the positive ranks or outcomes with the sum of the negative. According to this test measure, the median of differences in the Primed group indicates the increase in hope is significant at the 0.001 level (alpha set at 0.05), rejecting the null hypothesis. There was no pre-test and post-test difference in pain. These results confirm the paired t-test findings discussed above, rejecting the null hypothesis (i.e., that there is no significant difference in pre-and post-test scores).

Paired T-Tests: Neutral Group

The same statistical analyses, described above, were performed on the Neutral group's data. After establishing a baseline for hope and pain at the present moment (i.e., now), 54-subjects were exposed to a neutral pain tutorial and again took the Hope scale and rated pain at the present moment (i.e., now). In other words, a before and after measurement for each participant was taken on a four-item scale where six represents high hope and one represents low hope, and rated pain or discomfort experienced at the present moment (i.e., now) from 0-10, both before and after reading the neutral tutorial.

The mean of hope before the intervention was 4.578, and after was 4.995. The mean of pain experienced at the present moment of the pre-test was 5.185 and after 5.055. As in the Primed group, the paired t-test found no statistical pre- post-difference in pain; however, the difference in hope was, again, significant at the .001 level. After determining that the difference

in hope scores reached statistical significance, Cohen's d was used to calculate the magnitude of the effect. According to Cohen's d there is a moderate effect size at 0.546.

As performed on the Primed group sample, the Wilcoxon Signed-Rank Test finds the median difference of pre- and post-test hope scores to be significant at the 0.001 level (alpha set at 0.05), and no difference in pain.

Results of Paired Tests: Summary—and Rationale for a Third Group

Two of the research questions guiding this pilot study were: Does exposure to a positively primed Pain Neuroscience Educational (PNE) tutorial promote hope in respondents experiencing chronic pain? And does exposure to a positively primed PNE tutorial influence the experience of pain as perceived at the present moment? In both samples, paired tests demonstrated that only the dependent variable of hope changed from one analysis to the next. The difference in pain scores did not reach the level of significance in either group. In both the Primed and Neutral groups, the Wilcoxon Signed-Rank Test and the paired t-test found statistically significant differences between the pre-and post-test hope scores at the 0.001 level, with medium effect sizes, $p = 0.05$. The Primed tutorial (i.e., hope manipulation) did not perform better than the Neutral tutorial (i.e., control manipulation). The third question probed whether hope impacts the perception of pain at the moment (i.e., now). The uptick in hope across both groups did not correspond with a reduction in pain now (i.e., at the present moment).

These results indicate that while hope increased during the survey process, it could not be established whether the effect was due to the tutorials, the positively phrased hardiness scale, the repetition effect, or a combination. As a result, a third group was recruited in an attempt to isolate and clarify the findings.

Paired T-Test Results: A Third Group is Surveyed

Since hope increased significantly throughout the survey process for both groups, the decision was made to reduce the number of variables by removing the positively phrased hardiness scale in case it was serving as a prime, while keeping all other measures. Although both tutorials raised hope, the Neutral group had a slightly greater effect size, so the decision was made to use the Primed tutorial to better isolate any hope effects of the hardiness scale. Forty-one individuals responded and results were uploaded into SPSS. Of these, three respondents did not qualify, and six did not complete the survey, so the scores of the remaining 32 were evaluated in SPSS.

This sample includes 23 females and nine males; and aside from a participant citing Canada as country of origin, all others listed their country of origin as the United States. As in the Primed and Neutral groups, the mean age was 4.6 which corresponds to the same 45-54 age group. The mean of typical pain throughout the past year was 6.18.

For statistical purposes, as in the other two groups, a test of normality was performed on the difference in hope scores, pre-test and post-test. According to the Shapiro-Wilk Test of Normality, this sample was normally distributed with skewness of 0.862 and kurtosis of 0.545; therefore, a paired t-test was performed. As in the Primed and Neutral groups, there was no difference in pain, as pre-test and post-test scores for pain at the present moment (i.e., pain now) did not reach statistical significance at 0.165. However, the difference in hope—as in the other two groups—was significant at the 0.001 level, with a medium effect size at 0.67 (Cohen's d)—which is somewhat greater than the other two groups.

Although effect sizes have been reported, it should be noted that after adjusting for the pre-intervention hope scores, an Analysis of Covariance did not find a statistically significant difference in post-intervention hope between the three groups, $p = 0.660$.

In summary, and for ease of comparison, Table 1 compares the paired t-tests results of hope, before and after, and effect sizes of all three groups. Pain ratings did not change in any group, but in all three groups the change in hope was significant at the 0.001 level. In the Primed group (n = 68) the effect size was 0.425, in the Neutral group (n = 54) Cohen's d was 0.546, and in the Primed Without Hardiness group (n = 32) it was 0.672. Although the effect size appears greater in the Primed Without Hardiness group, an Analysis of Covariance (i.e., ANCOVA) did not find a significant difference between groups, p = 0.660.

The final research query involves the potential relationships among the variables of hope, pain, and hardiness in this sample population. The next section of this chapter examines these findings.

Relationships: Pearson's Correlation Coefficient

To better characterize the sample chronic pain population, this inquiry also measured the trait factor of stress-hardiness to examine the relationship between this factor and the outcomes of pain perception and the experience of hope.

Bivariate correlation analysis determines the strength and direction, whether positive or negative, of the relationship between two continuous variables; in this case, between hope and hardiness, hope and pain, and between pain and hardiness. A bivariate analysis can be descriptive or inferential, but in both cases, it is used to examine the relationship between two variables. Pearson's bivariate correlation coefficient assumes a linear relationship between variables, best confirmed by a scatterplot.

In a scatterplot, each point represents the intersection of two variables, and the line indicates the correlative (i.e., not causal) nature of the relationship and its direction. Although a non-linear relationship is possible, a scatterplot confirmed a linear relationship between the two

variables of hope and hardiness, indicating Pearson's bivariate correlation coefficient to be the appropriate test statistic for this evaluation, which will be discussed in more detail later in this section.

The analysis of the correlation between hope and hardiness should be distinguished from the hope *difference*. The trait of hardiness does not explain the difference in hope—pre-test and post-test Hope scales—in the Primed and Neutral groups, as it was barely significant at the 0.07 and 0.24 levels accordingly (e.g., a strong correlation is +/- 0.50 and 1.0). Likewise, there was no pre-test and post-test difference in pain, therefore, no statistically significant relationship with hardiness in this particular test statistic.

However, Pearson's Correlation Coefficient demonstrates a significant and strong correlative relationship between hardiness and hope in the Primed and Neutral groups. In the Primed group, the before measure, HopeT1 (i.e., time 1), is strongly correlated with hardiness at 0.73, as is HopeT2 (i.e., time 2), at 0.72, $p = 0.01$ level. Likewise, a significant correlation was found between hardiness and hope in the Neutral group, which became stronger post-test, as indicated by Pearson's Correlation Coefficient for HopeT1 (i.e., before) and HopeT2 (i.e., after) at 0.58 and 0.83, respectively, $p = 0.01$ level. On the other hand, there is no meaningful relationship between pain now, before and after, and hardiness, $r = 0.09$ and 0.20, $p = 0.05$.

Although there was no difference between the baseline measure for pain at the present and the post-test measure in either group, the researcher wanted to know if there was a relationship between typical pain experienced throughout one year (i.e., as opposed to pain at the present moment) and hardiness. Pain throughout the year was assessed only once in the pre-test, prior to being exposed to either the hope intervention or the control intervention, or the Adapted Hardiness scale.

In the Primed group, Pearson's Correlation Coefficient found the relationship between hardiness and an individual's typical pain level to be significant at the 0.01 level, and moderately correlated at -0.32, indicating an inverse relationship: As hardiness levels rise, typical pain experienced throughout the year decreased (i.e., an upper left to lower right pattern on the scatterplot). Moderate correlation is established between 0.30 and 0.49. The relationship was weaker in the Neutral group but still statistically significant, $r = -0.29$, $p = 0.05$, confirming an inverse correlation between hardiness and typical pain.

Therefore, typical pain experienced throughout the year (i.e., as opposed to pain at the present, measured before and after) appears to be moderately and inversely correlated with hardiness in the Neutral and Primed groups ($n = 122$). A linear relationship between these two variables was established by a scatter plot confirming that Pearson's Correlation Coefficient was an appropriate test statistic to examine the strength and direction of the two continuous variables, hardiness, and typical pain throughout the year.

A correlation analysis was also performed to gauge the association between typical pain throughout the past year and hope. In both the Neutral and Primed groups ($n = 122$), the correlation was significant at the 0.01 level, indicating a moderate inverse relationship (-0.41 for the Primed group and -0.44 for the Neutral group) between pain and hope. In contrast, no significant correlation between hope and typical pain throughout the last year was found in the Primed Without Hardiness group ($n = 32$), $r = 0.037$.

Summary of Correlations

The final guiding query concerned the relationships among the traits of stress-hardiness, hope, and pain. Pearson's Correlation Coefficient found hope to be strongly correlated with hardiness in the Primed and Neutral groups at -0.73 and -0.83 respectively, and significant at the

0.01 level. As hope rose, hardiness did as well. Hardiness and pain were significant at the 0.05 level with a correlation of -0.29 in the Neutral group, with a more moderate correlation between hardiness and pain at -0.32, significant at the 0.01 level, in the Primed group. There was, however, a stronger, inverse relationship between typical pain and hope (using the pre-test measure of HopeT1), significant in the Primed and Neutral groups at the .01 level, r = -0.41 and -0.449 respectively.

A striking difference was observed in the third group (n = 32), where–-unlike the other two groups—no correlation between hope and pain was found. Since hardiness was not assessed in this group, the pre-test hope score was correlated with typical pain throughout the past year and no relationship between the two was found in this group as evidenced by Pearson's Correlation Coefficient, r = 0.037.

Summary

This study was constructed to understand the effect of a priming intervention designed to instill hope and to explore the relationship between hope and the perception of pain. This chapter reported the findings of several analyses carried out on the primary sample of 122. After examining the results, a revised survey was constructed, and an additional 32 qualified participants were recruited (N = 154). This chapter was organized by test statistics for ease of comparison between groups.

There were no significant demographic or descriptive differences between the Primed (n = 68), Neutral (n = 54), and Primed Without Hardiness (n = 32) groups. Likewise, the Primed and Neutral groups (n = 122) scored similarly on the variables of hope, pain, and stress-hardiness. As a result of these analyses, the randomization of the experiment appears successful.

A central guiding question was whether hope can be primed via brief, written communication in respondents experiencing chronic pain. Further questions were: Does exposure to a positively primed PNE tutorial influence the experience of pain (i.e., as perceived at the present moment)? Does hope impact the experience of pain as perceived at the present moment (i.e., now)? And finally, what is the relationship between hope, pain, and the trait of stress-hardiness?

To answer these questions paired tests and correlational analyses were performed. Paired t-tests were conducted to compare means between the pre-test and post-test samples, but due to the presence of kurtosis, a nonparametric test, the Wilcoxon Signed-Test was also performed as a supplemental statistic. Neither paired test demonstrated a significant difference between the two groups in the pre-test and post-test scores for the dependent variable of pain; however, both the Primed and Neutral groups showed a significant gain in hope at the 0.001 level, with a medium effect size. Therefore, hope did not change as a result of the primed intervention, but it did change in both conditions (i.e., the hope manipulation and the control manipulation) throughout the process of taking the survey. The gain in hope, across both samples, did not affect pain as perceived at the moment.

