1-1-2006

Brain wave measures of attention to human faces and non-face forms and objects in print media advertisements

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by

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A thesis submitted to the graduate faculty

in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Major: Journalism and Mass Communication

Program of Study Committee:
Joel Geske, Major Professor
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Dennis Dake

Iowa State University
Ames, Iowa
2006

Graduate College
Iowa State University

This is to certify that the master's thesis of

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Signatures have been redacted for privacy

DEDICATED TO:

My amazing constellation of family, faculty and friends.

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ABSTRACT

The sense of vision and the phenomenon of visual attention constitute some of the prime processes with which human beings communicate with their non-mediated and mediated environment. The objective of this study was to explore how the human brain, as part of a complex visual system, deploys its attentional resources to human face and non-face forms and objects, when tested as primary visual elements in basic print-media advertisement layouts. With the theoretical basis of a two-component attention framework that distinguishes between image-based *bottom-up attention* (50ms) and task-dependent *top-down attention* (250ms), it was hypothesized that faces would evoke significantly higher bottom-up attention than non-face forms, whereas non-face forms and objects would evoke significantly higher top-down attention when compared to faces. Using a repeated measures design with twenty participants, and brain wave measures or electroencephalographic (EEG) activity as the dependent variable, the study examined differences in attention evoked by four categories of stimuli – faces, products, product-in-use and abstract drawings across three cortical regions of the brain, the occipital, temporal and parietal lobes.

Wilcoxon signed-ranks test showed that faces did not evoke significant bottom-up attention, whereas abstract drawings and product-in-use evoked significant attention both in the bottom-up and top-down attention frameworks. These results suggest that processing of simple and familiar stimuli like faces might be more implicit and holistic when they are juxtaposed with more novel and complex forms of stimuli like abstract drawings and products-in-use that call forth higher attentional and cognitive resources. Implications of these results for further studies of advertising effects are discussed.

CHAPTER 1

INTRODUCTION AND STATEMENT OF THE PROBLEM

"Was this the face that launched a thousand ships
And burnt the topless towers of Ilium?"
- Christopher Marlowe *(Dr. Faustus, 1904-19,Scene XIII)*

In ancient times, a face might have launched heroic wars and inspired poetry of epic dimensions. But, for the advertiser today, are faces powerful enough to launch a line of products and brands?

Faces can be considered a rich source of visual communication because of their ecological importance to human beings (Tanaka and Farah, 2003). Face perception has been considered one of the earliest tasks that human beings acquire. As early as two months, human infants have been noted to recognize the faces of people around them (Nelson, 2001; Peterson and Rhodes, 2003). In addition to this, faces are capable of evoking innumerable non-verbal expressions that can communicate more or less the same message effectively across age, gender and other universal demographics (Grusser, Kirchhoff and Naumann, 1990).

The purpose of this study is to explore how the human brain, as part of a complex visual system, deploys its attentional resources to human face and non-face forms and objects, when tested individually as primary visual elements in basic print-media advertisement layout. Using a physiological approach that employs brain wave or electroencephalographic (EEG) measures as the dependent variable, this study will examine the attention evoked by human faces and non-face forms and objects using a two-component attention framework.

This framework distinguishes between pre-attentive, *bottom-up attention* where visual stimuli that are inherently salient, pop-out of a visual scene and catch our attention, as opposed to attentive, *top-down attention* where our attention is dependent on a task and is driven by previous knowledge or current goals and expectations. (Corbetta and Shulman, 2002)

Even amidst visual clutter and extraneous objects in our visual field, we can immediately recognize the faces of friends, acquaintances and family members. Although most faces have the same structural components (a nose, a mouth, and a pair of eyes) we have mastered the subtle nuances that will help us differentiate one person from another (Peterson and Rhodes, 2003). What is more remarkable is that the discrimination of such intricate details from face to face and from objects to objects, is accomplished within milliseconds by our rich visual system in a journey starting with the eye, comprising several processes of attention and perception that culminate in the brain.

