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The emotional divide: Alpha wave asymmetry of the frontal lobes during mild, moderate and high fear commercials.

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Alpha wave asymmetry of the frontal lobes during

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By

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ABSTRACT

Advertising is embedded into everyday American life. Many television commercials aim to connect with the audience on an emotional level. Amongst these emotions, fear is often used to gain consumer attention. Theorists believe that moderate fear is the most effective level of fear to gain consumer attention, and cause behavioral changes. The emotion of fear also has effects on human physiology. Two different theories describe that the emotion of fear is linked to frontal lobe asymmetry, claiming that the emotion of fear will activate the right side of the frontal lobes. This study examined the modulated levels of fear (low, moderate and high) to determine if fear does activate the right hemisphere of the frontal lobes. Specifically, this study predicted that moderate fear would activate the right hemisphere of the frontal lobes by decreasing amplitude and frequency of alpha EEG waves, more than low and high fear. Significant results were not found when comparing moderate fear to low and high fear in the right frontal lobe. However, mean scores for moderate fear compared to low and high fear scores reveal a trend of activation indicating moderate fear to activate the right hemisphere more than the other two levels of fear. Also, results show significant differences in alpha activation when moderate fear was compared to happy and neutral advertisements.

CHAPTER ONE

INTRODUCTION AND

STATEMENT OF THE PROBLEM

> "Some current advertising, and especially that appearing on television, has been challenged as calculated to appeal to nonrational concerns and considerations. These forms of advertising, which are essentially non-informational in character, may raise questions as to their fundamental fairness, their conformity with the traditional economic justifications for advertising as sources of information upon which a free and reasonably informed choice may be made and the extent to which such advertising is designed to exploit such fears or anxieties as social acceptance or personal well being, without fulfilling the desires raised" (Federal Trade Commission News, 1971 as cited by Spence & Moinpour, 1972).

Since this statement by the FTC in 1971, the developed anxieties of Americans are currently played out in the media on a daily basis. Television programs, for example, warn about health issues, advertise insurance for possible disasters, feature public service announcements about gun control, present news reporting war tragedies, and instill deep within the American heart the threat of terrorism and death. Numerous advertising campaigns are launched to ignite fear, awareness, anxiety or preventive actions among people. When the threat is significant, these advertising campaigns can have a profound emotional effect on particular audience segments—instilling a sense of fear, dismay, outrage or the capacity to cope.

Problem Statement

In the year 2006, 18 minutes out of an hour of primetime television were filled with commercials, public service announcements (PSAs) and program promotions (Campbell, Martin & Fabos, 2009 Ed.). With the intense amount of advertising clutter, how can advertisers expect to have a truly emotionally effective ad?

Many advertisers employ emotional appeals in their campaigns to connect products or services to particular feelings that are expected to lead to desired behaviors. Emotions play a large role in advertising because they are central to human thought processes and are linked to memories (Plessis, 2005). Thus, emotions are thought to determine the depth with which advertising messages are processed.

It has also been found that any type of emotional appeal can lead to better retention of an ad (Plessis, 2005). Within the ad, an emotional appeal may be presented in hopes of generating arousal. Emotional arousal is clarified by Bolls, Lang and Potter (2001) as "the level of activation associated with the emotional response and ranges from very excited or energized at one extreme to very calm or sleepy at the other" (p.629). Emotional arousal activates the nervous system and brain functions in ways that are still under investigation by researchers. If emotional arousal occurs, cognitive focus and processing increases, which can then lead to the development of an emotion-memory link surrounding a brand name (Percy & Woodside, 1983). Of the many emotional appeals available, fear appeals are extremely prominent.

Emotion is a change in organism subsystems that are synchronized or complimentary to produce an adaptive reaction to an event that is considered relevant to the individual's well being (Scherer, Schorr & Johnstone, 2001). Emotions are elicited by evaluation (appraisals) of events and situations (Scherer, Schorr & Johnstone, 2001, p.3). The appraisal process may be a deliberate action, or may come from an automatic unconscious origin. In other words, emotions cause changes in cognition, physiology and behavior in individuals due to an evaluation of a pertinent situation, and persist after the emotional exposure has ceased (Lerner & Keltner, 2001). Eliciting the appropriate emotions to subsequently influence cognition and behavior is an important objective of advertising.

The question remaining for many advertisers and researchers, however, is the emotional force of fear effective? One research review exemplified the response differences to negative and positive stimuli (Baumeister, Bratslavsky, Finkenauer & Vohs, 2001). The review indicated that participants have heightened responses to negative events over positive events and participants reported more negative than positive emotional words when asked to recall a previously viewed list. These findings indicate that not only are negative emotions such as fear important, but they have inherently more impact on an individual's cognitive and psychological systems than that of positive or neutral emotions, and thus, individuals seek to bring their arousal levels back to homeostasis (Steen, 2007).

In physiological studies, fear has been shown to have a correlation with activation in the right frontal cortex (Hofmann, Moscovitch, Litz, Kim & Davis, 2005; Davidson, Marshall, Tomarken and Henriques, 2000; Nitschke, Heller, Palmieri & Miller, 1999). Although these studies have not definitively labeled the right hemisphere as the 'fear area' of the brain, this type of research can help determine if fear is triggered while viewing fear appeal advertisements.

EEG, electroencephalograph, is a popular measurement tool of physiology that will determine if the emotional fear within advertisements can be detected in the brain. Utilizing

EEG measurements can help determine which part of the brain is activated during fear appeal advertisements and the amplitude of these activations.

Study Purpose

This study aims to answer ongoing questions concerning human emotional reactions and their physiological correlates. It will investigate the emotion of fear and its influence on human EEG activity. Since fear appeal advertisements are heavily used by advertisers to seek consumer interest and attention, this study will examine the effect of fear advertisements to determine if this genre of ad is working to ignite brain activity.

Some researchers believe there is a difference in frontal lobe activity between the right and left hemispheres of the brain when individuals are exposed to different emotions, with positive emotions activating the left hemisphere and negative emotions activating the right hemisphere (Nitschke, Heller, Palmieri & Miller, 1999; Jones & Fox, 1992; and Tomarken, Davidson & Henriques, 1990). However, other researchers believe that the differences in frontal lobe activity between the left and right hemisphere are not due to positive and negative polarity emotions, but instead that approach-oriented emotions activate the left hemisphere and avoidance emotions activate the right hemisphere (Davidson, Ekman, Saron, Senulis & Friesen, 1990; Harmon-Jones & Allen, 1998; and Davidson, 1992). This study will be testing these theories to either solidify or challenge these models of physiological emotional processing.

CHAPTER TWO

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Fear appeals are often applied to promote behavior change by outlining the harmful consequences of an existing unhealthy behavior (Rice & Atkin, 2001). There are two major parts to a message constructed to elicit fear. The first part consists of the threatening situation presented to raise a sense of alarm. In the second, the recommended behavior is presented as a reasonable mechanism to avert the threatening situation (Butter, Abraham & Kok, 2001). Fear appeals are also employed at different levels. Prominent literature (i.e., Janis & Feshbach, 1953) describes these levels as mild, moderate, and high risk. Janis and Feshbach (1953) have presented evidence to suggest that high fear tends to create avoidance towards the stimuli and can thus turn people away from the threatening message, whereas moderate and mild fear levels are more effective in persuading audience members to abide by the recommended behavior. In their original study design (1953), three groups receiving either low, moderate of high fear treatments, were presented with a lecture on dental hygiene and then asked to report their attitudes and hygiene practices in an interview. The main findings of this study suggest "the over-all effectiveness of a persuasive communication will tend to be reduced by the use of a strong fear appeal if it evokes a high-degree of emotional tension without adequately satisfying the need for reassurance" (p. 92). The moderate and low fear appeal conditions resulted in attitude and practice changes indicating a more effective form of communication.

Drive Model and Fear Appeals

The very basic implication behind a fear appeal is that it will bring forth a negative motivational drive among audience members. This heightened state of arousal is associated with behavior, attitude or intention changes (LaTour & Rotfeld, 1997). Janis and Feshbach (1953) submit that when exposed to an appropriate, moderate level of tension, people will be more motivated to accept the prescribed behavior of that communication. This fear-drive model posits that the initial aversive response to a threatening or risk-laden stimulus can be modulated or toned down by messages suggesting the benefits of a recommended course of action. Such action-oriented messages increase people's sense of efficacy or the realization that they can do something to reduce, if not eliminate, the risk (Rossiter & Thornton, 2004). In short, an undesirable situation can be eradicated by practicing a recommended behavior.

However, when the fear-drive is activated to an extremely high level, the suggested behavior may not resolve the tension or may not be processed by the audience member:

> "If a communication succeeds in arousing intense anxiety and if the communicatee's emotional tension is not readily reduced either by the reassurance contained in the communication or by self-delivered reassurances, the residual emotional tension may motivate defensive avoidances, i.e., attempts to ward off subsequent exposures to the anxiety-arousing content" (Janis & Feshbach, 1953, p. 78).

Findings that indicate a curvilinear relationship between levels of fear and consumer persuasion (Beck & Frankel, 1981) suggest that the level of fear arousal must be modulated to the right amplitude for the advertisement or communication to be deemed as effective. When fear levels are too low, they may not activate emotional reaction at all; when they are too strong, they may cause defensive avoidance, psychological manipulation of the advertising message or even denial (Rice & Atkin, 2001).

Defensive avoidance carries with it a very real possibility for psychological resistance. That is, audience members have a higher tendency to ignore the message and subsequent messages from the same source because it is overly threatening (Janis & Terwilliger, 1962; Janis & Feshbach, 1953; Rice & Atkin, 2001). Message manipulation involves the purposeful alteration of a message or the assigning of negative qualities to the source to discredit the message altogether. Message denial usually entails audiences arriving at the conclusion that a particular threat is not relevant to their situation. Witte (1992) refers to these psychological defenses as fear control, in which people try to avoid the strong sense of fear evoked by an advertisement or communication. Because people tend to "respond to the fear, not to the danger," they will act with defensive avoidance techniques like manipulation or denial (p. 337). In contrast, an individual will respond with danger control if the fear level is moderate. Danger control elicits protection motivation that leads the individual to avert the threat by adopting the recommended response-efficacy behavior. This is because "individuals respond to the danger, not to their fear" (p. 337). Fear control and danger control described by Witte (1992) explain the results of previous studies on low, moderate and high fear appeals.

Audience members will react to a fear advertisement in a way that is most psychologically rewarding; i.e. to dispose or equalize the unpleasantness of the fear (Rice & Atkin, 2001). For example, Rossiter and Thornton (2004) presented young drivers with one of two commercials denoting a fear-relief combination, or a shock only advertisement. They found that subjects who witnessed the fear-relief advertisement were more likely to report reduced speed choices, whereas the shock commercial was initially shown to increase speed choices (exemplifying fear control). In a study related to AIDS anxiety and condom use, moderate fear appeals were found to significantly bring about positive assessments of the recommended behavior among subjects (Hill, 1988).

The above findings exemplify that a modulated amount of fearful advertising tactic is needed to gain a consumer reaction. The appropriate amount of fear, or moderate level, will lead to further cognitive processing of the message. In opposition, too weak or too strong a fear appeal will shut down cognitive processing.

The curvilinear relationship of mild, moderate and high fear exemplify a human's ability to utilize cognitive processing of emotional reactions to respond to emotional advertising appeals. Humans are able to process, contemplate and react upon their own emotional experiences due to the evolving brain and the development of an emotional processing system.

The Triune Brain

Emotions are what drive humans on a day-to-day basis. These complicated feelings cause neural activation as well as physiological reactions. Emotions can cause laughter, increased perspiration, changes in heart rate, muscle twitches and brainwave activity. Many theories have been developed to explain the complexity of human emotions.

According to researcher Paul MacLean, the human brain as we know if today, is a summation of evolving emotional and primitive systems that influence each other and work together to benefit the living being. MacLean uses the word "triune" to describe the human brain (Holden, 1979). This term refers to the three different sections that create the whole; the ancient reptilian core, the old mammalian brain or limbic system, and the neocortex.

Figure 2.1 represents the three portions of the triune brain and different processes occurring in each section.

