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Resolving Specific Psychological Stressors Can Instantly Reduce or Relieve Chronic Neck Pain and Upper Back Pain: Case Reports

Brandy Gillmore[1], Gaetan Chevalier[2*], Stefan Kasian[2]

[1]The Brandy Gillmore Foundation, Beverly Hills, CA, USA
[2]Psy-Tek Labs, Encinitas, CA, USA
Email: *dlbogc@sbcglobal.net

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Abstract

Introduction: The goal of this study was to use a novel approach to pain relief which includes a participant using their mind to reduce or relieve their neck pain in a matter of minutes and taking continuous thermal medical imaging scans during the process to capture any concurrent temperature changes at the location of the self-reported pain. Previous studies using multidisciplinary approaches have shown that it is possible for a person to achieve a moderate reduction in pain over a period of time (typically two or more months). However, in this innovative study, the goal was to demonstrate rapid pain relief (in a matter of minutes) using only the mind. *Case report*: For this study, six subjects were selected, all of whom were experiencing long-term chronic neck pain. The subjects consisted of five adult females and one adult male. Several of the subjects also had pain that radiated into their upper back region. Each subject participated in one talk therapy session during which the subject's neck was actively scanned by a thermal imaging (TI) camera that was programmed to take a new thermal image every thirty (30) seconds. The goal of the talk therapy session was to create a strong emotional shift by encouraging the subject to let go of negative emotions and replace buried painful feelings with feelings of positive expectation and optimism. Then, as the subject created this emotional shift, the goal was to observe if this change affected the subject's self-reported physical pain, as well as noting any visible effects in thermal images. *Results*: All six subjects reported that they were able to relieve some or all of their pain by the end of the talk therapy session. As they did, there was simultaneously a significant decrease in temperature recorded on the TI images in the corresponding location in their neck and upper back region. This suggested that the pain relief the subjects reported was not merely "mind over matter", since there were marked physiological changes

taking place. *Discussion and Conclusion:* It's worth noting that three of the subjects had moments during their talk therapy session where they thought about a specific painful memory that *increased* their negative emotions. At that moment, their self-reported pain also increased, and simultaneously, the infrared camera detected an increase in temperature in the corresponding location where the subjects reported increased pain. Subsequently, when the subjects were able to change the painful memory and once again move towards feelings of optimism, they reported pain relief, and simultaneously, the TI camera reported a decrease in temperature. Neither this potential outcome nor any other potential outcome was discussed with the subjects before or during the session. This research shows that talk therapy may be used as a new therapeutic option for people not only with neck pain, but possibly other types of pain, and that under certain circumstances, the results can be rapid.

Keywords

Neck Pain, Stress, Chronic Pain, Cervicalgia, Thermography, Thermal Imaging, Infrared Imaging

1. Introduction

It is well-documented that psychological stress (defined here as negative emotions) is linked to increased illness, including cervicalgia (neck pain) and thoracic back pain [1] [2]. Conversely, research has shown that positive emotions such as optimism and emotional vitality can promote health and longevity [3] [4] [5]. This awareness that negative emotions can be detrimental to the physical body and that positive emotions can promote healing has been documented throughout history through spiritual, metaphysical, and religious teachings. For example, the Bible states, "A merry heart doeth good like a medicine: but a broken spirit drieth the bones" (KJV, Proverbs 17: 22) [6].

Medical research continues to reveal the deleterious impacts of stress and elucidate the varied mechanisms through which stress can adversely influence numerous physiological systems within the human body. Studies have substantiated that, under severe conditions, stress can even result in heightened mortality rates. For example, in one epidemiological study on the widowhood effect, data revealed that during the first week of bereavement, mortality for all natural causes was over two-fold compared to non-bereavement rates [7] [8]. Research also suggests that mortality rates attributable to the widowhood effect are elevated among individuals who lack a strong connection to a social network [9].

Ongoing advancements continue to reveal a multitude of diverse effects that stress can have on the human body. Research has shown that stress can impair the immune system, diminish T cell function (proliferative response to mitogens), and that feelings of anger can slow cell proliferation and wound healing [10]-[17]. Stress has been shown to increase the production of proinflammatory cytokines, which are linked to inflammation as well as a variety of health issues

[18] [19] [20] [21]. This includes interleukin IL-6, which has been linked to increased illnesses such as cardiovascular disease and diabetes [22] [23] [24] [25]. Research has also shown that loneliness and lack of emotional support can affect people of varying ages in a variety of different ways, such as stunting a child's growth, as well as leading to increased illness, dementia, and death in seniors [26]-[31]. Stress has even been linked to increased cancer growth and progression [32] [33] [34]. Studies on post-surgical outcomes have repeatedly shown that patients who have surgery while experiencing feelings of fear or distress can experience slower healing, poorer outcomes, longer recovery times, greater chances of postoperative complications, and higher rates of re-hospitalization than people in a positive state of mind [35] [36] [37]. Based on these studies, we can see there is substantial research showing that emotional stress can have a significant negative impact on the health of the body; however, the precise mechanisms by which this occurs are complex and are not fully understood.

Research has also shown that positive emotions and optimism can significantly improve post-surgical recovery times and healing in general [38]. Optimism has also been linked to decreased occurrence of illness and increased longevity [4] [39]. A 2019 study researching the connection between optimism and longevity found that people who were classified as being more optimistic could live up to 15 percent longer than those who were classified as the least optimistic [3]. Research has also shown that "emotional vitality" (defined as "a sense of energy, positive well-being, and effective emotion regulation") can decrease and may even protect against the risk of coronary heart disease [5] [40].

Research has shown that not only can stress have a profound impact on the physical body, but trauma can even change the physical structure of the brain [41] [42].

This study aims to test Gillmore's Mind-Body-Emotion-Health hypothesis towards neck pain (referred to as H1) to observe if making a radical emotional shift by changing one's mindset from negative emotions to positive emotions and addressing specific emotions can relieve chronic pain.

Previous studies on chronic neck pain have shown that there is a connection between stress and neck pain [43] [44] [45]. Studies have also shown that a multidisciplinary approach can provide benefits to treating chronic neck pain over a period of time [46]. However, to date, there is limited evidence that focuses on the relief of neck pain solely by addressing psychological stress in the form of negative emotions in a controlled environment. This study is the first of this type.

Hypothesis 1 (H1): Gillmore's Mind-Body-Emotion Health Hypothesis

While a significant portion of research on stress examines the effects of stress in general, in this H1 hypothesis, Gillmore has opted to focus on the impact that specific emotions can have on the physical body. Under this hypothesis, Gillmore argues that each emotion can affect the body differently and that specific negative emotions are linked to corresponding pains or illnesses in the body.

And if the specific negative emotion(s) that is affecting the physical body is changed or resolved, then a person can experience pain relief and/or the body can begin to heal itself.

As part of this proof of concept, in this study, it was hypothesized that when a person changes the specific emotional stress connected to their cervicalgia (neck pain), they can reduce or release their pain quickly.

There are three discrete data points that explain why this hypothesis focuses on the importance of specific emotions over other potential hypotheses.

1) The substantial body of evidence demonstrating that different emotions can produce a very different and unique impact on the physical body. For example, oxytocin has been nicknamed the "love" or "cuddle hormone" because it is commonly associated with feelings of love, touch, hugs, trust, and bonding [47]. In contrast, dopamine is referred to as the "reward hormone" because it is commonly associated with emotions of winning and motivation as well as activities like success, games, and shopping [48] [49].

Both empirical studies and clinical observations have demonstrated that different emotions can manifest corresponding visible effects on the physical body. For example, feelings of embarrassment and shame can result in facial blushing [50]. Sexual emotions can create physical sexual arousal. Feelings of anxiety and panic are associated with a physical panic attack as well as an increased incidence of nausea [51]. Research has also shown that reducing feelings of anxiety can reduce nausea [52]-[57]. If we thoroughly examine additional studies through this particular analytical lens, we can uncover additional evidence that can support this H1 Hypothesis. For example, a recent study investigated the prevalence of upper and lower back pain among police officers, concluding a notable link between stress and back pain. The study further noted that certain work-related stress correlated with pain in the upper back which was not associated with lower back pain [2]. There is also evidence that specific types of traumas can be linked to specific illnesses. For example, emerging evidence has found a link between childhood abuse and systemic lupus erythematosus (SLE), stating there is a significantly increased risk of SLE for women who have suffered from child abuse compared to those who have not [58]. Based on this data, we can begin to see the correlation between different emotions, positive or negative, and their ability to elicit corresponding physical and biochemical responses in the body. And that each emotion can have a specific effect on the body.

Despite the wealth of existing research, numerous aspects of this intricate relationship between stress and illness remain undiscovered and not fully understood. Even in the case of well-known conditions such as panic disorder, a variety of theories have been proposed to explain why certain individuals may be more susceptible to experiencing panic attacks, yet a definitive and comprehensive explanation still eludes us [51]. The objective of this hypothesis is to address the existing knowledge gaps and contribute to the augmentation of the current information base.

2) The second datapoint behind the rationale of this hypothesis is the research that revealed that patients who suffer from dissociative identity disorder (DID), formerly known as multiple personality disorder (MPD), can suffer from different, medically documented illnesses and pains when they are in alternate personalities (alters) [59]. It's further significant to note that the same ailments can occur with consistency in the same specific alters. For example, the alter "Anna" was shown to consistently suffer from back pain, while the alter "Carol" consistently suffered from asthma. There can also be alters who display stressful or negative emotions but do not suffer from physical ailments. There is also a case study of a woman who was blind in some of her alters but not others [60]. As this patient resolved her emotional trauma, she was able to regain her eyesight in her other alters [61]. This suggests that different illnesses and pains may be associated with different mindsets (thoughts and emotions).

Under this hypothesis, it is proposed that if a person makes a strong enough emotional shift and addresses the specific negative emotion(s) that is (are) connected to the pain or illness, then the body can make a rapid change in pain and even begin healing itself.

3) The third data point pertains to the location of the neural activity generated by each emotion. Researchers have found that each emotion consistently generates neural activity in the same parts of the brain and that different emotions generate neural activity in different parts of the brain [62]. That is to say, when two people experience the same emotion (e.g., fear), their fMRI brain scans are similar to one another. However, if one subject is experiencing feelings of disgust and the other is experiencing fear, their fMRI brain scans differ from one another. From this, we can further see how it would be scientifically plausible for specific emotions to affect specific parts of the physical body, with consistency, by affecting different parts of the brain, which, in turn, affects the body.

One way to illustrate this connection between the brain and the body and the importance of the location within the brain is to compare it to the example of a stroke. If a person suffers from a right hemisphere stroke, simply stated, it can affect the left side of the body. Conversely, a left hemisphere stroke, simply stated, can affect the right side of the body as well as a person's speech, language, and vision. It is evident that the location within the brain matters. While emotions in the brain may seem insignificant compared to a stroke, it's also important to remember they, too, can be impactful. Research has shown that significant stress and even PTSD after a car accident can alter the structure of the brain [63] [64] [65]. From this, we can see evidence that emotions can be impactful.

Further, when it comes to the brain-body connection, it is well documented that every part of the brain is connected to a different and specific part of the physical body. This was discovered in 1937 by Wilder Penfield, a neurosurgeon, and Edwin Boldrey, a professor of neurosurgery [66]. In their research, Penfield and Boldrey used electrical stimulation to stimulate different parts of their patient's brains, then recorded the location where each patient felt the stimulation

in their body. By using this method, Penfield and Boldrey created the first cortical homunculus, which is a brain-body map. This map included the somatosensory and motor cortex. It's worth noting that new research suggests that the somatosensory cortex is involved in each stage of emotional processing [67].