To define the variable potentially responsible for raising hope, a third survey was developed, and 32 qualified participants were recruited. This new survey eliminated the hardiness scale in case it was serving as a prime. The sample proved to be normally distributed, and similar to the other two groups demographically. Furthermore, the mean of hope "before" in all three groups is comparable: Primed group, $M = 4.31$, Neutral group, $M = 4.57$, and Primed Without Hardiness, $M = 4.42$. A paired t-test found the hope difference in the third group to be significant at the .001 level, but with a somewhat greater effect size than the other two groups

(i.e., $r = 0.672$, compared with 0.546 for the Neutral group and 0.425 for the Primed). As shown in Table 1, the increase in hope was statistically significant, with medium effect sizes, in all three groups, with the greatest effect size in the Primed Without Hardiness group. Nevertheless, an Analysis of Covariance did not find a statistically significant difference between groups, $p = 0.660$.

To better characterize the sample population, this inquiry also measured the trait factor of stress-hardiness in participants in the Neutral and Primed groups. This approach allowed the researcher to examine the relationship of this factor and the outcomes of pain perception and the experience of hope, via Pearson's Correlation Coefficient. In both groups, there was a strong correlation between hope and hardiness, an inverse medium correlation between pain and hardiness, and an inverse medium correlation between hope and pain.

In terms of correlations, an exception was found in the Primed Without Hardiness group where hope and pain were not correlated, $r = 0.037$. In other respects, the three groups are quite similar, but the lack of correlation in this particular sample ($n = 32$) is notable.

Having presented the findings in this chapter, the final section will discuss the strengths and limitations of the project, conclusions that can be drawn in light of existing literature, and future directions for research.

CHAPTER FIVE: DISCUSSION

As methodological details and the results of the experiment were covered in Chapters Three and Four, this final chapter interprets the findings in view of existing literature with an emphasis on implications for future research and clinical application. The first section of this chapter supports the rationale for this study in view of gaps in health priming literature, while the following section interprets the results according to each guiding research question. A discussion of the limitations and delimitations of the study follows, with a focus on how these may be addressed by future research. The final section highlights conclusions that can be drawn from the findings, how the project contributes to the literature, directions for future research and implications for clinical practice.

The Rationale: Addressing Gaps in Priming Literature

While the downstream effects of mindsets and self-efficacy beliefs are widely recognized, effective intervention tools are lacking (Papies, 2016). This pre- and post-test experiment, consisting of two randomized parallel groups, was designed in response to a collective call for research in nonconscious processes aimed at clinical application (Sheeran et al., 2013). Therefore, this study contributes to cross-categorical research with a goal of improving outcome.

Chronic pain, affecting more than fifteen percent of the world population and twenty percent of the US population, was selected as the target condition. In the aggregate, biomedical treatment for chronic pain is burdened by poor outcomes. When pain becomes chronic, “it can lead to dramatically reduced quality of life, depression and suicide, insomnia, lowered immune function, changes in eating patterns, impaired cognitive function, maladaptive stress responses,”

and other long-term deleterious effects (2015, p. 23). Even so, chronic pain is seldom studied in clinical practice (Brascher et al., 2018).

More recently, findings in pain perception contributed to the development of pain neuroscience education (PNE) as a treatment for chronic pain, coded for reimbursement by Medicare. Although adaptive mindsets are critical, according to Rondon-Ramos et al. (2020), the first trial to evaluate PNE in modulating self-efficacy beliefs in chronic pain was conducted in 2020. Furthermore, this researcher was unable to locate studies investigating its impact on hope. Self-efficacy beliefs and adaptive mindsets—including the actionable quality of hope—are recognized as essential to the attainment of valued goals (2020), and while these may be addressed in PNE as part of a biopsychosocial program, long-term effects and adherence have proved disappointing (Wood & Hendrick, 2018).

Priming methods, on the other hand, are purported to be more effective than purely conscious methods in recalibrating mindset, attitudes, beliefs, and health behavior (Elgendi et al., 2018; Papies, 2016; Sheeran et al., 2013; Wryobeck & Chen, 2003). Since priming does not appear to have been investigated in PNE, and attitudes and beliefs correlate strongly with well-being and health outcomes (Coughlin, 2006; Van Tongeren & Bernette, 2018), this research project also addresses a gap in clinical pain education research.

Additionally, there is little extant literature on priming hope, particularly in chronic pain. Hope—while well-represented in depression literature—is seldom studied in physical health outcomes and chronic pain despite its association with reduced morbidity and all-cause mortality (Long et al., 2020). Notwithstanding its determining role, hope is seldom studied in expectancy, priming and placebo research (Eaves et al., 2016). Claessen et al. (2016), for example, encouraged the study of "positively phrased words and concepts [that] can prime and coach

patients to be less ill for a given pathophysiology" (p. 54), inspiring this investigation to explore the feasibility of priming hope in chronic pain conditions. A primary guiding research question, then, was whether hope could be primed in chronic pain, a population particularly vulnerable to loss of hope (Kerns et al., 2014).

And finally, although resiliency measures are commonly studied, the trait of stress-hardiness has been found to be supportive of mental and physical health and is seldom investigated in pain conditions (France et al., 2020; Zerach, et al., 2020). Consequently, this project supports the call for targeted interventions that evaluate stress-hardiness in chronic pain populations.

Summary of Findings

A pre- and post-test intervention study consisting of two randomized parallel groups, hope manipulation v. control manipulation, was selected to investigate the primary research questions: Can hope can be primed via brief, written communication in respondents experiencing chronic pain? Does exposure to a positively primed PNE tutorial influence the experience of pain (i.e., as perceived at the present moment)? Does hope impact the experience of pain as perceived at the present moment? And finally, what is the relationship between hope, pain, and the trait of stress-hardiness?

To avoid the common pitfall of underpowered pilot studies (Freedland, 2020), an *a priori* power analysis indicated a sample of at least 75 was needed to detect a medium effect size between 0.3-0.5 (Cohen's d) with alpha set at 0.05. A post-hoc power analysis confirmed that the sample size ($N = 154$) provided sufficient statistical power in tests within and between subjects at 0.972 and 1.0 respectively, to detect a medium effect, $p = 0.05$ (Cohen, 1988; Lenth, 2001).

Since the social context and an experimenter's expectations can influence the placebo response, this investigation eliminated the risk of investigator bias and/or influence by administering all scales anonymously via a web link, and there was no physical interaction between researcher and participants. Participants were also unaware of the prime and the purpose of the study. After being exposed to the pain scale, a baseline of hope was established. Then, 122 of the 154-participants also completed a hardiness scale. Next, all participants (N = 154) focused on pain related material (i.e., the pain condition), either in the form of a relatively neutral pain tutorial or a primed PNE, before completing the Hope scale again (i.e., post-test) and rating pain at the present moment (i.e., now).

To answer the guiding research questions paired t-tests and correlational analyses were performed. Paired tests (N = 154) demonstrated a significant gain in *hope* at the 0.001 level, with a medium effect size at 0.425, 0.546 and 0.672 for the Primed, Neutral and Primed Without Hardiness groups, respectively, as shown in Table 1. The increased effect size in the third group could be due to the smaller sample, as an Analysis of Covariance did not find a statistically significant difference between the three groups, p = 0.660. Accordingly, it can be assumed that variations between groups are likely insignificant. Therefore, there was a statistically significant gain in hope in both conditions (i.e., the hope manipulation and the control manipulation) throughout the process of taking the survey, with and without the hardiness scale (N = 154). *Pain*—as perceived at the moment—did not change as a result of the tutorials, nor did the gain in hope as seen across all samples, affect pain as perceived at the moment.

Statistically significant correlations were found among hope, hardiness and typical pain experienced throughout the year. A moderate, inverse correlation between hope and typical pain was seen in the Primed and Neutral groups (n = 122) at the 0.01 level, r = -0.41, -0.449, p = .05.

An exception was found in the Primed Without Hardiness group (n = 32) where hope and pain were not correlated, r = 0.037. An inverse correlation between hardiness and typical pain throughout the past year was statistically significant at the 0.01 and 0.05 levels for both the Primed and Neutral groups, accordingly, and moderately correlated at -0.32 and -0.29, p = 0.05, respectively (Cohen's d). Moreover, there was a strong correlative relationship between hardiness and hope in both groups (n = 122) at 0.73 and 0.83 respectively, p = 0.05. Although elevated hope was more closely correlated with pain reduction than hardiness, the trait of hardiness is similar in that stress-hardy individuals seek to take responsibility for their behavior and attitudes via challenge, commitment, and control (Zerach et al., 2020).

Interpretation of Findings

In addition to the above, detailed descriptions of the experimental design (i.e., pre-test and post-test hope manipulation v. control manipulation) and outcome measures can be found in Chapters Three and Four. In sum, paired tests investigated the primary research questions, while further conclusions were derived from correlational analyses. The sections that follow present the conclusions drawn from those results. While the guiding research questions are interrelated, the findings and associated contributions for each are considered individually prior to being discussed collectively in the concluding section.

The First Guiding Question: Priming Hope

The first guiding research question was: Does exposure to a positively primed PNE tutorial promote hope in respondents experiencing chronic pain (i.e., can hope be primed via brief, written communication among participants experiencing chronic pain)? The results suggest that hope can be primed in chronic pain, however, the mechanism for the effect is not clear. In all three arms (N = 154), Neutral, Primed and Primed Without Hardiness, the differences in the

mean scores of hope, before and after the intervention, were significant at the 0.001 level with medium effect sizes as seen in Table 1.

There are several possible explanations for the notable gain in hope exhibited by all groups. The most obvious is that great care was taken to avoid the nocebo effect (Brascher et al., 2018) when constructing the Neutral tutorial. Although the Neutral tutorial did not feature new findings in pain science, nor provide a specific reference to hope, it did validate the pain experience and offer supportive language for communicating the unique nature of pain perception. A neutral tutorial on a different topic (e.g., organic gardening) selects against a pain focus and would not enable an adequate comparison of the two groups, as the experimental group (i.e., hope manipulation) was required to focus on pain throughout the survey. Were the control group to be exposed to a non-pain related topic, any subsequent change in hope could be attributed to the distraction. By requiring all subjects to focus on pain, conditions are consistent across groups and results are potentially more applicable to clinical practice, in that, patients are focused on pain when seeking treatment or participating in PNE. It is conceivable then, that this relatively neutral educational piece increased hope among participants.

The possibility that the positively phrased hardiness scale functioned as a prime was addressed by recruiting a third group. Since hope increased significantly throughout the survey process for both the Neutral and Primed groups (n = 122), a third group (n = 32) was exposed to the Primed tutorial but without the hardiness scale, while keeping all other measures. The significant gain in hope, at the 0.001 level, demonstrated by this third group—coupled with a moderate effect size—verified that the hardiness scale did not serve as a prime. The conclusions that can be drawn from the addition of the third group is that the hardiness scale did not increase hope, nor was the Neutral tutorial more effective than the Primed tutorial.

So, if the increase in hope was not due to the hardiness scale, nor to a notable advantage of either the Neutral or Primed tutorial, what other explanation is there? In the final analysis, there is another intriguing possibility to consider: repetition priming (Henik & Carr, 2002, Inhibition). In this study, the repetition of the Hope scale (i.e., baseline and post-intervention) could have elevated hope independently of the tutorials or had an additive effect, particularly since two of the positive phrases were in the first person (e.g., it is possible for me to reach goals; the future seems hopeful to me).