In answering why faces are more special when compared to objects, Tanaka and Farah (2003) claim that among the wide array of objects that humans can recognize, faces are the most ubiquitous and most ecologically important. They further add that to be a competent member of any social group, all people must become experts at recognizing faces and subsequently, the multitude of expressions that faces can portray. J. J. Gibson (1977, 1979) noted this ecological importance of faces in his theory of *affordances*. Simply put, *affordances* of the environment are the "things that the environment offers to those who inhabit it", which might be either innocuous or do them harm. If our perception of the reality around us can be significantly influenced by the *affordances* that people and objects in the real world offer, then would not mediated reality also be influenced in the same manner?

For instance, in the case of print media, although magazines and newspapers have innumerable visual formats occupying their pages, such as photographs and illustrations, the most prominent and powerful conduits of visual communication in them are advertisements. Advertisers have been using various visual elements to attract the attention of media audiences. Even as readers carefully peruse their favorite magazine or newspaper, or casually browse through its pages, consciously or not, they are participating in a rich visual journey from page-to-page and cover-to-cover. As Barry (1997) notes, even in print media, many people read ads with as much interest as the editorial content of the magazines. If, for instance, a magazine reader is browsing through the pages of a magazine at a rate of say, two seconds per page, what will make her pause and read the ad? What kind of immediate attentional responses are produced by various visual elements in a persuasive message and are these attentional states reflected in underlying physiological activities that can be captured and measured?

This study explores these questions by studying brain wave responses as indicators of attention to human faces and non-face forms and objects. The study will draw from various disciplines in answering the research questions involved. Starting from theories of attention, it will use several empirical studies in the fields of psychophysiology, neuroscience, and cognitive neurology that have previously explored some of the fundamental questions on how cellular and neural networks, cortical structures in the human brain, and associated visual processing areas attend to objects or matter in the environment.

Data from this interdisciplinary approach might find applications in various branches of the communication industry, for instance, in the design of magazine covers and image-based advertising. Findings from this study may also interest those studying consumer responses and audience behavior in the academic arena and media industry alike. With media environments offering richer sensory inputs, understanding a prime sensory dimension such as human vision and how it operates can further help us to understand how machine vision operates (Parasuraman, 1998) and eventually try to comprehend how the brain dexterously responds to a world that spins on a real-to-virtual continuum between non-mediated, traditional and new media environments.

CHAPTER 2

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

At the outset, this section will provide an overview of the concept of attention, as described by early researchers, and note its growing centrality in recent studies. A two-component framework of attention, the *top-down* and *bottom-up* attention mechanisms, is discussed. Finally, Koch and Ullman's (1985) computational model for bottom-up attention is discussed as a possible model for visual communication studies that deal with concept of saliency and other related questions on visual processing that emerge from this study.

Further, this section will discuss the findings of several empirical studies, which have used psychophysiological approaches like electroencephalography (EEG), event-related potentials (ERP) and functional magnetic resonance imaging (fMRI) to discover some of the crucial differences in the manner in which the brain processes or attends to faces and non-face forms and objects.

Concept and Definition of Attention

Concepts of attention and consciousness have been occupying a central role in how humans perceive themselves and the world around them. Hence, literature and theories of attention have been widely used and studied in fields like cognitive psychology and psychophysiology. Naatanen (1992) observes how the concept of attention is rooted in introspection – on the urge to examine what drives the self to "attend" to the world outside the self. This introspective emphasis, Naatanen (1992) notes was replaced by the behavioral school of psychology that focused more on overt behavioral responses rather than trying to measure internal responses. However, Lindsley (1960, p.1554) reiterates the importance of measuring internal mental processes that occur in the brain even before they manifest themselves in overt behavior. According to Lindsley (1960), attention seems to be contained in -

> shifting processes and states within the central nervous system, some of which are detectable through changes in electrical potentials recorded indirectly and diffusely from the brain, or directly and focally in certain regions of the brain. (Lindsley, 1960, pp.1554-1555)

