EXPLORING THE GUT BRAIN CONNECTION AND NEUROFEEDBACK:
A STUDY OBSERVING THE CONNECTION BETWEEN INTESTINAL AND PSYCHOLOGICAL DISTRESS

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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Acknowledgements</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>8</td>
</tr>
</tbody>
</table>

## Chapter 1: Introduction
- Setting: 9
- Purpose of the Study: 11
- Statement of the Problem: 11
- Hypothesis: 13
- Definition of Terms: 13
- Anticipated Outcomes: 14
- Summary: 15

## Chapter 2: Review of Literature
- Introduction: 16
- The Cranial Brain: 17
- The Gut Brain: 18
- General Description of Anxiety and Depression: 20
- General Description of Irritable Bowel Syndrome and Chronic Constipation: 24
- The Connection between Stress, Psychological Challenges and Poor Intestinal Health: 29
- Neurofeedback Defined: 36
- The History of Neurofeedback: 38
- Different Approaches to Neurofeedback: 42
- How Does Neurofeedback Work?: 45
- One Channel Training vs. Two Channel Training: 48
- Neurofeedback Research: 49
- Neurofeedback for Treating Anxiety and Depression: 50
Exploring the Gut-Brain Connection

Biofeedback for Treating Constipation..........................................................................................55
Summary........................................................................................................................................56
Chapter 3: Methodology..................................................................................................................58
Chapter 4: Results..........................................................................................................................63
Chapter 5: Individual Case Studies.................................................................................................69
Chapter 6: Discussion......................................................................................................................91
Introduction...................................................................................................................................91
Research Questions.......................................................................................................................91
Delimitations................................................................................................................................95
Limitations....................................................................................................................................95
Recommendations.........................................................................................................................96
Summary........................................................................................................................................97
Bibliography.................................................................................................................................98
Appendix A: Surveys.......................................................................................................................107
Appendix B: Participant Symptom Tracking Reports.....................................................................108

ABBREVIATIONS

IBS  Irritable Bowel Syndrome
NFB  Neurofeedback
mhz  milli herz
BAI  Beck’s Anxiety Inventory
BDI  Beck’s Depression Inventory
GI  Gastro Intestinal Assessment
Acknowledgements

First of all, I am so thankful that God has given me the desire and the ability to empower others to take control of their health and seek a better way of living. I want to thank my dad, Dr. Leslie Earl Glenn, who passed down his love for people and his desire for investing in the lives of others to me. Even though we took different paths in medicine, the end result of helping others heal both inside and out has been the same. I send a huge thank you to Dr. Gayle Bush who literally was my saving grace with her knowledge, skills, encouragement and most of all her friendship. Thank you to Dr. Ellen Tart-Jensen for her encouragement and excitement on this topic and her guidance throughout the project and to Dr. Mark Smith, as well. Thank you to my dear friends and mentors, Gil Ben-Ami and Dr. Eddi Boyd for opening the door to a whole new world to me just a few years ago. A special thanks to those who participated in my study, for their willingness to be transparent and to trust me as we worked towards healthier results. Thanks to all of my dear friends who cheered me on and encouraged me to keep going. And a special thanks to my husband, Mike, who has been so supportive during my new life adventure and has always believed in me more than I believed in myself.

A personal note

*And the day came when the risk to remain tight in the bud was more painful than the risk it took it to bloom.* ~ Anais Nin

This journey began as a small child with one of my earliest memories as always having trouble getting my bowels to “do their thing”. I also remember being a very anxious child, easily afraid and often having trouble sleeping. I have a vivid memory of sitting in my closet in the middle of the night, playing with my dolls. I also have a strong memory of swallowing this
yucky, thick, white medicine my dad (who was a physician) would give me when I was all stopped up. I remember my mom telling me that when I was born, I was allergic to milk but as I got older, cheese became my favorite snack. By the time I was in my twenties, I could put away a gallon of milk in two days. Little did I know that this yummy treat was one of my biggest enemies. My chronic constipation became the norm as I aged and would remain my norm until my thirties.

My first panic attack was at age 16 while cheering for my high school football team. I wasn’t sure what was happening and I remember trying to just push through the feelings of panic, dizziness, tightness in the chest and difficulty breathing. I began having these bizarre attacks several times a week until age 18 when I was experiencing them sometimes several times a day. EEG’s and ultrasounds were all normal…it must be in my head. I remember the day my dad brought me an article from one of his medical journals titled “Panic Disorder”. It was this day, just before entering college, that I was introduced to Xanax. While it didn’t stop the panic attacks, it made them somewhat tolerable. No one, other than my parents, knew about this horror I was living in every day. It became my secret nightmare and one that would be with me for many years to come.

My twenties were the hardest years both with my anxiety and my intestinal problems. My kitchen counter of medications looked like that of a 70 year old. I had my fiber bars, stool softeners, anti-depressant and my Xanax for anxiety. I had to have two colon related surgeries by my mid-twenties and while my panic attacks were not as often, I still lived with a significant amount of anxiety most of the time. My doctor never mentioned diet to me during all the visits
for my colon. She simply said to take my fiber and stool softeners and when I told her they weren’t working, she just shrugged her shoulders and said that some folks just have slow bowels. She never talked to me about my water intake, the dairy I was consuming, my stress levels or the possible emotional connection to my physical pain. I just assumed this would be my life long cross to bear. I was essentially, hopeless. It wasn’t until I was participating in an experiential group therapy session that I discovered what I now know as the gut-brain connection. After processing some very deep anger and experiencing a huge emotional breakthrough, I noticed a sudden urging from my bowels. From then on, every time I would release any anger I would almost immediately be able to eliminate my bowels. What an amazing discovery! Over the next few years I would not only connect this emotional release to my physical release but I would discover the same connection to my anxiety and later to certain foods. I removed dairy from my diet and saw significant improvements. I dealt with the years of “stuffed” anger and my anxiety began to disappear. It was all beginning to make sense. My body wasn’t turning against me as I had once believed; it was trying to communicate with me. It was giving me signs that I had emotions that needed to be released and foods that needed to be removed from my diet. It became my greatest teacher.

While this paper does not allow time for me to share my entire personal, healing story, I will share with the readers that I have been free of panic attacks for over ten years, my bowels move two or three times a day and I am free of all medications! It has been a long and sometimes brutal journey but my body has been such an amazing teacher and continues to speak to me in new ways. Many of us hear about the “mind-body connection” but don’t give it much thought. My goal in my practice is to help my clients understand this powerful connection...
and teach them how to listen to their bodies as they continue on this amazing journey we call “life”.

This project is not just a step towards the process of earning a PhD, it is a way of sharing my passion with others as I hope to further establish the powerful connection of our mind and our body. The gut-brain connection is truly one of the most miraculous bodily systems which continues to reveal itself to us over and over. It is my opinion that our second brain is the most crucial connection to physical healing. It is also my strong belief that our mind and our emotions are the underlying culprits of many physical problems. There is no way to treat one without treating the other. My hope is that the readers will further be reminded of this powerful relationship and possibly see that connection within themselves in a whole new way.
Abstract


This applied dissertation was designed to demonstrate the effectiveness of neurofeedback in treating intestinal distress such as IBS and constipation through the reduction of anxiety and depression symptoms. This research addressed and supported the connection between the gut brain and the cranial brain. The need for further research and larger studies was addressed. Prior to the implementation of the intervention, the researcher gathered information on the participants’ symptoms using three surveys; the Beck’s Depression Inventory, the Beck’s Anxiety Inventory and a Gastrointestinal Health Assessment. After gathering pretest data, the researcher implemented a 10 week program using neurofeedback for 30 min per session for a total of 15 sessions to address anxiety and depression symptoms. At the conclusion of the 15 sessions, participants were asked to complete the three surveys for a posttest data collection.

The design used for this study was a pretest-intervention-posttest design. Outcome measures were assessed by comparison of pre- and posttest symptom levels. Participants showed positive changes on all three surveys. Results from the Beck’s Depression Inventory showed 7 out of 21 questions as statistically significant (p < .05) and 2 out of 21 questions as statistically significant at the p < .01 level. The Beck’s Anxiety Inventory results indicated statistically significant improvement for 4 out of 21 questions (p < .05) and statistically significant improvement of 4 out of 21 questions at the .01 level. In addition, there were statistically significant findings for 12 out of 35 questions on the GI Assessment at the .05 level and statistically significant improvements for 2 out of 35 questions at the .01 level posttest.

The findings in this study support the importance of recognizing the gut-brain connection. Furthermore, the findings support the use of neurofeedback as an effective intervention for reducing symptoms of anxiety and depression, as well as symptoms of intestinal distress such as IBS and constipation.
CHAPTER 1: Introduction

The system (gut) is way too complicated to have evolved only to make sure things move out of your colon. ~ Emeran Mayer

The gut-brain phenomenon has been gaining attention across the U.S. as the numbers for IBS, constipation and acid reflux disease (GERD) continue to rise. Commercials are focused around medications for symptoms such as gas and bloating, diarrhea and acid reflux. The “little purple pill” is known not only among the aging population but more recently among adolescents and children. In addition to intestinal problems on the rise, the increase in anxiety and depression is striking. Practitioners are seeing rise in these disorders, even among the youth in America. It is no surprise that many seek help for a combination of these symptoms between the cranial brain and the gut brain. Many medical professionals relate it to an increase in stress in today's society. Among the alternative health practitioners, it is equally seen as a common denominator from stress, in addition to poor diet, bowel toxicity and the abundant use of genetically modified foods.

The statistics for these disorders are alarming. One of the number one reasons patients see a gastroenterologist is for symptoms of IBS, accounting for almost 3.5 million visits to the doctor and 2.2 million prescriptions per year with an estimated cost of over $8 billion in the United States (Harvard Medical School, 2001). Complaints of chronic constipation are just as profound averaging 2.5 million physician visits with some 20 percent of the population experiencing symptoms (Harvard Medical School, 2001). In addition to these well-known physical symptoms, those paired more with emotional problems are anxiety and depression,
also on the rise in epidemic proportion. The National Institutes of Health (NIH) reports that anxiety and depression affect 38 million Americans each year and that number doubles in relation to those who are predicted to suffer from anxiety or depression during some point in their lives (Amen, 2003). It is estimated that the cost of treating these two mental health problems is more than $80 billion each year which is more than half of the nation’s total mental health cost (Amen, 2003). It is the researcher’s opinion that the health industry, as a whole, has not been very successful in the treatment of any of these medical and mental conditions. Medical doctors receive very little, if any training in nutrition or the connection of certain foods and inflammation to intestinal challenges and are limited in their knowledge of the mind-body connection. This lack of training has been replaced with prescription medication that is designed only to treat symptoms and not the underlying cause of the disease or illness.

**Setting**

The research project took place in a small, clinical setting in the city of Nashville, Tennessee. A team approach of nutrition, herbology, acupuncture, massage and neurofeedback (NFB) training make up this particular wellness environment. Clients are educated in proper diet, exercise, nutritional supplementation, detoxification and the total mind-body-spirit connection through the various modalities. The research participants were chosen based on individual interviews and questionnaires pertaining to symptoms of intestinal inflammation as well as symptoms of either anxiety or depression, or both. All participants must have made previous attempts in relieving symptoms through the use of supplementation and dietary changes with either little or no change in symptoms. Some of the participants were on
additional medications for their presenting symptoms, as well. They remained on their medications throughout the study and no further dietary changes were made during this time.

*Purpose of the Study*

The researcher had been working with many clients presenting these symptoms of IBS, constipation, anxiety and depression. While many symptoms were improved with dietary changes, elimination of food sensitivities and additional lifestyle changes, the majority of the complaints remained with only some improvement. With the recent addition of NFB into the practice, the researcher used new information related to the gut-brain connection to conduct this study. This research would further prove the already established connection of the cranial brain to the gut brain. The researcher’s goal was to show that by training the brain through self-regulation using NFB to reduce anxiety and depression symptoms, that participants would additionally see a reduction in physical symptoms of IBS and constipation. It is the researcher’s hope that this study will bring enough significant findings to support a more detailed and lengthy study of its kind in the near future.

*Statement of the Problem*

The problem addressed in this research study is that the majority of patients reporting these symptoms to their physicians are not finding relief, regardless of various prescription medications and even some using nutritional supplementation. While those who make diet and lifestyle changes appeared to have better results than those just taking prescription medications, overall they each continued to show signs of these reported physical and mental conditions. A UCLA study done in 2001 indicated that less than a third of patients suffering from
anxiety and depression receive proper medical treatment and that a “medication only” treatment for these disorders is often unsuccessful (Amen, 2003). In addition, while there are numerous drugs on the market designed to treat intestinal problems such as IBS and constipation, the number of those affected continue to rise. It is this researcher’s belief that one cannot ignore the health of the gut and its connection to the brain and emotions. Other researchers in the field agree. One author inferred that the problem lies not only in the gut, alone, but in the brain. Dr. Michael Gershon stated in his famous book, *The Second Brain* (1998):

> Studies have shown that 40% of patients visit their internists for gastrointestinal symptoms with most of them finding no anatomical or chemical defects. This leaves both the patient and physicians frustrated and angry. Those same patients who present themselves with these unexplained problems are labeled as “mentally unbalanced” (p. 14, preface).

Another researcher stated that one of the biggest influences on the bowel is a person’s emotions. Those under emotional stress are more likely to suffer from problems such as gastritis, heartburn, colitis, IBS, ulcers, constipation or diarrhea (Jensen, 1999). This researcher also believes in the powerful connection of the gut and the brain. While many clients find symptom relief after calming the conditions of the gut, the fact that many are still exhibiting symptoms is further proof that the brain must be treated, as well. If there is stress in the body, resulting in symptoms such as anxiety and depression, it would only make sense that this same stress could be affecting the gut and vice versa.
Research Question

One main question led the researcher to this study which is “If we know there is a gut-brain connection, could we produce a better symptom relief of IBS and constipation by introducing the client to NFB in order to teach the brain/body to self-regulate in the areas of anxiety and/or depression?”

Hypothesis

To prove the value of using Neurofeedback for stress reduction for anxiety and/or depression as an additional approach to relieving symptoms of IBS and/or constipation when nutritional approaches have previously taken place with little or only some improvement of symptoms, thus further establishing the gut-brain connection.

Definition of Terms

For the purpose of this study, the following terms have been defined:

1. \textit{Constipation} is a symptom of infrequent hard to pass bowel movements including, bowel movements of three times or fewer per week, difficulty during defecation (straining during more than 25% of bowel movements) or the sensation of incomplete bowel evacuation (Wikipedia, 2012).

2. \textit{Irritable Bowel Syndrome} is a symptom-based diagnosis characterized by chronic abdominal pain, discomfort, bloating and/or alteration of bowel habits (Wikipedia, 2012).
3. **Anxiety** is a psychological and physiological state characterized by somatic, emotional, cognitive and behavioral components. It is the displeasing feeling of fear and concern (Wikipedia, 2012). For this study the level of anxiety was determined by the Beck’s Anxiety Scale with 0-7 points indicating a minimal level of anxiety, a score of 8-15 indicating mild anxiety, 16-25 suggesting moderate anxiety and 26-63 indicating severe anxiety (Beck, 1993).

4. **Depression** is a state of low mood and aversion to activity (Wikipedia, 2012). For this study depression was categorized using Beck’s Depression Inventory-II. A score of 1-10 indicated normal ups and downs, scores of 11-16 indicated a mild mood disturbance, scores of 17-20 suggested borderline clinical depression, scores of 21-30 indicated moderate depression, 21-40 indicated severe depression and over 40 suggested an extreme depressed state (Beck, 1996).

**Anticipated Outcomes**

There are two anticipated outcomes of this study:

1. To decrease symptoms of IBS and/or constipation by finding a positive mean change from pre to posttest of participants, shown by a significant decrease of presenting symptoms based on self-report answers to the GI Health Assessment.

2. To decrease symptoms of anxiety and/or depression by finding a positive mean change from pre to posttest of participants, shown by a significant decrease of presenting symptoms based on the BAI and/or the BDI.
Summary

There appears to be a significant increase among the current population complaining of IBS symptoms and chronic constipation. In spite of new medications and progressive treatments, there appears to be little to no relief of these problems in addition to a growing number of younger patients beginning to experience these symptoms, as well. While many find relief after seeking help through an alternative health practitioner by learning to change their diet and lifestyle, some still suffer in spite of these changes. The researcher implemented a program to address the brain in addition to the gut in hopes that this gut-brain approach would be the key to resolving these often debilitating health issues. Most health professionals agree that stress is the cause for much of the dis-ease in the body, including anxiety, depression and many intestinal disorders. It is this researcher’s belief that by reducing stress through the use of NFB, it will automatically reduce the same stress that is affecting bowel elimination or significantly reducing symptoms of bowel distress.
CHAPTER 2: Review of Literature

Putting the bowels (gut) in the closet and making believe they don’t exist have led many down the path of improper living, treating the bowel indiscriminately, and reaping the sad harvest in later years. ~Dr. Bernard Jensen

Introduction

There has been an increasing interest in the connection between the brain and the gut in the last few years. Most have experienced the all familiar “butterflies” in the stomach before giving a speech or going on that first date. In addition, many people at some point in their lives have felt sick to their stomach at the occurrence of a trauma event or memory. Society is inundated with television ads for medications promising relief of IBS, constipation and acid reflux disease. With almost just as much popularity are advertisements for anxiety, depression and insomnia. So why is this connection so powerful? Furthermore, are these medications really offering long term relief or just short term symptom management? The purpose of this paper is not only to research this connection between the brain and the gut, but to look at a possible solution to the underlying cause of distress in the mind and body. First, one must look at the physical connection, then the connection the emotions play in affecting that physical component. One must also understand the definitions of anxiety, depression, IBS and chronic constipation. Methods of treatment can then be explored. These points are all examined in this review of literature. The sections contained in this literature review are as follows: (a) the cranial brain, (b) the second brain, (c) a general description of anxiety and depression, (d) a general description of IBS and constipation (e) the connection between stress, psychological
challenges and poor intestinal health, (f) neurofeedback defined, (g) different approaches to NFB, (h) how does NFB work, (i) the history of NFB, (j) one channel vs. two channel training, (k) NFB and research, (l) NFB training for anxiety and depression, and (m) biofeedback for treating constipation.