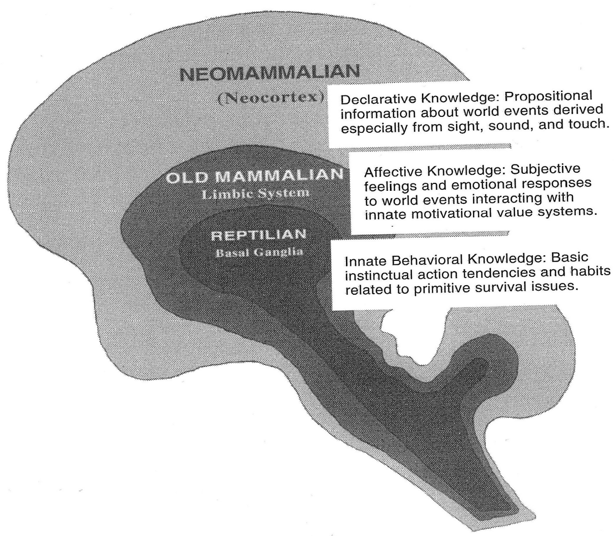

Figure 2.1 A simplified depiction of Paul MacLean's Triune Brain.

The reptilian brain lies at the deepest core of development in human brain structure. In this section of the brain many basic motor skills, such as whole-body movements, including primitive behavioral responses related to fear, anger and sexuality are triggered (Panksepp, 1998). MacLean (1990) claims the processes in this area of the brain are instinctual movements and behaviors, such as "routinization, repetition, reenactment, and deception" (p. 142). These processes are present in all organisms from reptiles to humans. Such behaviors promote survival of the organism by following primitive emotional urges.

The next portion of the evolved triune brain is the limbic system or the visceral brain. The limbic system contains newer schema related to social emotions and other unique mammal emotions (Panksepp, 1998). The limbic system builds upon the reptilian brain adding "behavioral and psychological resolution to all of the emotions and specifically mediates the social emotions such as separation, distress, social bonding, playfulness, and maternal nurturance" (p. 43).

Lastly, the outermost layer and most recently developed brain system is the neomammalian brain or the neocortex. The neocortex not only influences many aspects of cognition, but also can influence and is influenced by emotions (Panksepp, 1998). This component of the triune brain is different amongst mammal species but offers the newly evolved processes of logic, problem solving and causality. The neocortex will utilize emotional cues from the limbic system to process, evaluate and choose a behavior.

The triune brain builds its systems upon each other and thus, these systems work together to process an emotional reaction. This ability to process and analyze emotions is a very important evaluation process that occurs during emotional advertisements and messages. When fear is generated in a lower portion of the brain, such as the limbic system, the neocortex is needed to process the fearful message more thoroughly to ensure that the individual selects a beneficial behavior or outcome.

Physiology and emotion

Much of what we know about the pre-frontal cortex and emotion related occurrences have been associated with certain physiological activation and damage. Matthews, Zeidner and Roberts (2002) cite the rare case of railroad worker Phineas Gage who suffered a serious brain injury when a four-foot iron rod speared through his skull following an explosion. Although memory, motor skills and language remained functional, his personality grossly changed in that hostility and impulsiveness were magnified. In fact, the Gage case is an initial and primary example of the phenomenon referred to as catastrophic-dysphoric reaction (Springer & Deutsch, 1991), in which after left-brain hemispheric damage, patients report feelings of anger, depression and hopelessness. In contrast, after right brain hemispheric damage, patients become “inappropriately indifferent or manic” (Demaree, Everhart, Youngstrom & Harrison., 2005, p.4), exemplifying the phenomenon referred to as indifference-euphoric reaction (Heilman, 2002; Springer & Deutsch, 1997).

Research has also shown that individuals with right hemisphere lesions are unable to correctly name the emotion associated with emotionally laden sentences (Heilman, 2002). Another study found that individuals with bilateral orbito-frontal cortex damage experience deficits in voice prosody and face expression identification, as well as severe changes in their own subjective emotional state (Hornak, Bramham, Rolls, Morris, O’Doherty, Bullock & Polkey, 2003). Similarly, right hemispheric damages have also been known to produce deficits in facial reactions and to lead to poor judgments of facial emotions. “Since the left side of the brain controls the right side of the face, and vice versa, these results support the hypothesis that the right hemisphere primarily controls the facial expression of emotion” (Heilman, 2002, p. 65).

The aforementioned results on frontal lobes and emotion show that there is an undeniable connection between the frontal lobes and the processing and evaluation of emotion. Research results point to differing organization systems of emotion within the hemispheres of the frontal lobes. However, there are differing opinions on the exact emotional asymmetry between the right and left hemispheres. Two theories have been proposed to explain the differing emotional segregation between the left and right frontal lobes; they are the theory of emotional valence, and the theory of motivational direction.

Emotional Valence

The premise of the emotional valence theory is that positive and negative emotions are laterally related to brain activation. Specifically, positive emotional experiences are related to the activation of the left anterior and pre- frontal cortices, and negative emotions are shown to activate the right anterior and pre- frontal cortices (Tomarken, Davidson & Henriques, 1990). *Positive* and *negative* are words with relative and subjective definitions. Most individuals are able to identify emotions and whether these emotions feel good or bad, but in this theory, not much supporting information is revealed about the classification of these emotions. The assumption is that positive emotions include "contentment, happiness, joy, and pleasant surprise" while negative emotions include "sadness, anger, disgust and fear" (Heilman, 2002, p. 79).

Measurements of alpha brainwaves have been used to indicate the asymmetry discovered between the brain's hemispheres. Schaffer, Davidson and Saron (1983) revealed that clinically depressed individuals had significantly less left frontal activation than that of non-depressed individuals. Alpha waves were associated with greater right hemispheric activation during negative compared to positive elicited emotions.

Davidson and Fox (1989) found that infants who cried when separated from their mothers revealed greater right frontal activation than those who did not cry. Another study revealed that emotional anxiety and anticipation fear activated the right frontal part of the brain when individuals were asked to give an impromptu speech, as compared to a relaxation period and a period of only worrying about public speaking (Hofmann, Moscovitch, Litz, Kim & Davis, 2005).

Davidson, Marshall, Tomarken and Henriques (2000) tested fear reactions among phobic individuals and found that phobic persons anticipating a public speech had greater activation of the right-sided anterior temporal and lateral prefrontal regions of the brain in comparison to a control group. In accordance with these findings, EEG results demonstrate that a pre-tested group categorized as anxious arousal participants had more right hemispheric activation than individuals in groups categorized with anxious apprehension (Nitschke, Heller, Palmieri & Miller, 1999).

Another study had participants watch video clips that were developed to elicit disgust or happiness (Jones & Fox, 1992). Results for this study support the theory that the right hemisphere is specialized for the experience of negative emotions, whereas the left hemisphere operates during pleasurable emotions. Davidson and Irwin (1999) indicate a trend "in supporting the view of right-sided activation in several regions within PFC (pre-frontal cortex) during the experimental arousal of negative emotion" (p.14). However, Davidson believes that there is less evidence to indicate a left hemisphere activation elicited by positive emotion "in part because much of the literature on negative affect is derived from the study of patients with anxiety and mood disorders" (p. 14). Although, a study from Herrington, Mohanty, Koven, Fisher and Stewart (2005) presented subjects with positive, neutral and negative words in which the subjects were to report the color the word was printed in. fMRI results show more activity in the dorsolateral prefrontal cortex and more activity in the left prefrontal cortex with positive words.

Some studies have contradicted and challenged the theory of emotional valence. For example, Hamon-Jones and Sigelman (2001) experimented with the state-factor of anger and found that when anger was induced in individuals, there was greater left hemisphere activation. Researcher Harmon-Jones has found consistent results indicating that anger does not follow the emotional valence theory, in that anger is thought to be a negative emotion, but tends to activate the left (not the right) hemisphere of the frontal lobes (Harmon-Jones & Allen, 1998; Harmon-Jones, Sigelman, Bohlig & Harmon-Jones, 2003).

Other discrepancies have been found in evaluation of the emotional valence theory of frontal lobe asymmetry. Papousek and Schulter (2002) note an asymmetrical shift from the right hemisphere to the left hemisphere while participants conversely reported decreased feelings of tension, anxiety and depression, depicting a negative relationship between unpleasant emotions and right hemisphere activation. Nitschke et. al. (1999) found another type of anxiety that causes physical correlates of muscle tension, shortness of breath, dizziness and sweating, but did not activate either hemisphere of the brain. Also, Hofmann, Moscovitch, Litx, Kim and Davis (2005) revealed that emotional worry, a negative emotion, activated the left frontal part of the brain. Cognizant of these discrepancies, Heller and Nitschke (1998) contend that there are different forms of anxiety in human psychology. They report that both depression and anxiety have results that vary in magnitude and direction of asymmetry.

Crawford, Clarke and Kitner-Triolo (1996), demonstrated that both hypnotized and wakeful persons show no differences in alpha frequency during self-generated happy and sad emotional states. Instead, the results of this study show that with eyes closed, experiment subjects show low alpha band activation differences between happy and sad emotions in the posterior portions of the brain, and not the frontal regions.

Based on the above contradictions to the emotional valence theory literature, researchers in general seem to be assembling toward a different explanation of emotional stratification than positive and negative valence. The emotional valance theory of alpha frontal lobe asymmetry cannot explain why anger activates the left frontal region of the brain, or why some forms of anxiety activate the left hemisphere more than the right hemisphere of the frontal lobes.

Motivational Direction

The motivational direction theory of physiological emotion states that the right and left hemispheres of the brain are "lateralized" according to two primal subsystems of human reaction. Specifically, the right frontal lobes are involved in mediating withdrawal-type reactions and emotions, and the left frontal lobes are utilized in approach-based emotions and reflex (Davidson, Ekman, Saron, Senulis & Friesen, 1990). The approach system involves positive emotions such as happiness and amusement, but can also explain anger, and perhaps some forms of anxiety. The withdrawal system incorporates more negative emotions associated with "fight or flight" responses such as fear, disgust and other types of anxiety. "Fight or flight" situations are highly arousing, and can cause great fear or preparation for fighting or fleeing (Terry, 2000).

The motivational direction or approach-withdrawal systems theory espouses propositions similar to other physiological theories of primal reflex and response. One such theory specifies "an organism's emotional state will modify responses to valenced stimuli" (Lang, 1995 as cited by Kenntner-Mabiala & Pauli, 2005, p. 559). There are two separate drive systems that lead to motivational priming of human emotions—appetitive and aversive or defensive (Bradley, Codispot, Cuthbert & Lang, 2001). The emotional stimulations of the motivational priming system are seen as "action dispositions that prepare the organism to respond to environmental stimuli ultimately improving survival by approaching or by avoiding certain stimuli" (Herbert, Kissler, Junghofer, Peyk & Rockstroh, 2006).

The aversive motivational system is activated primarily when a threatening, hostile or unpleasant stimulus exists. Among organisms, aversive or unpleasant circumstances can cause a physiological reaction to fight or flee away from the aversive condition (Andreassi, 2000). In contrast, the appetitive system is activated when a pleasant life-affirming stimulus is present. This motivational system is prepared during situations involving nurture, procreation or health. The division of motivation systems was exemplified in a study where individuals were presented with aversive and appetitive word pairings. The aversive and appetitive emotional reactions were found to produce laterally divided physiological reactions (Sutton & Davidson, 1997).

The motivational direction theory builds on this past model of motivational systems by declaring that these systems are found in separate areas of the brain. This frontal lobe division theory stems from a survival form of emotional development and consists of two primal urges to approach or avoid. Although the motivation direction theory of frontal lobe asymmetry may reflect new portions of the developed brain, the ideas behind the theory come from a primitive biological background and previous physiological theories of human emotional development.

The motivational direction theory can help explain how emotions are developed. Motivation is a result of the appraisal process of a situation or environmental event. "Appraisals start the emotion process, initiating the physiological, expressive, behavioral and other changes that comprise the resultant emotional state" (Scherer, Schorr & Johnstone, 2001, p. 7). According to these authors, there are two different types of appraisal that may occur. Primary appraisal is the process of determining the relevance of the situation to oneself and what that appraisal means (i.e. Is the situation relevant and substantial to one's goals, beliefs and values, and in what way?). Secondary appraisal is the process of determining what actions or decisions can be made about the situation. This includes evaluating coping skills, determining social constraints, and evaluating the expected outcome (Scherer, Schorr & Johnstone, 2001). The appraisal process determines which motivational direction system is activated, and thus, whether an emotion is approach or avoidance oriented.

The motivational direction theory contains explanations that the emotional valence theory lacks. Motivational direction theory explains that anger is neither a positive nor a negative emotion and cannot be classified as such. Instead, in the motivational direction theory, anger is classified as an approach-based emotion (Harmon-Jones & Sigelman, 2001). An editorial eliciting angry reactions from college students showed increased left mid-frontal activity, specifically when the students had the ability to cope with the anger, and approach the mechanism with a rebuttal.