The increase in hope over such a short period of time, however, is notable for another reason: it underscores the malleability of hope and the potential effect(s) of even brief exposure to words—whether through the Hope scale, educational tutorials, or a combination of the two (Claessen et al., 2016; Crum & Zuckerman, 2017; Zion et al., 2019), even while focusing on pain and related sequelae.

In sum, to answer the initial research question—can hope be primed in chronic pain—the answer is yes. However, the mechanism for this effect is not clear. All groups experienced a statistically significant gain in hope. While it is possible that both the Primed and Neutral tutorials served as primes, the repetition of the Hope scale could have promoted hope independently or interacted in an additive manner with the tutorials. Future research, with a much larger sample, could distill results by administering the Hope scale before and after standard pain questionnaires at routine screenings in treatment centers, thereby isolating any effects.

Having explored whether hope can be primed, what of pain? Was pain at the moment affected by the Hope scale or the tutorials? Guiding research questions related to pain perception are discussed in the following section.

The Second & Third Guiding Questions: Pain Perception

An analysis of the remaining guiding research questions revealed additional contributions to priming literature. “While the majority of studies on placebo hypoalgesia and nocebo hyperalgesia examined healthy participants, only few investigated pain patients and even less focused on clinical pain” (Brascher et al., 2018). By gauging pain at the present, two interrelated guiding questions were evaluated: whether exposure to a primed PNE tutorial influenced pain as perceived at the present moment, and if an elevation in hope corresponded to a perceived difference in pain. Paired t-tests showed pain at the present moment (i.e., now) did not change in this study. Neither the Primed tutorial (n = 100), the Neutral tutorial (n = 54) nor the hardiness scale (n = 122) acted as an intervention in pain. Further, the notable increase in hope across all groups (N = 154) was not correlated to outcomes in pain perception at the present.

In brief, these findings are in line with classical conditioning in placebo research, wherein, pain relief accompanies implicit cues and verbal suggestions (i.e., spoken or written) (Brascher et al., 2018)—which was not the case in this study to avoid interference in the evaluation of hope. Put another way, priming/placebo effects are “related to the broader concept of expectancy . . . [in that] positive expectancy means the outcome is positively influenced and negative expectancy means the outcome is negatively influenced” (Claessen et al., 2016, p. 48). In this investigation there was no explicit or implicit suggestion that the intervention would affect pain. Before exploring the reasons for this design choice further, a primary question must be addressed: Is pain malleable in the moment?

Pain research indicates the answer is, yes. Verbal suggestion appears highly effective for acute procedural as well as chronic pain even after open-label placebo administration (Brascher et al., 2018). Equivalent results are also seen in nocebo pain responses. In one study, patients

"primed with pain-related questions with a negative connotation showed an increased pain rating compared with the control group" (Claessen et al., 2016, p. 54). Conversely, in Claessen et al.'s (2016) investigation, positively primed subjects experienced a gain in functional mobility but not a reduction in pain. In part, this could be attributed to repeated therapy failure—common in chronic pain—that "might lead to weakened placebo or persistent nocebo effects potentially contributing to the maintenance of chronic pain" (Brascher et al., 2018, Clinical Context, para. 5). In terms of PNE, a systemic review and meta-analysis found that it produced statistically significant but clinically small improvements in pain (Clarke et al., 2011).

Such contrasting findings contribute to the notion, supported by pain science, that perception (i.e., interpretation) drives the sensate experience. Pain, like pleasure, becomes part of the neural network and emotional memory circuitry of the brain reflecting "moment-to-moment shifts in value judgments regarding the self and regarding the relationship between the self and the environment" (Baliki & Apkarian, 2015, p. 9). To clarify the role of perception in pain, Baliki & Apkarian (2015) cite the example of a ballerina applying 50 kg of weight on a 1 cm area of skin. In purely biological terms the weight should be excruciating, yet the actual experience is gratifying. Although pain perception is reported to be highly malleable in the moment, "pain and negative moods are envisioned as a continuum of aversive behavioral learning, which enhance survival by protecting against threats . . . [in which] the limbic brain plays a critical role" (Baliki & Apkarian, 2015, p. 1). It is conceivable, then, that an increase in a positive emotion like hope could have imparted a measure of pain relief in the here-and-now (i.e., at the present moment) among participants in this project, particularly since "conditioned placebo and nocebo effects in pain [can occur independently] of explicit expectation" (Brascher et al., 2018, Clinical Context, para. 5).

In this study, to better isolate the hope effect, there was no suggestion that the intervention (i.e., exposure to the tutorial) would affect pain at the present, nor was there an implicit or hidden cue implying pain would decrease. There are three primary reasons the study was constructed without priming for pain relief. If, for example, hypoalgesia primes were included—and pain decreased and hope elevated—the results could be incorrectly conflated, in that a reduction in pain contributed to gains in hope. Without this interference hope was effectively isolated—its rise due to either the tutorials, the Hope scale, or a combination of the two. Secondly, as it stands, there is an existing body of evidence that supports the verbal (i.e., written) effect of priming (i.e., placebo) on pain—but not on hope. The study's design, therefore, provides a unique contribution to priming research.

The third reason is that the primed tutorial was designed to reflect the PNE model by implying that new learning and skills can lead to pain relief. Had it contained an implicit or explicit cue suggesting pain would be reduced at that very moment, it would not have mirrored PNE content. Since the tutorial was not primed for hypoalgesia effects, the researcher was able to explore whether a reduction in pain would accompany the information, and/or any elevation of hope. Future research could explore implicit and explicit hypoalgesia primes in PNE. In clinical practice, hypoalgesia priming may be further enhanced when suggested by the treating physician and allied health professionals (Crum & Zuckerman, 2017).

This investigation also measured a trait seldom studied in chronic pain (Zerach et al., 2020): the factor of stress-hardiness. The correlations among hardiness, pain perception and the experience of hope will be discussed in the following section.

Correlations: Hope, Stress-hardiness & the Experience of Pain

This study incorporated correlational analyses that contribute to an understanding of the relationship among chronic pain, stress-hardiness, and hope. As discussed in the previous section, there were no pre-test post-test differences in pain at the present moment, but the researcher also wanted to know if there was a relationship between the pre-test measure of hope and typical pain throughout the past year (i.e., as opposed to pain at the present moment). Indeed, in both the Neutral and Primed groups (n = 122), the correlation was significant at the 0.01 level, with a moderate inverse relationship, r = -0.44, -0.41 respectively, p = 0.05, in that, as hope increased the experience of typical pain decreased. The association between hope and pain perception is not surprising considering the "remarkable overlap between the brain structures . . . affected by pain chronification and pathological negative moods" such as hopelessness (Baliki & Apkarian, 2015, p. 39). It may be, then, that the mindset of hope, as related to agency, is protective, with downstream effects contributing to pro-health behaviors that moderate pain perception.

Surprisingly, however, the third group (n = 32) did not demonstrate a correlation between hope and pain on average, r = 0.037. It could be reasoned that since this group was not exposed to the hardiness scale it interfered in some fashion. This was not the case, however, as typical pain throughout the past year was correlated with the *pretest* measure of hope in the primary groups (n = 122), prior to the administration of the hardiness scale. Without definitive data to explain the difference in the third group, apart from its smaller size (n = 32), a much larger sample could better clarify the relationship.

While attitudinal measures such as "positive affect, pain acceptance, optimism and hope" (France et al., 2020) have been associated with improved outcomes, the protective characteristics of stress-hardiness are seldom studied in chronic pain. The unique facets of this

multidimensional disposition—commitment, control and challenge—distinguish hardiness from other resilience measures (Zerach et al., 2020); therefore, exploring this trait was a goal of this investigation.

In this study, the relationship between hardiness and typical pain throughout the past year was statistically significant at the .01 level and inversely correlated at -0.32 and -0.29, $p = 0.05$ for the Primed and Neutral groups, respectively. In other words, as hardiness levels increase, the level of typical pain decreases. Moreover, there was a strong correlative relationship between hardiness and hope for the Primed group, $r = 0.\ 73$, $p = 0.05$. The Neutral group's pre-hope score was moderately correlated with hardiness at 0.58 and the post-hope score strongly correlated at 0.83 (i.e., Cohen's d). Although hope was more inversely correlated with pain than hardiness, the trait of hardiness is similar in that stress-hardy individuals take responsibility for their behavior and attitudes (Zerach et al., 2020). As a notable aside, to date this is the first study comparing and contrasting Long et al.'s (2020) revised Hope scale with the trait of stress-hardiness. The correlation between the two indicates that this unique scale captures a vital aspect of agency.

In some studies, adaptive states (e.g., resilience) have been shown to foster adherence to health behaviors despite intense and prolonged pain (France et al., 2020). While such states promote a higher quality of life, in a review of the literature France et al., (2020) did not find an association between adaptive states and pain reduction. In this investigation, however, the actionable quality of hope was moderately correlated with lower levels of pain throughout the year, echoing longitudinal findings (Long et al., 2020; Rondon-Ramos et al., 2020), and strongly correlated with hardiness. The variability could be due to several factors, including discrepancies within resilience measures, as noted in the discussion of optimism and hardiness in Chapter

Three. Further, adaptive states—while clearly beneficial—do not necessarily imply that one finds meaning in difficult or challenging circumstances (i.e., hardiness). It is beyond the scope of this paper to contend with such conflicting findings, but they offer a rich opportunity for future research.

Nevertheless, capitalizing on the association between hope and hardiness could offer promising results in clinical practice. While short-term gains of PNE have been encouraging, long-term adherence has been poor (Wood & Hendrick, 2018). As hardiness and hope were moderately but significantly correlated with pain reduction over time, could targeted hardiness training, as suggested by France et al. (2020), yield—not only a measure of pain relief—but improved adherence to biopsychosocial and PNE programming? Likewise, would hope priming in chronic pain contribute to gains in hardiness over time? These questions cannot be answered with the current data but could be pursued more directly in another project.

In conclusion, the study design and its findings highlight both the malleability of hope and its correlation with pain reduction and the trait of hardiness over time. As "hope has rarely been considered in discussions of expectancy and the placebo response" (Eaves et al., 2016, p. 3), this investigation addresses gaps in health priming and chronic pain literature. To further contribute to the field, the limitations, and delimitations of the investigation, and how these may be addressed by future research, will be discussed in the following section.

Limitations, Delimitations & Future Research

It is important to note several factors that limit the generalization of findings to broad pain populations. This study, for example, limited participation to adults experiencing chronic pain for at least one-year and does not capture the experience of younger patients, those whose pain is of a shorter duration, nor individuals who have recovered from chronic pain. Further, the

self-selection bias assumes that "systematic differences may be present between subjects who choose to respond to a survey compared to those who do not" (Oppenheimer et al., 2012, Bias section, para. 3). The effect of hopelessness on motivation (Jaremka et al., 2014) is an additional factor which could indicate that individuals inclined toward hope were more likely to participate.

On the other hand, it could be that high functioning individuals with chronic pain were unwilling to spend time taking the survey, biasing the sample toward more debilitated individuals. By way of example, a Reddit chronic pain community with more than 50,000 members advertises: "For the broken, malfunctioning, pained people of the world and their friends/family. Got pain? This is the place to be. Bitching, complaining, whining, and otherwise venting about your condition is encouraged" (https://www.reddit.com/r/ChronicPain/). Since the study was accessed online, individuals inclined to participate in this type of forum could have been surveyed as well.