The Cranial Brain

The brain is an extremely complex part of the human anatomy. It is part of the central nervous system, along with the spinal cord. The brain is divided into three main areas often referred to as the triune brain (Cozolino, 2002). These main areas are the cerebral cortex, the limbic system and the brainstem. Each of these areas is responsible for different tasks. Temperature, reflexes and heart rate are the chief responsibility of the brainstem. Damage to this area can lead to paralysis and even death. Emotions and memory, as well as how the body responds to threats or trauma is primarily a function of the limbic system. The cerebral cortex is the outer layer of the brain and is responsible for our ideas and how we interact with the world.

The cortex is divided into four lobes, each related to specific brain functions. The frontal cortex carries the responsibility of executive functions such as memory and organizational skills, as well as expressive language, motor behavior, abstract reasoning and attention. The temporal cortex controls memory functions, auditory processing and receptive language. The parietal cortex connects motor skills and the senses, as well as body awareness. And lastly, the occipital cortex’s main function is visual processing. In addition, these four areas of the brain are divided by the right and left hemisphere. The left hemisphere is often associated with analytical reasoning, math and logic and is used to enhance skills in NFB training such as reading, writing
and arithmetic. The left hemisphere also houses the Broca’s area and the Wermicke’s which are associated with verbal expression and comprehension (Demos, 2005). The right hemisphere of the brain is in charge of creativity, emotions, music, artistic ability, visual-spatial processing, intuition, empathy and facial recognition. Each of these brain functions are considered when training the brain with NFB.

The Gut Brain

The intestinal system (the gut) is often times referred to as the “second brain”. One reason for this title is that the gut is part of the enteric nervous system capable of manifesting reflexes without the assistance of the brain or spinal cord. It has been suggested that the gut has the ability to “feel” emotion. One researcher stated that the gut is more intellectual than the heart and may have a greater ability for “feeling” (Gershon, 1998). The gut is connected to the brain by a large cranial nerve called the vagus nerve containing about two thousand nerve fibers compared to the one hundred million nerve cells found in the small intestines. This independent nervous system called the enteric nervous system is responsible for blood flow and secretion for digestion, as well as controlling motility (Grundy & Schemann, 2006). This advanced system contains the same neurotransmitters found in the brain, including serotonin. In fact, two researchers published papers back in 1982 (Marcello Costa and John Furness) stating that serotonin is an enteric neurotransmitter (Gershon, 1998). They went on to suggest that serotonin even plays a role in the development of a fetus. Most people tend to think of neurotransmitters like serotonin existing only in the cranial brain. Few realize that almost 95% of serotonin is actually produced in the gut, the second brain. While the serotonin found in the
gut brain isn’t shared with that found in the cranial brain, it does play a role in influencing the cranial brain by way of the vagus nerve, especially when it comes to digestion. Too much or too little of the gut serotonin can lead to constipation or diarrhea (Sarasohn, 2006). This serotonin plays a vital role in the communication between the gut brain and the cranial brain with the gut brain doing the majority of the communication. It is the researcher’s opinion that this plays a possible role in conditions such as depression where there is a lack of serotonin production. It is a further opinion that the state of health or lack of, in the intestinal tract can largely influence the brain and its ability to produce normal levels of neurotransmitters responsible for well-being.

Feelings and emotions have a direct effect on both the cranial and gut brains. One may notice that when he or she gets upset that there is also a noticeable change in digestion and/or bowel habits. Anxiety has frequently been associated with IBS symptoms while depression associated more with constipation. Stress, in general, has often been the targeted trigger for acid reflux disease. One researcher infers that aside from diet, the biggest influence on intestinal health, specifically bowel health, is emotional strain. In addition, the gut can in turn influence the emotions (Jensen, 1999). Dr. Gershon in his book, *The Second Brain*, stated that unresolved anger has often been associated with intestinal problems. With this in mind, emotions that go unexpressed and internalized will express themselves through chaos in the gut. He also comments on the theory that the brain is responsible for intestinal problems not explained by any “anatomical lesions” and takes it one step further to suggest another possibility – that problems with the gut’s own nervous system could be the underlying cause of intestinal discomforts (1998). This would indicate the power of the “gut brain” to be more
extensive and independent. It is clear to this researcher that the brain and gut connection continue to reveal more into these two, very complex systems. The mind-body connection remains a point of focus as seekers continue to unravel the mystery behind it all.

A General Description of Anxiety and Depression

For many people, anxiety is a normal response to a stressful thought or event. For others, it is an unexplained, uncontrollable and sometimes terrifying phenomenon. According to the Anxiety and Depression Association of America (ADAA), anxiety disorders rank highest in mental illness in the United States with an estimated 40 million adults affected with the disorder. A study reported in The Journal of Clinical Psychiatry found that over $42 billion dollars a year is spent on the treatment of this disorder, almost a third of the total mental health bill in the U.S. alone (60(7), July 1999). This researcher has observed an increase in complaints of anxiety among clients of all ages, even the very young. It could be inferred that the increase in anxiety could partly be due to the increase in the demand on our brains to deal with a constant bombardment of cell phone usage, long hours on laptops, the growing problem of pollution and chemical toxicity, as well as the overall increase in the stressors of this current way of living.

While many are seeing an increase in stress and feeling the effects in their bodies, often times they have not labeled these feelings as anxiety. Many report feelings of fear and worry over life circumstances. Anxiety is different from fear in that fear is a result of a response to danger while anxiety is often unexplainable, occurring many times when the person is not in any kind of stressful state or dangerous situation. Anxiety disorder symptoms can range
Exploring the Gut-Brain Connection

anywhere from nausea and sweating to an overwhelming fear of death. Other symptoms may include dizziness, dry mouth, digestive disturbances, chest pain and heart palpitations (Encyclopedia of Natural Medicine, 1998). Women seem to be affected twice as much as men although some psychologists believe this is because men’s symptoms often go unreported (Balch, 2006). One author states that anxiety and fear are the body’s conscious indication of a threat, preparing one to protect their self. Anxiety can be triggered consciously or unconsciously and has the ability to define our thoughts, our feelings and our behavior (Cozolino, 2002). Whether conscious or unconscious, chronic anxiety can be frightening and often debilitating.

Dr. Daniel Amen, noted for his SPECT brain imaging, suggests that anxiety is a result of an over arousal of the basal ganglia area of the brain. He states that when this area of the brain is over worked, people will most likely suffer with symptoms of anxiety, as well as headaches, intestinal problems and muscle tension. In addition, these people have a tendency towards hyper vigilance, have a difficult time relaxing and are often workaholics (Amen, 2005).

In his book, *Healing Anxiety and Depression* (2003), Dr. Amen puts anxiety and depression into seven different categories: (1) pure anxiety, (2) pure depression, (3) mixed anxiety and depression, (4) over focused anxiety/depression, (5) cyclic anxiety/depression, (6) temporal lobe anxiety/depression and (7) unfocused anxiety/depression. He believes that anxiety is either a direct result of the brain or a combination of brain vulnerability and life stresses. His book goes on to define these seven categories as follows (pp. 37, 38):

1. Pure Anxiety- based on excessive activity in the basal ganglia.
2. Pure Depression- based on excessive activity in the deep limbic system.

3. Mixed Anxiety and Depression- based on excessive activity in the basal ganglia and the deep limbic system.

4. Over focused Anxiety/Depression- based on excessive activity in the anterior cingulate gyrus, the basal ganglia, and/or the deep limbic system.

5. Cyclic Anxiety/Depression- based on focal increased activity in the deep limbic system and/or the basal ganglia.

6. Temporal Lobe Anxiety/Depression- based on increased or decreased activity in the temporal lobes and increased activity in the basal ganglia and/or deep limbic system.

7. Unfocused Anxiety/Depression- based on decreased activity in the prefrontal cortex and increased activity in the basal ganglia and/or limbic system.

The ADAA suggests that many of those suffering from anxiety may also suffer from depression and vice versa. Most people have experienced some level of sadness or feeling down but those occasional feelings tend to pass within a couple of days. While depression brings about these sad feelings, it also involves more serious symptoms such as the inability to sleep or oversleeping, a lack of motivation, irritability, fatigue, difficulty concentrating, loss of appetite or overeating, suicidal thoughts, loss of pleasure and overall symptoms that affect their jobs, families and the ability to cope.

The National Institute of Mental Health (NIMH) lists several forms of depression. The most common form of mild depression is dysthymia, depression lasting as long as two years with symptoms mild enough that they may not have an effect on the person’s ability to
function normally. Major depression is a form of depression involving symptoms severe enough that they prevent the person from normal day to day function such as the ability to work, eat, sleep and enjoy activities they previously enjoyed. Symptoms lasting only a couple of weeks are characterized as minor depression, usually surrounding a particular event. Bipolar depression is a more severe form with extreme, emotional highs referred to as “mania” and polar opposite depressive lows. Other forms of depression include psychotic depression, accompanying severe depression with hallucinations or delusions. A more common form of temporary depression can occur after a mother gives birth and hormone levels are changing. It is called postpartum depression and often referred to as “the baby blues”. Lastly is a form of depression often associated with the winter months called Seasonal Affective Disorder or SAD. This form of depression is believed to be caused from a lack of sunlight during the winter months and is often relieved with light therapy.

The NIMI statistics show that the milder form of depression, dysthymia, affects about 1.5% of the U.S. population. Major depression is much higher showing 6.7% suffering in the U.S. with 30.4% of those cases considered “severe”. This comes to no surprise as for years now television commercials for anti-depressant drugs have become the norm. With the increasing numbers of those experiencing more stress and anxiety, the number of people with mood disorders is likely to continue to rise. A more disturbing observation is the rise of depression among the youth and what seems to be affecting children younger and younger each year.

According to Dr. Daniel Amen, the part of the brain most associated with depression is the deep limbic system (2005). He suggests that when there is over activity or problem within
the deep limbic system that a person can experience a lack of motivation, sleep problems, fatigue, low libido and feelings of sadness. This high activity is often due to a decrease in certain neurotransmitters such as norepinephrine, dopamine and serotonin. One researcher adds to this the growing problem of poor diet which can have a direct effect on these brain chemicals resulting in mood disorders (Balch, 2006). Whatever is causing this imbalance in the brain must be addressed. It is the methods used to address these conditions that bring about debate. While medical doctors rely on medications, therapists claim depression and anxiety are best relieved through releasing one’s emotional wounds. Some use cognitive therapy while others rely on relaxation techniques. One author suggests that anxiety and depression are a result of a “bias toward right hemispheric processing” (Cozolino, 2002, pp 106). He goes on to say that for treatments to be successful, one must focus on balancing this system.

A General Description of IBS and Constipation

One of the most popular health topics advertised today revolves around digestive health whether it is a commercial for acid reflux disease or IBS relief. A recent journal article published by the Journal of the American Academy of Physician Assistants reported IBS as one of the top reasons for seeking a physician. The article indicated that IBS is responsible for 3.7 million doctor visits per year and that in the US, alone, approximately 10%-22% of the population suffers with this condition (Blesse, 2010). Women are three to five times more likely to complain to their doctors about intestinal symptoms than men (Harvard Medical School, 2000). IBS symptoms consists of abdominal pain and irregular bowel habits ranging from extremes of diarrhea and constipation with no other health explanation. The cause of IBS is unknown but
many speculate it is connected to stress, improper intestinal flora, increased visceral sensitivity, problems with GI motility and an abnormality in the gut-brain connection. Symptoms range in severity with each patient and some may go years before being diagnosed or never receive a diagnosis at all. Because of these variations in symptoms, it has been categorized as diarrhea-predominant (IBS-D), constipation-dominant (IBS-C) and mixed-type (IBS-M) (Blesse, 2010). Regardless of the type of IBS one may be experiencing, it can be a frustrating and sometimes painful way of living that often times goes untreated or treated unsuccessfully.

A common symptom seen in those patients with IBS is GI motility disturbances. GI motility is the process in which the intestinal muscles contract in order to move the contents of food and wastes throughout the GI system. When normal motility function is disturbed, the results can be painful abdominal cramping, diarrhea, constipation and bloating. If transit occurs too quickly, then the result is loose stools or diarrhea. If the transit time is too slow, this can result in constipation. While issues with motility are commonly seen in IBS sufferers, they can be seen in healthy individuals, as well. In addition, other symptoms such as abdominal pain and bloating can be present with the absence of motility changes. This suggests that IBS pain and discomfort could be related to a person’s sensitivity to pain. Some IBS patients have an increased sensitivity to feelings in their gut, chest, abdomen and rectum. This is referred to as visceral sensitivity or enhanced visceral nociception (Salt, 1997).

Due to the connection between the gut brain and the cranial brain there is strong speculation among researchers that problems with this connection are a major contributor to IBS symptoms. Serotonin receptors help with the absorption and secretion of fluid and have
been found to affect pain and gut motility. In fact, some doctors will use medications to block serotonin in the GI in order to decrease visceral pain and diarrhea (Harmon, 2007). Most patients with IBS report various levels of fatigue, stress, anxiety, depression and sleep disturbances. The frequency and severity of their IBS symptoms seem to correlate with stress and other psychological symptoms (Murray & Pizzorno, 1998). Patients with IBS have often been labeled as having a nervous stomach showing further belief in the emotional connection to physical symptoms (Meisler, 2001).

Improper intestinal flora has also been blamed for the symptoms of IBS. One research reported that 38-84% of those suffering with IBS showed some level of small intestine bacterial overgrowth (Posserud, Stotzer & Bjornsson, 2007). Intestinal flora can also be effected by the overuse of antibiotics, as well as foods that cause inflammation or the over growth of yeast. Foods, alone, can be the main trigger for IBS symptoms and relief from those symptoms can often be found by eliminating those particular triggers- most commonly found to be wheat and dairy (Salt, 1997). Regardless of what is causing these symptoms, it can be a frustrating way of life for those who deal with it on a day to day basis with little hope for complete relief from their symptoms.

While some patients with IBS go running to the bathroom following their favorite meal, others do quite the opposite. Constipation can be a more painful symptom of IBS causing abdominal pain and severe bloating. It is estimated that about 20% of the population, more women than men, experience ongoing problems with irregularity. In addition, Americans spend approximately $400 million each year on laxatives. While constipation can occur at any stage in
life, it seems to get worse with age (Harvard Medical School, 2000). Constipation is defined as slow moving bowels with no elimination or the elimination of small, hard stools. This can occur when the muscles in the intestines contract too slowly causing the stool to absorb too much water resulting in hard, dry fecal matter.

According to Harvard Medical School, one study showed that 20%-40% of people when asked said they strain when moving their bowels. This straining was explained by defecating less than three times a week, straining one to three times out of four when moving bowels and symptoms of abdominal bloating or discomfort (2000). They further defined constipation as experiencing a minimum of two of the following symptoms during a three month period (p. 106):

1. Straining during more than one quarter of bowel movements
2. Passing lumpy or hard stools during more than one quarter of bowel movements
3. Having a sensation that your rectum or anus is blocked during more than one-quarter of bowel movements
4. Resorting to manual maneuvers such as using a finger to help facilitate movement during more than one-quarter of bowel movements
5. Fewer than three defecations per week

One researcher suggests that constipation causes extreme toxicity in the body leading to disease and is responsible for indirectly killing more people than any other disease related to deficient function. He further stated that many refer to it as the “modern plague” and personally considers it to be the most dangerous internal disease (Jensen, 1999). Dr. Jensen
further comments that many people don’t even realize they are constipated. It is this researcher’s experience that many clients claim to think eliminating three times a week is normal and have even confirmed this belief with their medical doctor. Moving their bowels two or three times a day seems unnecessary and to many an unlikely scenario.

Some of the causes of constipation are not enough fiber in the diet, not drinking enough water, a lack of exercise, bowel inflammation, side effects of medication and ignoring the urge to go leading to irregular bowel habits. Treatment consists of increasing dietary fiber, re-training the bowel, laxatives and food elimination such as dairy. There is some research indicating a connection to distress and depression (Salt, 1997). It is the opinion of this researcher that there is also a correlation between constipation and those who tend to “hold in their feelings”, have a difficulty “letting go” or a tendency to stuff their anger. When one holds on to negative emotions, it can literally cause the bowels to tense up and no amount of fiber is going to be able to push waste through that tension. By letting go of those emotions that have been “stuffed”, it allows the bowels to relax so that transit is easier. This researcher has observed this phenomenon in many clients with type A personalities to over stressed moms who disregard their own feelings for the sake of keeping peace in the family environment. A more alternative approach to addressing constipation is to use fiber as well as adding magnesium and probiotic supplementation, relaxation techniques such as massage, yoga or meditation and in more chronic or unresponsive cases, neurofeedback.

The Connection between Stress, Psychological Challenges and Poor Intestinal Health
While most health professionals agree that stress is the leading cause of disease, there is a question to whether this stress can lead to anxiety and/or depression that ultimately results in intestinal challenges such as IBS and constipation. Most researchers agree that stress can certainly exacerbate the symptoms of poor intestinal health but there is debate on whether they are the cause or in turn, whether poor intestinal health leads to anxiety and depression. It is an accepted fact that anxiety can cause changes in bowel function such as diarrhea or bowel discomfort, but this does not necessarily mean a diagnosis of IBS. In addition, IBS symptoms can be depressing which may also lead to more anxiety (The Institute of Functional Medicine, 2005). In this same text researchers also stated that the problem with depression may lie in the gut while the issue of IBS may lie in the head. However, most agree that there is a connection to stressful events or prolonged stress and gut function. A study from 1947 supported the early discovery of this powerful connection. Researchers reported the observation of a wounded soldier with a gastrocutaneous fistula, as well as the famous “Tom’s stomach” where changes in gastric motility and secretion were seen in reaction to emotional stress (Emmanuel, Mason & Kamm, 2001; Wolf, et. al). Another study indicated that symptoms of IBS correlate with the involvement of the brain’s emotional limbic system. It was suggested that visceral pain pathways and the pathways of the limbic system can overlap explaining the connection of IBS with psychological factors (Mertz, 2002). Another researcher concurs by stating that anxiety and depression are a result of problems with central autonomic activity which can manifest itself in intestinal distress (Emmanuel, 2001).