It's also important to note that when Penfield and Boldrey stimulated their patients' brains, the patients didn't merely report that they felt a sensation in their bodies; instead, the patients could experience specific physical reactions. For instance, Penfield documented that when he probed the insular cortex, patients could feel nauseated, gassy, bloated, or even ready to vomit [68].

To provide additional evidence of this mind-body connection, as well as the connection to emotions, we could combine this data with a case study of a 30-year-old man who suffered from extreme fear [69]. The patient also experienced tightness in his throat, seizures, and projectile vomiting. Researchers monitored his brain, which revealed spikes in the insula. The patient underwent temporal lobectomy. Following his surgery, researchers continued to monitor his brain activity, which showed residual spikes in the unresectable tissue of the insula; however, both the seizures and vomiting were gone. In this study, the researchers specifically noted that it appeared as though the insula could be a trigger area for emesis (vomiting). This was consistent with Penfield's findings, except in this case, the researchers documented the emotions of extreme fear. We can also note additional research has shown that extreme fear and panic can be connected to nausea and vomiting [51].

Upon synthesizing these data points, it becomes increasingly evident, from both a plausible and logical standpoint, how it is possible for different emotions (that generate activity in different locations in the brain) to affect different parts of the body.

In addition to these data points, another contributing factor to the formulation of this hypothesis was Gillmore's extensive research on the mind-body connection as well as her personal and clinical experience. In talk therapy sessions with clients, Gillmore has consistently observed that individuals who undergo a significant emotional shift can experience instantaneous alterations in various physical symptoms, including physical pain. This recurrent observation incited the development of the present hypothesis and prompted the initiation of this study, which aims to document such changes utilizing thermal imaging technology.

For this reason, under this hypothesis, we suggest that when a person creates a strong emotional shift, a rapid and almost immediate change can occur. While it may not seem realistic to expect that a person could experience immediate changes in their health or pain levels, we can see from the examples of MPD/DID or in the case of acute stressors, such as the sudden onset of a panic attack or an extreme case of takotsubo cardiomyopathy (broken heart syndrome) that, when an individual experiences a significant shift in emotion, the potential for radical physical changes is possible [59] [70].

To test this hypothesis in this study, our goals were: 1) to help the subjects identify the specific negative emotion affecting them; 2) to use talk therapy to help the subject reduce and release their negative emotions and replace the negative emotions with strong feelings of positive expectation and optimism; 3) to see if this approach could reduce or relieve their physical pain; 4) to simultaneously monitor the neck area with a TI camera in order to document any significant changes in temperature.

We opted for a TI camera in this study to ascertain whether pain relief represents merely a diminution in pain perception or if physiological changes are concurrently occurring. The TI camera was chosen because it is non-intrusive and an effective tool for monitoring physical pain [71] [72].

Confirmation of this hypothesis would suggest that emotions can play a significant role in pain and that pain from stress is not merely the brain's perception of pain but that physiological changes are transpiring within the body.

2. Subjects Information

The protocol for this study was approved by the Institutional Review Board (IRB) of the National Alliance of Energy Practitioners (https://naoep.org/). The study was conducted following ethical guidelines and approval from the IRB. Each subject signed an informed consent form approved by the IRB prior to their participation. Subjects also agreed for the information gathered as the result of their participation in the study to be presented at meetings or in publications, provided their identity is not disclosed.

Prior to the study, it was confirmed that each subject was psychologically able to understand the study-related information, and they freely and expressly gave their informed consent. Six (6) subjects were recruited for this study. Some subjects were recruited by Brandy Gillmore, but most subjects were recruited from the subjects' base of Psy-Tek Labs.

The inclusion criteria were male or female, aged between 18 and 75 years old, diagnosed with local pain (at least 25% on the VAS pain scale), absence of cognitive impairment, psychologically able to understand the study information and to give a written informed consent freely. The requisite cognitive competency for engagement in talk therapy sessions was also a precondition for inclusion. The exclusion criteria were: current pregnancy; consumption of antidepressant medications, opioid-based substances, or other analgesic medications within the preceding two months; presence of diagnosed psychological disorders; or a history of drug and alcohol abuse. These exclusion criteria were meticulously delineated to mitigate the influence of potentially confounding variables, thereby safeguarding the validity and reliability of the study's findings.

The inclusion and exclusion criteria were the same for both groups. The reason that subjects were selected from both Gillmore's contacts and Psy-Tek's was that the initial attempt was for Gillmore to find all the subjects and thereby reduce lab costs. However, Gillmore is not local to the lab and was unable to find

enough contacts who could come into the lab. Since Psy-Tek has a database of local contacts, this proved to be an easier solution. Gillmore had no direct contact with any of the subjects from either group prior to the study. Subjects were asked to abide by all custom criteria for doing TI. Table 1 presents basic information on the age and gender of the subjects.

2.1. Primary Concerns and Symptoms of the Subjects

Each subject reported experiencing long-term neck pain. Upon intake, each subject was asked to determine their pain perception level on a VAS pain scale.

The VAS is a horizontal line about 10 cm long marked by short vertical lines at regular intervals going from 0 (No pain) to 10 (unbearable pain).

Subject 1: Age: 52. Initial VAS Pain Scale as reported by the subject: 6.

Subject 2: Age: 54. Initial VAS Pain Scale as reported by the subject: 4

Subject 3: Age: 50. Initial VAS Pain Scale as reported by the subject: 5.5

Subject 4: Age: 48. Initial VAS Pain Scale as reported by the subject: 5

Subject 5: Age: 48. Initial VAS Pain Scale as reported by the subject: 7

Subject 6: Age: 41. Initial VAS Pain Scale as reported by the subject: 6

2.1.1. Medical, Family, and Psychosocial History

Due to the nature of this study (working with the mind), there were limited questions asked of each subject so as to not suggest or reinforce any beliefs or emotions about their physical ailments or psychosocial history. This includes beliefs about their injury, accident, and genetic history, as well as inquiring about a person's psychosocial status. Any beliefs or emotions about these topics could potentially influence the study in one way or another.

2.1.2. Relevant Past Interventions and Their Outcomes

To maintain the integrity of this study, we avoided asking the subjects about their past interventions because this could trigger unpleasant negative emotions or further ingrained beliefs about their condition that would be counterproductive for this study.

Table 1. Basic information.

Subject #	Age	Gender
1	53	F
2	54	F
3	50	F
4	48	F
5	48	F
6	41	M
Ave:	49.00	
SD	4.65	

3. Therapeutic Intervention

The intervention used for this study was talk therapy. The goal was to determine if a person can reduce or relieve their pain solely by changing their mindset and resolving specific negative emotions. The intervention was limited to just one talk therapy session with Gillmore instead of ongoing therapy sessions over a duration of time. This was to eliminate external factors as much as possible, such as exercise, work, injury, sleeping "wrong", etc., that could potentially interfere with the results.

Initially, each subject was interviewed to gather basic health information to ensure they were in compliance with the study. Each subject also had the opportunity to ask any question regarding their participation in the study. Once this was done, the subject was asked to determine their pain perception level on the VAS pain scale.

Next, to get a baseline image of the area exhibiting pain, the subject was escorted into a temperature-controlled room dedicated to thermal imaging (TI). The subject was requested to remove any garments that obscured the cervical area of the spine. Subsequently, they were positioned on a stool in front of a state-of-the-art TI camera (FLIR, Model A655sc, https://www.flir.com/products/a655sc/), which records infrared radiations emitted by the subject's body. The TI camera is controlled by state-of-the-art software (Total Vision Medical Imaging Software, version 3.1.1.3; https://med-hot.com/).

Each subject then underwent thermal equilibration to acclimate to the temperature in the room. The thermal examinations followed a protocol in common usage for TI examinations.

Next, a baseline thermal image was taken for each subject. For all 6 subjects, this first baseline thermal image showed elevated temperatures in the neck region, which was consistent with the pain they reported on their intake form.

During the session, each subject remained sitting on the stool in front of the TI camera. The TI camera was programmed to automatically take new thermal images at 30-second intervals during the entire session. (Each subject had their back to the TI camera except for Subject #2 who was positioned perpendicular to scan the side of her neck). In each case, the subject could not see the images being taken during the session.

Once the session was done, the subject was asked to fill out the VAS pain scale again.

3.1. Administration of Therapeutic Intervention

3.1.1. Part 1 of the Intervention: Identifying the Specific Stress

During the talk therapy session, the goal was first to identify the specific stress in the form of negative emotions the subject was consciously or subconsciously experiencing. This is important because, as discussed previously, there is evidence that different emotions can have specific impacts on corresponding areas of the physical body.

It is important to note that Gillmore has been researching mind-body healing since 2003 and has been working in a clinical therapeutic setting since 2010, where she regularly provides talk therapy. Over this period, Gillmore developed clinical intuition that enables her to probe and identify issues that a subject may be experiencing more quickly. This skill was very helpful in the identification and implementation process.

Additionally, through years of clinical observation, Gillmore has been able to record that there are common stresses (negative emotions) that seem to be most prevalent with neck pain. The specific stress that Gillmore has identified as commonly associated with neck pain involves feelings of wanting to resist, avoid, or push others away. So, in this case, Gillmore engaged the subject in talk therapy to probe the subject to identify the specific wounding and who the subject might be wanting to resist or push away.

To some, this may seem like a less scientific approach. However, it is important to keep in mind that this is the case for many conditions relating to emotions, such as panic attacks (or panic disorder). Current research states that while it is well-known that a person can have a panic attack, there are no specific laboratory, radiographic, or other tests to diagnose panic disorder [51]. However, based on clinical observations, it has become evident that feelings of anxiety and panic are associated with a "panic attack". Similarly, through more than a decade of clinical observation, Gillmore has been able to observe patterns of stress that are more prevalent with specific ailments.

In this case, once Gillmore probed the subject to identify the negative emotion of resistance, the objective was to convince each subject to let go of the painful emotion and instead to get themselves into a state of positive expectation and optimism.

3.1.2. Part 2 of the Intervention: Changing the Mindset from Stress to Positive Expectation and Optimism

The protocol that Gillmore used to achieve this radical shift was to first discuss repetition compulsion with the subject [73] [74]. (Repetition compulsion, or reenactments, is the unconscious tendency that human beings have to repeat painful experiences from the past). Once the subject understood that negative patterns can reoccur, the next step involved requesting that the subject be willing to let go of their negative emotions. It was emphasized to the subject that it was in their best interest to do so. Subsequently, they were encouraged to cultivate feelings of positive anticipation and optimism for a more favorable future.

3.1.3. Part 3 of the Intervention: Noting Their Current Level of Pain

At the end of their participation, each subject was asked again to determine their pain perception level on the VAS pain scale. Each subject reported either eliminating their pain completely or decreasing their pain significantly, and in each case, these changes were consistent with the images from the thermal imaging camera.

4. Results

As Gillmore worked with each subject, they were able to identify an underlying psychological stress that resulted in feelings of resistance. Then, they were able to create a strong shift in their mindset by being willing to let go of the stress and instead embrace new feelings of positive expectation and optimism. And as they did, they reported a reduction or elimination of their physical pain.

4.1. Talk Therapy Session and Thermal Imaging Results

4.1.1. Subject 1

When Gillmore began working with this subject, the individual mentioned a few times that she linked her pain to a motor vehicle accident. Nevertheless, Gillmore directed the conversation towards identifying any hidden emotions connected to resistance towards others, pushing people away or feeling they are a "pain in the neck". This could be found directed towards her family. The subject had hurt feelings from her past which resulted in a strong "push-pull" feeling with people. Consciously, she also wanted more love, and she was also a very loving and kind person, but she had so much hurt that she also wanted to push them away due to fear of getting hurt. Gillmore helped her to change her mindset that pushing people away was not the answer. Instead, she needed to define how she wanted her relationships to be and heal her past hurt so she could have wonderful relationships moving forward. As can be seen from Figure 1, there was a very significant decrease in temperature by 3.89˚C after a session of 15 minutes.