Some interesting results from Noesselt, Driver, Heinze and Dolan (2005) indicate when hemifield facial expressions (i.e. faces divided in half revealing two different emotions) with fear shown in the left hemisphere are shown to subjects, they were more accurate at identification of the emotion and had more right-hemisphere activation, whereas when these faces were presented in the right visual field, no activation was detected in the left hemisphere. These findings show a quicker brain analogy of the emotion of fear in the right side of the brain. Also, Sutton and Davidson (1997) show that the approach and inhibition systems are directly linked to asymmetrical frontal region personality measurements.

Subjects with greater left prefrontal activation had more behavioral approach system strength, whereas individuals with greater right prefrontal activation exhibited more behavioral inhibition traits. Consistent with this, Coan, Allen and Harmon-Jones (2001) found that negative voluntary facial emotions depicted more activation in the right lateral-frontal, midfrontal, and frontal-temporal-central regions of the brain in comparison with these regions in the left hemisphere.

The aforementioned results do not conclusively clarify whether emotional valence or motivational direction is responsible for the asymmetric findings in brain hemispheric activation. Harmon-Jones and Allen (1998) have previously contended that asymmetrical activity is associated with motivational direction, implying that their results discredit the emotional valence asymmetrical relationship theory. However, one study indicates that anger does not always activate the left frontal lobe. Harmon-Jones et al. (2003) also found that when an individual had no way of rectifying or coping with anger, he/she would report angry emotions although no left frontal activity occurred (Harmon-Jones, 2003). According to the findings on anger and anxiety, there may be many facets of each individual emotion.

Davidson (1992) indicated that approach-withdrawal tendencies can be detected even in newborns, emphasizing the development of the motivational appetitive-aversive systems from birth. Also, he stresses that individual physiological differences play a role in lateralization. These differences include mood, emotional reactions to appeals, psychopathology, immune function, temperament, and handedness, among other factors.

However, there are research findings that may shed doubt upon the theories of hemispheric asymmetry. Kosslyn, Shin, Thompson, McNally, Rauch, Pitman and Alpert (1996) found that while individuals perceived aversive stimuli, activation increased in the left hemisphere increasing cerebral blood flow. This finding refutes both theories of frontal lobe asymmetry. Another study (Hagemann, Naumann, Becker, Maier, & Bartussek, 1998) predicted that subjects who had greater left side EEG readings should report more intense happy emotions after viewing positive slides, whereas subjects with greater right hemisphere activation in the frontal cortex, should report more intense negative emotions after viewing negative slides. However, these predictions were not found to be true.

EEG and Frontal Lobes

Electroencephalograph is a process of reading brain electrical activity through the scalp using metal electrodes and complicated media (Teplan, 2002). EEG has been around for over a century now, although the precise discovery of all the components is a complicated path. The discovery of significant electric activity in the brains of rabbits and monkeys was in 1875 by a gentleman named Caton (Teplan, 2002). In 1924, Hans Berger connected a radio to amplify the electrical activity of the brain. With this he discovered different patterns of waves with subjects that had neural damage, epilepsy, or lack of oxygen, or when they were sleeping. Progressive years revealed the discovery of the different types of waves within the EEG.

Beta waves have an electrical activity greater than 13 Hz, Alpha waves activity is between 8-13 Hz, Theta waves are between 4-8 Hz, and Delta waves are .5-4 Hz (Teplan, 2002). Beta waves are activated when an individual is involved in a mental or physical activity that may involve mental concentration (Andreassi, 2000). Delta waves appear only in deep sleep and are not of primary concern to this study. Theta waves are also activated during relaxation and early sleep stages. See Figure 2.2 for a visual depiction of the four different EEG waves.

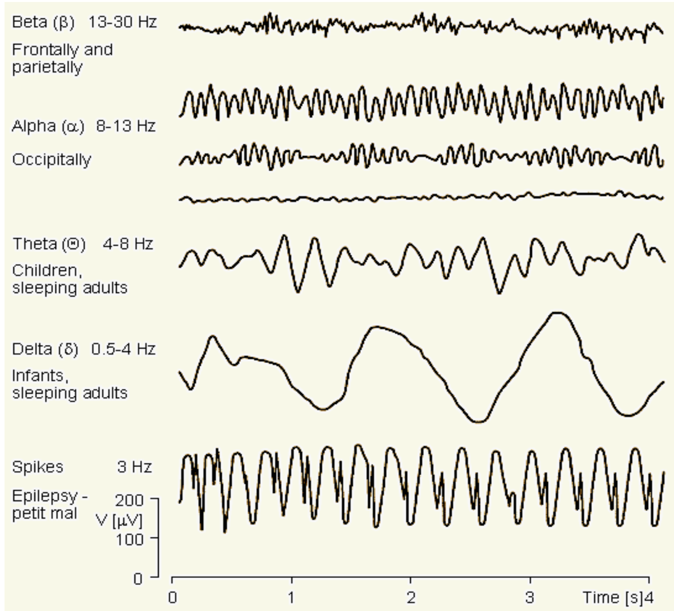

Figure 2.2: Examples of EEG wavelengths.

The most interesting and relevant of the EEG waves are the alpha waves, which rhythmically change according to the state of the individual. While relaxing and sitting with eyes closed, alpha waves are high in amplitude and magnitude (Andreassi, 2000). However, when an individual opens their eyes, or begins mental processing, the alpha waves decrease in amplitude and become more frequent. The abrupt change in alpha patterns after a subject opens their eyes is referred to as "alpha blocking" (Scott, 1976, p. 28). The alpha wave is blocked off and replaced with attention to visual awareness or a task. Thus, alpha wave amplitude is inversely related to cognitive activity (Tomarken, Davidson & Henriques, 1990; Peterson, Shackman & Harmon-Jones, 2008). In an exemplary study, individuals presented with emotionally positive and negative visual stimuli exhibited attenuation of alpha (Nencini & Pasquali, 1969 as cited in Brown & Klug, 1974). Removal of positive images decreased alpha amplitude and increased wave intensity, whereas removal of negative images increased alpha amplitude and decreased wave intensity. This study shows a pattern between alpha waves and emotional valence during some of the earlier studies on EEG.

Alpha waves originate in the posterior portions of the brain stem and oscillate up through the occipital, temporal, parietal and then frontal lobes (Scott, 1976). Thus, the frontal lobes are one of the last portions of the brain to receive alpha signals. Also, alpha waves are harmonious and synchronized between the left and right hemispheres (Scott, 1976). The alpha waves act the same in both hemispheres of the brain, and have identical patterns. However, due to research and growing technological capabilities, differences have emerged exhibiting asymmetrical activation between the right and left hemisphere during the presence of differing emotional cues (Davidson & Fox, 1989; Davidson & Irwin, 1999; Harmon-Jones & Sigelman, 2001; and Peterson, Shackman & Harmon-Jones, 2007).

The frontal lobes, shown in Figure 2.3, are the most recently developed part of the human brain, as well as the area where most consciousness occurs (Perecman, 1987). Due to investigation of the frontal lobes, researchers have found that the tasks performed by this part of the human brain are numerous, including: social behavior, affect, spatial control and movement. The frontal lobes are not necessarily the primary activating site for these occurrences, but instead are thought to regulate and integrate them into some larger scheme of human cognitive activity (Perecman, 1987). Thus, in this study, the frontal lobes do not cause the emotional reaction of fear, but instead, regulate, develop or respond to the emotion functions of the brain.

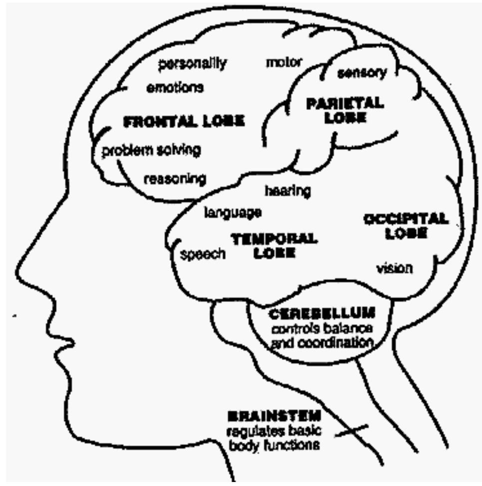

Figure 2.3: A breakdown of the regions of the brain and the processing that occurs in each region.

As indicated above, there is still no conclusion about the nature of hemispheric asymmetry and emotion. While some findings indicate a positive-negative emotional lateralization, others indicate an approach-withdrawal division of brain mechanisms. According to both the positive-negative and approach-withdrawal theories, the emotional reaction of fear should activate the right frontal regions of the brain. The ultimate prediction of this study is that the moderate fear level will activate the right hemisphere more than low or high fear. This prediction is developed based on the theory that levels of fear have a curvilinear relationship with advertising effectiveness and consumer's behavioral intentions, and thus, will also exhibit this relationship with physiological processing (Janis & Feshbach, 1953; Witte, 1992).

This study will provide more clarity about the non-definitive results listed in this literature review. By testing the emotion of fear, this study will provide evidence or denial to both of the frontal lobe asymmetry theories as well as improve the understanding of the human brain. It will also test frontal lobe asymmetry by comparing happy advertisements and fear advertisements. These findings will also help in determining the validity of the two theories of frontal lobe asymmetry. This study will also distinguish the validity of the drive model theory and its components.

Research Question and Hypotheses

The following section outlines hypotheses of this study and the rationale behind these predictions. Considering the foregoing literature, this study posits several hypotheses:

H1: Alpha wave patterns will be less in amplitude and frequency (less area under the EEG wavelength curve) in the right frontal lobe of the brain than in the left frontal lobe of the brain when viewing fearful advertisements.

The research that has been reviewed indicates that whether the theory of emotional valence or the theory of motivational direction is correct, the emotion of fear should activate the right frontal cortex of the brain. Fear and other negative and avoidance emotions are processed in this portion of the brain.

Alpha waves have been shown to correlate with emotional stimulation. When an individual is exposed to an arousing emotional stimulus, alpha activation will be less in amplitude and frequency. Alpha scores are inversely related to cognitive activation; therefore, alpha scores will be lower on the right side than on the left side of the frontal lobes when viewing fearful advertisements.

H2: Alpha wave patterns will be less in amplitude and frequency (less area under the EEG wavelength curve) in the left frontal lobe of the brain than in the right frontal lobe of the brain when viewing happy advertisements.

According to both the emotional valence and the motivational direction theories, positive or approach oriented emotions should activate the left hemisphere of the brain. Thus, happiness should be activated in the left frontal cortex.

Hypothesis 2 is important to the nature of this study to determine if the human brain is segregated into two different emotional systems. If Hypothesis 2 is supported, than the theories of emotional asymmetry will also gain support.

RQ1: Will there be hemispheric asymmetry differences in the right frontal lobes of the brain when comparing low, moderate and high fear appeals?

The studies cited in the literature review show that fear should activate the right frontal lobe of the brain. However, little is known about modulated levels of fear and frontal lobe activation. This study will be the first to look at the curvilinear relationship of fear to determine in the effects found by Janis and Feshbach (1953) hold true when extending the drive model from behavior analyses to physiological activation.

H3a: Alpha wave patterns will decrease more in the right frontal lobe during moderate fear appeals than in low or high fear appeal advertisements.

According to the drive model, fear is most effective at a moderate level. There are three groups of fearful commercials in this study at the mild, moderate and high levels. According to the research, moderate fear appeals will be most effective because unlike high and low fear appeals, they will not be ignored, denied or manipulated. Moderate fear appeals will be processed, accepted and perceived more thoroughly. Alpha wave patterns for moderate fear will be less in amplitude and frequency than high or low fear appeals. Hypothesis 3a is designed to show the differences between the levels of fear and activation of the brain. If the drive model is correct, Hypothesis 3a will show more activation for moderate fear than high or low fear.

H3b: Alpha waves patterns will decrease more in the right frontal lobe during low fear appeals than in high fear advertisements.

According to Janis and Feshbach (1953), moderate and mild fear received higher scores of advertising effectiveness by influencing behavior intentions and attitude change than did high fear. Low fear appeals should activate alpha waves in the right hemisphere more than high fear appeals and less than moderate fear appeals.

H4: There will be a greater difference in frontal lobe alpha wave asymmetry with alpha wave patterns decreasing more in the right hemisphere when comparing moderate fear and neutral ads, than when comparing high fear and neutral ads, or low fear and neutral advertisements.