Rossiter and Percy, (1987) define attention as -

> basically an 'orienting' response to a stimulus. It signifies that the stimulus has made contact with a sense organ, such as the eyes or ears of the decision maker, and one or both of the nervous systems, the central nervous system or brain, or the autonomic nervous system, as in purely a 'gut' reaction that may or may not be registered in the brain. (Rossiter and Percy, 1987, p.197)

Lang and Basil define attention as "the allocation of processing resources to a message. Attention to a task increases as the number of resources allocated to the task increases." (Lang and Basil, 1998, p. 447). Olshavsky, (1994, p.97) believes that attention is an epiphenomenon. In his view, attention is not a separate, preceding stage as shown in earlier information processing models, but rather, attention is a brain state that occurs in every stage of information processing. This study does not examine attention related to cognitive processes as described in information processing paradigms. The focus of this study instead, is at the sensory level at which attention operates and what makes attention to faces and non-face forms and objects at this sensory level different.

Two-Component Attention Framework

Connor, Egeth and Yantis (2004) suggest that the process of visual attention follows both *bottom-up* and *top-down* attention mechanisms. In their study, these authors examined what happens in the brain when these two processes interact. They contend that in the *bottom-up* mechanism, visual attention is caught by stimuli that are salient, that stand out or "pop-out" from the environment that surrounds them. At the same time they add that it is also possible for attention to be guided voluntarily in a *top-down* fashion to attend to objects that are of importance to the observer. These two processes are defined by Corbetta and Shulman (2002) as follows -

> Top-Down Processing: The flow of information from 'higher' to 'lower' centres, conveying knowledge derived from previous experience rather than sensory stimulation.
>
> Bottom-Up Processing: Information processing that proceeds in a single direction from sensory input through perceptual analysis, towards motor input, without involving feedback information from 'higher' centres to 'lower' centres.
>
> Corbetta and Shulman (2002, p. 201)

In *bottom-up* mechanism, attention is said to be triggered by inputs of raw sensory data. The authors give the example of a salient stimulus like a red fruit in a field of green, popping into the viewer's state of attention as purely sensory data catching attention in a *bottom-up* fashion. In the *top-down* mechanism however, viewers are said to make use of the cognitive strategies they have learned over a long period of time. The authors state that in this mechanism our attention is biased towards objects, which we choose to pay attention to because we have prior cognitive experience of how salient that stimulus has been. So, the stimulus here does not "pop-out" of its surroundings to catch our attention, but rather we consciously attend to such stimuli because we believe that they are salient to us, and hence require conscious, voluntary attention. The authors summarily note that while "bottom-up attention alerts us to salient items in our environment, but top-down attention modulates bottom-up signals when we need to look for something specific." (Connor et al., 2004.p. R850)

In a psychophysical experiment using humans to test top-down and bottom-up attention mechanisms, Lamy, Tsal and Egeth (2003) found that both in neural and psychophysical levels, bottom-up attention occurs first, and later top-down attention process takes over in a matter of 100 ms. From this study, Connor et al., (2004) conclude that simple visual characteristics like color, shape and orientation become salient or important in the attentional focus in the very early stage of visual processing, whereas features that require top-down attentional mechanism will occur at a later time in the stage of perception and will involve sensory inputs from higher cortical areas of the brain.

Itti and Koch, (2001) also propose a two-component framework to deploy attention. This framework hypothesizes that people use both top-down and bottom-up mechanism to selectively direct their attention to objects in a scene. Some stimuli are by nature salient, and are said to be driven by "image-based saliency cues". This bottom-up attention mechanism is said to occur at a speed of 50 milliseconds per item. (Itti and Koch, 2001).

The second component of this attention framework is more deliberate and is directed by a predetermined task. It takes into account prior knowledge and expectations in dealing with current goals, and is said to be driven by "task-dependent cues". Such top-down attention mechanism is reported to occur at 200 milliseconds or more. (Itti and Koch, 2001). As is evident, the time taken for top-down attention is several times more than what bottom up attention requires. Hence, top-down attention requires more processing effort than objects that are salient, which grab viewers' attention without much effort on their part. Thus, the research questions, which emerge from these conceptual frameworks are-

RQ 1: Is there a difference between the responses evoked by stimuli of *human faces* vs. *non-facial forms and objects* at the 50ms time frame of bottom-up attention mechanism?