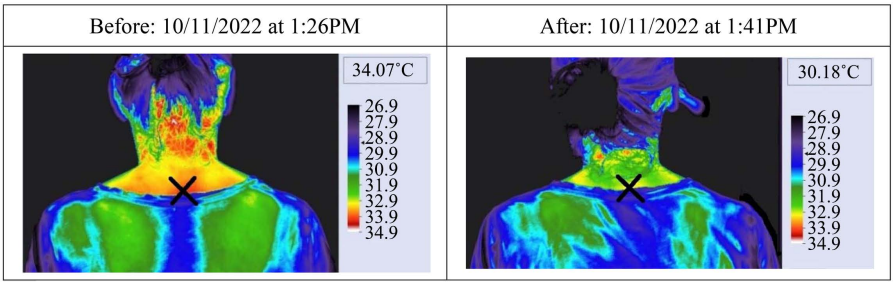

Figure 1. Left: TI image before the intervention showing increased temperatures in the neck and upper back which are consistent with the subject's self-reported pain. Right: After a 15-minute session the areas that initially had elevated temperatures showed an immediate marked decrease in temperature. Simultaneously, the subject also reported that her pain reduced from a level 6 to a 0 on the VAS scale. The position of the X indicates where the temperature was taken.

4.1.2. Subject 2

Subject 2 has a history of studying positive thinking and engaging in meditation practices. She presented with neck pain and several other health issues such as a recent myocardial infarction, Hashimoto's, significant dental issues with implants and infections, neck pain, facial pain and pressure, and headaches. She also mentioned that she'd had ongoing health issues as well as significant dental issues since childhood.

Gillmore worked with this subject and was able to identify that she had strong feelings of resistance towards her husband. In short, she felt nit-picked by him, and like he was mean and condescending and that he had humiliated her. She'd had a similar emotional pattern with her mother as a kid and then repeated the pattern in her marriage. She mentioned that her husband had been mean to her for most of their marriage. However, in the past few years, he had started treating her very kindly. Part of her felt that she wanted him closer, and it was what she'd always wanted. The other part of her felt that he was mean to her for so long that she wanted to push him away, both from hurt and also with a desire to punish him. In short, she was a kind and loving person who was very sensitive and hurt, which resulted in having a lot of mixed feelings.

In this case, Gillmore helped the subject to see that the pattern had repeated from her childhood and asked the subject if she wanted to heal her wounding and release her negative emotions and instead focus on feelings of positive expectation and optimism. The subject was agreeable to doing so.

Also note: As Gillmore worked with the subject on her neck pain, which was linked to her resistance towards her husband, feelings connected to both the thyroid as well as the facial region were addressed as well. This was connected to feelings of humiliation and wanting to be loved. Fifty (50) minutes into the session, the Subject let go of these emotions as well as her feelings of resistance and as she did her pain decreased substantially both in her facial area as well as her neck which can be seen in Figure 2.

Due to technical difficulties, it was not possible to perform temperature measurements for this subject. Also note that for this subject, it was easier to monitor activity with the TI camera on the side of her neck. This was due to two factors: 1) her pain was more present on the left side of her neck; 2) she had a short neck surface area with a crease in the skin of the neck. However, since there were visible markers on the left side of her neck, this provided an optimal location for monitoring.

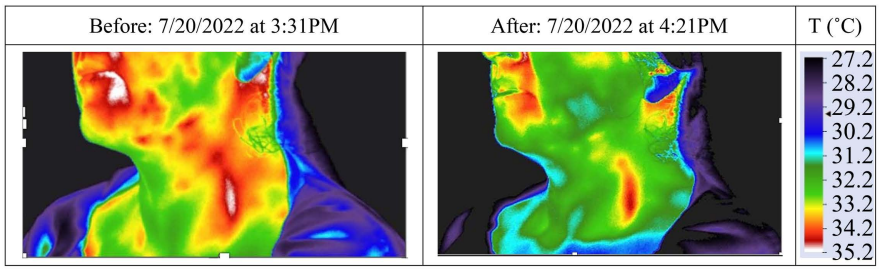

Figure 2. Left: TI image before the intervention showing pain of the face and left side of the neck which were consistent with the subject's self-reported pain. Right: After a 50-minute intervention the areas that initially had elevated temperatures, showed an immediate marked decrease in temperature. Simultaneously the subject also reported that her pain reduced from a level 4 to a 1 on the VAS pain scale.

4.1.3. Subject 3

The third subject's primary issue was neck pain that radiated into her upper

back. She was recently married and felt generally happy in life, which was visible in her demeanor. She was laughing and very kind as she was filling out her paperwork.

As she began her session, she and Gillmore identified that she had underlying feelings of resistance towards clients and work. She felt that she spent too much time working and had pressure from people, which created feelings of being overwhelmed and resistance and wanting "everyone to just leave her alone". However, consciously she wanted more love, more friends, and also more clients. And more than anything she wanted more time with her husband. While they had been coupled for many years, she was very much in love and spoke very kindly of him.

Gillmore helped her see that her feelings of resisting her work were not serving her and that getting her life more organized and efficient could provide more ease. Gillmore discussed some practical steps this subject could take, then helped the subject shift into a mindset of feeling positive expectation and optimism. As the subject changed her emotions on this topic, she was able to release her pain. The primary feeling of resistance was towards work and life being too much. Prior to this appointment she had a history studying positive thinking.

As shown in **Figure 3**, there were elevated temperatures in the neck and middle upper back upon arrival that disappeared after a session of 22 minutes. A reduction in temperature by 1.54˚C can be observed where the subject had reported her pain (in the region marked with an X). Any change in temperature above 1˚C is considered significant [75].

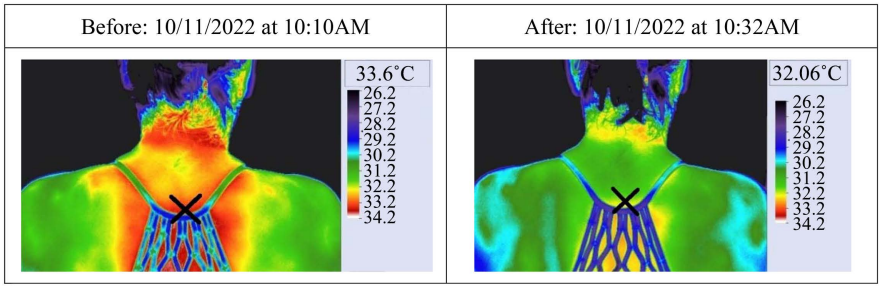

Figure 3. Left: TI image before the intervention showing increased temperatures in the neck and upper back which are consistent with the subject's self-reported pain. Right: After a 22-minute session the areas that initially had elevated temperatures, showed a marked decrease in temperature. The subject also reported that her pain reduced from a level 5.5 to a 0.5 on the VAS scale. The position of the X indicates where the temperature was taken.

4.1.4. Subject 4

The fourth subject also had feelings of resistance towards work and her busy schedule. She was very overwhelmed with her schedule and kids. While she consciously wanted more clients and work in her job, she was also overwhelmed. So much so that during the session, her pain increased when Gillmore mentioned her schedule. Her challenge was to balance her work responsibilities while also striving to be a supportive and nurturing parent for her children. It should be

noted that her children's father had committed suicide approximately six years prior to this appointment. While this is likely an important topic that the subject should further resolve, Gillmore did not probe for more details into this situation since it was not the core issue for her physical pain. Instead, the problem was her schedule and the feeling of being overwhelmed. However, the sudden death of her husband did have an underlying role in creating her overwhelming schedule. She was a very caring mother and she mentioned that since his death, she had been trying to be both the father and mother to her kids. She took her children to every extracurricular activity and sport that she could, in addition to working.

As we discussed the sports schedule, she mentioned that sports were going to be ending in a couple of weeks, and that thought brought some relief to her. As the discussion turned into feeling more optimistic about her schedule, her pain began to release. However, there was a second issue going on that was brought up during the session that we did not have time to resolve completely since she had a tight schedule. This second issue is linked to the remaining pain that was in her upper back (but not her neck area). She had recently (within the last day or two) found out that the house she was living in had mold and was upset about the situation. She felt protective of her kids and felt they were sick due to the mold. So, this topic elevated her negative feelings on that topic. So, the outcome of her session was that she felt better about her schedule and let go of feelings of resistance and her neck pain resolved from a level 5 to a 0. However, as she spoke about the mold in their house, she had negative feelings surface and a level 2 of pain increased in her upper back. Since the subject had a tight personal schedule (as noted above), we needed to end the session so there was no time to help her resolve her emotions on this topic. Still, **Figure 4** shows a very significant decrease in temperature by 2.67˚C after a session of 47 minutes.

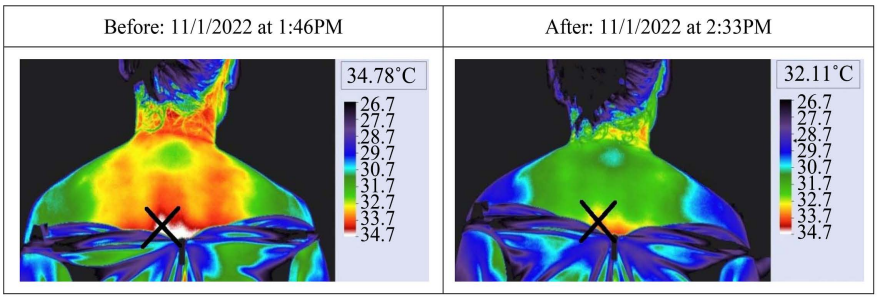

Figure 4. Left: TI image before the intervention showing increased heat in the neck and upper back areas, which corresponds with the pain that the subject reported on the VAS pain scale. Right: After a 47-minute intervention the areas that initially had elevated temperatures showed a marked decrease in temperature. The subject also reported that her pain reduced from a level 5 to a 2 on the VAS pain scale.

4.1.5. Subject 5

The fifth subject mentioned an injury or accident that initially caused the neck pain. Following her protocol, Gillmore moved on to talking to the subject to

identify the emotional component, which was a strong feeling of resistance towards men. The subject had grown up with an abusive father and was holding on to a lot of hurt. You would never guess that by her appearance—she was very friendly and likable. She was personable, had a great sense of humor, and held herself very confidently while filling out the paperwork before the session. However, as the session began and Gillmore brought up the topic of men, she was in tears. The subject had a negative and painful outlook towards men, her ex, her father, and male bosses. This pattern had been present throughout both her and her sister's life. They both had a pattern of dating what she described as "horrible men". In fact, she mentioned that, over the weekend, she and her sister had just been discussing this topic. They discussed that her sister had married a man just like their dad. During the session, as the topic of men or past wounding was discussed, the subject's pain increased 3 times. Then ultimately, released completely at the end.

To help her shift her mindset from the wounding into positive expectation and optimism, Gillmore probed for a topic that the subject loved: animals. Then, Gillmore used animals as an analogy: that there are some vicious animals but there are also some really wonderful animals who are loving and playful. If she decided that all animals were bad, then she would miss out on having friendly animals. The same is true for men; not all of them are bad, although some may be. She needed to let go of her hurt and patterns, particularly those related to repetition compulsion, in order to find a wonderful man. Figure 5 shows a significant decrease in temperature by 1.03˚C in her back after a session of 26 minutes. The high temperature in the neck area (red and white line) is due to the heat from a fold of skin caused by a dorsocervical fat pad.