Keeping in sync with the curvilinear relationship between fear and advertising effectiveness, moderate fear should elicit the most significant results when compared to neutral advertisements than high or low fear appeals. Since neutral advertisements do not facilitate positive or negative reactions, there should be no frontal lobe reactions during this treatment. Thus, when compared to the fear levels, the differences in asymmetry will become defined. Moderate fear will exhibit the highest level of activation in the right frontal hemisphere, according to background and research. However, high fear may cause defensive avoidance, manipulation or denying, ceasing mental processing and reaction to the high fear advertisement. Also, low fear advertisements will exhibit less right frontal lobe activation due to the low and insignificant threat. The low fear message may not be interpreted or received by the participants at all.

H5: There will be a greater difference in frontal lobe alpha wave asymmetry with alpha wave patterns decreasing more in the right hemisphere when comparing moderate fear and happy ads, than when comparing high fear and happy ads, or low fear and happy advertisements.

The happy and fearful advertisements are emotional opposites on the spectrum according to both theories of frontal lobe asymmetry. Thus, there should be a significant difference between the contrasting emotions of fear and happiness; where happiness is activated in the left hemisphere, and fear is activated in the right hemisphere. Once again, moderate fear will have the most opposing relationship with happy, according to the drive model of fear appeal modulation.

H6: There will be decreased alpha wave patterns in the left frontal lobes for happy advertisements when compared to low, moderate and high fear.

Building of the same rationale as Hypothesis 5, Hypothesis 6 is comparing two opposite emotions on the emotional spectrum. Thus, results should be significant. Also, this hypothesis will help support of refute the emotional valence and the motivational direction theories of frontal lobe asymmetry.

CHAPTER THREE

METHODS

This study aimed to determine the significance of fear appeals on physiological reactions in EEG brainwave measurements. According to the drive model, different intensities of fear arousal will cause different behavioral and emotional responses within human subjects. It has been shown that moderate fear appeals have significantly more effect on individuals in evoking emotional response and creating a behavioral change; whereas high and low fear appeals are defended, manipulated or denied by the audience. Also, physiology has shown that emotions follow a segregated pattern within the right and left hemispheres where approach/positive emotions tend to activate the left hemisphere, and withdrawal/negative emotions activate the right hemisphere. The goal of this study is to examine the relationship between hemisphere lateralization and emotional activation. Specifically, this study will help determine if moderate fear appeals evoke a greater hemispheric lateralization, evoking greater EEG alpha activity in the right hemisphere, than do low or high appeals. Also, the different levels of fear appeals will be compared to happy and neutral advertisements to show hemispheric lateralization.

Participants:

Volunteer subjects were recruited by placing advertisements and flyers around the Iowa State University campus area. Subjects were also recruited by class announcements and extra credit opportunities. Participants included 28 subjects ages 20 to 29. There were a total of 12 males and 16 females with the majority (24) of them being Caucasian, one African-American, two Hispanic and one individual from the Pacific Rim area.

The initial requirements of the participants were; they must speak English, be right-hand dominant, must not have neurological disorders such as epilepsy, and must not be taking mind-altering drugs, including antidepressants and illegal substances. All subjects confirmed the requirements listed above. Research participants were compensated with a $15.00 Target Store gift card or extra credit towards a Journalism course grade.

Although the sample size seems small, 10 to 90 participants is the average amount utilized in EEG experimental designs. This particular study maintains an exploratory tone, and all components of an experimental design have been met. However, due to the small number of participants, results remain non-generalizable to the population, and further investigation will be required to confirm or deny the results.

All participants were warned of the possible discomfort of having electrodes attached to their heads for a short period of time. They were also informed that the risk of any shock would be low to none.

Stimuli

A preliminary questionnaire was distributed to all subjects along with a consent form detailing the procedures of the experiment. This questionnaire included items that inquired about demographic information and confirmation of the requirements for participation.

The consent form outlined the nature of the experiment as well as the benefits and possible drawbacks of participating in the study. Participants were informed that their participation would be voluntary, and if at any time they felt a desire to drop out, they may do so without penalty. Before continuing with the study, participants were required to sign the consent form. A stamped version of the Iowa State University IRB approval is included in Appendix A.

Stimuli included 15 commercials approximately 30 seconds in length. The commercial lengths varied slightly simply due to advertisement creation. The commercials include three emotionally happy advertisements, three emotionally neutral advertisements, and nine fear-evoking appeals. Fear appeals differed in their levels of fear (three low, three moderate and three high). Television commercials were pre-tested in a journalism introduction course, including 166 survey respondents to confirm and standardize the emotions evoked and the extent of the emotions conveyed in the commercials. The pre-test consisted of four questions for each commercial (see Appendix B). Table 3.1 shows the results of the pre-test. The top three fear scores were used to categorize the high fear, the middle fear scores categorized the moderate fear commercials, and the low fear category consisted of the three lowest fear scores. The strong scores on the happy survey question indicated happy scores, while neutral advertisement scores did not reveal strength in either fear or happy categories.

Table 3.1:
Pre-test mean scores for dividing commercials into emotional categories. Fear and Happy indices are indicated on a scale of 1 to 7, with 1 being not at all and 7 being very much.

Brand N=166	*Emotional*	*Indices of emotion, 1=not at all 7=very much*			
		Fear		*Happy*	
		M	*SD*	*M*	*SD*
Little Debbie	Happy	1.08	0.48	6.27	0.93
Denver Mattress	Happy	1.28	0.84	5.92	1.25
Thorn	Happy	1.51	0.89	4.77	1.36
Sharp	Neutral	2.35	1.34	3.84	1.46
Turun Mustard	Neutral	1.32	0.76	3.3	1.51
Enamelon	Neutral	1.9	1.17	4.05	1.40
America’s Wetland	Mild Fear	4.28	1.30	1.47	0.74
Knowledge	Mild Fear	5.08	1.25	1.17	0.63
Nofunbeingdead.com	Mild Fear	4.58	1.58	1.81	1.07
Ministerio De Trabajo Y Auntos Sociales	Moderate Fear	5.38	1.45	1.2	0.73

Brand N=166	*Emotional*	*Indices of emotion, 1=not at all 7=very much* Fear		Happy	
		M	*SD*	*M*	*SD*
Melanoma Awareness	Moderate Fear	5.48	1.32	1.28	0.89
Prevent-it.ca	Moderate Fear	5.22	1.25	1.3	0.73
Think	High Fear	5.78	1.09	1.84	1.07
Stop Now	High Fear	6.33	1.15	1.19	0.79
No Terror	High Fear	6.61	0.95	1.17	0.82

During the experiment, commercials were presented in random order according to a latin square design to avoid any order effects. All commercials were retrieved from an archive on the internet at commercialarchive.com. Commercials were chosen from distant regions to avoid participants from having previously viewed the commercials and to avoid any possible brand wear-out effects. Between the presentations of each commercial, participants were given a questionnaire task to keep their attention focused on the commercials. The task consisted of the same four questions utilized in the pre-test treatment.

Apparatus and Procedure

Electroencephalograph measurements were taken using EEG hardware and software created and distributed by BIOPAC Student Lab. Participants were greeted by the experimenter and asked to have a seat in the laboratory. Their head length and circumference was measured from the Nasion (bridge of the nose) to the Inion (back of skull) points. An abrasive pad was used to clean off extra dust and skin from the electrode application sites. A small amount of conductive gel (Gel 100) was placed on every electrode (EL503) to gain a more precise reading. Electrode clamps were then placed on every position, including four ground electrodes positioned at both jaw joints and behind both ears. Electrodes were placed on the subject’s scalp according to The Ten-Ten Electrode System of the International

Federation (a by-product of the Ten-Twenty Electrode System) at the F3, F4, F7, F8, P3, P4, P7 and P8 positions. (See Appendix C)

Subjects were located in a rectangular 11x14 room with white walls and no windows. Lights were set to a natural soft level. Participants were seated comfortably in an adjustable office style chair with armrests. Subjects were asked to relax and stay as still as possible during the presentation of the stimuli.

Measurements and Data Analyses:

Alpha waves (8-13Hz) were relevant to this study (Theta and Delta waves measure sleeping states, and Beta waves show concentration) because they have been shown to measure emotion in the frontal areas of the brain.

This study recognizes the individualistic nature of EEG measurements. Thus, this study uses a within subjects design to determine EEG asymmetry. The area underneath the alpha curve was calculated during this experiment and was the primary mathematical function. Asymmetry has been measured in various ways; R=right, L=left, R-L; R/L and (R-L)/(R+L) (Rothschild, Hyum, Reeves, Thorson & Goldstein, 1988). This study used a different approach to measuring asymmetry by performing Wilcoxon statistical analysis to determine statistical significance. Although the conventional asymmetry equations work well to retrieve a percent change, the method does not allow for statistical significance

Particular portions of the commercials were utilized for measurement rather than the aggregate of the entire commercial. A thirty-second commercial can contain numerous emotions and thus the different emotional EEG readings may equalize over time, leaving no differences in alpha asymmetry.

The following study seeks to analyze the electroencephalograph measurements during certain emotional presentations of commercial advertisements. The measurements of the EEG will be precisely consistent between and throughout all the commercials. An outline of every commercial and measurement points is included in Table 3.2. Every commercial was carefully viewed to determine appropriate measurement points. The point in the commercial where the message ends and the efficacy, or the commercial push begins is considered the endpoint for the emotionally charged part of the commercial. Thus, measurements were done before this point. A baseline reading was taken for every commercial at the point in the beginning of the commercial where the EEG evens out after the person attends to the television again (after filling out questions about the previous commercial). A point of visual emotion was chosen in every commercial (i.e. textual appeals throughout the commercial were not utilized because language engages the brain in a functionally different way than visual stimuli), usually at the peak of the commercial. From this point, 50 millisecond measurement epochs were taken after 250ms and three seconds. Measurements of 50 milliseconds in length were used at every point of measurement.

Table 3.2:
A review of commercials, emotion, commercial length (in seconds) and measurement points in the study (in seconds).

Brand Name	*Commercial Subject*	*Length of Commercial*	*Point of Measurement*
Little Debbie	Brand Promotion	30	20
Denver Mattress	Brand Promotion	30	20
Thorn	Television Set	30	20
Sharp	Printers	30	20
Turun Mustard	Mustard	30	20
Enamelon	Toothpaste	32	20
America's Wetland	Save Coastal Louisiana	30	19
Knowledge	Anti-drug, anti-marijuana	30	26
Nofunbeingdead.com	Seatbelt PSA	43	32
Ministerio De Trabajo			

Brand Name	*Commercial Subject*	*Length of Commercial*	*Point of Measurement*
Y Auntos Sociales	Domestic Abuse	34	22
Melanoma Awareness	Tanning bed	30	22
Prevent-it.ca	Work Safety	30	22
Think	Drunk Driving	30	22
Stop Now	Anti-smoking	30	18
No Terror	Anti-terrorism	49	36

The measurement after 250ms exhibit was used due to the nature of information processing. After 250ms of stimulus presentation the brain has begun to utilize past experience and memories to analyze initial sensory input of the advertisement. This deeper information processing accesses the sensory input and can look for something specific (Connor, Egeth & Yantis, 2004, p.650). Thus, this point of information processing will be more of a conscious mental effort. The three-second mark of measurement is proposed as a mental breaking point. Experimental research has shown that short-term memory information can be retained for up to approximately 3 seconds (Schleidt & Kein, 1997). Additionally, Schleidt and Kein (1997) found that spoken language is interrupted by short breaks every 2-3 seconds. These researchers posit that "natural human behavior is segmented into action units, functionally related groups of movements with durations of a few seconds. In humans, a similar organization can be found in planning, preparatory behavior, perception and speech (p. 77).

An initial statistical analysis was performed to act as a control component in the study and ensure that the neutral advertisements had no emotional effect on the participants. Neutral advertisements were tested using the Wilcoxon analysis. Wilcoxon analysis shows neutral frontal alpha right compared with neutral frontal alpha left at 250ms (Z=-.501

p=.303) is not significant. Neutral frontal alpha right compared with neutral frontal alpha left at 3 seconds (Z=-.774, p=.245) is not significant.

Table 3.3
Wilcoxon Signed rank test results for alpha waves in frontal left and right lobes for neutral compared to neutral at 250ms and 3 seconds.

Neutral N=28	*Z*	*Right*		*Left*		*Sig.*	*Sig.*
		M	*SD*	*M*	*SD*	*(2-tailed)*	*(1-tailed)*
250ms	-.501	-46.90	74.44	-37.50	71.51	.303	.152
3 seconds	-.774	-37.72	71.51	-27.14	61.79	.245	.123

Table 3.3 reveals no significant results found while comparing the neutral condition in the right hemisphere to the neutral condition in the left hemipshere. The neutral advertisements chosen have no effect on emotional lateralization in alpha waves. This reinforces that the commercials chosen were ultimately emotionally neutral in content.