RQ 2: Is there a difference between the responses evoked by stimuli of *human faces* vs. *non-facial forms and objects* at the 250 ms time frame of top-down attention mechanism?

Neural Model of Attention

The processes of perception and cognition of non-verbal facial gestures and expressions are said to be "*automatically* recognized by means of corresponding inborn neural networks", which are a part of every human being and hence are universally used strategies in social communication (Grusser, Kirchhoff and Naumann,1990, p.165).

When we look at a visual field in our everyday life, we cannot process the whole array of stimuli that are present in our visual field. The process of attention thus imposes a "bottleneck" wherein only some information enters our short term or working memory. (Desimone and Duncan, 1995; Crick and Koch, 1998). Therefore these authors believe that we do not process visual stimuli in a parallel manner (all at once), instead we adopt a "serial strategy" where we break down the visual field into small units of analyses and understand them in a piece-meal fashion. Apart from the parallel and serial functions, another critical element of this attention framework is a feedback mechanism studied by Treisman and Gelade (1980); Hummel and Biederman (1992); and Reynolds and Desimone (1999). These authors describe the modulation of neural activity by feedback functions where the visual attributes of an object attended to (such as its color, shape, form) are combined into a unified whole.

Itti and Koch (2001) further emphasize that with this feedback process, attention not only chooses a location of interest in the visual field but also "enhances the cortical representation of objects at that location." (Itti and Koch, 2001.p.2) Thus a physiological measure like EEG is used as a dependent measure to capture such cortical activity when faces and non-face forms and objects are viewed.

Koch and Ullman's Saliency Model of Bottom-Up Attention

Among several theories and paradigms, (see Naatanen, 1992 for a detailed discussion) which account for the processes of attention, Koch and Ullman's (1985) model provides a biological basis and a neural based framework for the functioning of bottom-up attention processes. In their work Koch and Ullman (1985) examined how "*neuron-like*" networks can explain processes associated with shifts in selective visual attention while scanning elements in a visual scene. They cite several psychophysical studies (Neisser, 1967; Julesz, and Bergen,1983; Triesman 1983; Ullman 1984) that have proposed a two-stage theory on how we attend to and recognize objects in a visual field. This theory on "human visual perception" proposes a *pre-attentive* mode where basic characteristics (color, orientation) are processed rapidly, in a parallel fashion, and an *attentive* mode where attention is directly focused onto an object of interest. In the *attentive* mode complex objects are recognized and analyzed.

Koch and Ullman (1985) propose a three-step framework for shifts in selective visual attention. In the first step, basic features in the scene like color, orientation, and direction of objects are represented, separately and individually in many *topographical* cortical maps. This process is said to occur rapidly, and in a parallel manner. In this stage, elementary characteristics are scanned and processed simultaneously into respective topographical maps. Koch and Ullman term this stage - *early representation.* In the second stage, only one element or characteristic is chosen from the several topographical maps and is represented into a central, non-topographical map. This is the *selected* or the chosen location where visual attention is focused most in a given scene Thus they propose the existence of a "saliency map", whose function is to merge information from single, elementary topographical maps into a "global measure" of the most *conspicuous* or the most salient location or element in a given visual field. In the third stage, the authors propose that there are two cellular, neural networks that transmit information from the *early representation*, via the *saliency* map to the *central* map. One is called the Winner-Take-All (WTA) network (Feldman and Ballard, 1982) which determines the most salient location in a visual field and a second network that routes this information to the central map. A succeeding phenomenon called the *Inhibition of Return* (IOR) prevents visual attention from going back to the most conspicuous location once selected, and instead scans the scene for other elements in the scene with decreasing order of saliency.