Moreover, survey participation required access to a computer or smart phone, therefore, it may or may not have captured a variety of demographic contexts. Although libraries, prior to the SARS-CoV2 pandemic, provided computer access, these were not widely available at the time of survey completion. Therefore, the sample is skewed toward English speaking individuals who have access to technology. Future research could correct for this by implementing a similar investigation at various pain clinics that provide electronic or paper versions.

Additional research with a much larger sample could correct for some of these limitations. For example, while the sample in this study was mostly female (70-80%)—mirroring the prevalence in the chronic pain population—a pain center may treat more men who could be surveyed. Pain clinics and treatment centers are ideal environments to implement novel priming methods and collect relevant data. Greater collaboration between researchers and physicians

could further cost-effective data collection contributing to enhanced clinical application and improved outcomes. A database of cross-over studies like this one (i.e., inclusive of psychological priming and medical placebo) could incentivize collaboration and spark ingenuity.

Since this study gauged the perception of chronic pain and its relationship to hope, the influence of comprehensive health status and pain medication was not accounted for. Future research could include relevant medical data that could be analyzed and correlated to hope and pain perception.

With an objective to do no harm, a delimitation of this investigation is that it did not assess the difference in hope utilizing a negative prime. Brascher et al. (2018) explain, "due to ethical constraints, nocebo hyperalgesia cannot be investigated as rigorously as placebo hypoalgesia in clinical samples" (Clinical Context, para.5). Nevertheless, catastrophic pain statements were used by Claessen et al. (2016) as a negative prime. Pain catastrophizing is "empirically associated with greater disease severity, disability and poorer treatment outcomes" (Farris et al., 2020, p. 928). As such, scales and health questionnaires in clinical practice could unintentionally operate as negative primes, therefore a protective stance is clearly warranted.

Additionally, to control for Type I errors rigorous alpha levels were adopted and therefore may have increased the likelihood of Type II errors, particularly given the study's relatively small sample size ($N = 154$). Future research could focus on designing low-cost priming studies in clinical settings with hundreds if not thousands of subjects, thereby increasing power, reproducibility, and a greater store of knowledge from which to draw.

Finally, although the gain in hope was statistically significant, it is unknown how long the influence of hope priming lasts. Primes have been shown, though, to remain operational even when expectancy was extinguished. Put another way, when the prime or the placebo was

revealed as inert, the effects persisted (Brascher et al., 2018). Further priming research is needed to explore and clarify this issue, but clinical practice could scaffold primes in web pages, health questionnaires and through verbal discourse.

In summation, a pre- and post-test experimental design (i.e., intervention study) consisting of two randomized parallel groups, was selected to best answer the primary research questions, and contribute to a nuanced understanding of the relationship among chronic pain, pain education, hardiness, and hope. Utilizing a much larger sample from a pain clinic could correct for some of the limitations discussed. Suggestions for future research include assessing the hope difference utilizing a negative prime and designing low-cost priming studies with improved methodology (i.e., power) in clinical settings.

Conclusions: Implications for Research & Clinical Practice

This pre- and post-intervention study suggests that unconscious exposure can prime or condition implicit attitudes apart from conscious goal setting, supporting the utilization of positive primes in clinical practice.

While positive traits and mindsets are associated with greater overall health and lower all-cause mortality, their malleability (DuPont, 2020) underscores the relevance of attitudinal interventions. Of these, nonconscious methods are believed superior to conscious deliberation (Moskowitz, 2009; Papies, 2016). However, priming is not well-integrated among medical, psychological, and behavioral sciences and most published studies call for more research aimed at clinical application.

Classification conflicts, coupled with a striking lack of conceptual clarity in published research, are limiting factors in advancing priming research (Hollands et al., 2013). As Shashkevich (2017) and Sheeran et al. (2013) argue, the time and energy lost in debate could be

spent focusing on developing effective priming interventions for health and well-being (Fatemi, 2016).

While substituting an inert substance for an active medical treatment (i.e., placebo) can be ethically complex, utilizing verbal primes are less so. Primes are used regularly—if not consciously—when physicians share positive expectations or provide encouraging findings about a new treatment, but they can be classified as a placebo or a prime depending on the discipline. This study suggests that the briefest of verbal conditioning may have significant effects on mood (e.g., hope) and motivation (i.e., agency), and need not be cumbersome, complex and time consuming to incorporate in clinical practice.

The same applies to disentangling expectations from conscious versus unconscious conditioning effects. Although such distinctions are useful in psychological investigations exploring the nature of the subconscious, they unnecessarily burden health priming research (Brascher et al., 2018). While the mechanism behind priming/placebo may be debated, their power is not. The results of this cross-sectional study align with a growing consensus that restrictive classifications of conscious v. non-conscious priming (e.g., supraliminal, and subliminal) and the sectarian nature of priming research (e.g., medical placebo v. psychological primes) hinder an inclusive meta-analysis, reduce growth in the field and limit opportunities for clinical application.

Accordingly, this paper focused on the clinical application of conditioning elements, thereby defining priming in broad terms. Even so, participants had no expectation that hope was being manipulated, nor that it could increase; hence, this study would be considered a subliminal (i.e., nonconscious) priming investigation by most, and a supraliminal investigation by some.

Such restrictive distinctions could artificially limit search results, impinge on cross-sectional dialogue, and stymie the development of novel applications of priming in clinical settings.

As noted, this author was unable to locate studies on priming hope in chronic pain. Consequently, this study addresses an important demand since hope, according to Eaves et al. (2016), has its own distinct biovalue including stakeholders such as the biomedical research sector and patient advocacy groups. It can be argued that any biovalue should first be realized in medical care where the overarching imperative to do no harm recognizes that depletion of hope is toxic to the organism. Since words and their context function as primes, they play a critical role in chronic pain and other diseases (Brascher et al., 2018).

Pain-related beliefs are predictive of quality of life (France et al., 2020), thereby warranting feasible intervention strategies that target implicit beliefs and activate health goals (Papies, 2016; Vanaelst et al., 2016). Underscoring the potential, positive mindsets have top-down effects (i.e., physiological enhancements), contributing to a reduction in co-morbidities associated with chronic pain (DuPont et al., 2020). The weight of evidence notwithstanding, it bears repeating that despite a relatively robust literature on pain and placebo dynamics, little has been done in a clinical setting (Brascher et al., 2018). Therefore, this study also helps fills a gap by highlighting both the malleability of hope and its correlation with pain reduction over time.

This investigation also explored the relationship among hope, pain, and stress-hardiness. The results align with findings that show “self-efficacy beliefs are associated with less physical impairment and pain intensity in people with chronic pain” (Rondon-Ramos et al., 2020, p.1). To gain further insight on the relationship between stress-hardiness and hope, as well as the apparent alliance between the hardiness measure and Long et al.’s (2020) revised Hope scale, future research is needed, with a much larger sample.

Beyond these constructs, however, the evidence suggests a need for optimized education and targeted strategies that foster hope and advance stress-hardiness in health care. One of the challenges facing clinicians is the need for practical and economical delivery methods (Freedland, 2020). Given the potent downstream effects of mindsets, repeated exposure to primed materials, in paper and online, relieve the burden of time stress on medical professionals.

A scaffolding of methods need not be complex. Cost effective surveys can contribute to the development of more effective communication tools (e.g., tutorials and questionnaires) and priming opportunities. Claessen et al., 2016, argue that health can be improved "by consistently using positive language and concepts in medical care" (p. 48). As illustrated by this study, priming methods that recalibrate maladaptive beliefs and disruptive mindsets can be cost effective, with minimal risk, and should be expanded.

Pain clinics and treatment centers are ideal environments to implement novel priming methods and collect relevant data. Greater collaboration between researchers and physicians could further cost-effective data collection contributing to enhanced clinical application and improved outcomes. A database of cross-over studies like this one (i.e., inclusive of psychological priming and medical placebo) could incentivize further collaboration and spark ingenuity.

It is hoped that this study will highlight the feasibility and potential of priming strategies and encourage the use of similar platforms (e.g., medical questionnaires and web-based surveys) to deliver primed material in clinical settings.

Summary

Priming "affects all aspects of human behavior" (Claessen et al., 2016, p. 48), yet has only recently gained traction in the health sciences (Elgendi et al., 2018). In response to a

collective call to action by many of the sources cited herein, the results of this pre- and post-randomized intervention study, and associated literature, argue that unconscious exposure can prime or condition implicit attitudes apart from conscious goal setting with the potential to improve outcomes (Zion et al., 2019).

Hence, the findings suggest that hope, as related to agency, can be strengthened via priming, although the mechanism for the effect is not clear. Whether through the tutorials, the repetition of the Hope scale or an additive effect of both, this study indicates that the briefest of verbal conditioning (i.e., written or spoken) may have significant effects on mood (i.g., hope) and motivation (i.e., agency), and need not be cumbersome or time consuming to incorporate in clinical practice.

By addressing gaps in subliminal priming literature, as well as stress-hardiness and pain, this investigation highlights the potential for high fidelity, economical and time saving priming opportunities in clinical practice—not only in the pain population—but in the wide arena of health care. Claessen et al.'s (2016) forward thinking study utilizing a primed health questionnaire inspired this project, and it is hoped this study will contribute to the development of a diversified approach to priming research in clinical settings. Until then, there is clear evidence for health care practitioners to use language, spoken and written, that closes the gap between research and clinical application by leveraging targeted interventions aimed at instilling positive mindsets.

References

Akram, U., Milkins, B., Ypsilanti, A., Reidy, J., Lazurus, L., Stevenson, J., Notebaert, L., & Barclay, N. L. (2018). The therapeutic potential of attentional bias modification training for insomnia: Study protocol for a randomized controlled trial. *Trials 19*(1), 567. https://doi.org/10.1186/s13063-018-2937-4

Ashar, Y. K., Gordon, A., Schubiner, H., Uipi, C., Knight, K., Anderson, Z., Carlisle, J., Polisky, L., Geuter, S., Flood, T. F., Kragel, P. A., Dimidjian, S., Lumley, M. A., & Wager, T. D. (2022). Effect of Pain Reprocessing Therapy vs Placebo and Usual Care for Patients With Chronic Back Pain: A Randomized Clinical Trial. *JAMA Psychiatry*, *79*(1), 13–23. https://doi.org/10.1001/jamapsychiatry.2021.2669

Baliki, M. N., & Apkarian, A. V. (2015). Nociception, Pain, Negative Moods, and Behavior Selection. *Neuron*, *87*(3), 474–491. https://doi.org/10.1016/j.neuron.2015.06.005

Baltzell, A. & McCarthy, J. (2016). Langerian mindfulness and optimal sport performance. In S. Fatemi (Ed.) *Critical mindfulness: Exploring langerian models*. Springer. https://lib.ugent.be/catalog/ebk01:3710000000776805

Bargh, J. A. (2016). Awareness of the prime versus awareness of its influence: Implications for the real-world scope of unconscious higher mental processes. *Current Opinion in Psychology*, *12*, 49-52. https://doi.org/10.1016/j.copsyc.2016.05.006

Bargh, J. & Chartrand, T. (2000). The mind in the middle: A practical guide to priming and automaticity research. In H. Reis, C. Judd (Eds.), *Handbook of Research Methods in Social Psychology*, (pp. 253-285). Cambridge University Press.