CHAPTER FOUR

RESULTS

This experiment used a 95% confidence level to show significant results. However, due to the exploratory nature of this experiment, both 1-tailed and 2-tailed p-values have been reported. Showing 1-tailed significance values will help reveal findings that may not have been significant using a 2-tailed significance level. All significant p-values (p<.05) will be in bold, but all p-values that are (p<.100) level or less will be italicized to emphasize the relevant findings in this study, and to show emerging patterns within the data.

The dependent variables in this study are the **alpha** waves in the right and left hemispheres of the frontal lobes of the brain. The area under the EEG wavelength curve was the relevant measurement utilized. A baseline measurement was taken for every commercial presentation, as well as two additional measurements at the 250ms and three-second points from the reference point of measurement within the commercial. The aggregate scores for the five different emotional categories of interest were computed for the 250ms, three second and baseline points using Microsoft Excel. The scores were than subtracted from the baseline score for that category, and then the percentage of change from the baseline was calculated for every category. The percent change is the score utilized during the statistical analysis.

The average percent changes from the baseline were compared using the Wilcoxon Signed rank test, a non-parametric statistical test that is equivalent to the paired samples t-test. The findings for each comparison will be reported in the following section as they answer the relevant hypotheses and research question.

H1: Alpha wave patterns will decrease more (less area under the EEG wavelength curve) in the right frontal lobe of the brain than in the left frontal lobe of the brain when viewing fearful advertisements.

Table 4.1 below depicts the following results for Hypothesis 1: A Wilcoxon test shows that low fear frontal alpha right compared with low fear frontal alpha left at 250ms (Z=-1.844, p=***.033***) is significant. Low fear frontal alpha right compared with low fear frontal alpha left at 3 seconds (Z=-.205, p=.419) is not significant.

Table 4.1
Wilcoxon Signed rank test results for alpha waves in frontal left and right lobes for low fear compared to low fear at 250ms and 3 seconds.

Low Fear N=28	*Z*	*Right*		*Left*		*Sig.*	*Sig.*
		M	*SD*	*M*	*SD*	*(2-tailed)*	*(1-tailed)*
250ms	-1.844	-15.16	67.19	-49.80	72.40	*.066*	***.033***
3 seconds	-.205	-23.23	92.11	-29.96	71.24	.838	.419

Table 4.2 below exhibits the following results for Hypothesis 1: A Wilcoxon test shows that moderate fear frontal alpha right compared with moderate fear frontal alpha left at 250ms (Z=-.319, p=.375) is not significant. Moderate fear frontal alpha right compared with moderate fear frontal alpha left at 3 seconds (Z=-1.936, p=***.027***) is significant.

Table 4.2
Wilcoxon Signed rank test results for alpha waves in frontal left and right lobes for moderate fear compared to moderate fear at 250ms and 3 seconds.

Moderate Fear N=28	*Z*	*Right*		*Left*		*Sig.*	*Sig.*
		M	*SD*	*M*	*SD*	*(2-tailed)*	*(1-tailed)*
250ms	-.319	-10.35	53.08	-17.03	58.84	.750	.375
3 seconds	-1.936	1.43	51.97	-26.96	62.06	*.054*	***.027***

Table 4.3 exhibits the following results for Hypothesis 1: A Wilcoxon Signed ranks test shows that high fear frontal alpha right compared with high fear frontal alpha left at 250ms (Z=-1.116, p=.133) is not significant. High fear frontal alpha right compared with high fear frontal alpha left at 3 seconds (Z=-.956, p=.170) is not significant.

Table 4.3
Wilcoxon Signed rank test results for alpha waves in frontal left and right lobes for high fear compared to high fear at 250ms and 3 seconds.

High Fear N=28	*Z*	*Right*		*Left*		*Sig.*	*Sig.*
		M	*SD*	*M*	*SD*	*(2-tailed)*	*(1-tailed)*
250ms	-1.116	-25.81	65.10	-42.78	72.31	.266	.133
3 seconds	-.956	-29.83	105.80	-31.98	63.36	.340	.170

Hypothesis 1 is not fully supported by the statistical data gathered. Significant differences were found indicating activation in the right hemisphere when comparing low fear and low fear at the 250ms epoch, and when comparing the moderate fear to moderate fear at the 3-second epoch. The other relevant data from Hypothesis 1 indicates numbers lower than p=.200 for all the measurements during the high fear compared to high fear test. These results help determine that although Hypothesis 1 is not completely supported, relevant trends emerged during testing. Hypothesis 1 cannot be ruled out completely.

H2: Alpha wave patterns will be less in amplitude and frequency (less area under the EEG wavelength curve) in the left frontal lobe of the brain than in the right frontal lobe of the brain when viewing happy advertisements.

The results for Hypothesis 2 are exhibited in Table 4.4. A Wilcoxon analysis shows that happy frontal alpha right compared with happy frontal alpha left at 250ms (Z=-1.503, p=*.065*) is not significant. Happy frontal alpha right compared with happy frontal alpha left at 3 seconds (Z=-.774, p=.220) is not significant.

Table 4.4
Wilcoxon Signed rank test results for alpha waves in frontal left and right lobes for happy compared to happy at 250ms and 3 seconds.

Happy	*Z*	*Right*		*Left*		*Sig.*	*Sig.*
N=28		*M*	*SD*	*M*	*SD*	*(2-tailed)*	*(1-tailed)*
250ms	-1.503	-30.67	97.80	-67.44	88.60	.130	*.065*
3 seconds	-.774	-22.82	58.87	-43.54	79.07	.440	.220

Hypothesis 2 is not supported by the statistical data. In fact, the results show increased alpha wave patterns on the left side of the frontal lobes than on the right side. Alpha is inversely related to cognitive processing. Thus, lower percent changes in the right frontal lobes indicate activation of the right side of the brain during happy commercials.

RQ1: Will there be hemispheric asymmetry differences in the right frontal lobes of the brain when comparing low, moderate and high fear appeals?

To answer this research question, the three levels of fear were compared against each other using Wilcoxon Signed rank tests. Moderate Fear (MF) was compared against Low Fear (LF) and High Fear (HF), and HF was compared to LF.

H3a: Alpha wave patterns will decrease more in the right frontal lobe during moderate fear appeals than in low or high fear appeal advertisements.

Table 4.5 below exhibits results for Hypothesis H3a. A Wilcoxon statistical testing exemplifies that moderate fear frontal alpha right compared with low fear frontal alpha right at 250ms (Z=-.204, p=.419) is not significant. Also, a Wilcoxon test shows that moderate fear frontal alpha right compared with low fear frontal alpha right at 3 seconds (Z=-1.093, p=.137) is not significant.

Table 4.5

Wilcoxon Signed rank test results for alpha waves in right frontal lobes for moderate fear compared to low fear at 250ms and 3 seconds.

MF-LF	*Z*	*Moderate*		*Low*		*Sig.*	*Sig.*
N=28		*M*	*SD*	*M*	*SD*	*(2-tailed)*	*(1-tailed)*
250ms	-.204	-10.35	53.08	-15.16	67.19	.838	.419
3 seconds	-1.093	1.43	51.97	-23.23	92.11	.274	.137

Hypothesis 3a is not supported by this data analysis. No significant results were obtained during these three Wilcoxon analyses. However, when examining the Mean scores for these analyses, a slight pattern emerges in which moderate scores are less than low scores for right frontal hemisphere. This indicates that there is more cognitive activity on the right side due to the inverse relationship between alpha waves and mental processing. However, the results exhibited are not different enough to obtain significant scores.

More results for Hypotheses 3a are exhibited in Table 4.6. A Wilcoxon test shows that moderate fear frontal alpha right compared with high fear frontal alpha right at 250ms (Z=-.820, p=.206) is not significant. Also, statistical tests show that moderate fear frontal alpha right compared with high fear frontal alpha right at 3 seconds (Z=-1.344, p=*.089)* is not significant.

Table 4.6

Wilcoxon Signed rank test results for alpha waves in right frontal lobes for moderate fear compared to high fear at 250ms and 3 seconds.

MF-HF	*Z*	*Moderate*		*High*		*Sig.*	*Sig.*
N=28		*M*	*SD*	*M*	*SD*	*(2-tailed)*	*(1-tailed)*
250ms	-.412	-10.35	53.08	-25.81	65.10	.412	.206
3 seconds	-1.344	1.43	51.97	-29.83	105.80	.179	*.089*

Hypothesis 3a is not supported by the data results displayed in Table 4.6. Once again, however, noticeable differences appear in the Mean scores. Moderate fear Mean scores for alpha are much less than high fear mean scores in the right frontal alpha scores. Also, there are relevant p-values under p=.100 for moderate fear compared to high fear at the 3 second epoch. These scores show that alpha asymmetry may occur in the right frontal lobes when comparing moderate fear and high fear. Although Hypothesis 3a is not supported with significant findings, notable trends signify that Hypothesis 3a should not be completely ruled out.

H3b: Alpha wave patterns will decrease more in the right frontal lobe during low fear appeals than during high fear advertisements.

Table 4.7 below summarizes the results for Hypothesis 3b. A Wilcoxon Signed ranks test shows that high fear frontal alpha right compared with low fear frontal alpha right at 250ms (Z=-1.047, p=.147) is not significant. Statistical tests show that high fear frontal alpha right compared with low fear frontal alpha right at 3 seconds (Z=-.159, p=.436) is not significant.

Table 4.7
Wilcoxon Signed rank test results for alpha waves in right frontal lobes for high fear compared to low fear at 250ms and 3 seconds.

HF-LF N=28	*Z*	*High*		*Low*		*Sig.*	*Sig.*
		M	*SD*	*M*	*SD*	*(2-tailed)*	*(1-tailed)*
250ms	-1.047	-25.81	65.10	-15.16	67.19	.295	.147
3 seconds	-.159	-29.83	105.80	-23.23	92.11	.873	.436

According to the insignificant results collected, Hypothesis 3b cannot be supported. There were no significant findings indicating that low fear activated the right hemisphere more than high fear during the Wilcoxon statistical analyses. However, Table 4.7 does show relevant Mean score differences with lower p-values (p<.150) for the 250ms epoch. These insignificant findings may indicate a trend of differing activation in the right frontal lobes for low fear and high fear conditions. Further research would need to be completed to determine the relevance of these trends.

H4: There will be a greater difference in frontal lobe alpha wave asymmetry with alpha wave patterns decreasing more in the right hemisphere when comparing moderate fear and neutral ads, than when comparing high fear and neutral ads, or low fear and neutral advertisements.

Table 4.8 below summarizes the following results for Hypothesis 4: A Wilcoxon analysis exemplifies that moderate fear frontal alpha right compared with neutral frontal alpha right at 250ms (Z=-1.913, p=***.028*)** is significant. Also, statistical tests show that moderate fear frontal alpha right compared with neutral frontal alpha left at 3 seconds (Z=-2.414, p=***.008***) is significant.

Table 4.8
Wilcoxon Signed rank test results for alpha waves in right frontal lobes for moderate fear compared to neutral at 250ms and 3 seconds.

MF-Neutral N=28	*Z*	*Moderate*		*Neutral*		*Sig.*	*Sig.*
		M	*SD*	*M*	*SD*	*(2-tailed)*	*(1-tailed)*
250ms	-1.913	-10.35	53.08	-46.89	74.44	*.056*	***.028***
3 seconds	-2.414	1.43	51.97	-37.73	68.69	***.016***	***.008***

When comparing moderate fear alpha on the right side to neutral alpha on the right side, there are significant results for the 250ms and 3-second time epochs. These results indicate that Hypothesis 4 is supported.

Table 4.9 below summarizes data for Hypothesis 4. A Wilcoxon test shows that high fear frontal alpha right compared with neutral frontal alpha right at 250ms (Z=-.797, p=.212) is not significant. Statistical tests show that high fear frontal alpha right compared with neutral frontal alpha right at 3 seconds (Z=-.774, p=.220) is not significant.

Table 4.9
Wilcoxon Signed rank test results for alpha waves in right frontal lobes for high fear compared to neutral at 250ms and 3 seconds.

HF-Neutral N=28	*Z*	*High*		*Neutral*		*Sig.*	*Sig.*
		M	*SD*	*M*	*SD*	*(2-tailed)*	*(1-tailed)*
250ms	-.797	-25.81	65.10	-46.89	74.44	.425	.212
3 seconds	-.774	-29.83	105.80	-37.73	68.69	.439	.220

Hypothesis 4 is supported by these data. Table 4.9 illustrates that there are no significant findings when comparing high fear advertisements to neutral advertisements which supports Hypothesis 4 that moderate fear will exhibit greater mental processing, or a decrease in alpha patterns, when compared to neutral than when high fear is compared to neutral.