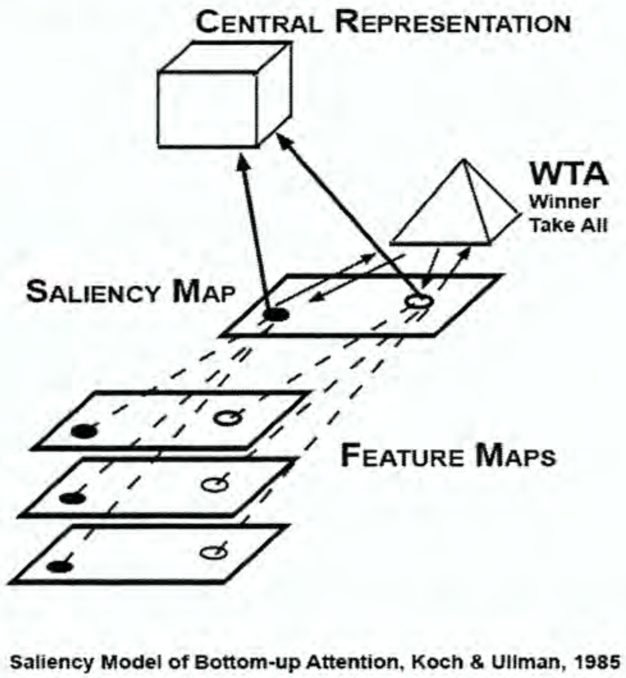


Figure 2.1: Koch and Ullman's Saliency Model of Bottom-Up Attention. (*Source*: "Shifts in Selective Visual Attention: towards the underlying neural circuitry". Koch & Ullman, 1985)

The Koch and Ullman model additionally includes a detailed computational and mathematical basis for calculating saliency and related attentional processes. Researchers like Parkhurst, Law and Niebur (2002), have built upon this computational model in their study that examines how attention is allocated in free viewing of everyday scenes. It is beyond the scope of this study to examine the computational underpinnings of the model. Although the model provides an understanding of how selective attention processes work in complex visual scenes, what makes the model pertinent to this study is that it gives us a basis to understand how pre-attention and attention work. Therefore, the focus of this study is the neural networks and their cortical representations as delineated by the bottom-up saliency model of Koch and Ullman because these authors discuss the concept of selective visual attention using a "cellular physiology" framework. They note that the selective attention model they propose may not be a replication of the exact processes that occur in a complex structure like the human brain, but they believe that "the shift of selective visual attention and related visual operations can be explained using simple mechanisms compatible with cortical physiology and anatomy." (p.221) Hence, it has to be noted that in keeping with the scope of this study, which measures immediate physiological (brain wave) responses to stimuli, Koch and Ullman's "biologically plausible" model of bottom-up attention serves to describe how attention is allocated to stimuli within the first few hundreds of milliseconds after its presentation (Itti and Koch, 2001.p.7).

Cortical structures and functions involved in primary visual processing

Occipital and Parietal lobes: The primary visual cortex is said to occupy the occipital lobes of the brain. Most visual functions have their cortical location in the areas V1, V2, V3, V4 and V5 of the occipital lobe. However, some visual function can also be found in sections of the parietal lobes to a large extent, and to a lesser extent in the frontal and temporal lobes. (Zeki, 1993).

Visual Cortex and the What-Where doctrine

Wallis (1999) provides a succinct view of the cortical areas and their functions related to primary visual processing. He notes that the primary visual areas once classified as the magno and parvocellular regions of the lateral geniculate nucleus (LGN), V1 and V2 are now broadly described in terms of the ventral and dorsal streams. The ventral stream comprising mostly the V1, V2 and V4 areas in the occipital lobe, along with the inferior part of the temporal lobe assists us in determining "what" we are looking at; whereas the dorsal stream, comprising the V1, V2 and V3 areas along with the movement area (MT) and the parietal lobe determine "where" we are looking. Thus, most studies conclude that the infero-temporal cortex (IT) is responsible for the identification of objects, and within IT, the fusiform gyrus responds maximally to faces.