Researchers for *The Encyclopedia of Natural Medicine* stated that there are several theories related to the connection of psychological factors and intestinal complaints such as
IBS. One of these theories is called “the learning model” which suggests that some children who are living in stressful situations may develop GI problems as a means of coping with the stress.

A second theory states that IBS is a direct result of anxiety or depression, or both (1998). Some researchers have taken this a step further inferring that patients with abdominal complaints may also present a psychiatric illness (Creed & Guthrie, 1987). In this same report the researchers suggest that when a patient with IBS is also diagnosed with a psychiatric disorder that there are three possibilities: (1) both conditions may have developed simultaneously in which case the intestinal complaints can be relieved by treating the psychiatric symptoms, (2) the psychiatric disorder may lead the patient to strong concerns about intestinal symptoms resulting in a visit to a physician. In this case the GI symptoms are a result of the psychiatric behavior and not induced by the anxiety or depression, and (3) patients with neurotic symptoms are screened for disease when presenting new intestinal symptoms (p. 1307). A study involving patients with anxiety and/or depression showed a connection between bowel disturbances and emotional distress. The study reported patients with IBS also had a high prevalence of psychiatric disturbances. In addition, their findings showed that patients suffering from chronic constipation also reported higher incidence of emotional distress, especially depression (Gorard, Gomborone, Libby & Farthing, 1996). An additional study looked at 41 patients diagnosed with IBS. Their findings revealed that those with IBS showed significantly more neurosis and were less extroverted than the norm. However, they were also measurably less neurotic and more extroverted than those with a psychiatric diagnosis (Creed, et al, 1987; Palmer, Stonehill, Crisp, Waller, & Misiewicz, 1974). A similar study looked at 80 patients with intestinal bowel disorders ranging from Crohn’s disease and ulcerative colitis. Patients were
given three questionnaires to complete. One questionnaire consisted of questions related to living with the disorder; the other two questionnaires were the Eysenek Personality Inventory and The Hospital Anxiety Depression Scale. The study was conducted to show a high prevalence of certain personality traits such as neuroticism and introversion in those diagnosed with inflammatory bowel disease. The results indicated that there was a significantly higher neuroticism in those patients with intestinal bowel disorders. However, high levels of anxiety, depression and introversion were not noted in those patients with bowel disorders. Depression was noted in those patients experiencing chronic symptoms (Robertson, Ray, Diamond & Edwards, 1989). In this same study, researchers conclude that persons with a particular personality predisposition may develop bowel inflammation when triggered by prolonged stressful events. This may offer one explanation of why some people under chronic stress develop intestinal problems while others do not.

There is also research exploring the effects of anxiety and mood disorders on bowel transit time with some findings suggesting that anxiety causes faster transit time while depression results in slower movement. The previously mentioned 1996 study concluded that anxiety was directly associated with frequent bowel elimination and depression was found to be more prominent in those patients who were constipated. The study consisted of 21 psychiatric outpatients diagnosed with generalized anxiety disorder and/or major depression and 21 healthy participants. The researchers used lactulose hydrogen breath test to determine orocaecal transit time and an abdominal radiography, after patients had swallowed a radio-opaque marker, to determine whole gut transit time. Their results indicated that patients with anxiety experienced a shorter whole gut transit time than those patients who were depressed.
Orocaecal transit time in patients with anxiety was also shorter than those patients who were depressed. In addition, the whole gut transit time correlated with the Beck Depression Inventory score, as well as the score on the Hospital Anxiety and Depression Scale. In addition, the study revealed that anxiety patients had an average of 13-16 bowel movements per week in comparison to depressed patients reporting a median frequency of 3-4 per week (Gorard et al., 1996). Another source suggested with the activation of the sympathetic nervous system as a result of a stress response, the bowels begin to slow down. When there is repeated exposure to stress, this can affect bowel motility by trapping the bowel in an “on-off” pattern (Keefer, Sanders & Sykes, 2005). While not everyone who is exposed to repeated stress develops intestinal symptoms, it does appear to impact a large percentage of the population. In an interview discussion of IBS, Dr. Susan Lucak suggested that this is due to a faulty GI tract calling it “a lack of impulse organization” (Meisler, 2001).

In addition to anxiety and depression, there are studies indicating a connection between trauma and/or sexual abuse to poor intestinal function, including IBS. One study revealed a strong connection between women who were experiencing intestinal disorders, who were also victims of childhood or adult sexual abuse, and childhood physical abuse (Drossman, 1995). Another study review reported that persons who had experienced trauma or PTSD were also found to be complaining of functional GI symptoms (Stam, Akkermans & Wiegant, 1997).

In this same study a connection was shown between stressful life events preceding IBS symptoms or diagnosis. There was more frequency of these stressful events in those who developed IBS than those with no symptoms. This nervous tension and stress can also result in
an inflammatory response in the bowel resulting in IBS type symptoms (Jensen, 1999). Another researcher reported similar findings of prevalence of psychological problems among IBS patients, as well as a higher incidence of physical and sexual abuse (Mertz, 2002). This further infers the association of emotional trauma and stress with intestinal challenges.

One researcher observed increased neuroendocrine responses and visceral perceptual alternations in individuals experiencing a stressful event indicating a possible relation to IBS symptoms (Posserud, Agerforz, Ekman, Bjornsson, Abrahamsson & Simren, 2004). This same researcher discussed the process of a stress response upon the central nervous system. This stress response is conducted through the autonomic nervous system activating the hypothalamus, pituitary and adrenals. One theory of IBS patients is a mechanical malfunction in this system response (Aggarwal, Cutts & Abell, 1994). An additional finding was reported in a 1998 study where the researcher noted a significant difference in hormone levels involved in the stress response of those patients diagnosed with IBS compared to healthy individuals (Munakata, Mayer & Chang, 1998). Another study looked at the effects of stress in the clinical outcome of IBS patients. The purpose was to evaluate the relation of symptom intensity to life stress threats. The study consisted of 117 outpatients who had met criteria for IBS. The research methods consisted of data collection through interview process at 6 and 16 months. The data looked at the potency of chronic stress threats as well as the frequency of IBS symptoms. The results showed a strong relation to chronic stress and the consistency of IBS symptoms. None of the patients exposed to any chronic stressors had improvement over IBS symptoms during the 16 week study period. Those who showed improvement of IBS symptoms had no chronic life stress threats. Their results concluded that chronic stress strongly affects the
clinical outcome of the majority of IBS patients (Bennet, Tennant, Piesse, Badcock & Kellow, 1998). One author suggests that stress affects the body in two significant manners. One is that stress inhibits protein production so that the body has to maintain a higher metabolism. The lack of protein production then affects the body’s ability to fight infections and disease. A second way stress affects the body is through this higher metabolism which increases sodium levels in the neurons making it difficult for the cells to unload the excess sodium. He reports that this results in cell death and damages the hippocampus resulting in problems with memory and depression (Cozolino, 2002).

In addition to life stressors, this researcher believes that emotions carry equal value in the relation to intestinal inflammation. In Dr. Bernard Jensen’s book *Guide to Better Bowel Care*, he discusses the effects of emotions such as anger, tension, worry and obsession on the body, especially the digestive system and bowels. He stated that in ancient times, the bowel was often referred to as “the seat of emotions” (p. 98). It is these same emotions that can lead to a lack of bowel secretion and contracting that are crucial in the process of digestion and elimination (1999). Another interesting study observed thirty seven women complaining of constipation (less than three bowel movements a week). The researchers used methods such as radio-opaque markers and laser Doppler assessment to observe gut transit time and mucosal blood flow. All patients were experiencing less than three bowel movements per week for a mean duration among the group of 21 years. More serious causes of the constipation had been ruled out and all patients appeared to have a normal diameter colon. Patients were not allowed to use laxatives a week prior or during the study. Each patient’s gut transit time was recorded using radio-opaque markers that were ingested over three consecutive days and monitored by
Exploring the Gut-Brain Connection

If a patient showed retention beyond the normal limit for any of the three markers, they were classified as having slow bowel transit time. Rectal mucosal blood flow was also assessed using laser Doppler flowmetry assessment.

The results indicated that the women who were constipated had a reduced rectal mucosal blood flow as compared to the healthy controls. The study reported that the constipated women had significantly higher levels of psychological complaints such as anxiety, depression and social dysfunction that those of the healthy control group (Emmanuel et al., 2001). So it would appear that there is a strong correlation between one’s emotional state, level of stress and physical health. How strongly it is related to the cause of IBS, constipation, anxiety and depression is strongly debated. The fact remains that there is a physical connection, through the vegaus nerve, to the gut brain and the cranial brain. In fact, when one researcher studied the brains of depressed patients, he found that they showed much higher frequencies such as frontal alpha and high beta usually associated with anxiety. He believes it was this high anxiety that led the person’s brain to a state of exhaustion and this exhaustion was experienced by the patient as depression (Larsen, 2012). It is this researcher’s belief that these mental states can then result in intestinal complaints whether IBS or constipation. For this reason, both the brain and the gut should be addressed in treatment.

Neurofeedback Defined

Wikipedia defines neurofeedback (NFB) as a type of biofeedback that uses real time displays of electroencephalography or functional magnetic resonance imaging (fMRI) to
illustrate brain activity. NFB is also referred to as neurotherapy and EEG biofeedback. Training involves the use of a monitoring device that provides immediate feedback specifically for the purpose of supporting the brain in self-regulation. One author defines NFB similarly referring to it as brainwave biofeedback which helps to normalize and optimize the functions of the brain through self-regulatory training (Swingle, 2008). NFB is different from other biofeedback instruments in that its focus is on the central nervous system and the brain. “Neurofeedback teaches the brain to modulate excitatory and inhibitory patterns of specific neuronal assemblies and pathways based upon the details of the sensor placement and the feedback algorithms used thereby increasing flexibility and self-regulation of relaxation and activation patterns” (Wikipedia, 2012).

Neurofeedback training is a non-invasive approach to re-training the brain. It involves the placement of sensors on the parts of the brain associated with particular symptoms such as organization and planning for pre-frontal lobes and anxiety reduction for parietal lobes. The sensors are connected to computer software designed to record brain activity and then reflect that activity back to the brain in the form of visual, auditory and sometimes tactile feedback using a video game, sounds or other displays and even movies. When the client is able to see brainwaves within seconds of them occurring, it gives the brain the ability to change or regulate those brainwaves. It is literally re-training the brain (Hammond, 2007). There are different schools of thought on how this training occurs and protocols used but all seem to be similar in some ways resulting in a common outcome. Symptoms addressed with NFB are ADD/ADHD, anxiety, depression, chronic pain, migraines, seizures, addictions, intestinal challenges, autism, PTSD, just to name a few. NFB training sessions range anywhere from 20 to 45 minutes with
some clients requiring as few as 10 sessions for visible changes, while others may need up to 60 sessions to get the desired results.

The EEG rhythms being observed are associated with different brain functions. The EEG bands are referred to as delta, theta, alpha and beta and are measured in cycles per second called hertz (Hz). Delta waves are slower and larger brainwaves ranging from 1-4 Hz and usually occur during sleep. High-amplitude rhythmic delta can sometimes be seen in clients who have experienced some type of traumatic brain injury (Demos, 2005). Theta waves are found in the 4-8 Hz range and reflect a dreamy state of mind or creative insight. These brainwaves are often seen during times of meditation or with clients who are experiencing difficulty focusing such as with ADD. Some NFB providers will train down high theta activity for those clients struggling with symptoms of ADD/ADHD. Alpha waves are seen in the 8-12 Hz range and are usually associated with relaxation or when the brain is idling. Alpha waves generally increase with eyes closed. However, some clients present high levels of alpha waves with eyes open. These clients are often associated with being day dreamers, as well as some cases of depression. High alpha waves seen in the frontal region are often down trained by NFB providers with clients who are experiencing depression, anxiety ADD/ADHD or brain injuries (Demos, 2005). The beta waves generally in the 12-21 Hz range suggest the brain is focused and alert. Beta frequencies are generally lower in children than adults. Higher beta frequencies are sometimes seen in clients with ADD, obsessive compulsive disorder, sleep disorders, bruxism, learning disorders, anxiety disorders and depression (Demos, 2005).

History of Biofeedback (and Neurofeedback)
Biofeedback was officially named at the first meeting of the Biofeedback Research Society in the fall of 1969. It was initially credited to the work of Dr. Berry Sterman of UCLA after he published his findings of training cats to control their brainwave activity. The cats were trained to increase sensorimotor in the brain known as SMR training (at 12-15 hz). Each time the cats’ SMR increased, they were rewarded. NASA contacted Sterman for another study. They wanted to see the connection of rocket fuel to seizures in humans. Sterman took 50 cats, 10 of which had previously received SMR training. After each of the 50 cats were injected with the rocket fuel, all developed seizures except the 10 cats who had received the SMR training. This was Sterman’s discovery of using biofeedback training for treating seizures (Demos, 2005). While this was the pivotal for future clinical uses, NFB roots can be traced as far back as the early 1900’s.

One Harvard researcher in 1908 developed a muscle relaxation technique in order to relieve neurotic tensions in patients experiencing various medical disorders. He used an electromyographic device to monitor the levels of muscle tension in the patients receiving treatment. His work continued until the 1930’s (Moss, 1998). However, many consider another researcher by the name of Richard Caton to be one of the first to introduce biofeedback as early as 1875 when he discovered the connection between brain activity and mental activity (Demos, 2005). His research consisted of studying the brains of animals by placing electrodes on their exposed brains to record electrical activity. It wasn’t until the 1920’s that the first EEG was measured on the human scalp and by Hans Berger. He would then go on to identify the first brain waves of alpha and beta after recording the first raw EEG data. Many
of the protocols used today by NFB practitioners are based on his discoveries of the areas of the brain related to cognitive function and behavior.

By the late 1960’s and 1970’s researchers at UCLA, while working to control seizures, discovered the ability to re-train the brain by increasing alpha wave activity in order to achieve relaxation. This type of brain training was called EEG biofeedback or what is most commonly referred to today as neurofeedback (Hammond, 2008). NFB was originally used primarily to treat seizures and was used primarily for this purpose until around roughly 1990 (Larson, 2012). However, as more discoveries were made and more researchers began exploring other techniques, it is now being used in many addiction centers for recovering addicts, VA clinics for PTSD and educational settings for children with autism and ADHD. Some practitioners even focus on working with athletes or corporate clients for performance enhancement.

As mentioned previously, one school of thought is to train the brain based off the information gathered by the QEEG. These brain assessments first originated in the 1970’s and 1980’s with the work of Frank Duffy, E.Roy John, and Robert Thatcher (Demos, 2005; Budzynski, 1999). Quantitative EEG (QEEG), also referred to as brain mapping is used by practitioners to look at the brain function and raw EEG in its entirety. It analyzes the individual frequencies that make up the raw EEG (Demos, 2005). A cap is arranged on the client’s head lining up with the scalp locations designated by the nineteen points of the International 10-20 system. Once the information is gathered, the technician removes any artifacts such as eye blinks. The information is compared to normative data and displayed in color-coded maps. The normative database software compares the data collected from the client to other clients. This
information is used to determine specific signatures relating to a variety of disorders from ADHD to head injuries. These patterns are derived from other clients in a related clinical population (Demos, 2005). It appears that there are different viewpoints in the field regarding the use of the QEEG. One party relies heavily on the data for diagnosing and treatment of the NFB client while others question its validity and necessity. However, it seems to be growing in popularity. One researcher stated the information provided by the QEEG is much better than that provided by a visual EEG display due to its ability to show such high resolution and its ability to “measure network dynamics that are simply invisible to the naked eye” (Larson, 2012, pp 51).

Within recent years NFB has begun focusing even more on Alpha-theta training, specifically for the treatment of drug and alcohol addictions, as well as post-traumatic stress disorder (PTSD). Alpha-theta training, or what is also referred to as deep state training, is a low frequency training used to help guide the client into a deep meditative state. It is based on the psychotherapeutic model and it allows the client to access painful memories through an alpha-theta state (Wikipedia, 2012).

The alpha wave was the first of the brain waves to be named, as well as trained (Demos, 2005). The alpha state is compared to a meditative state or a sense of deep calming. They are more prominent when eyes are closed or during meditation. By training the brain in a deep state and increasing the alpha activity, it allows the client to deal with past issues while remaining in a relaxed state. Some have found this to be more effective than “talk therapy”, especially when dealing with clients suffering from PTSD, personality disorders and addictions.
One research reports that it calms down the limbic system, allowing the client to process the trauma in the frontal lobes. This same researcher stated that “It is an effective tool for the resolution of trauma and the building up of the human spirit” (Demos, 2005, pp 183; White, 1999). This form of NFB is gaining attention recently in its treatment for PTSD with war veterans, specifically in the research arena of Siegfried and Sue Othmer. In their 2009 report titled Post Traumatic Stress Disorder-The Neurofeedback Remedy, Siegfried stated that the most common symptom of those experiencing PTSD is that of replaying the traumatic event in their minds. With the repeat of these traumatic events, the mind and body become stuck in a constant state of threat. Using alpha-theta training helps to “disengage” the mind from the traumatic event. This helps reprogram the brain’s memory from a traumatic one to merely a historical event. He describes this process so eloquently:

“The remedy lies in giving the body-mind the visceral experience of calmness to which it no longer has access, and in reinforcing that state to the point where the body can once again live there in a steady state. Cognitively based methods don’t accomplish this task very well” (pp. 24).

The Othmers are doing some of the most leading research using neurofeedback training methods with war veterans experiencing PTSD.