Table 4.10 summarizes the following results for Hypothesis 4: The Wilcoxon analysis shows that low fear frontal alpha right compared with neutral frontal alpha right at 250ms (Z=1.913, p=***.028***) is significant. Statistical tests show that low fear frontal alpha right compared with neutral frontal alpha right at 3 seconds (Z=-1.526, p=*.064*) is not significant.

Table 4.10
Wilcoxon Signed rank test results for alpha waves in right frontal lobes for low fear compared to neutral at 250ms and 3 seconds.

LF-Neutral N=28	*Z*	*Low*		*Neutral*		*Sig.*	*Sig.*
		M	*SD*	*M*	*SD*	*(2-tailed)*	*(1-tailed)*
250ms	-1.913	-15.16	67.19	-46.89	74.44	*.056*	***.027***
3 seconds	-1.526	-23.23	92.11	-37.73	68.69	.127	*.064*

For Hypothesis 4, results indicate that significant differences are present for moderate fear compared to neutral advertisements showing that the right hemisphere is activated more during moderate fear than during neutral advertisements. High fear compared to neutral advertisements generates no significant differences between right frontal lobe comparisons. Low fear compared to neutral advertisement show only one significant finding at the 250ms epoch, and a relevant finding at the 3-second epoch. High fear and low fear cause less right hemisphere activation than moderate fear when compared to neutral advertisements, Thus, Hypothesis 4 is supported.

H5: There will be a greater difference in frontal lobe alpha wave asymmetry with alpha wave patterns decreasing more in the right hemisphere when comparing moderate fear and happy ads, than when comparing high fear and happy ads, or low fear and happy advertisements.

Table 4.11 below exhibits results for Hypothesis 5. A Wilcoxon test shows that moderate fear frontal alpha right compared with happy frontal alpha right at 250ms (Z=.410, p=.341) is not significant. Also, statistical tests show that moderate fear frontal alpha right compared with happy frontal alpha left at 3 seconds (Z=-1.913, p=***.028***) is significant.

Table 4.11
Wilcoxon Signed rank test results for alpha waves in right frontal lobes for moderate fear compared to happy at 250ms and 3 seconds.

MF-Happy N=28	*Z*	*Moderate*		*Happy*		*Sig.*	*Sig.*
		M	*SD*	*M*	*SD*	*(2-tailed)*	*(1-tailed)*
250ms	-.410	-10.35	53.08	-30.67	97.80	.682	.341
3 seconds	-1.913	1.43	51.97	-22.82	58.87	*.056*	***.028***

Hypothesis 5 is somewhat supported by these Wilcoxon analyses. Moderate fear causes activation in the right frontal hemisphere when compared to happy advertisements at the 3-second epoch.

Table 4.12 below summarizes more data for Hypothesis 5. A Wilcoxon analysis indicates that high fear frontal alpha right compared with happy frontal alpha right at 250ms (Z=-.114, p=.454) is not significant. Statistical tests show that high fear frontal alpha right compared with happy frontal alpha right at 3 seconds (Z=-.638, p=.263) is not significant.

Table 4.12
Wilcoxon Signed rank test results for alpha waves in right frontal lobes for high fear compared to happy at 250ms and 3 seconds.

HF-Happy N=28	*Z*	*High*		*Happy*		*Sig.*	*Sig.*
		M	*SD*	*M*	*SD*	*(2-tailed)*	*(1-tailed)*
250ms	-.114	-25.81	65.10	-30.67	97.80	.909	.454
3 seconds	-.638	-29.83	105.80	-22.82	58.87	.527	.263

Hypothesis 5 is supported by the comparison of high fear and happy alpha waves. There is not significant right-sided dominance in the frontal lobes when comparing high fear advertisements to happy advertisements. Hypothesis 5 predicted that there would be more activation in the right hemisphere when comparing moderate fear to happy conditions than when comparing high fear to happy conditions. This holds true with a significant finding for moderate fear, but not for high fear.

Table 4.13 below shows data related to Hypothesis 5. A Wilcoxon test shows that low fear frontal alpha right compared with happy frontal alpha right at 250ms (Z=911, p=.181) is not significant. Statistical tests show that low fear frontal alpha right compared with happy frontal alpha left at 3 seconds (Z=-.387, p=.349) is not significant.

Table 4.13
Wilcoxon Signed rank test results for alpha waves in right frontal lobes for low fear compared to happy at 250ms and 3 seconds.

LF-Happy N=28	*Z*	*Low*		*Happy*		*Sig.*	*Sig.*
		M	*SD*	*M*	*SD*	*(2-tailed)*	*(1-tailed)*
250ms	-.911	-15.16	67.19	-30.67	97.80	.362	.181
3 seconds	-.387	-23.23	92.11	-22.82	58.87	.699	.349

The comparison of low fear to happy data shows that there are no significant results. When viewing the Mean scores of low fear and happy advertisements, there is very little difference between the numbers. Also, the same is true when viewing the Mean scores of high fear advertisements and happy advertisements. However, when comparing moderate fear to happy advertisements, there is a significant finding and the Mean scores appear somewhat different between the two conditions.

The three above comparisons, moderate fear with happy, high fear with happy and low fear with happy all support Hypothesis 5 in that moderate fear shows the most significant differences in alpha asymmetry.

H6: There will be decreased alpha wave patterns in the left frontal lobes for happy advertisements when compared to low, moderate and high fear.

Table 4.14 below exhibits data for Hypothesis 6. A Wilcoxon test shows that happy frontal alpha left compared with moderate fear frontal alpha left at 250ms (Z=2.232, p=***.013***) is significant. Statistical tests show that happy frontal alpha left compared with moderate fear frontal alpha left at 3 seconds (Z=-.1.070, p=.143) is not significant.

Table 4.14
Wilcoxon Signed rank test results for alpha waves in left frontal lobes for happy compared to moderate fear at 250ms and 3 seconds.

Happy-MF N=28	*Z*	*Happy*		*Moderate*		*Sig.*	*Sig.*
		M	*SD*	*M*	*SD*	*(2-tailed)*	*(1-tailed)*
250ms	-2.232	-67.44	88.60	-17.03	58.84	***.026***	***.013***
3 seconds	-1.070	-43.54	79.07	-26.96	62.06	.285	.143

Results in Table 4.14 show that happy advertisements do not create a decrease in alpha patterns in the left hemisphere when compared to moderate fear. In fact, the opposite is true. Moderate fear advertisements elicit smaller alpha patterns and Mean scores than happy advertisements in the left frontal lobes.

Table 4.15 below exhibits data for Hypothesis 6. A Wilcoxon test shows that happy frontal alpha left compared with low fear frontal alpha left at 250ms (Z=1.025, p=.153) is not significant. Statistical tests show that happy frontal alpha left compared with low fear frontal alpha left at 3 seconds (Z=-1.025, p=.153) is not significant.

Table 4.15
Wilcoxon Signed rank test results for alpha waves in left frontal lobes for happy compared to low fear at 250ms and 3 seconds.

Happy-LF N=28	*Z*	*Happy*		*Low*		*Sig.*	*Sig.*
		M	*SD*	*M*	*SD*	*(2-tailed)*	*(1-tailed)*
250ms	-1.025	-67.44	88.60	-49.80	72.40	.305	.153
3 seconds	-1.025	-43.54	79.07	-26.96	71.24	.305	.153

The results in Table 4.15 reveal that there are no significant findings for Hypothesis 6. However, Mean scores are very high for the Happy advertisements than for the low fear advertisements. These data contradict the prediction of Hypothesis 6.

Table 4.16 below exhibits data for Hypothesis 6. A Wilcoxon test shows that happy frontal alpha left compared with high fear frontal alpha left at 250ms (Z=1.207, p=.114) is not significant. Statistical tests show that happy frontal alpha left compared with high fear frontal alpha left at 3 seconds (Z=-.387, p=.350) is not significant.

Table 4.16
Wilcoxon Signed rank test results for alpha waves in left frontal lobes for happy versus high fear at 250ms and 3 seconds.

Happy-HF	*Z*	*Happy*		*High*		*Sig.*	*Sig.*
N=28		*M*	*SD*	*M*	*SD*	*(2-tailed)*	*(1-tailed)*
250ms	-1.025	-67.44	88.60	-42.78	72.31	.227	.114
3 seconds	-1.025	-43.54	79.07	-31.98	63.36	.699	.350

Once again, there are no significant findings to support Hypothesis 6. The results in Tables 4.14, 4.15, and 4.16 all show that fear decreases alpha patterns sufficiently more than happy advertisements in the left frontal lobes. Thus, Hypothesis 6 cannot be supported. In fact, these results are showing opposite trends of what Hypothesis 6 had predicted.

For a summary of Research Questions and Hypotheses, see APPENDIX D.

CHAPTER FIVE

DISCUSSION AND CONCLUSION

The objective of this study was to examine how the human brain reacts to different levels of fear during the presentation of advertising commercials. This study employed a within subjects design to show differences in the right and left frontal lobes during emotionally neutral, happy and fearful stimuli. Specifically, this study examined modulated levels of fear (low, moderate and high) to determine if alpha waves show asymmetrical differences revealing greater right hemisphere frontal lobe activation for moderate fear (i.e. lower alpha wave pattern scores).

Hypothesis 1 stated that fear appeals would activate the right frontal lobe when statistically compared against their respected hemispheric counterparts. (i.e. low right compared to low left, moderate right compared to moderate left and high right compared to high left). However, this data does not conclusively support the hypothesis. Tables, 4.1, 4.2, and 4.3 show results indicating only two significant values for right hemisphere activation in low fear at the 250ms epoch and moderate fear at the 3-second epoch. These findings do not conclusively support the literature on frontal lobe emotional asymmetry. These results indicate that alpha asymmetry may not occur when comparing fear against itself in the frontal lobes. This may be due to the lack of contrast in the emotional comparison or a similarity of activation in the motivation systems (i.e. perhaps the emotional fear in the commercials was not motivational, and did not activate the approach or avoidance systems). For instance, some significant differences were found, but these differences may not be fully pronounced. Hypothesis 1 is not fully supported, but further research will be needed to completely disregard Hypothesis 1.

Hypothesis 2 predicted that when the right and left alpha waves were compared within the happy emotional condition, asymmetry would lead to greater *left* hemisphere activation (lower alpha wave scores). However, the results in Table 4.4 were significant showing activation of the right hemisphere over the left hemisphere. A relevant score of p=.065 at the 250ms epoch indicate that the happy emotional commercials lead to greater *right* hemisphere activation. These data contradict previous data on asymmetrical dominance. With the mean scores of the happy emotional condition on the left side being much larger in comparison to the right mean scores, the results indicate that the theory of emotional valence is not supported by the data in this research Hypothesis. The findings also lend no support to the motivational direction theory. However, the lack of support for the motivational direction theory could be due to a lack of motivation within the commercial stimuli. This study found no inclination for left hemisphere asymmetry when viewing happy, neutral or fearful advertisements.

Research Question 1 stated: Will there be hemispheric asymmetry differences in the right frontal lobes of the brain when comparing low, moderate and high fear appeals? According to the significant results, the answer is no. However, when examining mean scores in Table 5.1 below, a pattern emerges revealing much lower scores for moderate fear than high or low fear.

Hypothesis 3a predicted that modulated moderate fear would activate alpha waves more than low and high fear conditions in the right hemisphere of the frontal lobes. Results in Tables 4.5 and 4.6 support this hypothesis somewhat. When comparing moderate fear to low fear in the right hemisphere of the frontal lobes, no significant scores were calculated. Moderate mean scores were M=-10.350 at 250ms and M=1.435 at 3 seconds compared to the mean scores of M=-15.160 at 250ms, and M=-23.232 at 3 seconds. When viewing these numbers side by side, as can be seen in Table 5.1 below, low fear scores appear to only be slightly larger than moderate fear scores. As Janis and Feshbach (1953) had previously illustrated, moderate and low fear are more effective than high fear at engaging the consumer mind to adhere to the recommended behavior. Therefore, these differences in mean scores support Janis and Feshbach's Drive Model indicating that moderate fear will be the most effective level of fear appeal, but low fear will come in a close second place. Therefore, although these results are not significant, a pattern has been detected and should be further investigated to truly determine the validity behind Hypothesis 3a. Also, Table 4.6 indicates that when comparing the moderate fear and high fear conditions, relevant results with $p<.100$ have been recorded at the 3 second epoch. This data shows that moderate fear mean scores and high fear mean scores are quite different (see Table 5.1 below), as the previous literature has predicted (Witte, 1992; and Janis & Feshbach, 1953). The alpha mean scores, are much higher for high fear than moderate fear. This observation indicates that high fear has been processed less in the right frontal lobe, supporting the possibility that subjects began practicing defensive motivation tactics such as denial, message manipulation and avoidance (Witte, 1992). Not only are these psychological tactics a definite possibility for avoiding the strong fear appeal, but also once again, the Drive Model for fear processing has been deemed reasonable. High fear appears to be less effective at evoking mental processing and contemplation than the moderate or low fear level appeals. The above results support Hypothesis 3a somewhat.