Bartone, P. (1991). *Development and validation of a short hardiness measure*. Hardiness-Resilience.com. http://www.hardiness-resilience.com/docs/aps91b.pdf

Bartone, P. (2007). Test-retest reliability of the dispositional resilience scale-15, a brief hardiness scale. *Psychological Reports*, *101*(3), 943-44. DOI: 10.2466/pr0.101.3.943-944

Bartone, P. (2013). *Cross-cultural adaptation of the DRS-15 Dispositional Resilience Scale: A short hardiness measure.* Final report on Fulbright Research Fellowship, Bergen, Norway. Retrieved from https://www.hardiness-resilience.com/docs/Cross-cultural%20adaptation%20of%20DRS%20Fulbright.pdf

Beck, B., Weissman, A., Lester, D., & Trexler, L. (1974). The measurement of pessimism: the hopelessness scale. *Journal of Consulting and Clinical Psychology*, *42*(6), 861-65. DOI: https://doi.org/10.1037/h0037562

Belcher, A., Cole, T., Greenblatt, A., Hoag, S., Epstein, D., Wagner, M., Billing, A., Massey, E., Hamilton, K., Kozak, Z., Welsh, C., Weintraub, E., Wickwire, E., Wish, E. Kaptchuk, T., & Colloca, L. (2019). Open-label dose-extending placebos for opioid use disorder: A protocol for a randomised controlled clinical trial with methadone treatment. *British Medical Journal Open*, *9*(6): e026604. doi:10.1136/bmjopen-2018-026604

Benedetti, F., Carlino, E., & Pollo, A. (2011). How placebos change the brain. *Neuropsychopharmacology, 36*(1), 339-54. doi:10.1038/npp.2010.81

Bergland, C. (2015, April 20). Subliminal messages can fortify inner strength. *Psychology Today*. https://www.psychologytoday.com/us/blog/the-athletes-way/201504/subliminal-messages-can-fortify-inner-strength

Blair, I. V., Ma, J. E., & Lenton, A. P. (2001). Imagining stereotypes away: The moderation of implicit stereotypes through mental imagery. *Journal of Personality and Social Psychology*, *81*(5), 828-841. doi:10.1037/0022-3514.81.5.828

Bräscher, A. K., Witthöft, M., & Becker, S. (2018). The Underestimated Significance of Conditioning in Placebo Hypoalgesia and Nocebo Hyperalgesia. *Pain Research & Management*, *2018*, 6841985. https://doi.org/10.1155/2018/6841985

Bussche, E., Vermeiren, A., Desender, K., Gevers, W., Hughes, G., Verguts, T., & Reynvoet, B. (2013). Disentangling conscious and unconscious processing: A subjective trial-based assessment approach. *Frontiers in Human Neuroscience*, *7*, 769. doi:10.3389/fnhum.2013.00769

Carver, C. S., Scheier, M. F., & Segerstrom, S. C. (2010). Optimism. *Clinical Psychology Review*, *30*, 879-89. https://doi.org/10.1016/j.cpr.2010.01.006

Claessen, F., Mellema, J., Stoop, N., Lubberts, B., Ring, D., & Poolman, R., (2015). Influence of priming on patient-reported outcome measures: A randomized controlled trial. *Psychosomatics*, *57*(1), 47-56. doi:10.1016/j.psym.2015.09.005

Clarke, C. L., Ryan, C. G., & Martin, D. J. (2011). Pain neurophysiology education for the management of individuals with chronic low back pain: systematic review and meta-analysis. *Manual Therapy*, *16*(6), 544-549. https://doi.org/10.1016/j.math.2011.05.003

Claessen, M., Claessen, F., Mellema, J., Stoop, N., Lubberts, B., Ring, D., & Poolman, R. (2015). Influence of priming on patient-reported outcome measures: A randomized controlled trial. *Psychosomatics*, *57*(1), 47-56. doi:10.1016/j.psym.2015.09.005

Cleeland, C. (1991). *The brief pain inventory: User guide.* MDAnderson.org. https://www.mdanderson.org/documents/Departments-and-Divisions/Symptom-Research/BPI_UserGuide.pdf

ClinicalTrials.gov. (2019, July 15). *Leveraging mindsets to improve health and wellbeing in patients with cancer*. https://clinicaltrials.gov/ct2/show/NCT03910283

Cohen, J. (1988). *Statistical Power Analyses for the Behavioral Sciences* (2nd ed.). Lawrence Erlbaum Associates. https://www.pilesofvariance.com/Chapter13/Cohen_Power_Tables.pdf.

Cohn, A., Fehr, E., & Maréchal, M. A. (2014). Business culture and dishonesty in the banking industry. *Nature*. doi:10.1038/nature13977

Colloca, L., & Howick, J. (2018). Placebos without deception: Outcomes, mechanisms, and ethics. *International Review of Neurobiology, 138*, 219–40. doi:10.1016/bs.irn.2018.01.005

Correll, D. (2007). The measurement of pain: Objectifying the subjective. *Pain Management*, *1*, 197-211. https://doi.org/10.1016/B978-0-7216-0334-6.50022-4

Coughlin S. S. (2006). Hope, ethics, and public health. *Journal of Epidemiology and Community Health*, *60*(10), 826–27. https://doi.org/10.1136/jech.2006.047431

Cox, N. J. (2010). Speaking stata: The limits of sample skewness and kurtosis. *The Stata Journal*, *10*(3), 482–495. https://doi.org/10.1177/1536867X1001000311

Cristea, I., Kok, R., & Cuijpers, P. (2016). The effectiveness of cognitive bias modification interventions for substance addictions: A meta-analysis. *PLoS One*, *11*(9): e0162226. doi:10.1371/journal.pone.0162226

Crum, A., Leibowitz, K., & Verghese, A. (2017). Making mindset matter. *British Medical Journal,* 356: j674 doi:doi:10.1136/bmj.j674

Crum, A., & Langer, E. (2007). Mind-set matters: exercise and the placebo effect. *Psychological Sciences*, *18*(2), 165-71. doi:10.1111/j.1467-9280.2007.01867.x

Crum, A. J., Salovey, P., & Achor, S. (2013). Rethinking stress: The role of mindsets in determining the stress response. *Journal of Personality and Social Psychology*, *104*(4), 716-33. doi:10.1037/a0031201

Crum, A., & Zuckerman, B. (2017). Changing mindsets to enhance treatment effectiveness. *Journal of the American Medical Association, 317*(20), 2063–64. doi:10.1001/jama.2017.4545

Custers R., & Aarts H. (2010). The unconscious will: How the pursuit of goals operates outside of conscious awareness. *Science, 329*(5987), 47-50. doi:10.1126/science.1188595

Dionigi, R. (2015). Stereotypes of aging: Their effects on the health of older adults. *Journal of Geriatrics*. doi:10.1155/2015/954027

Doering, B., & Rief, W. (2012). Utilizing placebo mechanisms for dose reduction in pharmacotherapy. *Trends in Pharmacological Science, 33*(3), 165-72. doi:10.1016/j.tips.2011.12.001

Donnelly, C. R., Andriessen, A. S., Chen, G., Wang, K., Jiang, C., Maixner, W., & Ji, R. R. (2020). Central Nervous System Targets: Glial Cell Mechanisms in Chronic Pain. *Neurotherapeutics : The Journal of the American Society for Experimental NeuroTherapeutics*, *17*(3), 846-860. https://doi.org/10.1007/s13311-020-00905-7

Doyen S, Klein O, Pichon C., & Cleeremans A. (2012). Behavioral priming: It's all in the mind, but whose mind? *PLoS One, 7*(1): e29081. doi:10.1371/journal.pone.0029081

DuPont, C.M., Weis, T.M., Manuck, S.B., Marsland, A.L., Matthews, K.A. & Gianaros, P.J. (2020). Does well-being associate with stress physiology? A systematic review andmeta-analysis. *Health Psychology*, *39*(10), 879-890. http://dx.doi.org/10.1037hea0000979

Edwards, R., Dworkin, R., Sullivan, M., Turk, D., & Wasan, A. (2016). The role of psychosocial processes in the development and maintenance of chronic pain. *Journal of Pain*, *17*, T70-T92. https://www.jpain.org/article/S155900(16)00018-3/fulltext

Elgendi, M., Kumar, P., Barbic, S., Howard, N., Abbott, D., & Cichocki, A. (2018). Subliminal priming: State of the art and future perspectives. *Behavioral Sciences (Basel, Switzerland)*, *8*(6): 54. doi:10.3390/bs8060054

Engel GL. (1977). The need for a new medical model: A challenge for biomedicine. *Science*, *196*(4286), 129-36. https://doi.org/10.1126/science.847460

Everson, S. A., Goldberg, D.E.M., Kaplan, Cohen, R., Pukkala, E., Tuomilehto, J., & Salonen, J. (1996). Hopelessness and risk of mortality and incidence of myocardial infarction and cancer. *Psychosomatic Medicine*, *58*(2), 113-121. https://doi.org/10.1097/00006842-199603000-00003

Ewart, C., Elder, G., Laird, K., Shelby, G., & Walker, L. (2014). Can agonistic striving lead to unexplained illness? Implicit goals, pain tolerance, and somatic symptoms in adolescents and adults. *Health Psychology, Journal of the American Psychological Association*, *33*(9), 977-85. http.//dx.doi.org/10.1037/a0033496

Falk, E., Berkman, E., Whalen, D., & Lieberman, M. (2011). Neural activity during health messaging predicts reductions in smoking above and beyond self-report. *Health Psychology*, *30*(2), 177-85. doi:10.1037/a0022259

Falk, E., Berkman, E., Mann, T., Harrison, B., & Lieberman, M. (2010). Predicting persuasion-induced behavior change from the brain. *Journal of Neuroscience*, *30*(25), 8421-24. doi:10.1523/JNEUROSCI.0063-10.2010

Farris, S.G., Kibbey, M.M., Steffen, K.J., Thomas, J.G., Pavlovic, J.M., & Bond, D.S. (2020). Treatment effects on pain catastrophizing and cutaneous allodynia symptoms in women with migraine and overweight/obesity. *Health Psychology, 39*(10), 927-933. http://dx.doi.org/10.1037/hea0000920

Feinberg, C. (2013, Jan-Feb). The placebo phenomenon. *Harvard Magazine*. https://harvardmagazine.com/2013/01/the-placebo-phenomenon

Field M., Marhe R., & Franken I. H. (2014). The clinical relevance of attentional bias in substance use disorders. *CNS Spectrums, 19*(3), 225-30. doi:10.1017/S1092852913000321

France, C.R., Ysidron, D.W., Slepian, P.M., French, D.J., & Evans, R.T. (2020). Pain resilience and catastrophizing combine to predict functional restoration program outcomes. *Health Psychology*, *39*(7), 573-579. http://dx.doi.10.1037/hea0000877

Freedland, K.E. (2020). Pilot trials in health-related behavioral intervention research: Problems, solutions, and recommendations. *Health Psychology*, *39*(10), 851-862. http://dx.doi.org/10.1037/hea0000946

Friedman, S. (2013). Priming subconscious goals. In E. A. Locke & G. P. Latham (Eds.), *New developments in goal setting and task performance* (pp. 549–565). Routledge/Taylor & Francis Group. https://psycnet.apa.org/record/2013-00428-033

Garfin, D. R., Silver, R. C. & Holman, E. A. (2020). The novel coronavirus (COVID-2019) outbreak: Amplification of public health consequences by media exposure. *Health Psychology.* Advance online publication. https://doi.org/10.1037/hea0000875.