Neurofeedback has ultimately developed into two main approaches. One focuses training on correcting or normalizing the QEEG while the other approach focuses on the client’s personal development and mental adaptability (Demos, 2005). In addition, NFB providers appear to come from a variety of backgrounds with different levels of training making this an
area of debate and concern among some professionals. Not all providers in the field are equally trained. Some have clinical backgrounds while others have a more educational or therapeutic training. Some providers base success of treatment on the QEEG data before and after NFB training while others use treatment protocols for specific symptoms and base change purely on the client’s self-report of symptom decrease or increase.

**Different Approaches for Neurofeedback**

There are varying approaches to NFB training. Some practitioners focus on setting rewards for the brain in order to reduce excess theta or increase beta while other practitioners focus on specific parts of the brain related to symptoms and merely look for a reduction in those symptoms allowing the brain to self-regulate. While some NFB practitioners prefer to use SMR training, others are using infra low frequency training where the brain is trained at a frequency as low as .1mhz. One other form of NF training is called LENS (Low Energy Neurofeedback System) which uses a very small electromagnetic signal along the sensors for just a few seconds. Its purpose is to help the brain to become more flexible by reducing excessive amplitude and variability in the brainwaves (Hammond, 2007). Another form of NFB that is quickly gaining a strong popularity among NFB practitioners uses Z-score training. This form of NFB was developed by Mark Smith and Thomas Collura and is based on the NeuroGuide database of Robert Thatcher (Larsen, 2012). It is used to help recognize where the brain is failing to listen to itself and to reveal where there is a lack of coherence. It is determined by first doing a QEEG or quantitative electroencephalogram of nineteen brain sites through a cap containing sensors that is placed on the scalp. The brain waves are recorded, measured and
compared to “normal” brain patterns based on age and gender of the client and a Z-score is then determined. This is used in turn as the guide for the Z-score training (Larsen, 2012).

An additional form of NFB to mention briefly is called LORETA which stands for low resolution electromagnetic tomography. It was developed by Roberto Pascual-Marqui PhD who also developed the LORETA key software. The LORETA-Key software is a collection of independent modules that the user must run in sequence in order to get from raw EEG to LORETA images. When used with a fast computer, LORETA allows the QEEG to read the brain’s deep cortical and subcortical regions. Some believe it provides a stronger, more enhanced form of brain training in that it allows the client to train these deeper parts of the brain directly instead of training through the cortex (Robbins, 2000). In 2002, Pascual-Marqui released a newer form of the LORETA software which he called sLORETA. The new software has the ability to localize test point sources with zero localization error in the absence of noise, which previously it was unable to do.

The method of NFB used for this study was infra low training with the Cygnet NFB equipment developed by Dr. Siegfried and Sue Othmer with EEG Institute. The Othmers were first introduced to NFB after attending a UCLA seminar on the NFB approach back in the 1980’s. Sue then searched for a NFB practitioner to treat their son’s seizures and quickly found it to be a technique that not only worked, but needed more research, as well as a more simplistic approach. She and Dr. Siegfried eventually opened the EEG Institute at the Brian Othmer Foundation and have been researching and developing NFB software since. Their focus has
been on both the emotional and physiological responses of clients during NFB training, as opposed to comparing QEEG data.

The Othmer’s current Cygnet system, as used in this study, is capable of training the brain at an infra low frequency of .1 milli hertz (mhz). This infra low training has instrumented amazing results among a wide range of client issues. The majority of the participants trained at .1mhz with the exception of a couple of participants who trained at .2mhz. These infra low frequencies (ILF) are slower than delta waves ranging anywhere from .1-4hz. Not all equipment is designed to work at these low frequencies but the Othmers have had much success with their Cygnet system and continue to put the majority of their focus in training clients with ILF. One researcher suggests that the ILF are similar to the energy patterns that are found running through the acupuncture meridians (Larsen, 2012). The Othmers claim that working with infra low frequencies impacts regulation of core functions, the default mode network, symptoms related to early development and neuronal excitability and seizure susceptibility (Othmer, 2011). They state that this low frequency training has shown to be very effective with clients experiencing trauma such as PTSD, as well as those suffering from anxiety, the autism spectrum and even addictions. While previous lower frequencies were generally reserved for clients with symptoms of over arousal, the infra low frequencies are tolerated with almost all populations. The Othmers continue to do more research in the area of infra low training in their California clinic.

Many confuse NFB with biofeedback. While NFB is a form of biofeedback, it differs in that its focus is on the brain and the Central Nervous System. Biofeedback relates to the
Peripheral Nervous System and uses techniques such as galvanic skin response, skin temperature training and heart rate variability. Biofeedback is associated with operant conditioning and allows the client to gain control over their symptoms and the ability to change those negative reactions. For instance, when using skin temperature control, the client can monitor their temperature as their anxiety fluctuates. Muscles can be re-trained not to tense up or heart rate can be slowed down by the client as he or she is observing these responses taking place in the body. One researcher suggests that the two combined can be very beneficial. He suggests that biofeedback training can enhance the NFB results (Demos, 2005).

How Does Neurofeedback Work?

The best way to explain the way NFB is that it works similarly to exercising the body or learning to play a musical instrument. It is a way of exercising the brain, so to speak. The amplitude and frequency of the brain waves are monitored and fed back to the brain in the form of some auditory, visual and often tactile feedback. This is done through video games or movies the client watches while training. It’s a way of mirroring back to the brain what it is doing so that the brain can learn to self-regulate (Othmer, 2011). For example, when training with a movie in Cygnet System, the changes in the brain’s frequency and amplitude will be mirrored back by the movie screen shrinking or expanding and the volume fluctuating. Some NFB providers also incorporate the “neuro bear” which is connected to the device and provides a tactile feedback through vibration. The client does not have to try and control the brain but relaxes and lets the brain train on its own. Other systems use beeps and various tones to train
the brain. The brain understands the client wants to hear the beep so it works with the feedback to provide the reward (Demos, 2005).

As neurologists have studied the brain, they have connected specific functions of the various lobes through observing brain lesions. Symptoms have been correlated to match the areas of the brain and treatments designed around these regions. For NFB treatment, electrode or sensor placement is often determined by connecting the symptoms presented with these specific areas of the brain (Demos, 2005). In addition, studies have noted specific parts of the brain related to certain psychological disturbances such as anxiety and depression. The left side of the brain is generally the focus for improving symptoms of depression while the right side of the brain appears to be the focus for reducing anxiety (Demos, 2005; Davidson, 1998).

NFB training uses the International 10-20 system for sensor placement on the head. The International 10-20 system divides the brain using numbers and letters. Even numbers are used for the right side of the brain and odd numbers for the left side. The sections consist of the frontal lobes (F), frontal poles (Fp), temporal lobes (T), occipital lobes (O), parietal lobes (P), central or sensorimotor cortex and the centerline that divides the left and right hemispheres (Z). These areas are all used for different types of symptom reduction and brain training. The frontal lobes are generally associated with executive function such as focus, time management, planning, organization, and memory as well as right side focus such as emotions and social skills. The parietal lobes are responsible for math calculation, special recognition, recognizing personal space and body awareness and are often the focus when training the brain for reducing anxiety and hyperactivity. Functions of the left temporal lobe are word recognition,
reading and language whereas the right temporal lobe is associated with facial and object recognition, social cues and musical creativity. The occipital lobes assist the brain in locating objects, visual acuity, as well as reading and writing. The sensory motor cortex is responsible for muscle movement and spatial discrimination. It is often the area of the brain that is trained after strokes, paralysis or seizures. Knowing and understanding the client’s symptoms and the correct location on the brain for training is of great importance for the success of NFB. While some clients may not have noticeable changes during the sessions, they do sustain changes over a period of time. Other clients can “feel” the immediate effects of training reporting feelings of relaxation or calming during the training session and after. Some clients experience negative effects such as sleep disturbances, confusion, irritation or a mild headache. These negative results can be relieved by choosing a different frequency or site location during the training session. This selection of frequency is referred by some as the client’s ORF or optimal reward frequency. This is a frequency where the brain responds in a positive manner producing the desired results.

The NFB training sites used for this study consisted of T3-T4, T4-P4, T3-Fp1 and T3-Fp2. Those participants complaining of depression and IBS symptoms were trained primarily at T3-T4 and T3-Fp1. Those experiencing anxiety symptoms and chronic constipation were primarily trained at sites T4-P4 and T4-Fp2. Most participants began at either T3-T4 or T4-P4 for the first three to five sessions before adding in a second site. Frequency and site placement were adjusted based on symptom changes.

*One Channel Training vs. Two Channel Training*
NFB training can be done using either one channel or two channel training protocols.

One channel training records one raw signal and separates it into parts with electronic filters. To record the EEG using one channel training, the practitioner must place three separate electrodes on the head. One electrode is the ground which is placed on the earlobe or anywhere on the scalp. The other two electrodes are called the actives and are responsible for collecting the EEG data. One of the two active electrodes is referred to as the reference. The reference can be set up on the earlobe or the scalp providing the option of two different montages. A reference set up on the earlobe is called a referential (monopolar) montage and is considered to be neutral in value. A bipolar (sequential) montage is when both actives are set up on the scalp. The bipolar montage allows two areas of the brain to train at the same time. Bipolar placement is used for asymmetry training. In essence, bipolar training is an exercise for the brain to regulate and control the two sites in reference to one another. Practitioners using the one channel training focus on specific areas of the brain relating to various symptoms and using one channel protocols specific to those symptoms.

Two channel training uses two raw EEG signals. Each of the channels has filters which are able to break down the raw EEG into frequency bandwidths. While both channels can use the same ground electrodes, they must each have their own set of active electrodes. Some researchers believe that two channel training is more beneficial than one channel training. Two channel training focuses on coherence training, asymmetry training, alpha synchrony training and two channel training along the motor strip. It presents a different kind of challenge for the brain. Here the provider is asking the brain to create more of a certain frequency. The
goal is to make increasing amplitude within the normal rhythm. So it is important to know the appropriate resting frequency of that part of the brain.

In addition, there is what is referred to as Referential Training which simply means that one electrode is used on a neutral site (such as an earlobe or the mastoid) where there are no EEG readings. This allows the active electrode site to give the resting rhythm of that lobe of the brain. For this research study, the researcher implemented one channel biopolar training protocols.

*Neurofeedback Research*

In 1976 the Biofeedback Society of America was formed followed by the Association for Applied Psychophysiology and Biofeedback in 1988. They emphasized clinical research using biofeedback as treatment (Moss, 1998). A variety of techniques have been developed for many types of health conditions being treated with NFB today. The clinical efficacy for using NFB has been demonstrated for disorders such as anxiety, ADD/ADHD, cerebral palsy, enuresis, seizures, chronic pain, hypertension, migraines, incontinence, insomnia, IBS, motion sickness, neuromuscular disorders, rectal pain, raynaud’s disease, rheumatoid arthritis, stroke and TMJ disorders (Moss, et. al; Shellenberger, Amar, Schneider & Turner, 1994).

The research focus on NFB treatment for this paper was for anxiety and depression, as well as IBS and constipation. However, there is very little research past or present for treating any of these conditions. Some research for NFB and depression was uncovered but very little recent information could be found. Research studying the effects of NFB on intestinal conditions does not seem to exist. There is some research in the field of biofeedback in the use
of constipated patients referring to bowel transit. Most of the current, and past, research focuses on autism, ADD/ADHD and PTSD. Maybe this has to do with the fact that most NFB practitioners are not focusing on nutrition so are not seeing clients with intestinal conditions or, perhaps those conditions are merely going unreported to the NFB practitioner. While this researcher’s former background is in education working with students with ADD/ADHD, her current alternative health practice focuses more on natural solutions for anxiety, depression, fatigue and intestinal disorders. Due to the strong gut-brain connection seen in the client population of this researcher, the study was geared towards using NFB for these particular disorders. Due to the lack of research available, the literature review for this section will only cover NFB and its use for treating anxiety and depression, with the exception of a couple of inserts relating to biofeedback and constipation.

Neurofeedback for Treating Anxiety and Depression

Neurofeedback is gaining popularity in the use of relieving stress related symptoms such as anxiety and depression, among other conditions. As many clients begin to seek alternatives to medications for their illnesses, NFB is gaining mobility among those alternative approaches. One author puts it quite eloquently stating that NFB has the ability to “mobilize endogenous systems within the person” as opposed to medications which only offer a chemical flooding to the brain in which it has to then figure out how to function correctly while under the influence of these drugs (Larson, 2012, p.14). In addition, according to research reviews anti-depressant medications are not capable of changing brainwave patterns (Hammond, 2004). While anti-depressant drugs have a mere 18% effect over placebos for treating depression (Antonuccio,
Danton, DeNelsky, Greenburg & Gordon, 1999), NFB has been shown to offer more promising
effects due to the fact that it is changing the biological environment for becoming depressed
(Baehr; et al 1997; Hammond, 2000, 2004).

There is strong research in the field for a neurophysiological basis for depression,
especially for those born into a family with a history of depression. Quantitative
electroencephalograms (QEEG) and other forms of brain imaging have revealed similar patterns
for those who are diagnosed or who have a predisposition for depression (Hammond, 2004). A
common theme found in symptomatic clients is an increase of slow alpha brain activity in the
left frontal lobe of the brain. Studies reveal that these clients are more inclined to becoming
depressed, anxious or withdrawn (Hammond, 2004). One of the first in using a clinical approach
to treating depression with NFB were the Othmers (1994), in which studies they conducted
showed a lack of activity in the left hemisphere in depressed clients. It would appear that NFB
plays a significant role in the ability to influence changes in this brainwave activity. Because
this is still a relatively new field, it has gone somewhat unnoticed among those unfamiliar with
its practices but it is this researcher’s opinion that it is slowly gaining respect. A 2008
publication titled Evidence-Based Practice in Biofeedback and Neurofeedback provided
evidence that NFB is effective for the treatment of anxiety, depression and psychosis (Yucha &
Montgomery, 2008). Another study reported findings stating that NFB, in a blinded placebo-
controlled study, showed significant results over the placebo for the treatment of depression
(Hammond, 2011; Choi, et al 2011). This study examined the effectiveness of using NFB to
enhance the right frontal alpha band to decrease symptoms of depression. Results showed that
asymmetry NFB training of the right frontal lobe brought about positive change and the
alleviation of depressive symptoms. A 2001 study used an alpha symmetry protocol for depression and reported a significant improvement of mood disorder symptoms which remained stable up to five years post treatment. The study observed three of six patients who completed an average of 27 NFB sessions for depression. The purpose was to increase difference in activation of the right and left frontal cortices. The hope was that if effective, the results would remain over time (1 to 5 years). Pre and posttest for depression were based on the Beck’s Depression Inventory. The findings supported the hypothesis with significant data for effective treatment of depressive symptoms (Baehr, Rosenfeld & Baehr, 2001).

In a review of a previous study conducted by Baehr & Baehr in 1997 which consisted of three clients, two who were diagnosed with adjustment disorder and the other client with dysthymic disorder, all three clients showed significant positive change in their depressive symptoms (Earnest, 1999). Another researcher conducted a case study of an adolescent who received 67 NFB sessions using an asymmetry protocol in which the purpose was to increase left hemispheric activity and decrease right hemispheric activity. This is often the approach with depressed clients due to the fact that the left hemisphere of the brain is connected to more positive emotions while the right side of the brain tends to promote more negative emotions (Evans, 2009). The client had not attempted the use of medication but had tried psychotherapy with no results. Beck’s Depression Inventory (BDI) was given with a pre-treatment score of eleven. By the completion of the NFB sessions, depressive symptoms were decreased with a post BDI score of three and the client’s psychologist stated that NFB had “saved the client from early mental illness” (Earnest, 1999). Another study stated that decreasing theta and increasing beta along the central motor strip would reduce symptoms of depression (Othmer, 1994). In
their 1997 study they noted that for manic-depression or bipolar disorders that bipolar training was more effective. However, they cautioned that too much beta training could lead to agitation, anxiety, anger and obsessive thoughts.

While most studies reported positive results in using NFB for the treatment of depression, one study did report a less desirable outcome initially. The initial training protocol attempting to correct alpha asymmetry in a depressed client failed. However NFB training to increase left hemispheric activity resulted in more positive results with the client who reported a reduction in depression symptoms and more energy. In addition, the client became less withdrawn. The researcher stated a possible reason for the failed first attempt was due to the client’s excessive concern and worry over his performance (Hammond, 2000). Another research states that while NFB can bring incredible results for most clients, some may present issues unreachable by neurotherapy alone. Clients who have experienced chronic issues for many years often make these conditions their life. They become “experts” in the area of their disease and it becomes all they think about and talk about. This author states that “Such clients present major challenges that go far beyond the realm of neurotherapy” (Swingle, 2008, pp 92).

Overall, there seems to be some significant studies reporting positive findings using NFB for the treatment of depression. With advances in the neurobiology of depression and anxiety, practitioners have a clearer understanding of the different locations of the brain responsible for a client’s happiness and well-being (Evans, 2009). However, there is a lack of research in this area and more studies with depressed clients are needed (Hammond, 2011). This appears to be the same issue surrounding studies with clients experiencing anxiety. One study was
performed using a traditional biofeedback technique called earlobe temperature biofeedback (ETB) where participants experiencing anxiety were trained to warm their right earlobe. In addition to ETB, two forms of NFB were used; alpha suppression and alpha symmetry training. The participants were trained to reduce alpha asymmetry in order to reduce anxiety symptoms. All of the clients were successful in reducing alpha asymmetry and there was a reduction in all anxiety symptoms. However, the results from the State-Trait Anxiety Inventory revealed that even though the participants were able to reduce alpha asymmetry with both the ETB and NFB, the anxiety symptoms improved with NFB but not with the ETB (Kerson, Sherman & Kozlowski, 2009). A 2011 NFB update in the Journal of Neurotherapy reported that out of eight studies using NFB for anxiety disorders, seven of those studies found positive changes (Hammond, 2011). Even a study as far back as 1977 reported significant reduction in anxiety among anxious alcoholics, compared to the control group, after ten hours of NFB (Hammond, 2011; Passini, Watson, Dehnel, Herder & Watkins, 1977).