Hypothesis 3b predicted that low fear would show significant right hemisphere asymmetry and lower alpha wave scores when compared to high fear alpha. However, this prediction is not supported by any significant findings. The results in Table 4.7 exhibit p-values under p=.2, hinting at a slight difference between high fear and low fear mean scores in the right frontal lobe hemisphere. The Drive Model does state that moderate fear is the most effective level of fear, followed by low fear and then high fear. Therefore, the results of Hypothesis 3b do not deny this model. Table 5.1 shows the mean scores for low fear compared to high fear and there are differences indicating less mental processing for high fear than low fear. However, due to insignificant results, Hypothesis 3b is not fully supported

Table 5.1
Mean score results for alpha waves in right frontal lobes for neutral, happy, low fear, moderate fear and high fear conditions at 250ms and 3 seconds.

Commercial Condition	*Frontal Lobe Hemisphere*	*Measurement Point*	*M*	*SD*
Happy	Right	3s	-22.82	58.87
Happy	Right	250ms	-30.33	97.80
Neutral	Right	3s	-37.73	68.69
Neutral	Right	250ms	-46.89	74.44
Low Fear	Right	3s	-23.23	92.11
Low Fear	Right	250ms	-15.16	67.19
Moderate Fear	Right	3s	1.43	51.97
Moderate Fear	Right	250ms	-10.35	53.08
High Fear	Right	3s	-29.83	105.80
High Fear	Right	250ms	-25.81	65.10

The mean scores and trends determine that these Hypotheses 3a and 3b cannot be disregarded completely. Examining the trends in Table 5.1 will show that moderate fear scores are truly less than high fear and low fear scores, followed by low fear scores and than high fear scores for the right frontal lobe.

Hypothesis 4 states that moderate fear will show alpha wave activation in the right hemisphere over neutral commercials, more so than the low or high fear conditions. The data collected in Table 4.8 shows a pattern that supports this prediction. Great asymmetrical differences were found when comparing moderate fear right to neutral right showing significant results at the 250ms epoch (p=.028) and the 3-second epoch (p=.008). These results suggest that to truly find asymmetrical differences between the right frontal lobes, a contrast of emotion may be needed. That is comparing the levels of fear against each other may not have enough contrast to significantly effect EEG waves, but adding another type of emotion, or lack of emotion in this case, may lead to more pronounced differences in EEG waves. The findings in Table 4.8 support the predictions of the emotional valence and motivational direction theories that fear is processed in the right frontal lobe.

However, results in Table 4.9 show no significant differences were found when comparing high fear right hemisphere to neutral. These results may indicate that information processing in the right frontal lobes is similar for both high fear and neutral advertisements. Table 5.1 shows no emerging patterns when looking at mean scores of high fear compared to neutral in the right frontal lobe hemisphere. It is possible that very little processing is occurring in the high fear condition because of psychological defenses. Witte (1992) stated that high fear causes fear control, a psychological reaction that involves denial, message manipulation or defensive avoidance. These psychological defenses cause mental processing to be limited and thus, no asymmetry will be found. Another possibility for why high fear has a lack of right frontal lobe activation may be due to the mental resources being redirected to the limbic system of the Triune brain to prepare for a fight or flight response (Andreassi, 2000). Also for Hypothesis 4, Table 4.10 displays results for low fear compared to neutral conditions. One significant score was found when comparing low fear right hemisphere to neutral right hemisphere at the 250ms epoch (p=.027) and a relevant result was found at the 3 second epoch, p=.064. However, these results are not as prominent as those in the moderate fear to neutral comparison. The evidence may suggest that less mental processing is occurring in low fear because people are not emotionally aroused by the message.

Given the above results, Hypothesis 4 can be supported. Moderate fear causes more asymmetry in the right frontal lobe hemisphere when compared to neutral advertisements than low fear or high fear. These results fully support the Drive Model (Janis & Feshbach, 1953) and previous results indicating that high fear will be mentally processed the least, low fear will be mentally processed somewhat and moderate fear will be mentally processed the most. Also, the comparisons of moderate fear to neutral advertisements and low fear to neutral advertisements reveal trends that support the theories of frontal lobe asymmetry. In these two tests, fear was shown to cause lower alpha scores in the right hemisphere indicating that fear is processed in the right hemisphere. However results for the high fear compared to neutral test do not lend support to frontal lobe asymmetry. The possibility that high fear is processed in an inherently different way than low and moderate fear is becoming more prominent according to these results.

Hypothesis 5 posits that there will be greater difference in frontal lobe alpha wave asymmetry in the right hemisphere when comparing moderate and happy advertisements than when comparing low fear and happy advertisements or high fear and happy advertisements. Table 4.11 shows one significant result for moderate fear appeals compared to happy advertisements at 3 seconds (p=.028). However, Table 4.12 and Table 4.13 reveal no true differences when comparing high fear to happy and low fear to happy.

The data somewhat support Hypothesis 5. Moderate fear compared to happy exhibits greater right hemisphere asymmetry during comparisons than do low fear or high fear compared to happy advertisements. There appears to be minimal difference amongst the mean alpha scores of happy advertisements and low and high fear advertisements. Table 5.1 shows that moderate fear right alpha scores are much lower than the above listed conditions.

Hypotheses 4 and 5 offer support for the theories of frontal lobe emotional asymmetry. Both sets of data show that moderate fear activates the right frontal lobe of the brain. If happy emotions are truly processed in the left hemisphere, and not the right, then there should be very little difference between the alpha means for happy ads and neutral ads. Looking at Table 5.1 above, it is easy to see that this pattern holds mostly true. Also, low fear alpha scores seem to be slightly higher than moderate fear scores. Therefore, the results suggest that moderate fear does activate the right hemisphere more than any of the other emotional conditions, leading to the thought that not only is the curvilinear relationship of fear supported and the Drive Model, but also, these results support the theories of frontal lobe emotional asymmetry.

Hypothesis 6 compared happy scores in the left hemisphere to the three levels of fear, predicting that left hemisphere alpha scores would be less for happy advertisements. Findings in Tables 4.14, 4.15 and 4.16 indicate that Hypothesis 6 is not supported. Table 4.14 indicates that happy left compared to moderate fear left had a significant p-value at the 250ms epoch (p=.013). However, these results indicate that the left alpha scores for happy are much larger than moderate fear, indicating less activation for happy advertisements in the left hemisphere. In fact, looking at Table 5.2 below, the mean scores are much lower for moderate fear in the left hemisphere than happy mean scores in the left hemisphere. The findings in Table 4.15 and 4.16 show no significant difference for comparing happy left to high fear left and happy left to low fear left. In fact, all the mean scores for the conditions of happy, low fear and high fear (left hemisphere) are high. High means indicate very little cognitive activity during the presentation of these emotional commercials. Thus, the left side of the frontal lobes had very little cognitive processing during happy, low or high fear commercials.

The above findings for Hypothesis 6 offer no evidence to support the two models of frontal lobe asymmetry. Not only are there very few differences between low fear, high fear and happy advertisements on the left side of the brain, but also, moderate fear has lower alpha wave pattern scores indicating higher cognitive processing for moderate fear on the left side. The emotional valence theory indicates that positively valenced emotions will activate the left hemisphere and negatively valenced emotions will activate the right hemisphere. According to the findings, this model of frontal lobe asymmetry cannot be supported. The motivational theory explains that approach emotions are on the left and avoidance emotions are on the right. Although, there is no support for the motivational theory, it is difficult to discredit this theory. The happy commercials in this study may not have been motivational, and thus there is no support to deny the theory of motivational direction. However, Hypothesis 6 is not supported.

Table 5.2
Mean score results for alpha waves in left frontal lobes for neutral, happy, low fear, moderate fear and high fear conditions at 250ms and 3 seconds.

Commercial Condition	*Frontal Lobe Hemisphere*	*Measurement Point*	*M*	*SD*
Happy	Left	3s	-43.54	79.07
Happy	Left	250ms	-67.44	88.60
Neutral	Left	3s	-27.14	61.79
Neutral	Left	250ms	-37.49	71.51
Low Fear	Left	3s	-29.96	71.24
Low Fear	Left	250ms	-49.80	72.40

Commercial Condition	*Frontal Lobe Hemisphere*	*Measurement Point*	*M*	*SD*
Moderate Fear	Left	3s	-26.96	62.06
Moderate Fear	Left	250ms	-17.03	58.84
High Fear	Left	3s	-31.98	63.36
High Fear	Left	250ms	-42.78	72.31

The main findings of this study indicate that moderate fear does not significantly activate the right hemisphere of the frontal lobes more than low or high fear. However, comparisons of mean scores reveal trends indicating decreased alpha scores for moderate fear and not low or high fear in the right frontal lobes. Congruent to previous literature, moderate fear appears to cause more cognitive activity in the brain than low or high fear. However, analyses of moderate fear compared to neutral advertisements reveals a significant and strong pattern showing that lower alpha scores arise in these comparisons than when comparing high fear to neutral and low fear to neutral. Another comparison was performed between right frontal lobe alpha scores in happy and moderate fear advertisements revealing some significant findings for moderate fear asymmetry in the right frontal lobe. Both the moderate fear compared to neutral and the moderate fear compared to happy support the previous literature on frontal lobe asymmetry, revealing that moderate fear does activate the right hemisphere of the brain. However, when comparing low and high fear to the happy condition, no alpha wave asymmetry was shown. Finally, an analysis was performed comparing the three levels of fear to happy conditions in the left frontal lobes. These results show no support for the previous research on emotional asymmetry of the frontal lobes.

Limitations

First and foremost, the sample size for this study was 28 subjects. This is a small sample size, and these results are not necessarily generalizable to the public. Also, the sample used was a convenience sample of mostly college students seeking compensation. This sample may or may not be fundamentally different from the population as a whole.

As mentioned in chapter one, advertising is very invasive today. There are a plethora of emotional appeals on the television at any given time. Thus, emotional desensitization can affect the way individuals think about commercials, including fear appeals. It is difficult to determine where to modulate moderate fear. With the entertainment industry pushing constant violence and scary scenarios, there may be a point in time when what was once thought to a very strong fear appeal will become low fear to the consumer.

EEG studies are beneficial because they can determine that mental processes are happening in the brain even when the person is unaware. However, this brings about a lot of different occurrences in the brain at one time. Within a 30 second commercial, an individual can go through a series of mental processes, including sensory input, past memory searches, and emotional reactions. This study used very precise measurement points within the commercials, but there may be some confounds within the data collected considering the array of functions the brain is capable of completing at any one moment. The EEG may be picking up signals from different areas of the brain, including the limbic system of the brain, when viewing fearful manifestations.

The level of arousal a subject felt during commercial presentations may also have an effect on the results. As mentioned earlier, arousal is the intensity of activation associated with an emotion (Bolls, Lang & Potter, 2001). The intensity of the arousal produces by the commercials in this study may confound the emotional reaction that the subject was feeling. Additionally, although the commercials in this study were tested to trigger the appropriate emotions, the level of motivational activation was not measured. Thus, to test the motivational direction theory of frontal lobe asymmetry, an assessment of motivation solicited by advertisements must be validated.

There are always individual differences when performing research. Mood, temperament, sleepiness, hunger, and many other factors are included in EEG wave patterns. These differences will cancel out once you have accrued enough participants. But, as previously mentioned, this study had fewer subjects than a typical parametric study.

Implications for Advertising and Future Research

This study looked at the obtrusive fear appeal and how it affects human physiology. Results show that properly modulated moderate fear appeals cause somewhat more processing in the right frontal lobes of the brain than high or low fear appeals. Thus, if advertisers would like their ad campaigns to be effective, utilizing a moderate fear appeal is the best way to get consumers to process the emotional influence of the commercial. This emotional processing could lead to mental focus and thus more retention of the advertisement (Plessis, 2005). Many advertisers believe that you must shock and awe your audience. This thought may not be true according to the results of this study. A truly high fearful shock and awe effect does not appear to cause emotional processing in the right fontal lobes, and thus, will not lead to retention of the advertisement.