Gaspelin, N., & Luck, S. J. (2018). "Top-down" does not mean "voluntary" [Commentary on "Visual selection: usually fast and automatic; seldom slow and volitional," by Jan Theeuwes]. *Journal of Cognition, 1*(1), 25. doi:10.5334/joc.28

Gatchel, R., Howard, K., & Haggard, R. (2011). The biopsychosocial perspective. In R. J. Contrada & Baum, A. (Eds.), *The Handbook of Stress Science: Biology, Psychology, and Health* (pp. 461–473). Springer Publishing Company. https://www.practicalpainmanagement.com/treatments/psychological/biopsychosocial-approach

Gebhardt, W.A., van der Doef, M. P., & Paul, L. B. (2001). The revised health hardiness inventory (RHHI-24): Psychometric properties and relationship with self-reported health and health behavior in two Dutch samples. *Health Education Research*, *16*(5), 579–92, https://doi.org/10.1093/her/16.5.579

George, D., & Mallery, M. (2010). SPSS for Windows Step by Step: A Simple Guide and Reference, 17.0 update (10a ed.) Boston: Pearson. https://lib.ugent.be/catalog/rug01:001424067

Gibbons, H. (2009). Evaluative priming from subliminal emotional words: Insights from event-related potentials and individual differences to anxiety. *Consciousness and Cognition*, *18*(2), 383-400. doi:10.1016/j.concog.2009.02.007

Girgis, F. l., Lee, D., Goodarzi, A., & Ditterich, J. (2018). Toward a neuroscience of adult cognitive developmental theory. *Frontiers in Neuroscience*, *12*(4). doi:10.3389/fnins.2018.00004

Goodin, B. R., & Bulls, H. W. (2013). Optimism and the experience of pain: Benefits of seeing the glass as half full. *Current Pain and Headache Reports*, *17*(5), 329. https://doi.org/10.1007/s11916-013-0329-8

Grierson, G. (2014, October 22). What if age is nothing but a mindset? *New York Times Magazine*. https://www.nytimes.com/2014/10/26/magazine/what-if-age-is-nothing-but-a-mind-set.html

Hair, J., Black, W. C., Babin, B. J. & Anderson, R. E. (2010) *Multivariate data analysis* (7th ed.). Upper Saddle River, New Jersey: Pearson Educational International. https://lib.ugent.be/catalog/rug01:002813538

Hanscom, D. (2017). *Back in control: A spine surgeon's roadmap out of chronic pain*. Vertus Press: Seattle, WA. https://backincontrol.com

Hardin, E. (2019, March 29). Myth: Subliminal messages can change your behavior. *Association for Psychological Science*. https://www.psychologicalscience.org/uncategorized/myth-you-can-be-influenced-by-things-outside-your-awareness.html

Harper, M., Kanayama-Trivedi, S., Caldito, G., Montgomery, D., Mayeaux, E., & DelRosso, L. (2017). Photographic art in exam rooms may reduce white coat hypertension. *British Medical Journal,41*(2), 86-8. doi:10.1136/medhum-2014-010609

Hine, K., & Tsushima, Y. (2018). Not explicit but implicit memory is influenced by individual perception style. *Plos One,13*(1): e0191654. doi:10.1371/journal.pone.0191654

Hollands, G., Marteau, T., & Fletcher P. (2016). Non-conscious processes in changing health-related behavior: A conceptual analysis and framework. *Health Psychology Review, 10*(4), 381-94. doi:10.1080/17437199.2015.1138093

Hollands G. J., Shemilt I., Marteau T. M., Jebb S. A., Kelly M. P., Nakamura R., & Ogilvie D., (2013). Altering micro-environments to change population health behaviour: Towards an evidence base for choice architecture interventions. *BMC Public Health, 13,*1218. Doi doi:10.1186/1471-2458-13-1218

Jaremka, L., Andridge, R., Fagundes, C., Alfano, C., Povoski, S., Lipari, D., Agnese, M., Arnold, M., Farrar, W., Yee, L., Carson, W., Bekaii-Saab, T., Martin Jr., E., Schmidt, C., & Kiecolt-Glaser, J. (2014). Pain, depression, and fatigue: Loneliness as a longitudinal risk factor. *Health Psychology, Journal of the American Psychological Association, 33*(9), 948–57. doi: 10.1037/a0034012

Jelsness-Jørgensen, L. P., Moum, B., Grimstad, T., Jahnsen, J., Opheim, R., Prytz Berset, I., Hovde, Ø., Torp, R., Frigstad, S. O., Huppertz-Hauss, G., & Bernklev, T. (2016). Validity, reliability, and responsiveness of the brief pain inventory in inflammatory bowel disease. *Canadian Journal of Gastroenterology & Hepatology*, 5624261. https://doi.org/10.1155/2016/5624261

Kang, Y., Cooper, N., Pandey, P., Scholz, C., Brook O'Donnell, M., Lieberman, M., Taylor, S., Strecher, V., Dal Cin, S., Konrath, S., Polk, T., Resnicow, K., An, L., & Falk, E. (2018). Effects of self-transcendence on neural responses to persuasive messages and health behavior change. *Proceedings of the National Academy of Sciences, 115*(40) 9974-79. doi:10.1073/pnas.1805573115

Kaplan, U. & Epstein, G. (2011). Psychophysiological coherence as a function of mental imagery practice. *Imagination, Cognition and Personality*. *31*(4), 297-312. DOI: 10.2190/IC.31.4.d.

Kappes, H.B. & Oettingen, G. (2011). Positive fantasies about idealized futures sap energy. *Journal of Experimental Social Psychology*, *47*, 719-29. https://doi.org/10.1016/j.jesp.2011.02.003

Kardum, I., Hudek-Knežević, J., & Krapić, N. (2012). The structure of hardiness, its measurement invariance across gender and relationships with personality traits and mental health outcomes. *Psychological Topics*, *21*, 487-507. https://psycnet.apa.org/doi/10.1037/t05558-000

Karremans, J. C., Stroebe, W., & Claus, J. (2006). Beyond Vicary's fantasies: The impact of subliminal priming and brand choice. *Journal of Experimental Social Psychology, 42*(6), 792-98. doi:10.1016/j.jesp.2005.12.002

Katsimigos, A. M., O'Beirne, S., & Harmon, D. (2021). Hope and chronic pain-a systematic review. *Irish journal of medical science*, *190*(1), 307–312. https://doi.org/10.1007/s11845-020-02251-1

Kegan, R. (2000) What form transforms? A constructive-developmental approach to transformative learning. In J. Mezirow (Ed.) *Learning as Transformation: Critical Perspectives on a Theory in Progress* (pp. 35-70). San Francisco, CA: Jossey-Bass. https://eric.ed.gov/?id=ED448301

Kerns, R., Shulman, M., Nielson, W., Chatkoff, D., Burns, J., Jensen, M., Czlapinski, R., Dallas, M., Chatkoff, D., Sellinger, J., Heapy, Al, & Rosenberger, P. (2014). Can we improve cognitive-behavioral therapy for chronic back pain treatment engagement and adherence? A controlled trial of tailored versus standard therapy. *Health Psychology, Journal of the American Psychological Association*, *33*(9), 938-47. http://dx.doi.org/101037/a0034406

Kim, T. K., & Park, J. H. (2019). More about the basic assumptions of t-test: Normality and sample size. *Korean Journal of Anesthesiology*, *72*(4), 331–335. https://doi.org/10.4097/kja.d.18.00292

Kirchhof, J., Petrakova, L., Benson, S., Schmidt, J., Unteroberdorster, M., Wilde, B., Kaptchuk, T., Witzke, O., & Schedlowski, M. (2018). Learned immunosuppressive placebo responses in renal transplant patients. *Proceedings of the National Academy of Sciences, 115*(16) 4223-27. doi:10.1073/pnas.1720548115

Kleine-Borgmann, J., Schmidt, K., Hellmann, A., & Bingel, U. (2019). Effects of open-label placebo on pain, functional disability, and spine mobility in patients with chronic back pain: a randomized controlled trial. *Pain*, *160*(12), 2891–2897. https://doi.org/10.1097/j.pain.0000000000001683

Knowles, M. S., Holton III, E. F., & Swanson, R. A. (2014). *The Adult Learner: The Definitive Classic in Adult Education and Human Resource Development* (8th ed.). New York, NY: Routledge. https://eric.ed.gov/?q=The+Adult+Learner%3a+The+Definitive+Classic+in+Adult+Education+and+Human+Resource+Development+&id=ED428293

Kobasa, S. C. (1979). Stressful life events, personality, and health: An inquiry into hardiness. *Journal of Personality and Social Psychology*, *37*(1), 1-11. doi: 10.1037//0022-3514.37.1.1

Kuner, R. & Flor, H. (2017). Structural plasticity and reorganisation in chronic pain. *Nature*, *18*, 20-30. Retrieved from http://pcpr.pitt.edu/wp-content/uploads/2018/01/Kuner-2017.pdf

Lancee J., Yasiney S. L., Brendel R. S., Boffo M., Clarke P. J., & Salemink E. (2017). Attentional bias modification training for insomnia: A double-blind placebo controlled randomized trial. *PLoS One,12*(4): e0174531. doi:10.1371/journal.pone.0174531

Layton, B. & Krikorian, R. (2002). Memory mechanisms in posttraumatic stress disorder. *Journal of Neuropsychiatry and Clinical Neuroscience, 14*(3), 254-261. doi: 10.1176/jnp.14.3.254

Lenth, R. (2001). Some practical guidelines for effective sample size determination. *The American Statistician*, *55*(3), 187-193, doi: 10.1198/000313001317098149

Levy, B. (2009). Stereotype embodiment: A psychosocial approach to aging. *Current Directions in Psychological Science*, *18*(6), 332-36. doi:10.1111/j.1467 8721.2009.01662

Levy, B. R., Hausdorff, J. M., Hencke, R., & Wei, J. Y. (2000). Reducing cardiovascular stress with positive self-stereotypes of aging. *The Journals of Gerontology Series B: Psychological Sciences & Social Sciences, 55*(4), 205-13. doi:10.1093/geronb/55.4.P205

Levy, B., Pilver, C., Chung, P., & Slade, M. (2014). Subliminal strengthening: Improving older individuals' physical function over time with an implicit-age stereotype intervention. *Psychological Science, 25*(12), 2127-35. doi:10.1177/0956797614551970

Levy, B. R., Slade, M. D., & Kasl, S. V. (2002). Longitudinal benefit of positive self-perceptions of aging on functioning health. *The Journals of Gerontology Series B: Psychological Sciences & Social Sciences, 57*(5), 409-17. doi:10.1093/geronb/57.5.P409

Levy, B., Slade, M., Murphy, T., & Gill, T. (2012). Association between positive age stereotypes and recovery from disability in older persons. *JAMA*, *308*(19), 1972-73. doi:10.1001/jama.2012.14541

Levy, B., Slade, M., Pietrzak R., & Ferrucci, L. (2018). Positive age beliefs protect against dementia even among elders with high-risk gene. *PLoS One, 13*(2): e0191004. 21. doi:10.1371/journal.pone.0191004