On the same note, Zeki (1993) proposes the 'what' and 'where' doctrine as two "mutually exclusive" and "hierarchically organized" visual pathways emerging out of area V1. One of them, the ventral pathway is said to terminate in the temporal lobe and is said to exclusively deal with "form vision" and "analysis of the physical properties of a visual object" (Mishkin, Ungerleider and Macko, 1983), forming the "what" pathway. The dorsal pathway is said to terminate in the parietal lobe and is thought to be specialized in "spatial vision", forming the "where" pathway. This 'what' and 'where' doctrine receives further support from studies of lesions. When the parietal cortex suffers lesions, there is prominent loss of spatial orientation and an inability to see the how the objects in the field of view are related to each other. Similarly, lesions in the posterior and inferior temporal cortex are said to cause severe defects in the recognition of objects. (Zeki, 1993, p. 187). The author further notes that the two systems may not be as separate as was once believed but rather, there could sharing of at least some functions between the dorsal and ventral pathways.

Injuries and Disorders. A more substantial connection between holistic face recognition and brain function is found in the studies of brain-damaged patients, in particular, those affected by prosopagnosia, which is an impairment of the ability to recognize faces due to brain injury. Farah (2000) found that patients with prosopagnosia had some difficulty in recognizing common objects. However, their disability was much more pronounced in their severe loss of ability to recognize very familiar faces – of their close friends, family members and often, even their own faces.

Patients suffering from visual agnosia are believed to demonstrate lack of integration. Neurologists call such a condition as being "form blind", where patients fail to integrate what they see of an object and understand what it means. In some instances, patients can recognize some objects but not other objects, because they are not capable of seeing forms that call for more complex levels of integration of what is seen, along with a lack of involvement of higher cortical areas in understanding them (Zeki, 1993). In two neuropsychological experiments conducted by Grusser et al., (1990) it was found that schizophrenic patients had higher error scores when compared to patients with brain-lesions in recognition of faces and facial expression tasks making it one of the main clinical symptoms of this psychotic condition. When to compared to a group of normal participants, schizophrenics also had a higher error score while engaged in simple face-recognition tasks.

Holistic versus Analytic coding of faces and objects

There have been two major theoretical constructs that have tried to explain how we perceive faces, objects and scenes. Gestalt psychologists have emphasized the perception of wholes over parts, that is, a ***holistic*** manner of processing. Whereas structuralists have emphasized the role of individual elements, thus proposing an ***analytic*** way of processing of matter in our environment (Peterson and Rhodes, 2003). These researchers note that there is no single definition of the words ***holistic*** and ***analytic***. However, they add that terms such as "global", "configural", and "coarse" could be seen as synonyms for ***holistic***; and terms such as "piecemeal", "local", "part-based", "componential" and "fine-grained" as synonyms for ***analytic***. Peterson and Rhodes (2003) also discuss studies that have sought neuro-anatomical evidence for the existence of these dual routes.

Similar to Peterson and Rhodes (2003), Tanaka and Farah (2003) also approach the face recognition question from a strong gestalt viewpoint, where perception of the whole stimulus takes precedence over the sum of its individual parts. They observe that when we see a face, we recognize it immediately without conscious effort, and this recognition does not happen in a piece-meal fashion as in identifying eyes, nose and mouth separately but rather a recognition of the entire face at once, taken along with its structural components. Presenting a "holistic face hypothesis" these researchers state – "normal object recognition depends on the decomposition of the object into its constituent parts. The holistic face hypothesis maintains that faces are represented and recognized as undifferentiated wholes." (Tanaka and Farah, 2003, p.54)

Fusiform Gyrus or the Fusiform Face Area (FFA)

Face perception has been defined as "any higher-level visual processing of faces from the detection of a face as a face, to the extraction from a face of any information about the individual's identity, gaze, direction, mood, sex, etc." (Kanwisher, Mc Dermott and Chun, 1997, p.4302). Face perception has been attributed to a specialized region in the brain called the *fusifrom gyrus* also known as the *fusiform face area (FFA)*, located in the temporal lobe. (Kanwisher, Mc Dermott and Chun, 1997; Ishai , Ungerleider, Martin, Schouten and Haxby 1999; Tong, Nakayama, Moscovitch, Weinrib and Kanwisher, 2000)

Kanwisher et al. (1997) conducted a functional Magnetic Resonance Imagery (fMRI) study where they found that an area in the fusiform gyrus, located in the human extrastriate cortex, (which they label as the FF area) responded significantly to faces as opposed to other control stimuli used in the study such as scrambled faces, full-front or three-quarters views of photos, houses, human hands, etc. The study was able to provide evidence for the observation that the FF area did not respond significantly to any *animate* human part (such as hands, or views of a face at different angles, and low-level visual elements) but responded significantly to a holistic representation of a face as seen in everyday, natural or free viewing conditions.