Through the process of literature review, this study appears to be one of the first to look at modulated fear levels and physiological correlates. The results show that Janis and Feshbach's (1953) Drive Model also works when applied to physiology. Reviewing the results and the mean scores in Table 5.1 will ultimately show lower Mean scores for moderate fear, followed by slightly higher Mean scores for low fear, then by high Mean scores for high fear. Also, the results show that high fear Mean scores in the right hemisphere are comparable to neutral scores in the right hemisphere. Witte (1992) proposed that high fear appeals would not be mentally processed by consumers due to psychological defenses and fear control tactics. The results of this study suggest that when subjects in this study viewed the high fear commercials, fear control took over possibly causing defensive avoidance, denial or message manipulation, which in turn caused a lack of mental contemplation of the high fear advertisements. An explanation of the results suggests high fear advertisements were shocking and the processing of the message was not completed as thoroughly as moderate and low fear messages.

Low fear mean scores were slightly higher than moderate fear scores, re-emphasizing the acceptability of the Drive Model and the curvilinear relationship of fear. Although, low fear did not differ significantly from moderate fear or high fear, the results in Hypothesis 4 show that low fear advertisements were different than neutral advertisements showing some effectiveness of low fear advertisements.

Hypotheses 4 and 5 support the theories of frontal lobe asymmetry, but Hypothesis 6 casts a shadow of doubt. Moderate and low fear caused frontal lobe asymmetry in the right hemisphere when compared to neutral and happy advertisements. However, high fear did not gain similar results. Also, happy advertisements did not cause alpha activation on the left side of the frontal lobes as other researchers had previously postulated. In fact, happy advertisements revealed the highest left frontal mean scores within this study. More research is needed to solidify a clear theory of emotional asymmetry in the frontal lobes.

Future research should continue to look for asymmetrical differences within the frontal lobes of the brain and examine the different emotions. Davidson and Irwin (1999) specifically stated, “Less evidence is available on the prefrontal changes associated with positive affect.” (p.14). More emphasis needs to be in this area of study. Researchers know enough about the negative and avoidance emotions, there should be a push to find physiological and psychological correlates of positive emotions and advertisements. Thus, a true understanding of emotion processing can be revealed in the frontal lobes.

Conclusion

This study examined the physiological components of emotional advertising appeals in the human brain. EEG measurements were utilized to determine notable differences within these physiological reactions. Specifically, this study examined the emotion of fear and its effects on the frontal lobes of the brain. Alpha wave asymmetry was thoroughly examined during this study to determine if fear activated the right hemisphere of the brain.

The frontal lobes of the human brain are a processing center for emotional reactions. This study shows that the curvilinear relationship for fear proposed by Janis and Feshbach (1953) holds true for emotional appeals in fearful advertising commercials. This study also provides some support for the theories of emotional valence and motivational direction, showing that moderate and low fear do cause asymmetry in the right hemisphere of the brain. Although this study did not reveal extreme significance, moderate fear mean scores show more activation in the right frontal lobe when compared to neutral and happy advertisements than low and high fear, and have alpha mean scores less than high and low fear advertisements. However, this study did not gain support for the notion that happy emotional appeals will activate the left hemisphere of the frontal lobes. More thorough research will be needed to isolate the emotion of happiness in the left hemisphere of the frontal lobes.

In conclusion, this study exemplifies that the use of fear appeals in advertising campaigns are not a frivolous endeavor. Fear appeals still work at getting consumers to process the message, but the message must be the appropriate level of fear. This study helps support previous literature on the drive model, and the curvilinear relationship between mild, moderate and high fear. If fear is too high, the message may be psychologically avoided or denied. However, if the fear is too low, the individual may not process the message thoroughly. Thus, this study supports the notion that moderate fear is the most effective level of fear to utilize during advertising.

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APPENDIX A

IRB APPROVAL DOCUMENT

04-572 12/14/05 IRB FEB 0 1 2005

For IRB Use Only	Review Date: 2/17/05 Approval Date: 2/23/05 Approval Expiration Date: 2/23/06 EXEMPT per 45 CFR 46.101(b): ____ Date: ____ EXPEDITED per 45 CFR 46.110(b) 4 Category ____, Letter ____	IRB ID: 05-057 Length of Approval: 1 yr FULL Committee Review: ____ Minimal Risk: ✓ More than Minimal Risk: ____ Project Closed Date: ____

ORIGINAL

ISU NEW HUMAN SUBJECTS RESEARCH FORM

IRB FEB 0 1 2005

SECTION I: GENERAL INFORMATION

Principal Investigator (PI): Prof. Joel GESKE	Phone: 515-294-0477	Fax: 515-294-5108
Degrees: M.A., ABD	Correspondence Address: 209 Hamilton Hall, Iowa State University, Ames, IA. 50014.	
Department: Journalism and Mass Communication.	Email Address: geske@iastate.edu	
Center/Institute: Greenlee School of Journalism and Communication	College: College of Liberal Arts and Sciences	
PI Level: ☒ Faculty ☐ Staff ☐ Postdoctoral ☒ Graduate Student ☐ Undergraduate Student		

Title of Project:
Physiological Responses to Print, Broadcast and Online Media
Project Period (Include Start and End Date): [02/01/05] to [08/31/05]

FOR STUDENT PROJECTS	
Name of Major Professor/Supervising Faculty: Dr. Ann Thompson	Signature of Major Professor/Supervising Faculty:
Phone: 515-294-5287	Campus Address: N 108, Lagomarcino Hall, Iowa State University, Ames, IA 50014.
Department: Curriculum and Instruction	Email Address: eat@iastate.edu
Type of Project: (check all that apply) ☒ Research ☐ Thesis ☒ Dissertation ☐ Class project ☐ Independent Study (490, 590, Honors project) ☐ Other. Please specify:	

KEY PERSONNEL

List all members and relevant experience of the project personnel. This information is intended to inform the committee of the training and background related to the specific procedures that the each person will perform on the project.

NAME & DEGREE(S)	SPECIFIC DUTIES ON PROJECT	TRAINING & EXPERIENCE RELATED TO PROCEDURES PERFORMED, DATE OF TRAINING
1. Joel Geske. B.A., M.A., A.B.D	Associate Professor at the Greenlee School of Journalism. Principal Investigator. Will direct the content, procedure, analyses and interpretation of the study.	Workshop Training on the protection of human subjects in research. DATE: Sept. 19, 2000.
2. Saraswathi T. Bellur B.A., M.A	Graduate Student / Research Assistant at the Greenlee School of Journalism. Co-Investigator. Will acquire psycho physiological variables like the EEG	Web-Based Training on the protection of human subjects in research. DATE: Nov. 5, 2004.

APPENDIX B

COMMERCIAL QUESTIONNAIRE

COMMERCIAL 1

1. **Have you seen this commercial before?**
   1=yes 2=no 3=maybe

2. **To what extent do you think this commercial is conveying fear?**

1	2	3	4	5	6	7
Not at all						Very much

3. **To what extent do you think this commercial is conveying happiness?**

1	2	3	4	5	6	7
Not at all						Very much

4. **To what extent are you emotionally affected by this commercial?**

1	2	3	4	5	6	7
Not at all						Very much

COMMERCIAL 2

5. **Have you seen this commercial before?**
   1=yes 2=no 3=maybe

6. **To what extent do you think this commercial is conveying fear?**

1	2	3	4	5	6	7
Not at all						Very much

7. **To what extent do you think this commercial is conveying happiness?**

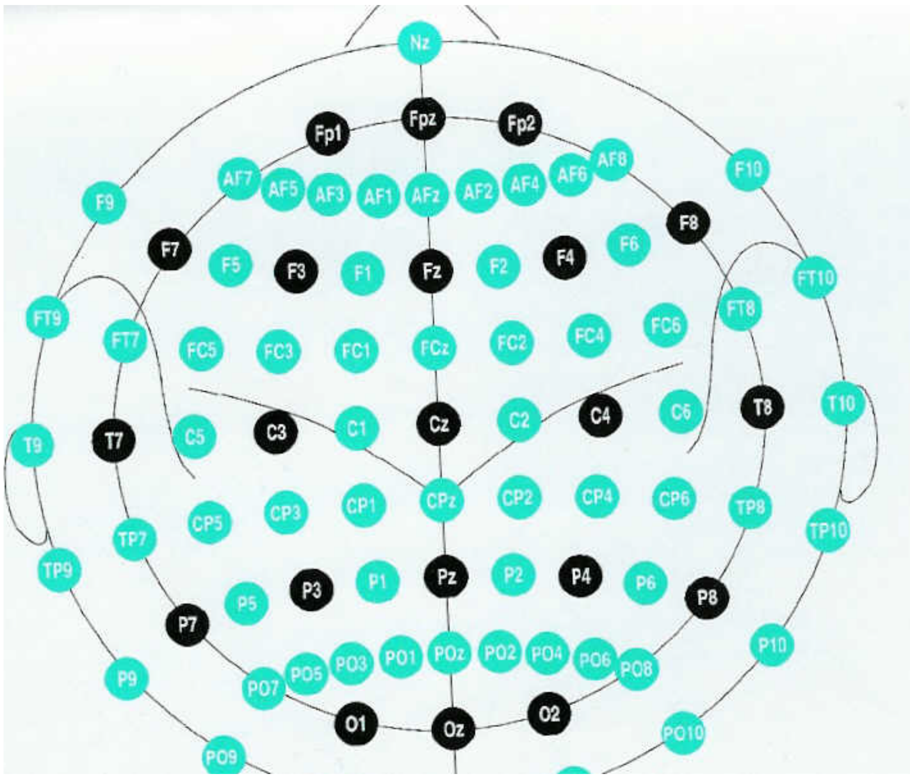
1	2	3	4	5	6	7
Not at all						Very much

8. **To what extent are you emotionally affected by this commercial?**

1	2	3	4	5	6	7
Not at all						Very much

APPENDIX C

THE TEN-TEN ELECTRODE PLACEMENT SYSTEM



Appendix C: Electrode positions and labels for the 10-20 and 10-10 systems. Black circles indicate positions of the original 10-20 system. Gray circles indicate additional positions introduced in tin the 10-10 system.

The ten-ten electrode placement has been endorsed as the standard of the American Electroencephalographic Society and the International Federation of Societies for Electroencephalography and Clinical Neurophysiology (Oostenveld & Praamstra, 2001).

APPENDIX D

SUMMARY FOR RESULTS OF RESEARCH QUESTIONS AND HYPOTHESES

Summary of Hypotheses and Research Question results.

Hypotheses and Research Questions		***Supported?***
H1	*Alpha wave patterns will decrease more (less area under the EEG wavelength curve) in the right frontal lobe of the brain than in the left frontal lobe of the brain when viewing fearful advertisements.*	*Not fully supported. However, H1 has some significant results, and cannot be fully ruled out.*
H2	*Alpha wave patterns will decrease more (less area under the EEG wavelength curve) in the left frontal lobe of the brain than in the right frontal lobe of the brain when viewing happy advertisements.*	*Not supported. Alpha wave activation occurs on the right side.*
RQ1	*Will there be hemispheric asymmetry differences in the right frontal lobes of the brain when comparing low, moderate and high fear appeals?*	*Yes and No. No significant results were found. But, Mean score patterns indicate lower alpha pattern scores for moderate fear over high and low fear.*
H3a	*Alpha wave patterns will decrease more in the right frontal lobe during moderate fear appeals than in low or high fear appeal advertisements.*	*Not fully supported. However, Mean scores are less for moderate fear than low or high fear.*
H3b	*Alpha waves patterns will decrease more in the right frontal lobe during low fear appeals than in high fear advertisements.*	*Not fully supported. Although results indicate a trend showing lower alpha scores for low fear than high fear.*
H4	*There will be a greater difference in frontal lobe alpha wave asymmetry with alpha wave patterns decreasing more in the right hemisphere when comparing moderate fear and neutral ads, than when comparing high fear and neutral ads, or low fear and neutral advertisements.*	*Supported. Significant differences were found in alpha for moderate compared to neutral. Low compared to neutral indicated one significant result, whereas high versus neutral was not significant.*
H5	*There will be a greater difference in frontal lobe alpha wave asymmetry with alpha wave patterns decreasing more in the right hemisphere when comparing moderate fear and happy ads, than when comparing high fear and happy ads, or low fear and happy advertisements.*	*Supported. Moderate fear shows greater alpha asymmetry than low or high fear when compared to happy.*
H6	*There will be decreased alpha wave patterns in the left frontal lobes for happy advertisements when compared to low, moderate and high fear.*	*Not supported.*

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