Levy, B. R., Zonderman A. B., Slade M. D., & Ferrucci, L. (2009). Age stereotypes held earlier in life predict cardiovascular events in later life. *Psychol Sci*, *20*(3), 296-8. doi:10.1111/j.1467-9280.2009.02298.x

Long, K., Kim, E., Chen, Y., Wilson, M., Worthington Jr., E. & VanderWelle, T. (2020). The role of hope in subsequent health and well-being for older adults: An outcome-wide longitudinal approach. *Global Epidemiology*, *2*, doi: 10.1016/j.gloepi.2020.100018

Lynam, E. (2018, Dec 17). *DNA tests can come with a placebo effect*. BioNews. https://www.bionews.org.uk/page_140455

Maoz, K., Abend, R., Fox, N., Pine, D., & Bar-Haim, Y. (2013). Subliminal attention bias modification training in socially anxious individuals. *Frontiers in Human Neuroscience*, *7*, 389. doi:10.3389/fnhum.2013.00389

Marques, S., Lima, M. L., Abrams, D., & Swift, H. (2014). Will to live in older people's medical decisions: Immediate and delayed effects of aging stereotypes. *Journal of Applied Social Psychology, 44*(6), 399-408. doi:10.1111/jasp.12231

Matore, E.& Khairani, A. (2020). The pattern of skewness and kurtosis using mean score and logit in measuring adversity quotient (AQ) For Normality Testing. *International Journal of Future Generation Communication and Networking*, *13*(1), 688 -702. http://www.sersc.org/journals/index.php/IJFGCN/article/view/6571

McLachlan, K., Cole, J. H., Harris, S. E., Marioni, R. E., Deary, I. J., & Gale, C. R. (2020). Attitudes to ageing, biomarkers of ageing and mortality: the Lothian birth cohort

1936. *Journal of Epidemiology and Community Health*, *74*(4), 377–383. https://doi.org/10.1136/jech-2019-213462

Meisner, B. A. (2012). A meta-analysis of positive and negative age stereotype priming effects on behavior among older adults. *The Journals of Gerontology, Series B, Psychological Sciences and Social Sciences, 67*(1), 13-17. doi:10.1093/geronb/gbr062

Milkins, B., Notebaert, L., MacLeod, C., & Clarke, P. J. F. (2016). The potential benefits of targeted attentional bias modification on cognitive arousal and sleep quality in worry-related sleep disturbance. *Clinical Psychological Science, 4*(6), 1015–27. doi:10.1177/2167702615626898

Moser, C., Spagnoli, J., & Santos-Eggimann, B. (2011). Self-perception of aging and vulnerability to adverse outcomes at the age of 65-70 years. *The Journals of Gerontology, Series B, Psychological Sciences and Social Sciences, 66*(6), 675-80. doi:10.1093/geronb/gbr052

Moskowitz, G. B. (2009). The compensatory nature of goal pursuit: From explicit action to implicit cognition. In G. B. Moskowitz & H. Grant (Eds.), *The Psychology of Goals* (pp. 305-336). New York: Guilford Press. https://lib.ugent.be/catalog/rug01:001321136

Moskowitz, G. B., & Gesundheit, Y. (2009). Goal priming. In G. B. Moskowitz & H. Grant (Eds.), *The Psychology of Goals* (pp. 203-233). New York: Guilford Press. https://lib.ugent.be/catalog/rug01:001321136

Nasrallah, M., Carmel, D., & Lavie, N. (2009). Murder, she wrote: Enhanced sensitivity to negative word valence. *Emotion, 9*(5), 609-18. doi:10.1037/a0016305

Niraula, A., Sheridan, J., & Godbout, J. (2017). Microglia priming with aging and stress. *Neuropsychopharmacology, 42*(1), 318-33. doi:10.1038/npp.2016.185

Oppenheimer, A., Pannucci, C., Kasten, S., Haase, S. (2011). Survey Says? A primer on web-based survey design and distribution. *Plastic and Reconstructive Surgery*: *128*(1), 299-304. doi: 10.1097/PRS.0b013e3182174413

Pagnini, F., Cavalera, C., Volpato, E., Comazzi, B., Vailati, F., Chiara, V., Bercovitz, K., Molinari, E., Banfi, P., Phillips, D., & Langer, E. (2019). Ageing as a mindset: A study protocol to rejuvenate older adults with a counterclockwise psychological intervention. *British Medical Journal Open*, 9: e030411. DOI:10.1136/bmjopen-2019-030411

Papies E. K. (2016). Health goal priming as a situated intervention tool: How to benefit from nonconscious motivational routes to health behaviour. *Health Psychology Review*, *10*(4), 408-24. doi:10.1080/17437199.2016.1183506

Park, C., Pagnini, F., Reece, A., Phillips, D., & Langer, E. Blood glucose level in diabetes and perceived time. *Proceedings of the National Academy of Sciences, 113*(29), 8168-70; doi:10.1073/pnas.1603444113

Payne, B., Brown-Iannuzzi, J., & Loersch, C. (2016). Replicable effects of primes on human behavior. *Journal of Experimental Psycholology, 145*(10), 1269-79. doi:10.1037/xge0000201

Payne, B., Brown-Iannuzzi, J., Loersch, C., Philips, D., & Pagnini, F., (2016). Health and the psychology of possibility. In S. Fatemi (Ed.) *Critical mindfulness: Exploring Langerian models*. Springer. doi:10.1007/978-3-319-30782-4_11

Petrie, K., MacKrill, K., Derksen, C., & Dalbeth, N. (2018). An illness by any other name: The effect of renaming gout on illness and treatment perceptions. *Journal of Health Psychology, 37*(1), 37-41. doi:10.1037/hea0000548

Phillips, D., & Pagnini F. (2016). Health and the psychology of possibility. In S. Fatemi (Ed.) *Critical mindfulness: Exploring Langerian models* (pp. 173-82). Springer. doi:10.1007/978-3-319-30782-4_11

Puentedura, E.L. & Flynn, T.W. (2016). Combining manual therapy with pain neuroscience education in the treatment of chronic low back pain: A narrative review of the literature. *Physiotherapy Theory and Practice, 32*(5), 1-7. doi: 10.1080/09593985.2016.1194663

Rappleye, E. (2017, March 27). Seven ways hospital design may affect C-section rates. *Becker's Hospital Review*. https://www.beckershospitalreview.com/facilities-management/7-ways-hospital-design-may-affect-c-section-rates.html

Regmi, P. R., Waithaka, E., Paudyal, A., Simkhada, P., & van Teijlingen, E. (2017). Guide to the design and application of online questionnaire surveys. *Nepal Journal of Epidemiology*, *6*(4), 640–644. https://doi.org/10.3126/nje.v6i4.17258

Rondon-Ramos, A., Martinez-Calderon, J., Diaz-Cerrillo, J. L., Rivas-Ruiz, F., Ariza-Hurtado, G. R., Clavero-Cano, S., & Luque-Suarez, A. (2020). Pain neuroscience education plus usual care is more effective than usual care alone to improve self-efficacy beliefs in people with chronic musculoskeletal pain: A non-randomized controlled trial. *Journal of Clinical Medicine*, *9*(7), 2195. https://doi.org/10.3390/jcm9072195

Rosen, Y., Kirsch, I., Kaptchuk, T., Ingvar, M., & Jensen, K. (2017). Effects of subtle cognitive manipulations on placebo analgesia: An implicit priming study. *European Journal of Pain, 21*(4), 594-604. doi:10.1002/ejp.961

Sargent-Cox, K. A., Anstey, K. J., & Luszcz, M. A. (2012). The relationship between change in self-perceptions of aging and physical functioning in older adults. *Psychology and Aging, 27*(3), 750-60. doi:10.1037/a0027578

Savary, J., Kleiman, T., Hassin, R., & Dhar, R. (2014). Positive consequences of conflict on decision making: When a conflict mindset facilitates choice. *Journal of Experimental Psychology. General, 144*(1), 1-6. http://dx.doi.org/!0.1037/a0038551

Scheier, M. F., & Carver, C. S. (2018). Dispositional optimism and physical health: A long look back, a quick look forward. *The American Psychologist*, *73*(9), 1082-94. https://doi.org/10.1037/amp0000384

Seminowicz, D., Wideman, T., Naso, L., Hatami-Khoroushahi, Z., Fallatah, S., Ware, M.A., Jarzem, P., Bushnell, M.C., Shir, Y., Ouellet, J., & Stone, L. (2011). Effective treatment of chronic low back pain in humans reverses abnormal brain anatomy and function. *Journal of Neuroscience*, *31*, 7540-50. https://www.ncbi.nlm.nih.gov/putdopt=Abstract

Serbic, D., Pincus, T., Fife-Schaw, C., & Dawson, H. (2016). Diagnostic uncertainty, guilt, mood, and disability in back pain. *Health Psychology, Journal of the American Psychological Association*, *35*(1), 50-59. http://dx.doi.org.10.1037/hea0000272

Shafir, E. (Ed.). (2013). *The behavioral foundations of public policy*. United Kingdom: Princeton University Press.

Shashkevich, A. (2017, March 16). Is the placebo effect more powerful than we think? *Greater Good Magazine*, UC Berkley. https://greatergood.berkeley.edu/article/item/is_the_placebo_effect_more_powerful_than_we_think?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%25253A+GreaterGoodBriefs+Greater+Good+Research+Briefs#When:12:01:00Z

Sheeran, P., Gollwitzer, P., & Bargh, J. (2013). Nonconscious processes and health. *Health Psychology, 32*(5), 460-73. doi:10.1037/a0029203

Sliwinski, J., & Elkins, G. R. (2013). Enhancing placebo effects: Insights from social psychology. *The American Journal of Clinical Hypnosis*, *55*(3), 236-48. doi:10.1080/00029157.2012.740434

Sinclair, R. & Oliver, C. (2003, Dec 12). *Development and validation of a short measure of hardiness*. Portland State University. https://apps.dtic.mil/dtic/tr/fulltext/u2/a562799.pdf

Smarandescu, L., & Shimp, T. (2015). Drink Coca-Cola, eat popcorn, and choose Powerade: Testing the limits of subliminal persuasion. *Marketing letters, 26*, 715-26. doi:10.1007/s11002-014-9294-1

Spiegel, A. (2008, January 3). *Hotel maids challenge placebo effect*. NPR. https://www.npr.org/templates/story/story.php?storyId=17792517

Squire, L.R. (2004). Memory systems of the brain: A brief history and current perspective. *Neurobiology of Learning and Memory,* 82(3), 171-7. doi: 10.1016/j.nlm.2004.06.005

Stephan, Y., Sutin, A. R., Luchetti, M., & Terracciano, A. (2018). Subjective age and risk of incident dementia: Evidence from the national health and aging trends survey. *Journal of Psychiatric Research, 100*(5), 1-4. doi:10.1016/j.jpsychires.2018.02.008

Stephan, Y., Sutin, A. R., & Terracciano, A. (2018). Subjective Age and Mortality in Three Longitudinal Samples. *Psychosomatic Medicine*, *80*(7), 659–664. https://doi.org/10.1097/PSY.0000000000000613

Stockdale, B. (2009). *You can beat the odds: Surprising factors behind chronic illness & cancer.* Boulder: Sentient Publishing.

Stockdale, B. (2011). Writing in physical and concomitant mental illness: Biological underpinnings and applications for practice. In L'Abate, L., & Sweeney, L. G.