In another fMRI study, Ishai et al., (1999) note that not just a specific area (fusiform gyrus), rather the entire "posterior ventral temporal cortex" responded with various degrees of preference to three categories of stimuli used in their study – faces, buildings and letters. They attributed perception of buildings to the medial fusiform gyrus, lateral inferior temporal gyrus to chairs and observed that the intermediate lateral fusiform gyrus "responded maximally" to faces. The authors of this study emphasize that object representation is spread across various regions of the ventral temporal cortex and is not necessarily categorized into mutually exclusive "modules" or parts in the fusiform gyrus area.

In a comprehensive fMRI study involving four series of experiments Tong et al., (2000) provide results which strongly indicate that the fusiform face area is involved in the detection and perception of faces, although the data does not support other processes like recognition and memorization of faces. Using stimuli in four different experimental settings, this study explored FFA activation for human (full-front view and cheek view), cat and cartoon faces and found that these responded with *optimal* FFA activation. However, inverted cartoon faces, faces without eyes, schematic representation of faces and only a pair of eyes elicited *intermediate* FFA activation whereas non-objects (non-faces and other inanimate stimuli) evoked *weakest* activation in the fusiform gyrus.

In a study using both magnetoencephalography (MEG) and electroencephalography (EEG) Watanabe, Miki and Kakigi (2005) found that when unfamiliar faces were presented as stimuli in both upright and inverted formats, the "inferior temporal cortex (IT) centred on the fusiform gyrus" and the "lateral temporal cortex (LT) near the superior temporal sulcus" were activated at once. This study used 10 subjects, aged between 26 to 42 years. The chief visual stimulation consisted of – upright face, inverted face, butterflies and scrambled faces with responses to objects (non-faces) acting as controls. The main finding of this study by Watanabe et al., (2005) was that neuronal generators were activated both in the infero-and lateral temporal cortex as a response to presentation of faces.

In evoked-potential research, Botzel, Schulze and Stodieck (1995) presented black-and-white pictures of human faces, flowers and leaves to sixteen healthy subjects and found that face waveforms evoked a negative peak at 175ms, which was not as pronounced for non-faces. The authors cite that these differences were noted in the occipital, lateral temporal and mesio-temporal brain regions. Other researchers, (Paller, Bozic, Ranganath, Grabowecky and Yamada, 1999) examined EEG signals time-locked to the presentation of forty unknown faces where they instructed participants to remember (R-faces) twenty faces accompanied by voice/audio and to forget the other twenty faces (F-faces). This study reported that the brain-potentials evoked in the frontal and parieto-occipital regions between 300 to 900 ms after the presentation of the stimulus was larger for remembered faces (R-faces) than for the ones forgotten (F-faces).

Herzmann, Schweinberger, Sommer and Jentzsch (2004) studied various psychological (cognitive and affective dual-routes) and physiological event-related brain potential (ERPs) responses to unknown faces, famous faces and personally familiar faces. This study found that "large autonomic responses" were evoked only for personally known or familiar faces. This study tested face recognition models and concluded that "unit activation" progressively increased while subjects moved from recognizing unknown, to famous to personally known faces.

Thus, while results from most studies, especially those using fMRI and other brain-potential studies do seem to suggest that processing of faces does create significant activity in the FFA located in the temporal lobe, there are other studies (Botzel and Grusser, 1989) that suggest that face-specific EEG components may not appear in the temporo-occipital cortical area but may originate in the limbic structures, such as the amygdala and the hippocampus, located in the deeper parts of the temporal lobe.