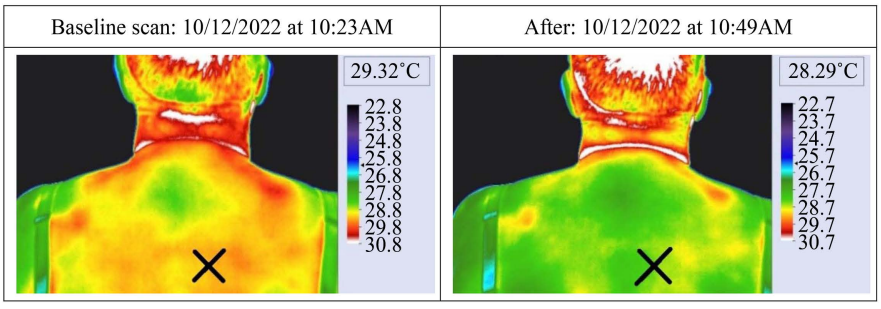

Figure 5. Left: TI image before the intervention showing increased heat in the neck and upper back areas which corresponds with the pain that the subject reported on the VAS pain scale. Right: After a 26-minute intervention, the areas that initially had elevated temperatures showed a marked decrease in temperature. Note: this subject had a *d*orsocervical fat pad that created a fold of skin in the neck area that generated heat which can be observed by the red and white line across the neck area. The subject reported that her pain reduced from a level 7 to a 0 on the VAS scale. The position of the X indicated where the temperature was taken.

4.1.6. Subject 6

The sixth subject was a man who was extremely kind, intelligent, thoughtful, and

self-aware. He practiced meditation regularly and studied personal growth. Simultaneously, he also had feelings of resistance towards authority. He did not feel wounded by this thought pattern; he felt it was good to be rebellious and to resist authority. However, through talk therapy, Gillmore helped him reframe the feeling of resisting authority as being juvenile and, instead, replaced the thought pattern with a feeling that he was the authority in his own life. As he made this change, he was able to release his pain. He also had a second pattern of resistance, which was connected to feelings of a push-pull with women: part of him wanted closeness, but he also had resistance. He had an underlying feeling of expecting to get his feelings hurt by women. This was connected to a childhood feeling of hurt that he experienced with his mom. In working with Gillmore, he was able to bring down his pain level to zero. This pain reduction happened within 28 minutes, as seen in Figure 6. Due to technical difficulties, it was not possible to do temperature measurements for this subject.

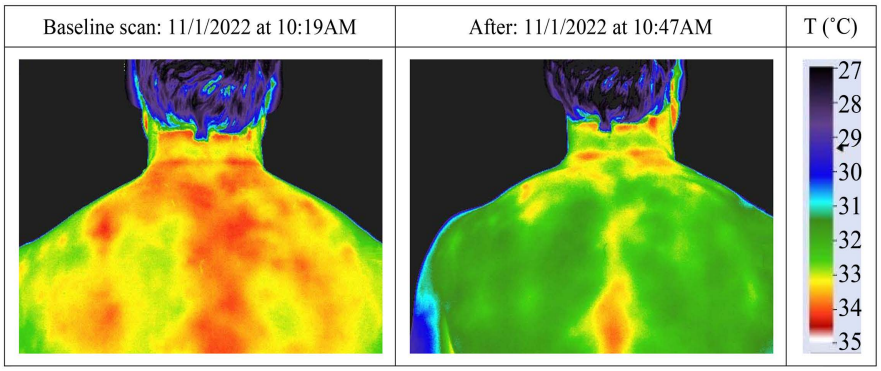

Figure 6. Left: TI image before the intervention showing increased temperatures in the neck and upper back, which are consistent with the subject's self-reported pain. Right: After a 28-minute intervention, the areas that initially had elevated temperatures showed an immediate marked decrease in temperature. The subject also reported that his pain reduced from a level 6 to a 0 on the VAS scale.

4.2. Combined Results

Combining the four subjects for which we have temperature readings, it can be seen from Table 2 that the temperature in a region of pain decreased by 2.28˚C on average after a session with Brandy. This is significant in 2 ways: 1) a decrease in temperature by 1˚C or more is considered to be significant [75]; 2) a t-test comparing the average temperature after vs. before the session shows a statistically significant decrease in temperature ($p = 0.0185$, which is smaller than the accepted threshold of significance which is $p \leq 0.05$).

4.2.1. VAS Pain Scale

At the end of their participation, all 6 subjects were asked again to determine their pain perception level on the VAS pain scale. The result is presented in Table 3. The statistical analysis performed involved t-tests, or non-parametric equivalent tests, with a 5% threshold of significance.

Table 2. Temperature (˚C) of area that was exhibiting pain.

Subject #	Before	After	Diff	Diff (%)
1	34.07	30.18	3.89	11.42%
3	33.60	32.06	1.54	4.58%
4	34.78	32.11	2.67	7.68%
5	29.32	28.29	1.03	3.51%
Ave:	32.94	30.66	2.28	6.80%
SD	2.46	1.82	1.27	3.55%
t-test:		0.0185		

Table 3. VAS pain scale.

Subject #	Before	After	Diff	Diff (%)
1	6.0	0.0	6.00	100.0%
2	4.0	1.0	3.00	75.0%
3	5.5	0.5	5.00	90.9%
4	5.0	2.0	3.00	60.0%
5	7.0	0.0	7.00	100.0%
6	6.0	0.0	6.00	100.0%
Ave:	5.58	0.58	5.00	87.7%
SD	1.02	0.80	1.67	16.7%
t-test:		0.00037		

All subjects reported a substantial decrease in pain by 5 points on average on a scale from 0 to 10. A t-test comparing the average pain scale before and after a session came up with a very significant result ($p = 0.00037$).

4.2.2. Outcomes

As each subject began their talk therapy session, four of the six subjects shed tears as they discussed their painful, buried emotions. However, as each subject began to talk through the issue, they were able to change their perspective from hurt feelings to feelings of optimism. For each of them, this was not an insignificant change. There was plenty of internal resistance. The change took effort and coaxing and getting the subject to a state of being willing to embrace change and a more optimistic outlook.

To get results in this limited amount of time, Gillmore helped each person reframe their perspective on future expectations and encouraged them to view their emotions in a new way; to see that their emotional patterns can attract more of the same types of problems. She helped them realize that the best thing for them to do was to let go of hurt and negative thought patterns to embrace optimism and a more positive vision for their life. As each subject embraced an

optimistic perspective, there was a noticeable change in their smile and happiness. They each visually appeared happier. All 6 subjects reported pain relief solely by changing their mindset and emotions.

Results and observations:

- For all 6 subjects, their first baseline scan showed elevated temperatures in the neck region, which was consistent with the pain they reported on their intake form.
- During the talk therapy session, as each subject began to change their emotions, they verbally noted that their pain also decreased. At the same time, the TI camera detected a decrease in heat in the neck region.
- During the talk therapy session, if the subject had an increase in negative emotions as they were discussing the negative topic, they verbally noted that their pain also increased. Concurrently, thermal images measured increased heat in the area.
- The differences between the first thermal image, before starting the talk therapy session and the last thermal image at the end of the session show significant changes. These changes are also reflected on the VAS pain scale.

It's also important to note:

1) Four of the subjects reported that the onset of their neck pain was due to a physical accident or injury (not stress).

2) Three of the six subjects from this study mentioned they were active in meditative practices. Five of the six subjects mentioned that they had previously studied positive thinking and meditative practices. One of the five had recently attended a 10-day healing meditation retreat as well as a personal empowerment and positivity seminar. Despite these practices, they all still suffered from chronic neck pain. However, during these sessions, when they addressed the specific stress, that is when their pain resolved.

4.2.3. Intervention Adherence and Tolerability

In this study, adherence and tolerability are mostly subjective; however, overall, we would evaluate this as a positive response to both adherence and tolerability. Based on the results from each subject, as well as their overall attitude (every subject was noticeably happier and expressed verbal appreciation for their talk therapy session), we could surmise that adherence and tolerability went very well. Gillmore also offered to record the session for the subject if they would like so they could listen to it again to ingrain the new way of thinking and feeling. Five of the six subjects who were offered this option accepted it.

4.2.4. Adverse and Unanticipated Events

During the talk therapy sessions, three of the subjects had moments during their talk therapy session where they thought about a specific painful memory that increased their negative emotions. As this occurred, the subjects reported increased pain, and the infrared camera also detected an increase in heat. Then, when the subjects were able to change the painful memory and move into feelings of optimism, their pain resolved.

While these were adverse events, they were not unanticipated. Based on Gillmore's hypothesis, as well as her clinical experience, it was expected that if a subject increased their negative emotions, the pain would also increase; however, this was not discussed with the subjects prior to the session. In fact, there were no discussions about the process or potential outcomes with the subjects in an effort to be cautious not to suggest any possible outcome.

5. Discussion

The purpose of this study was to determine: 1) If a person could reduce or relieve their neck pain by changing their mind and emotions; 2) If any changes the subject reported were accompanied by physiological changes. The results from this study provide evidence that both of these can be achieved, which supports Gillmore's *Mind-Body-Emotion-Health Hypothesis* (*H1*).

Table 2 shows the changes in temperature at the beginning and at the end of the session of a specific region for each subject for which we were able to determine spot temperatures on the thermal images. We found that the temperature in a region of pain decreased by 2.28˚C on average after their session. This is significant in 2 ways: 1) Thermographers consider a decrease in temperature by 1˚C or more to be significant [75]; 2) A t-test comparing the average temperature after vs. before the session shows a statistically significant decrease in temperature which, therefore, could not be attributed to chance alone.

Table 3 shows the VAS Pain Scale scores as reported by the 6 subjects before and after their session. All subjects reported a substantial decrease in pain by 5 points on average on a scale from 0 to 10. A t-test comparing the average pain scale before and after a session came up with a statistically significant result, essentially eliminating the possibility that the change was due to chance alone.

This study could open the door to more possibilities for treatments for healing. Many current-day pain therapies include pain medications that have side effects or may lead to addiction; further, these pharmaceutical treatments don't typically resolve the pain.

As far as mind-body therapies (MBTs), many focus on relaxation, meditation, relieving stress, trauma healing, mindfulness, and brain entrainment. However, in this case, most of the subjects had already tried meditation prior to this study. And, as mentioned, one subject had recently attended a 10-day healing meditation retreat as well as a personal empowerment and positivity seminar. Despite these practices, they all still suffered from chronic neck pain.

That said, the focus of this novel study is to work with the mind in a more specific and assertive way to: 1) Identify the specific negative emotions; 2) Transform the issue by being willing to let go of negative emotions and instead embrace strong feelings of optimism. These are vitally important distinctions for this hypothesis, and something that we feel is being overlooked in MBTs.

It may also be helpful to note that it is a common assumption with mind-body healing that a person must have experienced a trauma. However, Subject 3 did

not have any related trauma. Subject 4 did have trauma; however, it was not addressed to resolve her neck pain. From this, we can begin to see that it was important to address the specific stress that was connected to the pain. And that to obtain results, it was important to address how the person was thinking and feeling about the past, present, and future.

5.1. Additional Discussion

During the study, when a subject reported their pain had been reduced, the corresponding change in temperature was almost instant. In the cases where a subject reported a spike (increase) in their level of pain, there was an immediate increase in temperature on the scan in the corresponding location.

We asked, how could this happen? How can emotions produce such rapid changes? What could radiate heat so quickly? Based on research, it is commonly suggested that an injury radiates heat due to increased blood flow. However, in this case, the instantaneous significant elevations or reductions in temperature do not fully align with the logical expectations one might have of augmented blood flow. To address this aspect, Gillmore created a second hypothesis which we will refer to as Gillmore's Mind-Body-Biophoton Hypothesis H2:

This hypothesis is that the mechanism whereby the mind and emotions can positively or negatively affect the physical body is due to the changes in the body's biochemistry as well as changes in biophotons.