(Eds.), *Research on writing approaches in mental health* (pp. 23-35). Bingley: Emerald Group Pub Ltd. https://doi.org/10.1163/9780857249562_003

Stockdale, B. (2019). *Meeting the challenge of chronic pain: A four-step developmental process*. Unpublished paper, Lesley University.

Tenney, E.R., Logg, J.M. & Moore, D.A. (2015). Too optimistic about optimism: The belief that optimism improves performance. *Journal of Personality and Social Psychology*, *108*(3), 377-99. http://dx.doi.org/10.1037/pspa0000018

Thaler, R., Sunstein, C., & Balz, J. (2012). Choice Architecture. In S. Eldar (Ed.) *The Behavioral Foundation of Policy* (Chapter 28). Princeton University Press. doi:10.13140/2.1.4195.2321

Thorndike, A. N., Sonnenberg, L., Riis, J., Barraclough, S., & Levy, D. E. (2012). A 2-phase labeling and choice architecture intervention to improve healthy food and beverage choices. *American Journal of Public Health, 102*(3), 527–33. doi:10.2105/AJPH.2011.300391

Van Tongeren, D., & Burnette, J. (2018). Do you believe happiness can change? *The Journal of Positive Psychology, 13*(2), 101-9. doi:10.1080/17439760.2016.1257050

Vanaelst, J., Spruyt, A., & De Houwer, J. (2016). How to modify implicit evaluations of fear-related stimuli: Effects of feature-specific attention allocation. *Frontiers in Psychology, 13*(7), 717. doi:10.3389/fpsyg.2016.00717

Vanhaudenhuyse, A., Gillet, A., Malaise, N., Salamun, I., Grosdent, S., Maquet, D., Nyssen, A. S., & Faymonville, M. E. (2017). Psychological interventions influence patients' attitudes and beliefs about their chronic pain. *Journal of Traditional and Complementary Medicine*, *8*(2), 296–302. https://doi.org/10.1016/j.jtcme.2016.09.001

Wegesin, D., Ream, J., & Stern, Y. (2004). Explicit contamination contributes to aging cffects in episodic priming: Behavioral and ERP evidence. *The Journals of Gerontology: Series B, 59*(6), 317-24. doi:10.1093/geronb/59.6.P317

Windle, G., Bennett, K. M., & Noyes, J. (2011). A methodological review of resilience measurement scales. *Health and Quality of Life Outcomes*, 9, 8. https://doi.org/10.1186/1477-7525-9-8

Wilson, D., Klein, W., Sweeney, A., Lorig, K., Riley, W., Christensen, A. (2019). Efficacy and cost-effectiveness of behavioral interventions in nonclinical settings for improving health outcomes. *Health Psychology, Journal of the American Psychological Association*, *38*(8), 689-700. http://dx.doi.org/10.1037/hea0000773

Wood, L., & Hendrick, P.A. (2019). A systematic review and meta-analysis of pain neuroscience education for chronic low back pain: Short-and long-term outcomes of pain and disability. *European Journal of Pain*. *23*, 234-249. https://doi.org/10.1002/ejp.1314

Wryobeck, J., & Chen, Y. (2003). Using priming techniques to facilitate health behaviours. *Clinical Psychologist*, *7*(2), 105-8. doi:10.1080/1328420041000170755

Wurm, S., Warner, L., Ziegelmann, J., Wolff, J., & Schuz, B. (2013). How do negative self-perceptions of aging become a self-fulfilling prophecy? *Psychology and Aging, 28*(4),1088-97. doi:10.1037/a0032845

Zerach, G., Shevlin, M., & Solomon, Z. (2020). Associations between hardiness, c-reactive protein, and telomere length among former prisoners of war. *Health Psychology*, *39*(11), 1007–1012. https://doi.org/10.1037/hea0001030

Zhang, M.W., Ying, J. B., Song, G., Fung, D., & Smith, H. E. (2018). Recent advances in attention bias modification for substance addictions. *International Journal of Environmental Research and Public Health*, *15*(4), 676. doi:10.3390/ijerph15040676

Zion, S., Schapira, L., & Crum, A. (2019). Targeting mindsets, not just tumors. *Trends in Cancer, 5*(10), 573-76. doi:10.1016/j.trecan.2019.08.001

Appendix A

Recruitment Announcement

Chronic Pain Study: Help researchers understand your pain.

Anonymity protected. Please forward/share.

Your participation is meaningful! By means of a brief (10-15-minutes) online questionnaire you can help researchers at Lesley University learn more about the relationship between pain and well-being. No names or personal identifiers are collected.

If you have questions about taking the survey or would like to discuss the study and its findings afterward, please feel free to contact Brenda Stockdale.

Thank you for helping advance our understanding of pain!

Brenda Stockdale, PhD cand., Lesley University

P: 678-393-0066 E: Brenda.stockdale@gmail.com

Appendix B

Online Consent Form

You are invited to participate in a research project titled "Understanding the Relationship Between Chronic Pain and Well-being." By means of a brief (10-15minutes) online questionnaire you can help researchers at Lesley University learn more about the relationship between pain and well-being.

The online questionnaire consists of 29-click-to-answer questions and reading a few paragraphs.

- Former knowledge about pain and well-being is not necessary.
- Participation is strictly anonymous.
- You are free to choose not to participate in the research and to discontinue your participation in the research at any time by quitting the survey.
- No risks have been identified by taking the survey, apart from any feelings that arise from answering multiple choice questions about the experience of pain.
- There is no reward for participating apart from the free 30-minute audio download.
- No names or identifying details are collected by the researchers.
- If any problem in connection to the research arises, you can contact the researchers: Brenda Stockdale at 678-393-0066 or brenda.stockdale@gmail.com and/or Ulas Kaplan, EdD, Associate Professor at Lesley University at ukaplan@lesley.edu.

There is a Standing Committee for Human Subjects in Research at Lesley University to which complaints or problems concerning any research project may, and should, be reported if they arise. Contact the Committee Chairperson at irb@lesley.edu

Participation in this online questionnaire by clicking "next" will constitute consent.

Appendix C

The Hope Scale

Derived and adapted from Everson et al. (1996) and Beck et al. (1974) by Long et al. (2020). Permission for use granted.

The Hope Scale consists of four statements rated from 1 to 6 (strongly disagree to strongly agree):

1. It is possible for me to reach goals.
2. The future seems hopeful to me.
3. I do expect to get what I really want.
4. There is use in trying.

The statements below were reverse coded (Long et al., 2020) (see above) in order to construct a hope, rather than hopelessness scale. This was done for a few reasons, one of which was to align with the "empirical conceptualization of hope as a positive motivational state directing perseverance towards goals" (Long et al., 2020, p 2). Another was to avoid the negatively phrased scale that can indicate depression.

1. I feel it is impossible for me to reach the goals that I would like to strive for.
2. The future seems hopeless to me and I can't believe that things are changing for the better.
3. I don't expect to get what I really want.
4. There's no use in really trying to get something I want because I probably won't get it.

The negatively worded items 1, 3 and 4 implicitly reference agency and item 2 references hope itself.

Appendix D

Five-Item Pain Inventory

Adapted version of the Brief Pain Inventory (Short Form)

For more information on the original Short-form Hardiness Scale:

https://apps.dtic.mil/dtic/tr/fulltext/u2/a562799.pdf

1. Throughout our lives, most of us have had minor aches, sprains, and toothaches from time to time. Other than these everyday kinds of pain, please indicate the number that best tells how much discomfort you have right now. (0-10)

2. Please indicate the one number that best describes your experience of pain on average. (0-10)

3. Please select the one number that describes how much pain interferes with your general activity.

(Likert Scale: Does not Interfere to Completely Interferes, 0-10)

4. Please select the one number that describes how much pain interferes with your ability to walk. (Likert Scale: Does not Interfere to Completely Interferes, 0-10)

5. Please select the one number that describes how much pain interferes with your enjoyment of life. (Likert Scale: Does not Interfere to Completely Interferes, 0-10)

The original paper and pencil version of the Brief Pain Inventory (Short Form) can be found here:

https://www.mdanderson.org/documents/Departments-and-Divisions/Symptom-Research/BPI-SF_English-24h_Original_SAMPLE.pdf

Permission for use granted by MD Anderson.

https://www.mdanderson.org/documents/Departments-and-Divisions/Symptom-Research/BPI_UserGuide.pdf

Appendix E

Adapted Short-form Hardiness Scale (DRS-II, short-form)

Permission requested via email, September 26, 2020. Reduced from 18-items to 10.

Items that have been reverse coded are indicated by an asterisk.

Instructions: Each of these statements reflects ways people sometimes feel. Please carefully read each statement and use the scale below to indicate the extent to which you feel each statement is true.

1 = Definitely False 2 = Mostly False 3 = Don't know 4 = Mostly True

5= Definitely True

1. My successes are because of my effort and ability.
2. I enjoy most things in life.
3. Despite challenges, life seems meaningful to me. *
4. I take a head-on approach to facing problems in my life.
5. I feel confident I can handle just about any challenge.
6. Most of my life gets spent doing things that are worthwhile.
7. I often feel connected to the people around me. *
8. I see really stressful events as opportunities to grow personally,
9. My successes are related to the choices I make.
10. Most days, life is really interesting.

Appendix F

Neutral & Primed Tutorials

50% of Participants Receive the Neutral Tutorial (219-words): Control Group

There are several definitions for chronic pain, but pain is often classified as chronic when it persists longer than six-months. Medically speaking, pain can be a protective signal. For example, pain can quickly alert us to stop touching something hot. But if we happen to burn ourselves, the pain can motivate us to apply cold water or other treatment.

This kind of pain may be relatively easy to describe to others. But other types of pain may be challenging to put into words. That is because "pain is mediated by nerve fibers in your body, and these nerve fibers have the job of sending pain signals to the brain . . . Once they find their way to the brain, the brain acts to make you aware of the pain. Because every person's body is different, their nerve fibers and their brain can react differently to the same stimuli" (www.Beaumont.org).

This understanding helps explain why some people experience more pain than others even with the same condition or injury. Since everyone experiences pain differently, it can be particularly difficult to describe our experience. Not only that, but we can even experience more than one type of pain at the same time, making it even more complex to describe. *

*The quoted text is from Beaumont; other concepts are from WebMD.

50% of Participants Receive the Primed PNE (219-words): Intervention Group

Neuroscience offers new hope for chronic pain! For the first time, scientific evidence (reported in the *Journal of Pain, Journal of Neuroscience, Journal of the American Medical Association*, etc.) shows that we can experience relief without pills, injections, and surgeries. Before and after results can even be seen in brain imaging studies.

Inspired by the evidence, surgeons, neurologists, and pain specialists are teaming up to educate physicians and patients in how to treat a major source of pain—the brain and nervous system. These easy-to-apply methods target the specialized pain-sensing network in the brain and help rewire the nervous system. This new approach helps the brain "unlearn" pain and has been shown to be effective even when there is nerve, bone, and tissue damage.

As a result, these strategies are empowering thousands, providing significant and measurable relief, while restoring hope and a valuable sense of control over one's body and life. *

* There are books and interactive websites written and developed by physicians that feature these new findings, such as orthopedic spinal surgeon David Hanscom's book, *Back in Control* (2017) and the Curable app. There is also a growing network of medical centers (i.e., Mayo Clinic) and insurers (i.e., Kaiser Permanente in California, United Health Group Research & Development), utilizing these methods and bringing new hope to chronic pain.