There seems to be some controversy in the field over protocols used for treating anxiety with NFB. One viewpoint approaches treatment by attempting to decrease high beta waves often seen with anxiety, as well as increasing alpha amplitude by training specific areas of the brain and rewarding lower frequencies. Another viewpoint doesn’t focus as much on the brain wave patterns but allows the brain to learn to self-regulate, thus reducing the anxiety symptoms on its own. Other researchers reported the opposite in brainwave activity seeing high alpha amplitude in clients experiencing anxiety (Thomas, Sattlberger & Elizabeth, 1997). This same researcher presented a case study conducted with an anxious client using NFB to decrease alpha amplitude. Within ten sessions the client’s anxiety levels had significantly
decreased and after fifteen sessions, the client was free of panic after starting a new job which would not have been possible before treatment. The researchers determined that increasing alpha only helps those clients who show lower alpha amplitude. Those clients with very high levels of alpha brain waves do not respond positively to increasing alpha and in fact, this approach could cause anxiety symptoms to become worse. Furthermore, the researchers suggested that no uniformed protocols for either increasing or decreasing alpha activity in the brain should be used when treating anxiety disorders stating that a more important focus should be on finding a balance in brain wave activity instead of increasing or decreasing the alpha amplitude (Thomas et al, 1997).

Biofeedback for Treating Constipation

While there was very little research to be found on this subject, none of which was directly related to NFB practices, there are a couple of important findings worth mentioning here. One study written on the psychological approach to constipation stated that many patients experiencing constipation may require some type of psychological assessment. In addition, for those patients with extremely slow bowel transit time, biofeedback could be beneficial. Those gaining the most benefit from biofeedback are those patients with isolated anorectal dysfunction. This researcher further commented that popular surgical treatments for these disorders can be dangerous with biofeedback offering a safer and harmless approach. (Thompson, 2000). Another researcher suggested that biofeedback should only be used with a certain patient population and found it most useful for those with more severe defecation disorders such as pelvic floor disorders (Pare, 2011). This same researcher stated that trials in
the area of patients suffering with chronic constipation are lacking for all therapies. It appears that the little research in the field on this topic focuses more on the use of biofeedback for retraining rectal responses and bowel transit times. This researcher did not find any current research regarding the use of NFB for reducing anxiety or depressive symptoms often related to improper bowel function.

Summary

Research clearly validates the use of NFB for treating anxiety and depression. Although there is little to no research using NFB for IBS and constipation, this paper will indicate its effectiveness in these conditions, as well. There is undoubtedly a need for research in this field to have a more integrated approach in treating the gut-brain connection. However, it is this researcher’s belief that NFB will become a leading tool in treating these kinds of health challenges in the future. Although it is often misunderstood and relatively unknown among non-neurofeedback practitioners, it works. NFB offers an alternative to drugs. It doesn’t rely on years of talk therapy, nor does it rely on pharmaceuticals to attempt to change the chemical messengers of the brain. It connects the client to a neutral device (Larson, 2012) and gives the brain a chance to correct itself. The more research is presented, the more this powerful tool can be shared with the world. For now, it is a tool that presents itself outside of most health professional’s frame of reference (Robbins, 2000). Yet other modalities in the Western world, such as chiropractic treatments and acupuncture that have been misunderstood in the past have not only gained respect today, but are considered as viable treatments for disease. As more research unfolds, this gut-brain connection will become even more accepted. It is the
researcher’s hope that bowel dis-ease will no longer be something patients are told they have to live with, but a temporary state of imbalance that can be easily corrected through healing the gut and changing the brain.
Overview

The problem addressed in this study was that clients experiencing symptoms of either IBS or chronic constipation were only getting little or some relief of their symptoms even after making dietary changes to relieve inflammation, as well as nutritional supplementation through the use of digestive enzymes, probiotics and fiber. For this reason, the purpose of the study was to examine the connection between these physical, intestinal symptoms to those emotional challenges such as anxiety and/or depression and whether treating these symptoms using NFB training would result in not only a decrease in the anxiety/depression, but the intestinal challenges, as well.

Research Design

The design used for this study was a pretest-posttest design allowing the participants to answer questions on three different questionnaires before and after fifteen sessions of NFB training. The researcher began by giving each participant a Beck’s Depression Inventory (BDI), a Beck’s Anxiety Inventory (BAI) and a general intestinal health questionnaire.

The BDI consists of 21 self-scored items primarily designed to assess depressive symptoms using a Likert scale of 0-3. Totals are added up and put into a scoring scale with the highest possible total for the whole test being sixty-three. The rating scale for interpretation consists of the following ranges: 1-10, “These ups and downs are considered normal”; 11-16, “Mild mood disturbance”; 17-20, “Borderline clinical depression”; 31-40, “Severe depression”; and over 40, “Extreme depression”. Clients are asked to answer based on their feelings over
the last two weeks as consistent with the DSM-IV criteria for depression. (See Appendix A for sample).

The BAI consists of 21 anxiety symptoms which are rated on a 4-point scale with the following self-reports: “Not at all” (0) points; “Mildly, it did not bother me much” (1) point; “Moderately, it is very unpleasant, but I could stand it” (2) points; and “Severely, I could barely stand it” (3) points. The items on the BAI consist of descriptions related to anxiety symptoms in four different categories: (1) subjective (e.g., unable to relax), (2) neurophysiologic (e.g., numbness or tingling), (3) autonomic (e.g., feeling hot) or (4) panic-related (e.g., fear of losing control). The total scores are added together with scores from 0-7 reflecting minimal anxiety; scores of 8-15 suggesting mild anxiety, scores of 16-25 indicating moderate anxiety and scores of 26-63 reflecting severe anxiety. The BAI is easy to administer and takes only 5-10 minutes for the client to complete. (See Appendix A for sample).

The GI health assessment consisted of 35 questions sectioned off into Gastric Function, GI Inflammation, Small Intestine and Pancreas, and Colon. Each section ranged from 7 to 10 questions with clients choosing the number best describing their symptoms: “No/rarely” (0); “Occasionally” (1); “Often” (4); and “Frequently” (8). In some cases a “yes” or “no” was indicated with “yes” rated as (8) and “no” rated as (0). Points were totaled for each of the four sections and then rated as “low priority”, “moderate priority” and “high priority”. All sections were added together for a total initial test score and a total re-test score which are the numbers used in this research design. (See Appendix A for sample)

Participants
The participants were clients of an alternative health clinic who had been receiving help for issues of either IBS or chronic constipation, as well as some GERD symptoms. Participants were chosen after completing an interview questionnaire with the results and method of selection unknown. The questionnaire included questions related to IBS, constipation, other intestinal symptoms, as well as questions related to anxiety and depression. In order to be selected for the study, the participants must have been experiencing IBS or chronic constipation and/or anxiety or depression. They must have previously made dietary changes, as well as participated in nutritional supplementation consisting of digestive enzymes and probiotics for a minimum of thirty days with only some symptom improvement.

Ten participants were selected and given the pre and post tests before beginning fifteen NFB sessions over a two to three month period with most of the participants doing two NFB sessions per week. Participants also completed a symptom tracking email questionnaire once a week during the course of the study. (See Appendix B) The questionnaire tracked selected symptoms that were self-rated from 0 to 10 with 0 being no symptoms at all and 10 indicating very severe symptoms.

The researcher used three client, self-report rating scales, NFB training and an online symptom tracking program. The first scale used was Beck’s Anxiety Inventory (Beck, Epstein, Brown & Steer, 1988) which is a 21-item scale that measures the severity of anxiety in adults and adolescents. The second scale used was the Beck’s Depression Inventory (Beck & Steer, 1987) a 21-item scale used to measure the intensity of depression in clinical and normal patients. A gastrointestinal health assessment (Heller & Katke, 2006) was given which included
various symptom based questions divided into four different GI categories. All participants trained for 15 sessions of NFB and completed an online symptom tracking form (EEG Expert, 2002) once a week for the duration of the study.

**Procedures**

Each participant was asked to complete the three rating scales, as well as an initial intake session with the researcher in order to gather family history, medical history and additional background information to best determine where to begin with site placements. Participants engaged in a 30 minute NFB session, two times a week for a total of 15 sessions. Each week they were to complete a symptom tracking questionnaire in order to track changes in symptoms during the training process. Beginning training sites were chosen based on initial symptoms. For those experiencing depression symptoms, the researcher began at the T3-T4 training site at .1mhz. For those experiencing anxiety symptoms, the researcher began at T4-P4 training sites, also at .1mhz. These sites and frequencies varied throughout the training period based on individual symptom reports. At the end of the 15 NFB sessions, participants were then asked to complete the three rating scales once again and pre and post results were compared. The researcher also noted changes in symptoms based on each individual’s online symptom tracker.

**Summary**

Participants were introduced to NFB training as an additional method of re-training the brain to reduce symptoms of anxiety, depression, IBS and constipation. Each participant completed pre and post rating scales for anxiety, depression and gastrointestinal complaints.
They also participated in 15 NFB sessions and tracked their symptoms throughout the training process. Participants were educated on the connection between the “head brain” and the “gut brain” and how symptoms of anxiety and depression may have a direct impact on GI symptoms and vice versa. The importance of a healthy diet and exercise were also emphasized as well as continued use of nutritional supplementation such as digestive enzymes and probiotics.
Exploring the Gut-Brain Connection

Hypothesis

This literature leads to the argument that when applied correctly, Neurofeeback can be used effectively with stress reduction for anxiety and/or depression as an additional approach to relieving symptoms of IBS and/or constipation when nutritional approaches have previously taken place with little or only some improvement of symptoms, thus further establishing the gut-brain connection.

This study examined results of three surveys to explore three primary hypotheses.

1. Compared from pre to posttest on the Beck’s Depression Inventory survey, participants will show fewer signs and symptoms of depression after a 10 week program of 30 minutes sessions per week of neurofeedback training.

2. Compared from pre to posttest on the Beck’s Anxiety Inventory survey, participants will show fewer symptoms of anxiety after a 10 week program of neurofeedback training.

3. Compared from pre to posttest on the Gastrointestinal Inventory survey, participants will show fewer signs and symptoms of gastrointestinal problems after a 10 week program of neurofeedback training.

Results

The design used for this study was a pretest-intervention-posttest design, using the statistical analysis program SPSS 19.0. Two analyses provided the data used to draw conclusions in the research from the three surveys: pre-posttest frequency distributions for descriptive
data, and paired samples t-tests for inferential data. All participants were required to complete an initial intake session, followed by weekly training sessions.

Prior to implementation of the 10 weeks of sessions, the researcher assigned participant numbers to each person, and then data was collected for pretest values on each survey. The next ten weeks consisted of participants attending at least two NFB sessions each week. Each session consisted of an average of 30 minutes of NFB training. After 10 weeks, the surveys were given again as posttests. Outcome measures were assessed by comparison of pre and posttest change in frequency distribution percentages of response options for the group, to each question on each survey. Also, mean change and significance were assessed with paired sample t-tests for the group, for each question on each survey. The effectiveness of the intervention was evaluated by comparing changes in frequency distributions, mean change between pre and posttest, and discovering statistical significance levels of change at posttests.

The three hypothesis statements that guided the study were aligned with the purposes of the three surveys. After data collection, these hypotheses could be considered again with final data analyses of the study. The hypotheses postulated that participants would show a positive change from pre to posttest on all three surveys after the 10 week program.

Hypothesis one evaluated the BDI survey: The group showed positive change from pre to posttest according to the frequency distributions for all 21 questions, except question ten regarding time spent crying, which stayed the same. The paired samples t-tests showed questions 1, 4, 7, 12, 15, 17, and 21 had a statistically significant improvement at the .05 level, as well as the BDI Inventory Level, at posttest. The paired samples t-tests also showed
questions 11 and 20 had a statistically significant improvement at the .01 level, at posttest (see Table 1).

<table>
<thead>
<tr>
<th>Questions</th>
<th>Pre / Post</th>
<th>Mean</th>
<th>Change</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feelings of sadness</td>
<td>1.00 / .30</td>
<td>.70</td>
<td>.025*</td>
<td></td>
</tr>
<tr>
<td>Feelings of satisfaction</td>
<td>1.00 / .40</td>
<td>.60</td>
<td>.024*</td>
<td></td>
</tr>
<tr>
<td>Feelings of disappointment</td>
<td>.70 / .30</td>
<td>.40</td>
<td>.037*</td>
<td></td>
</tr>
<tr>
<td>Feelings of irritation</td>
<td>1.30 / .40</td>
<td>.90</td>
<td>.001**</td>
<td></td>
</tr>
<tr>
<td>Amount of interest in others</td>
<td>.90 / .30</td>
<td>.60</td>
<td>.024*</td>
<td></td>
</tr>
<tr>
<td>Feelings of productiveness</td>
<td>.90 / .40</td>
<td>.50</td>
<td>.015*</td>
<td></td>
</tr>
<tr>
<td>Feelings of tiredness</td>
<td>1.40 / .60</td>
<td>.80</td>
<td>.022*</td>
<td></td>
</tr>
<tr>
<td>Amount of worry regarding health issues</td>
<td>1.10 / .50</td>
<td>.60</td>
<td>.005**</td>
<td></td>
</tr>
<tr>
<td>Amount of interest in sex</td>
<td>1.20 / .70</td>
<td>.50</td>
<td>.015*</td>
<td></td>
</tr>
<tr>
<td>BDI Level Total Scores</td>
<td>2.40 / 1.30</td>
<td>1.10</td>
<td>.017*</td>
<td></td>
</tr>
</tbody>
</table>

**p<.01, *p<.05

Response options ranged on a continuum from 0 to 4; 0 showing very little or no depression as related to that question, and 4 showing a high level of depression as related to that question. The BDI Levels of Depression has 6 levels related to the total score of the 21 questions. The first level being considered normal and the sixth level being extremely depressed.

Hypothesis two evaluated the BAI survey: The group showed positive change from pre to posttest according to the frequency distributions for all 21 questions, except question one (regarding numbness and tingling) and twelve (regarding hands trembling), which stayed the same; and question 4 (regarding ability to relax), which showed a negative change. The paired
samples t-tests showed questions 7, 10, 15 and 19 had a statistically significant improvement at the .05 level, at posttest. The paired samples t-tests also showed questions 5, 8, 17 and 18 had a statistically significant improvement at the .01 level, at posttest (see Table 2).

Table 2. BAI Paired Samples T-test Results (See Appendix A)

<table>
<thead>
<tr>
<th>Questions</th>
<th>Pre / Post</th>
<th>Mean</th>
<th>Change</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fear of the worst happening</td>
<td>2.10 / .50</td>
<td>1.60</td>
<td>.000**</td>
<td></td>
</tr>
<tr>
<td>Heart pounding or racing</td>
<td>1.30 / .40</td>
<td>.90</td>
<td>.019*</td>
<td></td>
</tr>
<tr>
<td>Unsteady</td>
<td>.90 / .01</td>
<td>.80</td>
<td>.003**</td>
<td></td>
</tr>
<tr>
<td>Nervous</td>
<td>1.90 / .80</td>
<td>1.10</td>
<td>.040*</td>
<td></td>
</tr>
<tr>
<td>Difficulty breathing</td>
<td>.80 / .00</td>
<td>.80</td>
<td>.022*</td>
<td></td>
</tr>
<tr>
<td>Scared</td>
<td>1.20 / .20</td>
<td>1.00</td>
<td>.001**</td>
<td></td>
</tr>
<tr>
<td>Indigestion or discomfort in abdomen</td>
<td>2.30 / .90</td>
<td>1.40</td>
<td>.004**</td>
<td></td>
</tr>
<tr>
<td>Faint</td>
<td>.40 / .00</td>
<td>.40</td>
<td>.037*</td>
<td></td>
</tr>
</tbody>
</table>

**p<.01, *p<.05

Response options ranged on a continuum from 0 to 3 as related to how often the participant was experiencing the symptom; 0 = Not at all, 1 = Mildly, 2 = Moderately, 3 = Severely.

Hypothesis three evaluated the GI health assessment: The group showed positive change from pre to posttest according to the frequency distributions for all four sections of the assessment, which totaled 35 questions. In Section A, the paired samples t-tests showed questions 2, 3, 4, and 5 had a statistically significant improvement at the .05 level at posttest. In Section B, the paired samples t-tests showed questions 3 and 5 had a statistically significant improvement at the .05 level at posttest. In Section C, the paired samples t-tests showed questions 2, 6 and 9 had a statistically significant improvement at the .05 level at posttest. The
paired samples t-tests in Section C also showed question 4 had a statistically significant improvement at the .01 level at posttest. In Section D, the paired samples t-tests showed questions 1, 3, and 5 had a statistically significant improvement at the .05 level at posttest. The paired samples t-tests in Section D also showed question 2 had a statistically significant improvement at the .01 level at posttest (see Table 3).

Table 3. GI Paired Samples T-test Results (See Appendix A)

<table>
<thead>
<tr>
<th>Questions</th>
<th>Pre / Post</th>
<th>Mean</th>
<th>Change</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Section A</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excessive burping and/or bloating after meals</td>
<td>3.10/.80</td>
<td>2.30</td>
<td>.012*</td>
<td></td>
</tr>
<tr>
<td>Stomach spasms and cramping after eating</td>
<td>2.50/.30</td>
<td>2.20</td>
<td>.034*</td>
<td></td>
</tr>
<tr>
<td>A sensation that food stays in stomach</td>
<td>3.60/1.10</td>
<td>2.50</td>
<td>.024*</td>
<td></td>
</tr>
<tr>
<td>Bad taste in your mouth</td>
<td>1.40/.40</td>
<td>1.00</td>
<td>.023*</td>
<td></td>
</tr>
<tr>
<td><strong>Section B</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stomach pain or burning after eating</td>
<td>3.40/.60</td>
<td>3.00</td>
<td>.018*</td>
<td></td>
</tr>
<tr>
<td>Burning sensation in lower chest</td>
<td>2.50/.50</td>
<td>2.00</td>
<td>.027*</td>
<td></td>
</tr>
<tr>
<td><strong>Section C</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indigestion delayed 2-4 hours after eating</td>
<td>2.50/.40</td>
<td>2.10</td>
<td>.019*</td>
<td></td>
</tr>
<tr>
<td>Specific foods/beverages aggravate indigestion</td>
<td>3.70/1.40</td>
<td>2.30</td>
<td>.003**</td>
<td></td>
</tr>
<tr>
<td>Stool odor is embarrassing</td>
<td>1.80/.90</td>
<td>.90</td>
<td>.041*</td>
<td></td>
</tr>
<tr>
<td>Diarrhea (frequent loose stool)</td>
<td>3.10/1.20</td>
<td>1.90</td>
<td>.030*</td>
<td></td>
</tr>
<tr>
<td><strong>Section D</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discomfort, pain or cramps in colon</td>
<td>3.90/1.20</td>
<td>2.70</td>
<td>.017*</td>
<td></td>
</tr>
<tr>
<td>Emotional stress or raw foods upset stomach</td>
<td>4.10/1.40</td>
<td>3.00</td>
<td>.004**</td>
<td></td>
</tr>
<tr>
<td>Generally constipated</td>
<td>3.50/.80</td>
<td>2.70</td>
<td>.020*</td>
<td></td>
</tr>
</tbody>
</table>
Exploring the Gut-Brain Connection

Pass mucus in your stool  

2.30 / .90  
1.40  
.025*

**p<.01, *p<.05

Response options ranged on a continuum from 0 to 3 as related to how often the participant was experiencing the symptom; 0 = No / Rarely, 1 = Occasionally, 2 = Often, 3 = Frequently.