When it comes to biochemical effects, there is extensive evidence that having positive expectations can trigger beneficial changes in the body's biochemistry. These changes can potentially help alleviate physical pain. The biochemical alterations from positive expectations would still be attributed to the emotional shift; however, they would not align with the results observed from placebo analgesia for several reasons [76] [77]. First, there was never any suggestion to the subjects that the intervention could lead to pain reduction or relief. Secondly, the subjects experienced rapid changes in temperature, which was also never suggested to them. Third, during the talk therapy session, three of the subjects experienced a momentary increase in pain and temperature when they were triggered by the specific emotional pattern. This was never suggested to them, nor is this consistent with placebo analgesia. Additionally, as noted previously, several of the subjects had already been engaging in meditation and already felt a general sense of optimism in their lives, including one who was recently married. Given that the subjects experienced relief from pain as the specific emotion subsided and that several subjects experienced an increase in pain levels when the emotion was triggered—coupled with the fact that none of these outcomes were pre-suggested to them—we contend that focusing on the specific emotion was essential in yielding the observed results. Further, while a biochemical change could potentially contribute to these results, it does not entirely conform to logical expectations that these rapid outcomes could be solely attributed to biochemical changes.

Hypothesis 2 (H2): Gillmore's Mind-Body-Biophoton Hypothesis

In this hypothesis (H2), we argue that in addition to biochemical changes, biophotons are the other hidden factor that play a key role in the mind's ability to positively or negatively influence the health of the physical body.

The rationale for formulating this specific hypothesis over other potential alternatives lies in its ability to provide a logical explanation for aspects that would otherwise remain unexplained. Emerging from research as outlined below, there are a myriad of disparate reasons that the photon emission could be the underlying mechanism responsible for the results in this study.

1) Biophotons can influence and support the health of the body

Research has shown that most, if not all, cells emit light called biophotons (also known as ultra-weak photon emission). Further, research has also shown that biophotons support the basic functioning of cells and can influence cell proliferation [78] [79].

When this photon emission was first discovered by Gurwitsch in the 1920s, he called it mitogenetic radiation [80] [81]. In his experiment, he was able to demonstrate that it could influence cell proliferation. To do this, he used a tube to funnel mitogenetic radiation (now called biophotons) from one onion root (the emitter of biophotons) onto a second onion root (the receiver). His results showed that the onion root that received biophotons had a significantly higher number of cells in mitosis. For his work on mitogenetic radiation (biophotons), Gurwitsch was nominated for a Nobel Prize eleven times [82]. In 1941, he was awarded the State Stalin Prize because his discovery led to a less-expensive method to detect and diagnose cancer [83]. Gurwitsch's research generated a lot of excitement among medical scientists and researchers. However, other researchers initially failed to duplicate his results, so his discovery was largely forgotten until several years later. Then, as technology improved, not only were Gurwitsch's results validated, they were expounded upon [84]. Modern research has continued to reveal evidence of the significance of biophoton emission.

2) The mind can influence biophoton emission

Research has shown that there is a correlation between the fluctuations of brain wave activity and the fluctuations in biophoton emission [85]. Studies have also provided evidence that our minds and emotions have the ability to influence biophotons in a variety of different ways [86] [87] [88] [89]. For example, one study showed that feelings of anger increased biophoton emission [89]. Conversely, research has documented that relaxation techniques can decrease biophoton emission [90] [91] [92] [93].

Research has also noted that neural activity can increase biophoton emission in specific locations in the brain. In a 2011 study, researchers asked participants to visualize white light. As they did, the biophoton emission increased from the right side of the participant's head but not the left [94]. From this, we can see that studies have shown the connection between neural activity and biophoton emission. Further, it has also documented that biophoton emissions appear to be linked with the pathways for amine neurotransmitters such as dopamine, sero-

tonin, or noradrenaline [95].

3) Research has revealed there is a connection between illness and biophotons

Studies have shown that different illnesses have different biophoton emission. For example, in a 2004 study, researchers found that "the intensity of biophoton emission reflects the viability of the tumor tissue" [96]. In a 2016 study, researchers compared the biophoton emission from sixty healthy patients to the biophoton emission of fifty patients with type 2 diabetes and found that there was a significant difference between the two groups. The researchers noted that the average biophoton intensity of the navel area was significantly higher in the diabetic group than in the healthy group [97]. However, the intensity of biophoton emission was higher in the forehead and throat areas for the group of healthy individuals than it was for the diabetic group. In a study in 2018, researchers documented the specific biophoton markers of malignant cells. Their results revealed that the patterns of biophotons emitted from cancerous cells had notably different patterns and wavelengths versus noncancerous cells [98] [99]. There are several other studies that show this connection between illness and biophotons.

4) Biophotons communicate to the cells

Research has also provided evidence that biophotons are capable of intercellular communication. In fact, cell-to-cell communication via biophotons has been demonstrated repeatedly in various types of eggs, plants, bacteria, and animal neutrophil granulocytes, as well as kidney cells [100] [101] [102]. Research also suggests that biophotons communicate vital information throughout the body, including reestablishing homeostasis [78] [95].

5) Biophotons possess the capacity to influence cells in manners that can be either beneficial or detrimental

Studies have shown that biophotons have the ability to influence cell proliferation in positive or negative ways. For example, a study on biocommunication involved a series of experiments on fish eggs and frog eggs, which demonstrated that biophotons possess the capacity to enhance cell proliferation, induce cellular deformation, or even inhibit cellular growth [103]. Since there is a correlation between neural activity and biophotons, and research has shown that biophotons can influence cells in a variety of different ways, it seems plausible that biophotons may be a hidden mechanism behind the influence of emotions. It's significant to note that, as discussed previously, research on emotions has revealed that there is also a connection between emotional states and the modulation of cell proliferation, which can be either beneficial or detrimental.

6) There is a connection between biophotons, pain, stress, oxidative stress, and illness.

While it is improbable that oxidative stress played a role in the rapid outcomes observed in this study, it is worth noting that existing research has shown there is a link between illness and oxidative stress [103]. Research has also revealed there is a correlation between psychological stress and oxidative stress

[104]. Furthermore, that there is a clear connection between stress, free radicals, and biophotons. One study specifically documented, "This association between stress, ROS generation (free radicals), and biophoton emission is well-documented, and numerous researchers, including us, consider that the stress levels of living organisms can be inferred in real-time by measuring biophoton emission [105] [106] [107] [108]."

7) Biophotons may also be a hidden mechanism behind the placebo

Given that biophotons possess the ability to communicate with the cells, we suggest that biophotons may also play a role in the results of the placebo. If we analyze the placebo, it is clear that a very specific communication is occurring within the body. For instance, it is well documented that if a person were told that a placebo could improve their symptoms from Parkinson's disease, then it can [109] [110]. If, instead, they were told the placebo would reduce their high blood pressure, then it could reduce their blood pressure [111]. In the case of the nocebo, if a patient were told there would be specific negative side effects, such as pain or headaches, the person could experience those side effects [112]. Research has also shown that different verbal instructions produce different results [77]. While it is known that biochemical changes can play a role in the effects of the placebo, the exact mechanisms through which these changes manifest and influence patient outcomes remain a topic of ongoing mystery. We propose that biophotons may also play a hidden role in this communication. To some, the notion that particles of light could possess the capacity to communicate information throughout the body may appear peculiar. However, within the telecommunications industry, photons—particles of light—are integral to fiber optics, which transmit data, text messages, emails, and other forms of digital information globally.

8) The notion of funneled energy

Another potential factor to analyze is what we will refer to as funneled energy. If we analyze Gurwitsch's experiment with the onion (noted previously), when the biophotons were funneled from one onion root (the transmitter) through a tube onto a second onion root (the receiver), the results were that the onion root that received biophotons had a significantly higher number of cells in mitosis in the specific location that received the biophotons. From this, we can see that funneled biophotons can have a greater impact on cells in the specific location that is receiving the funneled energy.

Another way to illustrate the impact of funneled energy is to consider the well-documented experiment involving the concentration of sunlight through a magnifying glass. If a person holds a magnifying glass in the sun in a focused location, this funnels the photons to a single point, which can start a fire. If we analyze the data through this lens of "funneled energy", we can begin to see one way that it is possible for biophotons to be the hidden mechanism behind emotions.

If we combine the research that shows that emotions generate increased neural activity in different parts of the brain [62] with the research that has shown

that neural activity influences biophoton emission [86] [87] [88] [89], we can see how it is possible for emotions to increase biophoton emission.

Then, if we combine this with the research that suggests that biophotons can conduct along neural fibers [88] [100] and are even involved in neural processing, we can see how it could be possible for increased emotional activity to funnel biophotons from the brain to different parts of the body (similar to Penfield and Boldrey's process whereby electrical stimulation was able to impact different parts of the body) [66] [68] [100].

And further, based on Gurwitsch's experiment, we can see that funneled energy has a greater impact. From this we can surmise that if these biophotons are funneled via the brain-body connection, then it would be plausible for them to have a greater impact on the specific location of the body they are funneled to, similar to the experiment with the onion root. From this, we can see how it would be possible for different emotions to influence different parts of the body with consistency.

Additionally, if we consider the research on biophotons, this funneled energy could impact the cells in a myriad of ways. As discussed previously, research has shown biophotons can support the basic functioning of the cells, communicate information to the cells (including homeostasis), and either enhance cell proliferation or inhibit it.

Based on combining this research, we can see how it is plausible for biophotons to be a hidden mechanism behind the impact of emotions. Further, as previously discussed, research has shown that different illnesses can have different patterns of biophoton emission. If we consider that stress has been linked to illness and that different emotions correspond with different illnesses, we can see how this H2 hypothesis could provide a possible explanation for this as well.

9) A possible explanation for the rapid changes in temperature.

During each talk therapy session, if the subject had a radical shift in their emotions, this resulted in an instant decrease or increase of heat on the thermal image scan. There was almost no lag time. This was perplexing considering that increased temperatures that are associated with physical pain are commonly attributed to increased blood flow. However, in this case, since the changes were rapid, increased blood flow does not entirely conform to logical expectations. This leads us to believe there may be an additional factor at play that may be generating the heat. That is also what led to the formation of this H2 hypothesis. Even though biophotons themselves are nonthermal, it seems they could be responsible for generating heat.

One possible cause behind this could relate to photoprotection. If we observe how cells function in general, they have a mechanism for photoprotection that turns excess energy from photons into heat. This occurs in the human body as well as in plants. For example, if a plant absorbs too much energy, it can get overloaded. This can cause the plant to produce free radicals, which can lead to disease and even death. In an effort to protect themselves, plants disperse this extra energy as heat [113] [114]. The human body also has the same type of

photoprotection for our skin cells and eyes from the photons from the sun [115]. If we look at our health through this lens, we can see how it could be possible for negative emotions to cause the cells to get too much energy and then release the excess energy of heat. After all, research has provided evidence that negative emotions (anger) can increase biophoton emission [89] and that cells absorb this energy. Initially, this may not seem plausible to some researchers since biophotons are considered to be "ultraweak"; however, researchers have found that the intensity of biophotons can be significantly higher inside of the cells than outside and that it is much higher than a person would expect from biophoton/UPE. Research has also stated that "the most significant fraction of natural biophoton intensity cannot be accurately measured because it is absorbed during cellular processes [86] [116]."