Summary

This study was designed to measure the effectiveness of a 10 week intervention treatment using NFB for complaints of anxiety and depression with concurrent symptoms of IBS and/or constipation where nutritional approaches have had little consequence in diminishing the gut related symptoms. This study was designed to demonstrate and statistically validate the presence and clinical importance of the gut-brain connection. Participants showed positive change in all three posttest surveys. The paired sample t-tests of the BDI survey showed 7 out of 21 questions had a statistically significant improvement at the .05 level, as well as the BDI Inventory level. The paired sample t-test at posttest also showed 2 questions out of 21 had a statistically significant improvement at the .01 level. The paired sample t-tests of the BAI survey showed 4 out of 21 questions had a statistically significant improvement at the .05 level at posttest. The paired sample t-tests also showed 4 out of 21 questions had a statistically significant improvement at the .01 level at posttest. The GI Assessment posttest showed positive change in all four sections of the assessment. In paired sample t-tests 12 out of 35 questions showed statistically significant improvement at the .05 level at posttest. Also at posttest, 2 out of 35 questions showed statistically significant improvement at the .01 level.

CHAPTER 5: Individual Case Studies
I look upon it, that he who does not mind his belly will hardly mind anything else.

~Samuel Johnson

Participant A

Participant A was a 34 year old female experiencing severe anxiety, chronic constipation, IBS, irritability, difficulty falling asleep and problems focusing. The symptoms of concern for this research study are the severe anxiety, IBS and chronic constipation. She has been in recovery for alcohol addiction, has been sober for six years and attends regular counseling sessions. She was diagnosed with a stomach ulcer at age 14 and has always remembered feeling somewhat anxious. Her mom is a child of an alcoholic and also experiences anxiety. The father is stable yet passive aggressive.

Participant A has been on probiotics and a blend of calming herbs to address her intestinal health and anxiety. She has also worked on removing inflammatory foods from her diet. She has experienced little relief, especially from the chronic constipation sometimes going three or four days between eliminations.

For the BAI, the participant originally answered “mildly” for heart pounding, fear of losing control, difficulty breathing, scared and face flushed. She answered “moderately” for unable to relax, nervous and indigestion or discomfort in the abdomen. She only answered “severely” for fear of the worst happening. Her posttest answers were all in the “not at all” category or “mildly” category. In the “mildly” category she checked feeling hot, unable to relax, heart pounding or racing, nervous, face flushed and sweating. For the BDI, the participant’s pre-training BDI indicated “0” in all areas except for I am critical of myself for my weaknesses or
mistakes, I don’t sleep as well as I used to, I am slightly more irritated now than usual, I put off making decisions more than I used to and I get tired more than I used to which all received scores of “1”. Her posttest scores showed the following changes: I don’t feel worse than anybody else, I don’t get more tired than usual, and I am no more irritated by things than I ever was, and I am no more worried about my health than usual. This client had an interesting increase in her score on a couple of questions but wrote in “reasons” for these increases that were indicators of positive change. She selected I cry more now than I used to but wrote in the margin, “But not in a bad way, just more present and in touch with my feelings”. She also chose I have greater difficulty making decisions than I used to but wrote in the margin “Just more aware really than I used to be”. Even with these changes, the participant remained in the normal range for her total score. These changes in awareness could be an indication that the NFB helped the participant to become more open to her feelings and her healing process.

Her pre-training BAI score was a (14) suggesting mild to moderate anxiety. BDI total score was a (5) considered to be normal ups and downs. The GI health assessment indicated a moderate priority for gastric function with a score of (8) high priority scoring in GI inflammation (13), small intestine and pancreas (17) and her highest in the colon section (38). Post-training score for the BAI was (6) indicating minimal anxiety. The BDI results remained in the normal category and GI post scores showed remarkable improvement with a (0) for gastric function, GI inflammation, and small intestine/pancreas and a (1) for colon.

The participant noticed changes in anxiety within the first three sessions and continued seeing a reduction in symptoms throughout the study. Her bowels were moving well, especially
following a training session, her anxiety levels were decreasing and she was less agitated. She reported an “ease” in handling stressors that previously caused stressful reactions both physically and emotionally. The main sites for training were T3-T4 at 0.2 mhz for the first few sessions then moving to T4-P4 and T4-Fp2 all at 0.2 mhz.

Participant B

Participant B was a 38 year old female presenting symptoms of anxiety, chronic constipation, severe abdominal bloating, fatigue, ADD and worry. This participant had experienced a hysterectomy, repeated surgery for endometriosis and was in constant pain, had been treated with several rounds of antibiotics over the years and currently on pain medications. At age 6 she was sexually abused by a cousin and received counseling. Her father was somewhat absent and she had recently lost her mother. Both her father and brother suffered from depression. She was currently in a high stress teaching position and unhappy at her job. Dietary changes consisted of eliminating wheat and cow’s dairy, as well as supplementing with probiotics, digestive enzymes, magnesium and a yeast detox formula. She experienced some relief, especially a decrease in abdominal bloating but was still not eliminating her bowels daily. She had also sought relief through regular colonic treatments with no results.

For the pretest BAI, the participant selected “severely” for nervous, indigestion or discomfort in abdomen and sweating. She chose “moderately” for feeling hot, unable to relax, fear of the worst happening, fear of losing control and face flushed. For her posttest survey she selected “not at all” for all questions indicating no more anxiety symptoms. For the pretest BDI
the participant selected *I feel quite guilty most of the time, I am critical of myself for my weaknesses or mistakes, I am quite annoyed or irritated a good deal of the time, I am less interested in other people than I used to be, I believe that I look ugly, It takes an extra effort to get started doing something, I wake up 1-2 hours earlier than usual and find it hard to get back to sleep, I get tired from doing almost anything, I have lost more than ten pounds* (note: this was intentional) and *I am worried about physical problems like aches, pains, upset stomach or constipation*. Posttest answers were all changed to non-depressive indicators. The only question that remained the same was *I have lost more than ten pounds* and this was an intentional weight loss unrelated to depression.

The pre-training BAI score was (20) indicating a high moderate anxiety level. BDI score was in the normal range at (3). Her GI health assessment suggested gastric function as a high priority (26), GI inflammation a (0), small intestine and pancreas at a moderate priority of (15) and colon with the highest score of (44) putting her in the high priority category. Post-training scores for the BAI were remarkably reduced to (0) based on the questionnaire, the BDI remained at the original score of (3) in the normal range. Scores for the GI health assessment were impressive, as well, with gastric function now at a (4), GI inflammation remaining at (0), small intestine and pancreas still at (15) and colon from (44) down to (0).

After completion of the study, the participant’s bowels were moving daily, she was experiencing no more anxiety and her pain was almost completely eliminated. She had lost over 10 pounds and was feeling better than she had felt in years. Sites used for training were T4-P4 for several sessions, adding in T4-Fp2 all at 0.1 mhz. Note: After completing 15 sessions of the
Exploring the Gut-Brain Connection

study, the participant’s constipation eventually returned only to be relieved when she would come back to the clinic for another NFB session. This indicates a strong relation of emotional stress to the constipation suggesting the need for further NFB sessions and possible Alpha Theta training.

*Participant C*

Participant C was a 51 year old female complaining of acid reflux and abdominal bloating, occasional loose stools, depression, insomnia, anger and chronic fatigue. She was easily bored and often unmotivated. Family history consisted of moving around a lot, a strict father who also traveled with his job, a brother who was deaf, depressed and had attempted suicide two times. Mother and sister also showed signs of depression. She was currently in counseling and receiving EMDR therapy.

For the BAI, the participant selected “severely” for wobbliness in legs, feelings of choking, difficulty breathing, and indigestion or discomfort in abdomen. She selected “moderately” for fear of the worst happening, heart pounding or racing, nervous, fear of losing control and sweating. She chose “mildly” for numbness or tingling, feeling hot, dizzy or lightheaded, shaky and faint. Her posttest answers were all in the “not at all” category except for unable to relax, heart pounding or racing, nervous and indigestion or discomfort in abdomen which were now all rated in the “mildly” category. Her BDI answers for pretest survey were I am sad all of the time and I can’t snap out of it, I feel discouraged about the future, I don’t get real satisfaction out of anything anymore, I feel quite guilty most of the time, I am disgusted with myself, I blame myself all the time for my faults, I have thoughts of killing myself,
but would never carry them out, I am quite annoyed or irritated a good deal of the time, I have lost most of my interest in other people, I feel there are permanent changes in my appearance that make me look unattractive. It takes an extra effort to get started at doing something, I wake up several hours earlier than I used to and cannot get back to sleep, I get tired from doing almost anything, I am very worried about physical problems and it’s hard to think of much else and I have almost no interest in sex. Her posttest selections were all in the non-depressive row except for I feel sad, I don’t enjoy things the way I used to, I am disappointed with myself, I am slightly more irritated now than usual, I am less interested in people than I used to be, I put off making decisions more than I used to, I am worried that I am looking old or unattractive, It takes and extra effort to get started at doing something (stayed the same), I get tired more easily than I used to, I am worried about physical problems like aches, pains, upset stomach or constipation and I am less interested in sex than I used to be. All of these selections were an improvement over the pretest selections other than those that remained the same.

Pre-training score for BAI was (27) indicating severe anxiety. BDI score was (28) in the moderate depression range. GI health assessment scores were partly in the high priority range with gastric function a (23), as well as GI inflammation. Small intestine and pancreas fell in the moderate priority with a score of (14) and a score of (8) for colon, also in the moderate priority range. Post-training score for the BAI was significantly better at (4) suggesting minimal anxiety. The BDI post-training score also improved at a (9) indicating the high end of the normal range. Post GI health assessment scores all fell within the low priority range with a (3) in gastric function, a (2) for GI inflammation, (1) for small intestine and pancreas and a (2) for colon.
The participant reported an increase in motivation noticed by her husband and children, a significant decrease in feelings of depression and anxiety as well as a decrease in acid reflux symptoms and IBS. She was less emotionally reactive and seemed to have an overall sense of well-being she had not previously felt. Her counselor noticed a better response to the counseling and EMDR therapy. She was sleeping well and had much more energy. Sites used for training were T3-T4 for several sessions then T4- Fp2 and T3, Fp1 at 0.1 mhz.

**Participant D**

Participant D was a 65 year old female experiencing anxiety, recent panic attacks, depression, bowel discomfort and indigestion. She had previously tried digestive enzymes and probiotics with little results. She was going through a terrible divorce after being married to an alcoholic who got sober and decided he no longer wanted to be married. She was an only child and remembered feeling lonely growing up.

Medical history indicated joint and sciatic nerve pain. The participant had rheumatic fever as a child and ten years ago was experiencing dizzy spells which resulted in a small aneurism over the right pre-frontal lobe. She was re-tested five years later and no aneurism was indicated. She was not currently experiencing dizzy spells.

For the pretest BAI, the participant selected “severely” for fear of the worst happening. She chose “moderately” for numbness and tingling, unable to relax, dizzy or lightheaded, terrified, nervous, scared, and indigestion or discomfort in abdomen. She had no “severely” selections for her posttest survey. She chose “moderately” for numbness and tingling, feeling
hot, unable to relax, and dizzy or lightheaded. She selected “mildly” for wobbliness in legs, fear of worst happening, terrified, nervous, fear of losing control, scared, indigestion or discomfort in abdomen, and sweating. Her pretest BDI selections were I am sad all the time and I can’t snap out of it, I feel I have nothing to look forward to, I feel I have failed more than the average person (same at posttest), I don’t get real satisfaction out of anything anymore, I feel guilty a good part of the time (same at posttest), I am disappointed in myself (same at posttest), I am critical of myself for my weaknesses or mistakes (same at posttest), I used to be able to cry, but now I can’t cry even though I want to (same at posttest), I am slightly more irritated now than usual (same at posttest), I am less interested in other people than I used to be (same at posttest), I have greater difficulty in making decisions more than I used to, I feel there are permanent changes in my appearance that make me look unattractive, I have to push myself very hard to do anything, I wake up several hours earlier than I used to and cannot get back to sleep (same at posttest), I get tired from doing almost anything, my appetite is not as good as it used to be, I have lost more than ten pounds, I am worried about physical problems like aches, pains, upset stomach or constipation (same at posttest), and I have almost no interest in sex.

Posttest BDI selections showed some improvement, other than those indicated as (same at posttest), including three that decreased to non-depressive selections, I do not feel sad, my appetite is no worse than usual and I haven’t lost much weight, if any, lately. As mentioned previously, while there were only some changes, her total score went from (32) indicating moderate depression to a (21) suggesting borderline clinical depression.

Pre-training score for the BAI was (24) in the moderately high range, borderline severe. Her BDI score was a (32) indicating moderate depression. GI health assessment scores were (4)
for gastric function in the moderate priority, (10) for GI inflammation in the high priority range, (23) for small intestine and pancreas falling in the moderate priority range and (16) for colon which was in the middle of moderate and high priority. Post-training BAI showed some improvement with a score of (16) in the low moderate to borderline mild range. BDI score decreased over ten points to a (21) suggesting borderline clinical depression. Her GI scores went to a (2) for gastric function falling in the low priority range, a (14) in GI inflammation still in the high priority range, down to an (8) in small intestine and pancreas and down to an (11) in colon still borderline high priority.

Overall, the participant reported a decrease in anxiety and sadness, even in the midst of the divorce procedures. She indicated her inability to sleep was from waking up and thinking about her current situation with her husband. Her sleep did not improve over the course of the training. For most of the study she appeared to be much happier and showing signs of decreased anxiety. If she came in feeling anxious, she reported feeling much calmer and relaxed after the training session. Training sites consisted of several sessions at T3-T4 adding in T4-P4; T4-Fp2 and T3-Fp1 all at 0.1 mhz (right side) and 0.2 mhz (left side, pre-frontal).

**Participant E**

Participant E was a 70 year old female with symptoms of anxiety, high blood pressure, stomach pain, gas and bloating, IBS and acid reflux. She had been on PPI’s for almost 20 years...
and had a long standing problem with intestinal inflammation, as well as stress and anxiety. She had been taking probiotics, digestive enzymes, adrenal and stress support herbs, as well as omega 3 fish oil for several years. At age 30, she experienced a traumatic divorce and was diagnosed with three stomach ulcers. She currently had no signs of ulcers but had been diagnosed with a hiatal hernia. She now happily married but still struggles with high anxiety and does not handle stress very well. She also experiences sinus problems including sinus infections and occasional vertigo.

For the pretest BAI, the participant selected “severely” for unable to relax, heart pounding or racing, and nervous. She selected “moderately” for fear of worst happening, dizzy or lightheaded, unsteady, scared and indigestion or discomfort in abdomen. She chose “mildly” for feeling hot, wobbliness in legs, shaky and face flushed. For her posttest selections she had no symptoms rated as “severely”. She had one “moderately” selection, indigestion or discomfort in abdomen. She selected “mildly” for feeling hot, unsteady, nervous and shaky. For her pretest BDI she selected I don’t enjoy things the way I used to, I am disappointed in myself, I am critical of myself for my weaknesses or mistakes, I am slightly more irritated now than usual, I feel there are permanent changes in my appearance that make me look unattractive (same at posttest), It takes an extra effort to get started at doing something, I don’t sleep as well as I used to, I get tired from doing almost anything (same at posttest), I am very worried about physical problems and it’s hard to think of much else, and I have almost no interest in sex (same at posttest). The posttest BDI selections showed improvement in all areas other than those indicated that remained unchanged.
Pre-training BAI score was a (23) indicating moderate anxiety levels. The BDI score was a (12) suggesting a mild mood disturbance. Her pre-training GI health assessment scores all fell in the high priority range with a (41) for gastric function, a (40) for GI inflammation, a (36) for small intestine and pancreas and a (20) for colon. Her post-training BAI score went down to a mild anxiety rating of (8). Her BDI score was now in the normal range at a score of (6). Her GI scores were still in the high priority range except for one with a (15) for gastric function, a (14) for GI inflammation, at (30) for small intestine and pancreas and a (8) for colon with a moderate priority rating. This participants scores did decrease suggesting some improvement of symptoms, however, they did remain in a high priority range overall. It is difficult to know the impact of the sinus infection and antibiotics on the body and how it may have disrupted the NFB training. More sessions would be needed, as well as a consideration for Alpha Theta training.

The participant noticed an improvement in her overall feelings of anxiety and depression. She stated feeling much less reactive to stress and very relaxed. She had a slight decline in blood pressure. During the study period she developed a severe sinus infection which led to vertigo. She had to take an antibiotic which flared up her IBS and acid reflux. An increase in symptoms was evident on her symptom tracker but a slight decline was noted towards the end of the study. Training sites were at T3-T4 as well as T4-P4 and some prefrontal training at Fp2, all at 0.1 mhz.

Participant F
Participant F was a 51 year old female presenting symptoms of anxiety, depression, ADD, stomach pain, gas, abdominal bloating, fatigue and IBS. She owned her own practice as a psychologist so experienced high amounts of stress. She had been taking probiotics and had tried digestive enzymes and had also been on a gluten free diet. The participant grew up with a father who was verbally abusive and her mom and brother both experienced anxiety and depression.

For the pretest BAI the participant selected “severely” for indigestion or discomfort in abdomen. She chose “moderately” for fear of the worst happening, heart pounding or racing, nervous, scared and face flushed. In the “mildly” category she selected feeling hot, wobbliness in legs, unable to relax, dizzy or lightheaded, fear of losing control, difficulty breathing, faint and sweating. For her posttest BAI she had no questions in the “moderately” or “severely” category. She selected “mildly” for numbness or tingling, feeling hot, fear of the worst happening, nervous, fear of losing control, indigestion or discomfort in the abdomen, and face flushed. For the BDI pretest survey the participant selected I feel sad, I feel discouraged about the future, I don’t enjoy things the way I used to (same at posttest), I am disappointed in myself, I am critical of myself for my weaknesses or mistakes (same at posttest), I am slightly more irritated now than usual, I put off making decisions more than I used to, I am worried that I am looking old or unattractive, I wake up 1-2 hours earlier than usual and find it hard to get back to sleep, I get tired more easily than I used to (same at posttest), my appetite is much worse now, I have lost more than five pounds, I am worried about physical problems like aches, pains, upset stomach or constipation, and I have almost no interest in sex. Her posttest BDI selections all improved.
either one level or to a non-depressive statement other than those indicated above that remained the same.

The BAI pre-training score was a (21) in the moderate anxiety range. BDI score was a (17) suggesting a mild mood disturbance. Her pre-training GI health assessment scores were all in the high priority range with a (29) for gastric function, a (37) for GI inflammation, a (44) for small intestine and pancreas and a (52) for colon. Post-training score for the BAI was a (7) in the normal anxiety range. The BDI score was reduced to a (7) indicating a normal range. Her GI scores decreased but remained in the moderate and high priority range with a (6) for gastric function, a (19) for GI inflammation, an (18) for small intestine and pancreas and a (32) for colon.

The participant reported a decrease in her anxiety and depression symptoms as well as a slow decline in her IBS. She did have several episodes of diarrhea during the study time frame but they had begun to decrease in severity by the end of the fifteen sessions. More sessions were needed and possibly some Alpha Theta training, as well. Training sites consisted of T3-T4 for the IBS and depression, as well as T3-Fp1 for emotional calming and focus.

Participant G

Participant G was a 65 year old female complaining of constipation, gas/bloating, acid reflux, anxiety, emotional reactivity, anger, fatigue, and obsessive negative thoughts. She was currently taking probiotics, omega 3 fish oils and homeopathic remedies. She exercised regularly and was otherwise in good health. She owned her own business so was under stress but loved her job. She grew up with an alcoholic father who was mean to her mom and had
affairs. She did not have a very good relationship with him. Depression and anxiety ran in her family. She had received some counseling in the past and had attended support groups for children of alcoholics.

For the pretest BAI, the participant selected no questions for the “severely” category. For “moderately” she selected fear of the worst happening. For the “mildly” category, she selected unable to relax, fear of the worst happening, dizzy or lightheaded, heart pounding or racing, nervous, fear of losing control, fear of dying, scared, indigestion or discomfort in abdomen, and face flushed. Her posttest BAI survey showed no questions selected in the “moderately” category and half of the previously selected questions for “mildly” now fell in the “not at all” category. Those remaining in the “mildly” category were unable to relax, fear of the worst happening, nervous, fear of losing control, fear of dying, and indigestion or discomfort in abdomen. For the BDI, the participant selected I feel guilty a good part of the time, I am slightly more irritated now than usual, I am less interested in other people than I used to be, I put off making decisions more than I used to (same at posttest), I am worried that I am looking old or unattractive, It takes an extra effort to get started at doing something, I don’t sleep as well as I used to (same at posttest), I get tired more easily than I used to (same at posttest), and I am worried about physical problems like aches, pains, upset stomach or constipation. For her posttest BDI, all question selections went down to non-depressive statements except for those stated above that remained the same.

The pre-training BAI score showed mild anxiety (12). Note: The researcher was somewhat surprised at this low score after hearing the level of anxiety expressed during the
intake process. When questioned about this later, the participant admitted she had not been truly honest in her answers. The pre-training BDI score was an (8) suggesting a normal range. The GI health assessment indicated moderate priority in all sections with a (4) in gastric function, a (13) for GI inflammation, an (8) for small intestine and pancreas and a (10) for colon. Post-training BAI score was a (6) putting the participant in the minimal anxiety range. Her BDI score was a (3) indicating normal range, as well. Her GI health assessment scores were reduced to a (2) for gastric function, a (5) for GI inflammation, a (0) for small intestine and pancreas and an (8) for colon.

The participant reported an almost immediate decrease in anxiety. She became much less reactive and was experiencing less anger. She stated that she began to feel calm and more focused. Her GI symptoms were significantly reduced other than the last week of training when she had a flare up of constipation after eating foods she normally did not eat. It was an observation of this researcher that the participant had a much higher state of anxiety at the beginning of the study than what was represented on the pretest BAI. When the researcher questioned the participant on this matter, she admitted that she was not completely honest on her selections because she was embarrassed at the level of anxiety she was feeling (she is a very successful and prominent interior designer in town). As the study unfolded, she became more open about her internal struggles and what drastic changes she was seeing from the NFB training. By the end of the study, she commented that NFB gave her the ability to “pause” and that it had “completely changed her life”. Training sites were T3-T4 and T4-Fp2 at 0.2mhz.

Participant H
Participant H was a 49 year old female reporting extreme stress, IBS, anxiety, depression, fatigue and difficulty waking up. She had recently moved to the area from her home town of 49 years after a second divorce. She was living on her own and in the midst of trying to begin a career in the theatre business. She had experienced sexual abuse from an in-law during her teenage years and had sought previous counseling and was currently participating in a 12-step support group. Her mom and sister had also experienced anxiety and depression. She was currently taking probiotics and digestive enzymes.

For the pretest BAI, the participant had no selections under the “severely” category. For the “moderately” category she selected feeling hot, unsteady, nervous, indigestion or discomfort in abdomen, face flushed, and sweating. She selected “mildly” for wobbliness in legs, unable to relax, fear of the worst happening, dizzy or lightheaded, scared and faint. Her posttest selections showed three remaining in the “moderately” category which were, feeling hot, indigestion or discomfort in abdomen, and face flushed. Two remained in the “mildly” category, unable to relax and sweating (previously in “moderately” category). For the pretest BDI, the participant selected, I am sad all the time and I can’t snap out of it, I feel discouraged about the future, As I look back on my life, all I can see is a lot of failures, I don’t get real satisfaction out of anything anymore, I feel I may be punished, I am disappointed in myself (same at posttest), I am critical of myself for my weaknesses or mistakes (same at posttest), I cry more easily now than I used to, I am slightly more irritated now than usual (same at posttest), I have lost most of my interest in other people, I put off making decisions more than I used to (same at posttest), I am worried that I am looking old or unattractive (same at posttest), I have to push myself very hard to do anything (same at posttest), I get tired more easily than I used to, and I have almost no
interest in sex. Her posttest selections improved either by reducing in severity or changing to a non-depressive statement, other than those stated above which remained the same.

The pre-training BAI score was an (18) in the moderate range. The BDI score was a (21) indicating moderate level of depression. Her GI health assessment scores were a (1) for gastric function, a (1) for GI inflammation and a (17) for small intestine putting her in the high priority range and a (27) for colon, also in the high priority range. Post-training BAI score was reduced to an (8) suggesting mild anxiety. BDI score went to a (16) indicating a mild mood disturbance. GI health assessment scores increased slightly for gastric function at a (5), and for GI inflammation at a (2). Small intestine and pancreas was only slightly decreased to a (16) and colon to a (20).

The participant reported a decrease in anxiety and depression, as well as a decrease in intestinal symptoms for the first half of the study. Symptoms began increase slightly towards the last two weeks of training due to circumstances surrounding job interviews and status of living situation. She did report that she had a much easier time waking up in the mornings and felt more energy overall. Training sites were T3-T4 and T3-Fp1 at 0.2 mhz for temporal sites and 0.4 mhz for pre-frontal training.

Participant I

Participant I was a 65 year old female complaining of chronic IBS, anxiety, depression, and difficulty staying asleep. She had taken probiotics, omega 3 fish oils and had tried digestive enzymes. She stated that she often internalized her feelings and had been struggling with anxiety and depression since the recent death of her husband who had been sick for three
years before his death. Her IBS had started just before her husband passed away. Her father was an alcoholic and her mother struggled with anxiety. The participant owned a high stress reality company but enjoyed her work. She was currently taking anti-depressant medication as well as sleep aids.

For the pretest BAI, the participant selected no symptoms in the “severely” range. For the “moderately” range, she selected fear of the worst happening, fear of dying, scared, and indigestion or discomfort in abdomen. In the “mildly” category, she chose feeling hot, unable to relax, dizzy or lightheaded, heart pounding or racing, unsteady, nervous, fear of losing control, difficulty breathing, and sweating. For the posttest BAI, she selected “moderately” for unable to relax, fear of the worst happening, and nervous. In the “mildly” category, she selected feeling hot, dizzy or lightheaded, heart pounding or racing, terrified, fear of losing control, fear of dying, scared and indigestion or discomfort in abdomen. For the pretest BDI, the participant selected I feel sad (same at posttest), I don’t enjoy things the way I used to (same at posttest), I am slightly more irritated now than usual, I put off making decisions more than I used to, I don’t sleep as well as I used to (same at posttest), I am worried about physical problems like aches, pains, upset stomach, or constipation (same at posttest) and I am less interested in sex than I used to be (same at posttest). The posttest BDI indicated improvement in a couple of statements, although one statement got worse (I feel discouraged about the future) and the others, as stated above, remained the same. This participant did not have very many changes in either the BAI or BDI surveys. It was noted that she was under tremendous stress with her job and the week of the posttest was the year anniversary of her husband’s death.
The participants pre-training BAI score was a (17) putting her in the moderate anxiety category. While the participant reported feeling sad and depressed, her pre-training BDI score of (7) indicated that she was in the normal range. The GI health assessment scores were (9) for gastric function, (14) for GI inflammation, and (23) for small intestine and pancreas, all in the high priority category. Her colon score was in the moderate priority range at (13). Post-training score for the BAI went to a (14), still in the moderate range. Her BDI score a normal rating of (7). Her GI health assessment scores were the same for gastric function (9) and GI inflammation (14) with decreases in the small intestine and pancreas to an (18) and colon to a (4).

The participant reported an immediate improvement in her sleep and was able to maintain sleep throughout the training process. In spite of the few changes in her surveys, she noted in her symptom tracking reports a decrease in her anxiety and sadness, as well as the ability to concentrate better. Her IBS symptoms improved slightly in that her abdominal cramping decreased and there were not as many instances of diarrhea. She reported an overall sense of well-being and a slight increase in her sadness the last week of training, as previously mentioned, due to the date of her husband’s passing. Training sites were T3-T4 and T3-Fp1 at .1mhz.

Participant J

Participant J was a 21 year old female with symptoms of chronic anxiety, IBS, indigestion, fatigue, difficulty waking up, anger and mild depression. In addition, she reported frequent tension headaches and had been previously diagnosed with mild narcolepsy. She had a previous history of eating disorders and some obsessive compulsive tendencies. She was in
college full time and under a lot of stress. She had made some dietary changes such as eliminating gluten and cow’s dairy. She was also taking probiotics. The participant admitted that she had an intense personality and was often an over achiever. She was taking extra courses so that she could graduate early. Her medications consisted of anti-anxiety meds, a mood stabilizer and medication for ADD.

For the pretest BAI, the participant selected “severely” for *nervous* and *indigestion or discomfort in abdomen*. She chose “moderately” for *feeling hot, unable to relax, fear of the worst happening, heart pounding or racing, and sweating*. She selected “mildly” for *wobbliness in legs, unsteady, terrified, hands trembling, shaky, difficulty breathing, scared and face flushed*. For the posttest, the participant had nothing selected in either the “severely” or “moderately” categories. She chose “mildly” for *feeling hot, unable to relax, heart pounding or racing and hands trembling*. For the pretest BDI, the participant selected, *I am sad all of the time and I can’t snap out of it, I feel I have failed more than the average person, I don’t enjoy things the way I used to, I feel guilty a good part of the time, I feel I am being punished, I am disappointed in myself, I am critical of my elf for my weaknesses or mistakes, I cry now more now than I used to, I am quite annoyed or irritated a good deal of the time, I have lost most of my interest in other people, I put off making decisions more than I used to (same at posttest), It takes an extra effort to get started doing something, I get tired from doing almost anything, my appetite is much worse now, I have lost more than five pounds, and I am worried about physical problems like aches, pains, upset stomach or constipation*. The posttest selections all improved with one remaining the same, as stated above, and one rated worse (*I blame myself all the time for my thoughts*).
The pre-training BAI score was a (22) falling in the moderate anxiety range. The BDI score was a (23) indicating a moderate level of depression. The GI health assessment scores all fell within the high priority range with the exception of one falling in the moderate range. Gastric function was a (27), GI inflammation a (4), small intestine and pancreas a (24) and colon at a (10). Her post-training BAI score was significantly decreased to a (4) now falling in the range for minimal anxiety. Her BDI score also showed significant reduction to the normal range of (7). The GI health assessment scores went to a (4) for gastric function, a (4) for GI inflammation, both in the moderate priority range, a (23) for small intestine and pancreas and a (5) for colon reduced to a low priority.

The participant reported significant reduction in indigestion and constipation. She was having less loose stools and frequency but still some symptoms. Her anger was better and she was not having as much trouble waking up in the mornings so experiencing less fatigue, as well. She was feeling less depressed and anxious although still reporting an overall feeling of stress as a result of her busy school schedule. Training sites were T4-P4 and T4-Fp2 at .1mhz.

In Summary

There was an overall decrease in anxiety and depression, as well as IBS and constipation among all ten participants. Some participants experienced more significant symptom relief than others. There were some participants who stated more severe symptoms in their intake interview than reported on their pre-training questionnaires. This could be a result of the often constant change in symptoms related to anxiety and IBS. It should be noted that none of the participants were allowed to see their pre-training or post-training scores until after the study.
was completed so they were unaware of how they had rated themselves before or after training. Once the study was complete, the participants were allowed to compare their pre and post results.

CHAPTER 6: Discussion

*Man should strive to have his intestines relaxed all the days of his life.*
Introduction

This applied dissertation study sought to give an alternative approach to treating intestinal challenges such as IBS and constipation by using NFB training to reduce symptoms of anxiety and depression which have been shown to have an effect on intestinal health. The purpose of the study was to show that by reducing symptoms of anxiety and depression, one can also expect to see a reduction or elimination of intestinal complaints such as those commonly experienced with IBS and chronic constipation.

While there are studies reviewed indicating the use of NFB for treating anxiety and depression, there was very little research available for using NFB to bring about positive changes for those experiencing intestinal distress. This area of treatment may need to be further explored.

Research Question

The main research question that guided the researcher in this applied dissertation study was, If we know there is a gut-brain connection, could we produce a better symptom relief of IBS and constipation by introducing the client to NFB in order to teach the brain/body to self-regulate in the areas of anxiety and/or depression? In addition, the first anticipated outcome of this study was to decrease the symptoms of IBS or constipation in at least 80% of participants by a significant decrease in the total rating of presenting symptoms based on self-report answers to the GI Health Assessment. Findings showed a positive change from pre to posttest according to the frequency distributions for all four sections of the assessment. In Section A of
the GI Health Assessment, the paired samples t-tests showed a statistically significant improvement at the .05 level at posttest for four questions: excessive burping, belching or bloating after meals; stomach spasms and cramping during or after eating; a sensation that food just sits in your stomach creating uncomfortable fullness and bloating; and, bad taste in your mouth. In Section B, the paired samples t-tests showed statistically significant improvement at the .05 level for two questions: stomach pain, burning or aching after eating; burning sensation in the lower part of your chest when lying down or bending forward. In Section C, the paired samples t-tests showed statistically significant improvement at the .01 level for question 4; specific foods/beverages aggravate indigestion. In Section D, the paired samples t-tests showed three questions with statistically significant findings at the .05 level; discomfort, pain or cramps in your colon, lower abdominal discomfort is relieved with the passage of gas or bowel movement; the consistency or form of your stool changes within the course of a day. In addition, question 2 of Section D had a statistically significant improvement at the .01 level. This question stated, Emotional stress and/or eating raw fruits and vegetables causes abdominal bloating, pain, cramps or gas.

The second anticipated outcome was to decrease the symptoms of anxiety and/or depression in at least 80% of participants by at least one level decrease in presenting symptoms rating scale based on the BAI or the BDI. The results showed positive change from the BDI pre to posttest according to the frequency distributions for all 21 questions, with the exception of question ten regarding time spent crying, which stayed the same. Statistically significant changes were found at the .05 level for the following questions: (1) regarding feeling sad, (4) regarding satisfaction, (7) regarding disappointment in self, (12) regarding a loss of interest in
others, (15) regarding work effort, (17) regarding fatigue and (21) regarding interest in sex. Questions 11 (regarding irritation) and question 20 (regarding worry over physical health) showed statistically significant improvement at the .01 level, at posttest.

In addition, positive changes from pre and posttest for all 21 questions of the BAI were found with the exception of questions one (regarding numbness and tingling) which remained the same and question twelve (regarding ability to relax) which showed a negative change.

Statistically significant changes were found at the .05 level for the following questions: (7) heart pounding or racing, (10) nervous, (15) difficulty breathing, (19) faint. Statistically significant improvement at the .01 level were shown in questions (5) fear of the worst happening, (8) unsteady, (17) scared, and (18) indigestion or discomfort in abdomen.