Based on these data points, we can see how it can be scientifically plausible and logical for biophotons to be a hidden mechanism behind the influence of emotions and that there are several ways that biophotons could play an important role in the results of this study. However, to date, there is no technology that is able to decode or fully test biophotons in order to test this second hypothesis at this time. Nonetheless, the results of this study support the first hypothesis, Gillmore's Mind-Body-Emotion-Health Hypothesis (H1).

5.2. Strengths and Limitations

The strengths of this study include the results, which demonstrate that if a person identifies the specific psychological stress (negative emotions) that is connected to their pain and then creates a strong emotional change from stressful negative emotions to positive emotions, it is possible to reduce and even achieve complete relief from their pain in a very short amount of time. Further, while it is not an "optimal" result, the study also demonstrated that when these negative emotions increase, so too can pain.

Being able to view the results in real-time with thermal imaging was also extremely insightful. It could be observed that pain is not solely based on the brain's perception; rather, physiological changes also occur, and these changes can happen rapidly.

There are two primary limitations in this study.

First is the inability to accurately measure biophotons inside the cells to determine the mechanism of action.

Second is the absence of a control group. However, it is worth noting that, while it was not an intentional part of the study, during the talk therapy sessions, three of the subjects had moments during their talk therapy session where they thought about a specific painful memory that increased their negative emotions. As this occurred, they reported increased pain and the infrared camera also detected an immediate increase in heat. Then, when the subjects were able to change the painful memory and move into feelings of optimism, their pain resolved. Based on Gillmore's hypothesis, we did expect that if a subject increased their negative emotions, the pain would also increase; however, this was not

discussed with the subjects prior to the session. In fact, there were no discussions about the process or potential outcomes with the subjects in an effort to be cautious and not to suggest any possible outcome.

6. Conclusions

While it is well known that stress can impact the health of the physical body, the mechanism by which this occurs has remained incompletely understood. So too has the ability to reverse these effects of stress. However, the results from this innovative study demonstrate, for the first time, that if a person identifies the specific psychological stress (negative emotions) that is connected to their pain and then creates a strong emotional shift from stressful negative emotions to positive emotions and optimism, it is possible to reduce and even eliminate their pain in a very short amount of time.

Additionally, the changes in the thermal images demonstrate that the link between psychological stress and pain is not solely based on the brain's perception or sensitivity to pain but that there are physiological changes that occur.

As far as the process for mind-body healing, these results suggest that it is advantageous to identify the specific stress (specific negative emotion) that is affecting a person and be willing to let it go. And further, that it can be beneficial to go beyond "stress relief" and instead to embody strong feelings of positive expectation and optimism.

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Conflicts of Interest

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References

[1] Blozik, E., *et al.* (2009) Depression and Anxiety as Major Determinants of Neck Pain: A Cross-Sectional Study in General Practice. *BMC Musculoskeletal Disorders*, **10**, Article No. 13. https://doi.org/10.1186/1471-2474-10-13

[2] Rabbing, L., Bjørkelo, B. and Langvik, E. (2022) Upper and Lower Musculoskeletal Back Pain, Stress, Physical Activity, and Organisational Work Support: An Exploratory Study of Police Investigative Interviewers. *Health Psychology Open*, **9**. https://doi.org/10.1177/20551029221146396

[3] Lee, L.O., *et al.* (2019) Optimism Is Associated with Exceptional Longevity in 2 Epidemiologic Cohorts of Men and Women. *Proceedings of the National Academy of Sciences of the United States of America*, **116**, 18357-18362. https://doi.org/10.1073/pnas.1900712116

[4] Koga, H.K., *et al.* (2022) Optimism, Lifestyle, and Longevity in a Racially Diverse Cohort of Women. *Journal of the American Geriatrics Society*, **70**, 2793-2804. https://doi.org/10.1111/jgs.17897

[5] Kubzansky, L.D. and Thurston, R.C. (2007) Emotional Vitality and Incident Coronary Heart Disease. *Archives of General Psychiatry*, **64**, 1393-1401. https://doi.org/10.1001/archpsyc.64.12.1393

[6] Holy Bible: King James Version (2023) King James Bible Online. https://www.kingjamesbibleonline.org/Proverbs-Chapter-17/#22

[7] Kaprio, J., Koskenvuo, M. and Rita, H. (1987) Mortality after Bereavement: A Prospective Study of 95,647 Widowed Persons. *American Journal of Public Health*, **77**, 283-287. https://doi.org/10.2105/AJPH.77.3.283

[8] Elwert, F. and Christakis, N.A. (2008) The Effect of Widowhood on Mortality by the Causes of Death of Both Spouses. *American Journal of Public Health*, **98**, 2092-2098. https://doi.org/10.2105/AJPH.2007.114348

[9] Cornwell, B. and Qu, T. (2023) I love You to Death: Social Networks and the Widowhood Effect on Mortality. *Journal of Health and Social Behavior*. https://doi.org/10.1177/00221465231175685

[10] Gouin, J.P., Kiecolt-Glaser, J.K., Malarkey, W.B. and Glaser, R. (2008) The Influence of Anger Expression on Wound Healing. *Brain, Behavior, and Immunity*, **22**, 699-708. https://doi.org/10.1016/j.bbi.2007.10.013

[11] Thornton, L.M. and Andersen, B.L. (2006) Psychoneuroimmunology Examined: The Role of Subjective Stress. *Cell Science*, **2**, 66-91. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2473865/

[12] Bosch, J.A., Engeland, C.G., Cacioppo, J.T. and Marucha, P.T. (2007) Depressive Symptoms Predict Mucosal Wound Healing. *Psychosomatic Medicine*, **69**, 597-605. https://doi.org/10.1097/PSY.0b013e318148c682

[13] Cohen, S. and Herbert, T.B. (1996) Health Psychology: Psychological Factors and Physical Disease from the Perspective of Human Psychoneuroimmunology. *Annual Review of Psychology*, **47**, 113-142. https://doi.org/10.1146/annurev.psych.47.1.113

[14] Kiecolt-Glaser, J.K., McGuire, L., Robles, T.F. and Glaser, R. (2002) Emotions, Morbidity, and Mortality: New Perspectives from Psychoneuroimmunology. *Annual Review of Psychology*, **53**, 83-107. https://doi.org/10.1146/annurev.psych.53.100901.135217

[15] Cutolo, M. and Straub, R.H. (2006) Stress as a Risk Factor in the Pathogenesis of Rheumatoid Arthritis. *Neuroimmunomodulation*, **13**, 277-282. https://doi.org/10.1159/000104855

[16] Sheridan, J.F. and Dobbs, C.M. (1994) Stress, Viral Pathogenesis, and Immunity. In: Glaser, R. and Kiecolt-Glaser, J.K., Eds., *Handbook of Human Stress and Immunity*, Academic Press, San Diego, 101-123. https://doi.org/10.1016/B978-0-12-285960-1.50009-5

[17] Cohen, S., Tyrrell, D.A. and Smith, A.P. (1991) Psychological Stress and Susceptibility to the Common Cold. *The New England Journal of Medicine*, **325**, 606-612. https://doi.org/10.1056/NEJM199108293250903

[18] Liu, Y.Z., Wang, Y.X. and Jiang, C.L. (2017) Inflammation: The Common Pathway of Stress-Related Diseases. *Frontiers in Human Neuroscience*, **11**, Article 316. https://doi.org/10.3389/fnhum.2017.00316

[19] Johnson, J.D., Barnard, D.F., Kulp, A.C. and Mehta, D.M. (2019) Neuroendocrine Regulation of Brain Cytokines after Psychological Stress. *Journal of the Endocrine Society*, **3**, 1302-1320. https://doi.org/10.1210/js.2019-00053

[20] Kim, Y.K. and Maes, M. (2003) The Role of the Cytokine Network in Psychological Stress. *Acta Neuropsychiatrica*, **15**, 148-155. https://doi.org/10.1034/j.1601-5215.2003.00026.x

[21] Rohleder, N., Aringer, M. and Boentert, M. (2012) Role of Interleukin-6 in Stress, Sleep, and Fatigue. *Annals of the New York Academy of Sciences*, **1261**, 88-96. https://doi.org/10.1111/j.1749-6632.2012.06634.x

[22] Ridker, P.M. and Rane M. (2021) Interleukin-6 Signaling and Anti-Interleukin-6 Therapeutics in Cardiovascular Disease. *Circulation Research*, **128**, 1728-1746. https://doi.org/10.1161/CIRCRESAHA.121.319077

[23] Bernberg, E., Ulleryd, M.A., Johansson, M.E. and Bergström, G.M.L. (2012) Social Disruption Stress Increases IL-6 Levels and Accelerates Atherosclerosis in ApoE$^{-/-}$ Mice. *Atherosclerosis*, **221**, 359-365. https://doi.org/10.1016/j.atherosclerosis.2011.11.041

[24] Guirao, J.J., Cabrera, C.M., Jiménez, N., Rincón, L. and Urra, J.M. (2020) High Serum IL-6 Values Increase the Risk of Mortality and the Severity of Pneumonia in Patients Diagnosed with COVID-19. *Molecular Immunology*, **128**, 64-68. https://doi.org/10.1016/j.molimm.2020.10.006

[25] Darcy, J. and Tseng, Y.H. (2020) The Link between Stress and IL-6 Is Heating Up. *Cell Metabolism*, **32**, 152-153. https://doi.org/10.1016/j.cmet.2020.07.011

[26] Huang, A.R., Roth, D.L., Cidav, T., *et al.* (2023) Social Isolation and 9-Year Dementia Risk in Community-Dwelling Medicare Beneficiaries in the United States. *Journal of the American Geriatrics Society*, **71**, 765-773. https://doi.org/10.1111/jgs.18140

[27] Doeker, B., Simić-Schleicher, G., Hauffa, B.P. and Andler, W. (1999) Psychosocially Stunted Growth Masked as Growth Hormone Deficiency. *Klinische Pädiatrie*, **211**, 394-398. (In German) https://doi.org/10.1055/s-2008-1043818

[28] National Academies of Sciences, Engineering, and Medicine (2020) Social Isolation and Loneliness in Older Adults: Opportunities for the Health Care System. National Academies Press, Washington DC.