All participants showed positive changes in symptoms of anxiety and/or depression, IBS and/or constipation. Participant A scored the same on the BDI in the normal range and went from mild anxiety to minimal anxiety on the BAI. Her GI score went from high priority to a low priority. Participant B remained in the normal range on the BDI and went from moderate anxiety to no anxiety at all on the BAI. Her GI score went from a high priority to a low priority. Participant C went from moderate depression to normal on the BDI and from moderate anxiety to minimal anxiety on the BAI. Her GI score went from moderate high to low priority. Participant D went from severe depression to moderate depression on the BDI and from severe anxiety to mild anxiety on the BAI. Her GI score went from moderately high priority to low moderate priority. Participant E went from mild depression to normal on the BDI and from moderate anxiety to mild anxiety on the BAI. Her GI scores remained in the high priority range;
however her scores in each section were lower in the posttest than pre-test giving her some significant changes. The lack of GI improvement for this particular client may be related to a hiatal hernia flare up during the study period. Participant F went from borderline depression to the normal range for the BDI and moderate anxiety to minimal anxiety on the BAI. Her GI score remained in the high priority range but her numbers in each section were lower on the posttest than the pre-test. Participant G remained in the normal range on the BDI; however, her score went from “8” to “3”. She went from mild anxiety to minimal anxiety on the BAI. Her GI score remained in the low priority range with lower numbers in each section in the posttest compared to the pre-test. This particular client noted that she did not completely answer honestly on the pre-test due to her lack of relationship of the researcher. As the study unfolded, the client began to feel more relaxed and open about her initial symptoms.

Participant H went from moderate depression to mild depression on the BDI and went from moderate anxiety to mild anxiety on the BAI. Her GI scores remained in the moderate priority range but she had much lower scores in the two sections related to the colon. This particular client was in the middle of a huge life change and stated that even though improvements were mild, her symptoms during this stressful time would have normally been much worse without the NFB training. Participant I remained in the normal range for the BDI and went from moderate anxiety to mild anxiety on the BAI. Her GI scores remained in the moderate priority range but were lower in two of the sections on the posttest score. Participant J went from moderate depression to the normal range on the BDI and from moderate anxiety to minimal anxiety on the BAI. Her GI score went from high priority to low priority.
Overall, there appears to be significant improvement in symptoms among participants. Based on the pre and posttest findings, 100% of the participants experienced at least one level decrease in the posttest scoring of the BAI. While only 70% showed a one level decrease in the BDI, the other three participants stayed the same which was in the “normal” range and two out of the three scored lower numbers in that normal range. For the GI Health Assessment, 50% of participants showed a one or more level decrease in posttest scores. However, it is important to note that the other 50% remained in the same category but had a reduction of their scores in those categories showing some improvement of symptoms. It is the researcher’s opinion that there are significant findings supporting positive changes in intestinal distress when reducing symptoms of anxiety and depression using neurotherapy.

**Delimitations**

The researcher used a sample of participants that consisted of only ten clients, at least half of those who had already worked previously with the researcher in the area of nutrition. Participants were only given 15 sessions of NFB while most clients experience at least 20 sessions before determining if significant changes have occurred. In addition, the sample group consisted of all female participants, most of who were over the age of forty.

**Limitations**

The researcher’s previous working relationship with some of the participants could have influenced the way they responded to the pre and post questionnaires. While none of the participants were aware of the goals or predicted outcome, it is possible that some of them
could have not answered questions in an entirely honest manner in fear of jeopardizing the study. They may have responded to both the pre and post questionnaires based on what they perceived as the researcher’s preferences. In addition, the short duration of the study did not allow for long term data collection.

**Recommendations**

Based on the findings obtained through this study, the following recommendations are presented:

1. This study should be replicated with a larger sample of participants consisting of both male and female clients. Participants should be randomly chosen from a pool of clients presenting the symptoms being observed.

2. The duration of the study should extend 15 sessions of NFB to a minimum of 20 sessions. A follow up study should be conducted a year later and possibly for subsequent years to document the effectiveness of the intervention for both the physical and emotional symptoms.

3. Due to the significant findings of this study, those findings from a larger study, if as significant, should be presented to local physicians working with patients suffering with bowel inflammatory diseases, as well as psychologists working with depressed and anxious clients.
It is this researcher’s strong recommendation that more studies using NFB for the treatment of IBS and chronic constipation should be conducted. In addition, more studies in the area of anxiety and depression should also be considered. These conditions affect millions of lives in the United States alone, and most are given little hope of symptom relief or complete healing. A 2008 study in the Journal of Neurotherapy observing the current research in NFB indicated that while there has been some improvement in research in the NFB field, more was needed. In this report, 26 studies were noted in the area of anxiety disorders, PTSD and sleep disorders before the year 2001, while only 8 published studies reported between the years 2001-2007. Studies involving depression were even fewer with only 13 published before 2001 and 7 publications reported between the years 2001-2008. No studies were noted relating to IBS and chronic constipation (Tinius, 2008).

Summary

The researcher implemented and evaluated a program using NFB training to improve overall symptoms of anxiety and depression with the expectation that a reduction in those symptoms would bring about positive changes in intestinal health. While the gut-brain connection has gained respect in the field of alternative medicine, it has not been a focus in the field of neurotherapy. It is this researcher’s hope that these significant statistical findings will spur interest in this area and bring about more in depth research studies.

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Exploring the Gut-Brain Connection


Exploring the Gut-Brain Connection

_Gut, 28, 1307-1318. doi: 10.1136/gut.28.10.1307._


Exploring the Gut-Brain Connection


doi: 10.4088/JCP.v60n0702.


Exploring the Gut-Brain Connection


conducted at Encino, CA.


APPENDIX A

Surveys
Below is a list of common symptoms of anxiety. Please carefully read each item in the list. Indicate how much you have been bothered by each symptom during the PAST WEEK, INCLUDING TODAY, by placing an X in the corresponding space in the column next to each symptom.

<table>
<thead>
<tr>
<th></th>
<th>NOT AT ALL</th>
<th>MILDLY</th>
<th>MODERATELY</th>
<th>SEVERELY</th>
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</thead>
<tbody>
<tr>
<td>1. Numbness or tingling.</td>
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<td>2. Feeling hot.</td>
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<td>3. Wobbliness in legs.</td>
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<td>4. Unable to relax.</td>
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<tr>
<td>5. Fear of the worst happening.</td>
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<tr>
<td>6. Dizzy or lightheaded.</td>
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<tr>
<td>7. Heart pounding or racing.</td>
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<td>8. Unsteady.</td>
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<tr>
<td>11. Feelings of choking.</td>
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<td>14. Fear of losing control.</td>
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<td>15. Difficulty breathing.</td>
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<td>17. Scared.</td>
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<tr>
<td>18. Indigestion or discomfort in abdomen.</td>
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<tr>
<td>19. Faint.</td>
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<td>20. Face flushed.</td>
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<tr>
<td>21. Sweating (not due to heat).</td>
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</table>
Beck's Depression Inventory
This depression inventory can be self-scored. The scoring scale is at the end of the questionnaire.

1. 0 I do not feel sad.
    1 I feel sad.
    2 I am sad all the time and I can't snap out of it.
    3 I am so sad and unhappy that I can't stand it.

2. 0 I am not particularly discouraged about the future.
    1 I feel discouraged about the future.
    2 I feel I have nothing to look forward to.
    3 I feel the future is hopeless and that things cannot improve.

3. 0 I do not feel like a failure.
    1 I feel I have failed more than the average person.
    2 As I look back on my life, all I can see is a lot of failures.
    3 I feel I am a complete failure as a person.

4. 0 I get as much satisfaction out of things as I used to.
    1 I don't enjoy things the way I used to.
    2 I don't get real satisfaction out of anything anymore.
    3 I am dissatisfied or bored with everything.

5. 0 I don't feel particularly guilty
    1 I feel guilty a good part of the time.
    2 I feel quite guilty most of the time.
    3 I feel guilty all of the time.

6. 0 I don't feel I am being punished.
    1 I feel I may be punished.
    2 I expect to be punished.
    3 I feel I am being punished.

7. 0 I don't feel disappointed in myself.
    1 I am disappointed in myself.
    2 I am disgusted with myself.
    3 I hate myself.

8. 0 I don't feel I am any worse than anybody else.
    1 I am critical of myself for my weaknesses or mistakes.
    2 I blame myself all the time for my faults.
    3 I blame myself for everything bad that happens.

9. 0 I don't have any thoughts of killing myself.
    1 I have thoughts of killing myself, but I would not carry them out.
    2 I would like to kill myself.
    3 I would kill myself if I had the chance.

10. 0 I don't cry any more than usual.
     1 I cry more now than I used to.
     2 I cry all the time now.
     3 I used to be able to cry, but now I can't cry even though I want to.
11. 
0 I am no more irritated by things than I ever was.
1 I am slightly more irritated now than usual.
2 I am quite annoyed or irritated a good deal of the time.
3 I feel irritated all the time.

12. 
0 I have not lost interest in other people.
1 I am less interested in other people than I used to be.
2 I have lost most of my interest in other people.
3 I have lost all of my interest in other people.

13. 
0 I make decisions about as well as I ever could.
1 I put off making decisions more than I used to.
2 I have greater difficulty in making decisions more than I used to.
3 I can't make decisions at all anymore.

14. 
0 I don't feel that I look any worse than I used to.
1 I am worried that I am looking old or unattractive.
2 I feel there are permanent changes in my appearance that make me look unattractive
3 I believe that I look ugly.

15. 
0 I can work about as well as before.
1 It takes an extra effort to get started at doing something.
2 I have to push myself very hard to do anything.
3 I can't do any work at all.

16. 
0 I can sleep as well as usual.
1 I don't sleep as well as I used to.
2 I wake up 1-2 hours earlier than usual and find it hard to get back to sleep.
3 I wake up several hours earlier than I used to and cannot get back to sleep.

17. 
0 I don't get more tired than usual.
1 I get tired more easily than I used to.
2 I get tired from doing almost anything.
3 I am too tired to do anything.

18. 
0 My appetite is no worse than usual.
1 My appetite is not as good as it used to be.
2 My appetite is much worse now.
3 I have no appetite at all anymore.

19. 
0 I haven't lost much weight, if any, lately.
1 I have lost more than five pounds.
2 I have lost more than ten pounds.
3 I have lost more than fifteen pounds.
20.  I am no more worried about my health than usual.
    0  I am worried about physical problems like aches, pains, upset stomach, or
    1  constipation.
    2  I am very worried about physical problems and it's hard to think of much else.
    3  I am so worried about my physical problems that I cannot think of anything else.

21.  I have not noticed any recent change in my interest in sex.
    0  I am less interested in sex than I used to be.
    1  I have almost no interest in sex.
    2  I have lost interest in sex completely.

INTERPRETING THE BECK DEPRESSION INVENTORY

Now that you have completed the questionnaire, add up the score for each of the twenty-one
questions by counting the number to the right of each question you marked. The highest possible
total for the whole test would be sixty-three. This would mean you circled number three on all
twenty-one questions. Since the lowest possible score for each question is zero, the lowest
possible score for the test would be zero. This would mean you circles zero on each question.
You can evaluate your depression according to the Table below.

Total Score __________________ Levels of Depression

1-10 __________ These ups and downs are considered normal
11-16 __________ Mild mood disturbance
17-20 __________ Borderline clinical depression
21-30 __________ Moderate depression
31-40 __________ Severe depression
over 40 __________ Extreme depression

A PERSISTENT SCORE OF 17 OR ABOVE INDICATES THAT YOU MAY NEED
MEDICAL TREATMENT. IF YOU HAVE ANY CARDIAC CONCERNS, PLEASE
CONTACT CARDIOVASCULAR INTERVENTIONS, P.A. at 407-894-4880
**HEALTH APPRAISAL QUESTIONNAIRE—PART I**

**DIRECTIONS**
This questionnaire asks you to assess how you have been feeling *during the last four months*. This information will help you keep track of how your physical, mental and emotional states respond to changes you make in your eating habits, priorities, supplement program, social and family life, level of physical activity and time spent on personal growth. All information is held in strict confidence. Take all the time you need to complete this questionnaire.

**For each question, circle the number that best describes your symptoms:**

- **0 = No or Rarely**—You have never experienced the symptom or the symptom is familiar to you but you perceive it as insignificant (monthly or less)
- **1 = Occasionally**—Symptom occurs and goes and is linked in your mind to stress, diet, fatigue or some identifiable trigger
- **4 = Often**—Symptom occurs 2-3 times per week and/or with a frequency that bothers you enough that you would like to do something about it
- **8 = Frequently**—Symptom occurs 4 or more times per week and/or you are aware of the symptom every day, or it occurs with regularity on a monthly or cyclical basis

Some questions require a **YES** or **NO** response: 0 = **NO** 8 = **YES**

### SECTION A

<table>
<thead>
<tr>
<th>No/Rarely</th>
<th>Occasionally</th>
<th>Often</th>
<th>Frequently</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Indigestion, food repeats on you after you eat</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Excessive burping, belching and/or bloating following meals</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Stomach spasms and cramping during or after eating</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. A sensation that food just sits in your stomach creating uncomfortable fullness, pressure and bloating during or after a meal</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Bad taste in your mouth</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Small amounts of food fill you up immediately</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Skip meals or eat erratically because you have no appetite</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total points**

### SECTION B

<table>
<thead>
<tr>
<th>No/Rarely</th>
<th>Occasionally</th>
<th>Often</th>
<th>Frequently</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Strong emotions, or the thought or smell of food aggravates your stomach or makes it hurt</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Feel hungry an hour or two after eating a good-sized meal</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Stomach pain, burning and/or aching over a period of 1-4 hours after eating</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Stomach pain, burning and/or aching relieved by eating food; drinking carbonated beverages, cream or milk; or taking antacids</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Burning sensation in the lower part of your chest, especially when lying down or bending forward</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Digestive problems that subside with rest and relaxation</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Eating spicy and fatty (fried) foods, chocolate, coffee, alcohol, citrus or hot peppers causes your stomach to burn or ache</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Feel a sense of nausea when you eat</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Difficulty or pain when swallowing food or beverage</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total points**

### SECTION C

<table>
<thead>
<tr>
<th>No/Rarely</th>
<th>Occasionally</th>
<th>Often</th>
<th>Frequently</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. When massaging under your rib cage on your left side, there is pain, tenderness or soreness</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Indigestion, fullness or tension in your abdomen is delayed, occurring 2-4 hours after eating a meal</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Lower abdominal discomfort is relieved with the passage of gas or with a bowel movement</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Specific foods/beverages aggravate indigestion</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. The consistency or form of your stool changes (e.g., from narrow to loose) within the course of a day</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Stool odor is embarrassing</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Undigested food in your stool</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Three or more large bowel movements daily</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Diarrhea (frequent loose, watery stool)</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Bowel movement shortly after eating (within 1 hour)</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total points**

### SECTION D

<table>
<thead>
<tr>
<th>No/Rarely</th>
<th>Occasionally</th>
<th>Once every 2 weeks</th>
<th>Once a week</th>
<th>Several times a week</th>
<th>Daily</th>
<th>Severe/always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Discomfort, pain or cramps in your colon (lower abdominal area)</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Emotional stress and/or eating raw fruits and vegetables causes abdominal bloating, pain, cramps or gas</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Generally constipated or straining during bowel movements</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Stool is small, hard and dry</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Pass mucus in your stool</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Alternate between constipation and diarrhea</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Rectal pain, itching or cramping</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. No urge to have a bowel movement</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. An almost continual need to have a bowel movement</td>
<td>0 1 4 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Which of these do you experience (check all that apply)**

- Bloating
- Belching
- Heartburn
- Nausea
- Loss of appetite
- Abdominal pain
- Vomiting
- Loose stool
- Diarrhea
- Smelly stool
- Light, clay colored, or greasy stool
- Bright blood in stool
- Feeling of incomplete evacuation of stool
- Dark, tarry stool
Gastrointestinal (GI) Health Assessment

An estimated 70% of the body’s immune cells reside in the GI tract, suggesting that maintaining GI health is essential to immune system function and overall health.

The GI system is quite complex, and evaluating GI health in order to recommend a therapeutic support program can be a difficult undertaking in a busy practice. To simplify matters, the following graph provides a quick scoring system for GI Health as assessed by the Health Appraisal Questionnaire (see reverse).

### Health Appraisal Graph

<table>
<thead>
<tr>
<th>Section</th>
<th>LOW PRIORITY</th>
<th>MODERATE PRIORITY</th>
<th>HIGH PRIORITY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SECTION 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gastric Function</td>
<td>1 2 3 4 5 6 7 8 20 32 44 56</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SECTION 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GI Inflammation</td>
<td>1 2 3 4 5 6 7 8 24 40 56 72</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SECTION 3</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small Intestine &amp; Pancreas</td>
<td>2 4 6 8 10 12 14 16 32 48 64 80</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SECTION 4</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colon</td>
<td>2 4 6 8 10 12 14 16 30 44 58 72</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX B

Symptom Tracking Reports
Symptom Tracking Report created with EEG Expert

CLIENT

<table>
<thead>
<tr>
<th>ID</th>
<th>Abbreviation</th>
<th>Age/day</th>
<th>Indication</th>
<th>Date</th>
<th>Class</th>
<th>Start Date</th>
<th>Delete Client</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>31</td>
</tr>
</tbody>
</table>

Setup Notes:

- No additional information for selected symptoms.
- No additional information for selected medications.

Legend: sorted from bottom to top
- Poor short-term memory
- Low Libido
- Poor concentration
- Chronic constipation
- Anxiety
- Agitation
- Difficulty falling asleep
- Intake bowel

Setup-Notes:
-no additional information for selected symptoms-
-no additional information for selected medications-
Setup-Notes:
-no additional information for selected symptoms-
-no additional information for selected medications-
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- No additional information for selected symptoms.
- No additional information for selected medications.
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-no additional information for selected symptoms-
-no additional information for selected medications-
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- no additional information for selected medications
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- no additional information for selected symptoms
- no additional information for selected medications