[29] Rico-Uribe, L.A., Caballero, F.F., Martín-María, N., Cabello, M., Ayuso-Mateos, J.L. and Miret, M. (2018) Association of Loneliness with All-Cause Mortality: A Meta-Analysis. *PLOS ONE*, **13**, e0190033. https://doi.org/10.1371/journal.pone.0190033

[30] Harris, E. (2023) Meta-Analysis: Social Isolation, Loneliness Tied to Higher Mortality. *The Journal of the American Medical Association*, **330**, 211. https://doi.org/10.1001/jama.2023.11958

[31] Wang, F., Gao, Y., Han, Z., *et al.* (2023) A Systematic Review and Meta-Analysis of 90 Cohort Studies of Social Isolation, Loneliness and Mortality. *Nature Human Behaviour*, **7**, 1307-1319. https://doi.org/10.1038/s41562-023-01617-6

[32] Moreno-Smith, M., Lutgendorf, S.K. and Sood, A.K. (2010) Impact of Stress on Cancer Metastasis. *Future Oncology*, **6**, 1863-1881. https://doi.org/10.2217/fon.10.142

[33] Perego, M., *et al.* (2020) Reactivation of Dormant Tumor Cells by Modified Lipids Derived from Stress-Activated Neutrophils. *Science Translational Medicine*, **12**, eabb5817. https://doi.org/10.1126/scitranslmed.abb5817

[34] Vignjević Petrinović, S., Milošević, M.S., Marković, D. and Momčilović, S. (2023) Interplay between Stress and Cancer—A Focus on Inflammation. *Frontiers in Physiology*, **14**, Article 1119095. https://doi.org/10.3389/fphys.2023.1119095

[35] Kiecolt-Glaser, J.K., Page, G.G., Marucha, P.T., *et al.* (1998) Psychological Influences on Surgical Recovery: Perspectives from Psychoneuroimmunology. *American Psychologist*, **53**, 1209-1218. https://doi.org/10.1037/0003-066X.53.11.1209

[36] Takagi, H., Ando, T. and Umemoto, T. (2017) Perioperative Depression or Anxiety and Postoperative Mortality in Cardiac Surgery: A Systematic Review and Meta-Analysis. *Heart and Vessels*, **32**, 1458-1468. https://doi.org/10.1007/s00380-017-1022-3

[37] Rosenberger, P.H., Jokl, P. and Ickovics, J. (2006) Psychosocial Factors and Surgical Outcomes: An Evidence-Based Literature Review. *Journal of the American Academy of Orthopaedic Surgeons*, **14**, 397-405. https://doi.org/10.5435/00124635-200607000-00002

[38] Ronaldson, A., Poole, L., Kidd, T., Leigh, E., Jahangiri, M. and Steptoe, A. (2014) Optimism Measured Pre-Operatively Is Associated with Reduced Pain Intensity and Physical Symptom Reporting after Coronary Artery Bypass Graft Surgery. *Journal of Psychosomatic Research*, **77**, 278-282. https://doi.org/10.1016/j.jpsychores.2014.07.018

[39] Arsyi, D.H., Dharma Permana, P.B., Karim, R.I. and Abdurachman (2022) The Role of Optimism in Manifesting Recovery Outcomes after Coronary Artery Bypass Graft Surgery: A Systematic Review. *Journal of Psychosomatic Research*, **162**, Article ID: 111044. https://doi.org/10.1016/j.jpsychores.2022.111044

[40] Rozanski, A., Bavishi, C., Kubzansky, L.D. and Cohen, R. (2019) Association of Optimism with Cardiovascular Events and All-Cause Mortality: A Systematic Review and Meta-Analysis. *JAMA Network Open*, **2**, e1912200. https://doi.org/10.1001/jamanetworkopen.2019.12200

[41] Lupien, S.J., McEwen, B.S., Gunnar, M.R. and Heim, C. (2009) Effects of Stress throughout the Lifespan on the Brain, Behaviour, and Cognition. *Nature Reviews Neuroscience*, **10**, 434-445. https://doi.org/10.1038/nrn2639

[42] Ancelin, M.L., *et al.* (2020) Structural Brain Changes with Lifetime Trauma and Re-Experiencing Symptoms Is 5-HTTLPR Genotype-Dependent. *European Journal of Psychotraumatology*, **11**, Article ID: 1733247. https://doi.org/10.1080/20008198.2020.1733247

[43] De Loose, V., Burnotte, F., Cagnie, B., Stevens, V., Van Tiggelen, D. and Defense, B. (2008) Prevalence and Risk Factors of Neck Pain in Military Office Workers. *Military Medicine*, **173**, 474-479. https://doi.org/10.7205/MILMED.173.5.474

[44] Daher, A. and Halperin, O. (2021) Association between Psychological Stress and Neck Pain among College Students during the Coronavirus Disease of 2019 Pandemic: A Questionnaire-Based Cross-Sectional Study. *Healthcare*, **9**, Article 1526. https://doi.org/10.3390/healthcare9111526

[45] Camacho, G. and Nakazato, T. (2018) Chronic Neck Pain and Its Relationship with Stress Symptoms: Regular Physical Exercise Could Be a Protective Factor? *Annals of Physical and Rehabilitation Medicine*, **61**, e111. https://doi.org/10.1016/j.rehab.2018.05.240

[46] Bruflat, A.K., Balter, J.E., McGuire, D., Fethke, N.B. and Maluf, K.S. (2012) Stress Management as an Adjunct to Physical Therapy for Chronic Neck Pain. *Physical Therapy*, **92**, 1348-1359. https://doi.org/10.2522/ptj.20110489

[47] Sumioka, H., Nakae, A., Kanai, R. and Ishiguro, H. (2013) Huggable Communica-

tion Medium Decreases Cortisol Levels. *Scientific Reports*, **3**, Article No. 3034. https://doi.org/10.1038/srep03034

[48] Bromberg-Martin, E.S., Matsumoto, M. and Hikosaka, O. (2010) Dopamine in Motivational Control: Rewarding, Aversive, and Alerting. *Neuron*, **68**, 815-834. https://doi.org/10.1016/j.neuron.2010.11.022

[49] Hartston, H. (2012) The Case for Compulsive Shopping as an Addiction. *Journal of Psychoactive Drugs*, **44**, 64-67. https://doi.org/10.1080/02791072.2012.660110

[50] Aan het Rot, M., Moskowitz, D.S. and de Jong, P.J. (2015) Intrapersonal and Interpersonal Concomitants of Facial Blushing during Everyday Social Encounters. *PLOS ONE*, **10**, e0118243. https://doi.org/10.1371/journal.pone.0118243

[51] Cackovic, C., Nazir, S. and Marwaha, R. (2023) Panic Disorder. StatPearls, Treasure Island. https://www.ncbi.nlm.nih.gov/books/NBK430973/

[52] Andrykowski, M.A. (1990) The Role of Anxiety in the Development of Anticipatory Nausea in Cancer Chemotherapy: A Review and Synthesis. *Psychosomatic Medicine*, **52**, 458-475. https://doi.org/10.1097/00006842-199007000-00008

[53] Karagozoglu, S., Tekyasar, F. and Yilmaz, F.A. (2013) Effects of Music Therapy and Guided Visual Imagery on Chemotherapy-Induced Anxiety and Nausea—Vomiting. *Journal of Clinical Nursing*, **22**, 39-50. https://doi.org/10.1111/jocn.12030

[54] Köken, G., Yilmazer, M., Cosar, E., Sahin, F.K., Cevrioglu, S. and Gecici, O. (2008) Nausea and Vomiting in Early Pregnancy: Relationship with Anxiety and Depression. *Journal of Psychosomatic Obstetrics & Gynecology*, **29**, 91-95. https://doi.org/10.1080/01674820701733697

[55] Pasyar, N., Rambod, M., Zahedi, F. and Ramzi, M. (2022) Pain, Fatigue, Nausea, and Vomiting as the Predictors of Anxiety in Patients Undergoing Hematopoietic Stem Cell Transplantation: A Prospective Cohort Study. *Supportive Care in Cancer*, **30**, 5871-5879. https://doi.org/10.1007/s00520-022-06997-5

[56] Madson, A.T. and Silverman, M.J. (2010) The Effect of Music Therapy on Relaxation, Anxiety, Pain Perception, and Nausea in Adult Solid Organ Transplant Patients. *Journal of Music Therapy*, **47**, 220-232. https://doi.org/10.1093/jmt/47.3.220

[57] Haug, T.T., Mykletun, A. and Dahl, A.A. (2022) Are Anxiety and Depression Related to Gastrointestinal Symptoms in the General Population? *Scandinavian Journal of Gastroenterology*, **37**, 294-298. https://doi.org/10.1080/003655202317284192

[58] Feldman, C.H., Malspeis, S., Leatherwood, C., Kubzansky, L., Costenbader, K.H. and Roberts, A.L. (2019) Association of Childhood Abuse with Incident Systemic Lupus Erythematosus in Adulthood in a Longitudinal Cohort of Women. *The Journal of Rheumatology*, **46**, 1589-1596. https://doi.org/10.3899/jrheum.190009

[59] Jacome, D.E. (2001) Transitional Interpersonality Thunderclap Headache. *Headache: The Journal of Head and Face Pain*, **41**, 317-320. https://doi.org/10.1046/j.1526-4610.2001.111006317.x

[60] Waldvogel, B., Ullrich, A. and Strasburger, H. (2007) Blind Und Sehend in Einer Person: Schlussfolgerungen zur psychoneurobiologie des sehens [Sighted and Blind in One Person: A Case Report and Conclusions on the Psychoneurobiology of Vision]. *Der Nervenarzt*, **78**, 1303-1309. (In German) https://doi.org/10.1007/s00115-007-2309-x

[61] Strasburger, H. and Waldvogel, B. (2015) Sight and Blindness in the Same Person: Gating in the Visual System. *PsyCh Journal*, **4**, 178-185. https://doi.org/10.1002/pchj.109

[62] Kassam, K.S., Markey, A.R., Cherkassky, V.L., Loewenstein, G. and Just, M.A.

(2013) Identifying Emotions on the Basis of Neural Activation. *PLOS ONE*, **8**, e66032. https://doi.org/10.1371/journal.pone.0066032

[63] Luodong, Y., *et al.* (2022) Dynamic Changes in Brain Structure in Patients with Post-Traumatic Stress Disorder after Motor Vehicle Accident: A Voxel-Based Morphometry-Based Follow-up Study. *Frontiers in Psychology*, **13**, Article 1018276..

[64] Chaney, A., *et al.* (2014) Effect of Childhood Maltreatment on Brain Structure in Adult Patients with Major Depressive Disorder and Healthy Participants. *Journal of Psychiatry & Neuroscience*, **39**, 50-59. https://doi.org/10.1503/jpn.120208

[65] Peverill, M., Rosen, M., Lurie, L.A., Sambrook, K.A., Sheridan, M.A. and McLaughlin, K.A. (2023) Childhood Trauma and Brain Structure in Children and Adolescents. *Developmental Cognitive Neuroscience*, **59**, Article ID: 101180. https://doi.org/10.1016/j.dcn.2022.101180

[66] Penfield, W. and Boldrey, E. (1937) Somatic Motor and Sensory Representation in the Cerebral Cortex of Man as Studied by Electrical Stimulation. *Brain*, **60**, 389-443. https://doi.org/10.1093/brain/60.4.389

[67] Kropf, E., *et al.* (2019) From Anatomy to Function: The Role of the Somatosensory Cortex in Emotional Regulation. *Brazilian Journal of Psychiatry*, **41**, 261-2699. https://doi.org/10.1590/1516-4446-2018-0183

[68] Penfield, W. and Faulk Jr, M.E. (1955) The Insula: Further Observations on Its Function. *Brain*, **78**, 445-470. https://doi.org/10.1093/brain/78.4.445

[69] Fiol, M.E., Leppik, I.E., Mireles, R. and Maxwell, R. (1988) Ictus Emeticus and the Insular Cortex. *Epilepsy Research*, **2**, 127-131. https://doi.org/10.1016/0920-1211(88)90030-7

[70] Golabchi, A. and Sarrafzadegan, N. (2011) Takotsubo Cardiomyopathy or Broken Heart Syndrome: A Review Article. *Journal of Research in Medical Sciences*, **16**, 340-345.

[71] Erel, V.K. and Özkan, H.S. (2017) Thermal Camera as a Pain Monitor. *Journal of Pain Research*, **10**, 2827-2832. https://doi.org/10.2147/JPR.S151370

[72] Lahiri, B.B., Bagavathiappan, S., Jayakumar, T. and Philip, J. (2012) Medical Applications of Infrared Thermography: A Review. *Infrared Physics & Technology*, **55**, 221-235. https://doi.org/10.1016/j.infrared.2012.03.007

[73] Chu, J.A. (1991) The Repetition Compulsion Revisited: Reliving Dissociated Trauma. *Psychotherapy*: *Theory*, *Research*, *Practice*, *Training*, **28**, 327-332. https://doi.org/10.1037/0033-3204.28.2.327

[74] Levy, M.S. (1998) A Helpful Way to Conceptualize and Understand Reenactments. *The Journal of Psychotherapy Practice and Research*, **7**, 227-235.

[75] Dey, N., Ashour, A.S. and Althoupety, A.S. (2017) Thermal Imaging in Medical Science. In: Santhi, S., Ed., *Recent Advances in Applied Thermal Imaging for Industrial Applications*, IGI Global, Hershey, 1-20.

[76] McGlashan, T.M., Evans, F.J. and Orne, M.T. (1969) The Nature of Hypnotic Analgesia and Placebo Response to Experimental Pain. *Psychosomatic Medicine*, **31**, 227-246. https://doi.org/10.1097/00006842-196905000-00003

[77] Pollo, A., Amanzio, M., Arslanian, A., Casadio, C., Maggi, G. and Benedetti, F. (2001) Response Expectancies in Placebo Analgesia and Their Clinical Relevance. *Pain*, **93**, 77-84. https://doi.org/10.1016/S0304-3959(01)00296-2

[78] Srinivasan, T.M. (2017) Biophotons as Subtle Energy Carriers. *International Journal of Yoga*, **10**, 57-58. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5433113/ https://doi.org/10.4103/ijoy.IJOY_18_17

[79] Wijk, R.V. and Wijk, E.P. (2005) An Introduction to Human Biophoton Emission.

Forschende Komplementarmedizin und klassische Naturheilkunde, **12**, 77-83. (In German) https://doi.org/10.1159/000083763

[80] Seifriz, W. (1931) Radiant Energy from Living Matter. *Science Education*, **16**, 34-37. https://doi.org/10.1002/sce.3730160109

[81] Gurwitsch, A.A. (1988) A Historical Review of the Problem of Mitogenetic Radiation. *Experientia*, **44**, 545-550. https://doi.org/10.1007/BF01953301

[82] (2022) Nomination Archive. http://NobelPrize.org https://www.nobelprize.org/nomination/archive/show_people.php?id=3725

[83] Pesochensky, B.S. (1947) Quenching of Mitogenetic Radiation of Blood in Cancer and Precancerous Diseases. USSR Academy of Medical Sciences, Moscow, 102-114.

[84] Naumova, E., Naumova, A., Isaev, D. and Volodyaev, I. (2018) Historical Review of Early Researchers on Mitogenetic Radiation: From Discovery to Cancer Diagnostics. *Journal of Biomedical Photonics & Engineering*, **4**. https://doi.org/10.18287/JBPE18.04.040201

[85] Kobayashi, M., *et al.* (1999) *In Vivo* Imaging of Spontaneous Ultraweak Photon Emission from a Rat's Brain Correlated with Cerebral Energy Metabolism and Oxidative Stress. Neuroscience Res., **34**, 103-113. https://doi.org/10.1016/S0168-0102(99)00040-1

[86] Rahnama, M., Tuszynski, J.A., Bokkon, I., Cifra, M., Sardar, P. and Salari, V. (2011) Emission of Mitochondrial Biophotons and Their Effect on Electrical Activity of Membrane via Microtubules. *Journal of Integrative Neuroscience*, **10**, 65-88. https://arxiv.org/abs/1012.3371 https://doi.org/10.1142/S0219635211002622

[87] Wang, Z., Wang, N., Li, Z., Xiao, F. and Dai, J. (2016) Human High Intelligence Is Involved in Spectral Redshift of Biophotonic Activities in the Brain. *Proceedings of the National Academy of Sciences of the United States of America*, **113**, 8753-8758. https://doi.org/10.1073/pnas.1604855113

[88] Tang, R. and Dai, J. (2014) Biophoton Signal Transmission and Processing in the Brain. *Journal of Photochemistry and Photobiology B*: *Biology*, **139**, 71-75. https://doi.org/10.1016/j.jphotobiol.2013.12.008

[89] Zapata, F., Pastor-Ruiz, V., Ortega-Ojeda, F., Montalvo, G. and García-Ruiz, C. (2021) Increment of Spontaneous Human Biophoton Emission Caused by Anger Emotional States. Proof of Concept. *Microchemical Journal*, **169**, Article ID: 106558. https://doi.org/10.1016/j.microc.2021.106558

[90] Van Wijk, E.P., Koch, H., Bosman, S. and Wijk, R.V. (2006) Anatomic Characterization of Human Ultra-Weak Photon Emission in Practitioners of Transcendental Meditation™ and Control Subjects. *The Journal of Alternative and Complementary Medicine*, **12**, 31-38. https://doi.org/10.1089/acm.2006.12.31

[91] Van Wijk, E.P., Ackerman, J. and Van Wijk, R. (2005) Effect of Meditation on Ultraweak Photon Emission from Hands and Forehead. *Forschende Komplementarmedizin und klassische Naturheilkunde*, **12**, 107-112. https://doi.org/10.1159/000084028

[92] Van Wijk, E.P., Van Wijk, R. and Bajpai, R.P. (2008) Quantum Squeezed State Analysis of Spontaneous Ultra-Weak Light Photon Emission of Practitioners of Meditation and Control Subjects. *Indian Journal of Experimental Biology*, **46**, 345-352. https://pubmed.ncbi.nlm.nih.gov/18697618/

[93] Van Wijk, E.P., Lüdtke, R. and Van Wijk, R. (2008) Differential Effects of Relaxation Techniques on Ultraweak Photon Emission. *Journal of Alternative and Com-*

plementary Medicine, **14**, 241-250. https://doi.org/10.1089/acm.2007.7185

[94] Dotta, B.T. and Persinger, M.A. (2011) Increased Photon Emissions from the Right But Not the Left Hemisphere While Imagining White Light in the Dark: The Potential Connection between Consciousness and Cerebral Light. *Journal of Consciousness Exploration & Research*, **2**, 1463-1473. http://jcer.com/index.php/jcj/article/view/190/203

[95] Mitrofanis, M.J., *et al.* (2022) The Code of Light: Do Neurons Generate Light to Communicate and Repair? *Neural Regeneration Research*, **17**, 1251-1252. https://doi.org/10.4103/1673-5374.327332

[96] Takeda, M., *et al.* (2004) Biophoton Detection as a Novel Technique for Cancer Imaging. *Cancer Science*, **95**, 656-661. https://doi.org/10.1111/j.1349-7006.2004.tb03325.x

[97] Yang, M., *et al.* (2017) Ultra-Weak Photon Emission in Healthy Subjects and Patients with Type 2 Diabetes: Evidence for a Non-Invasive Diagnostic Tool. *Photochemical & Photobiological Sciences*, **16**, 736-743. https://doi.org/10.1039/c6pp00431h

[98] Murugan, N.J., Rouleau, N., Karbowski, L.M. and Persinger, M.A. (2018) Biophotonic Markers of Malignancy: Discriminating Cancers Using Wavelength-Specific Biophotons. *Biochemistry and Biophysics Reports*, **13**, 7-11. https://doi.org/10.1016/j.bbrep.2017.11.001

[99] Takeda, M., *et al.* (1998) A Novel Method of Assessing Carcinoma Cell Proliferation by Biophoton Emission. *Cancer Letters*, **127**, 155-160. https://doi.org/10.1016/S0304-3835(98)00064-0

[100] Sun, Y., Wang, C. and Dai, J. (2010) Biophotons as Neural Communication Signals Demonstrated by *in situ* Biophoton Autography. *Photochemical & Photobiological Sciences*, **9**, 315-322. https://doi.org/10.1039/b9pp00125e

[101] Fels, D. (2009) Cellular Communication through Light. *PLOS ONE*, **4**, e5086. https://doi.org/10.1371/annotation/8d99ccc5-cc76-44f4-b468-d63e42e0b9e1

[102] Mayburov, S.N. (2009) Coherent and Noncoherent Photonic Communications in Biological Systems. https://arxiv.org/pdf/0909.2676.pdf

[103] de Araújo, R.F.F., Martins, D.B.G. and Borba, M.A. (2016) Oxidative Stress and Disease. In: Morales-Gonzalez, J.A., Morales-González, Á. and Madrigal-Santillan, E.O., Eds., *A Master Regulator of Oxidative Stress—The Transcription Factor Nrf2*, InTech Open, London. https://doi.org/10.5772/65366

[104] Srivastava, K.K. and Kumar, R. (2015) Stress, Oxidative Injury and Disease. *Indian Journal of Clinical Biochemistry*, **30**, 3-10. https://doi.org/10.1007/s12291-014-0441-5

[105] Kobayashi, K., Okabe, H., Kawano, S., Hidaka, Y. and Hara, K. (2014) Biophoton Emission Induced by Heat Shock. *PLOS ONE*, **9**, e105700. https://doi.org/10.1371/journal.pone.0105700

[106] Winkler, R., Guttenberger, H. and Klima, H. (2009) Ultraweak and Induced Photon Emission after Wounding of Plants. *Photochemistry and Photobiology*, **85**, 962-965. https://doi.org/10.1111/j.1751-1097.2009.00537.x

[107] Fedoroff, N. (2006) Redox Regulatory Mechanisms in Cellular Stress Responses. *Annals of Botany*, **98**, 289-300. https://doi.org/10.1093/aob/mcl128

[108] Kartha, S., Weisshaar, C.L., Pietrofesa, R.A., Christofidou-Solomidou, M. and Winkelstein, B.A. (2020) Synthetic Secoisolariciresinol Diglucoside Attenuates Established Pain, Oxidative Stress and Neuroinflammation in a Rodent Model of Painful

Radiculopathy. *Antioxidants*, **9**, Article 1209. https://doi.org/10.3390/antiox9121209

[109] Lidstone, S.C. (2014) Great Expectations: The Placebo Effect in Parkinson's Disease. In: Benedetti, F., Enck, P., Frisaldi, E. and Schedlowski, M., Eds., *Placebo*, Springer, Berlin, 139-147. https://doi.org/10.1007/978-3-662-44519-8_8

[110] Fink, J.S. (2013) The Placebo Effect in Clinical Trials in Parkinson's Disease. American Parkinson Disease Association. https://www.apdaparkinson.org/article/the-placebo-effect-in-clinical-trials-in-parkinsons-disease/

[111] Wilhelm, M., Winkler, A., Rief, W. and Doering, B.K. (2016) Effect of Placebo Groups on Blood Pressure in Hypertension: A Meta-Analysis of β-Blocker Trials. *Journal of the American Society of Hypertension*: *JASH*, **10**, 917-929. https://doi.org/10.1016/j.jash.2016.10.009

[112] Planès, S., Villier, C. and Mallaret, M. (2016) The Nocebo Effect of Drugs. *Pharmacology Research & Perspectives*, **4**, e00208. https://doi.org/10.1002/prp2.208

[113] Holt, N.E., Zigmantas, D., Valkunas, L., Li, X., Niyogi, K.K. and Fleming, G. (2005) Carotenoid Cation Formation and the Regulation of Photosynthetic Light Harvesting. *Science*, **307**, 433-436. https://doi.org/10.1126/science.1105833

[114] Lawrence Berkeley National Laboratory (2005) Key Molecule In Plant Photo-Protection Identified. ScienceDaily https://www.sciencedaily.com/releases/2005/01/050121093925.htm

[115] Seagle, B.L., Rezai, K., Kobori, Y., Gasyna, E., Rezaei, K. and Norris Jr, J. (2005) Melanin Photoprotection in the Human Retinal Pigment Epithelium and Its Correlation with Light-Induced Cell Apoptosis. *Proceedings of the National Academy of Sciences of the United States of America*, **102**, 8978-8983. https://doi.org/10.1073/pnas.0501971102

[116] Bókkon, I., Salari, V., Tuszynski, J. and Antal, I. (2010) Estimation of the Number of Biophotons Involved in the Visual Perception of a Single-Object Image: Biophoton Intensity Can Be Considerably Higher Inside Cells than Outside. *Journal of Photochemistry and Photobiology B*: *Biology*, **100**, 160-166. https://doi.org/10.1016/j.jphotobiol.2010.06.001