EEG as a measure of attention

Alpha and Beta Waves. In a review of psychophysiological literature related to EEG activity, Rothschild and Thorson (1983) note that electroencephalographic (EEG) activity was first reported in 1875 by Caton; and that the alpha and beta rhythms were discovered in human beings by Berger in 1929. They further note that these sine-wave frequencies of EEG activity can be seen as a measure of the power (amplitude) and frequency of electrical activity that occur below a certain cortical region of the skull.

The basic, unfiltered EEG recording can be broken down into four component frequencies with the help of band-pass filters. Out of the four frequency components of alpha, beta, delta and theta waves, alpha and beta waves constitute the variables of interest in this study. Alpha waves, with a frequency range of 8 to 13 Hz, are said to characterize a brain state marked by feelings of deep relaxation and calmness. Alpha rhythms also indicate a more holistic processing of information. Beta waves are normally recorded in the 14 to 30 Hz frequency range and are said to signify a normal waking state, and are associated with alertness, attention and concentration (Mullholland, 1978). Describing the measurement of visual attention, Mulholland states that EEG can reveal large-scale gradations of cortical processes related to attention. Berger (1929) is credited with the observation that the alpha rhythms are suppressed by a visual stimulus in a phenomenon called **alpha-blocking**.

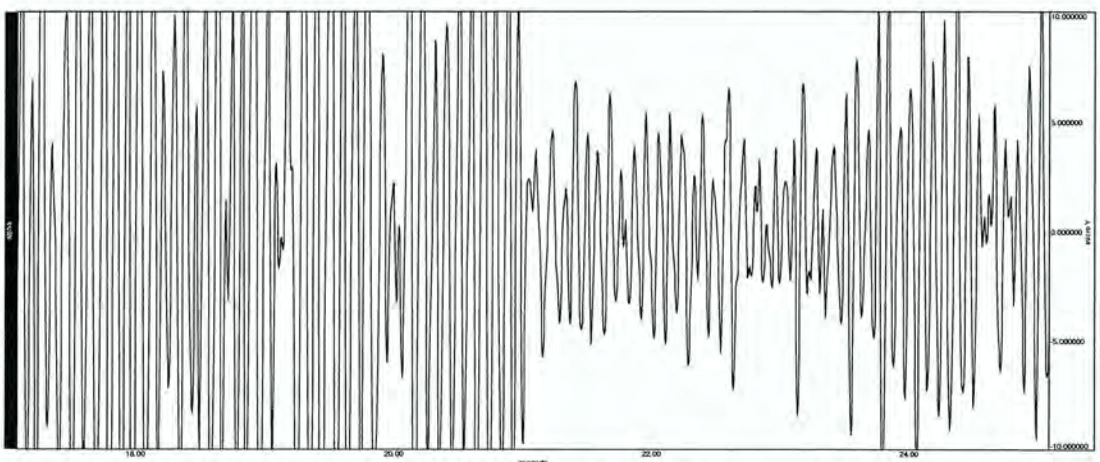


Figure 2.2: Participant demonstrates *alpha blocking* on the presentation of a stimulus. In terms of EEG morphology, alpha waves (8-13 Hz) change from long and loopy sine waves into shorter, crisper waveforms of lower amplitude.

If there was no further change in the stimulus, alpha levels gradually increased. Alpha waves are said to be *suppressed* by the occurrence or *onset* of a visual stimulus, with their *recovery* to their original baseline beginning immediately following the *suppression*; and the rate of recovery is said to be dependent on the "content" of a stimulus and "interest" in it (Rothschild and Thorson, 1983).

In biofeedback studies, Lubar (1991) found that children with attention deficit and hyperactivity disorder (ADHD) produced a huge amount of theta rhythms (4 to 8 Hz), but were unable to produce beta activity (13 to 30Hz), which resulted in poor attention and lack of concentration. However, the study claimed that when children with ADHD were trained with EEG biofeedback to increase the production of beta waves, there was a marked increase in their ability to attend and concentrate.

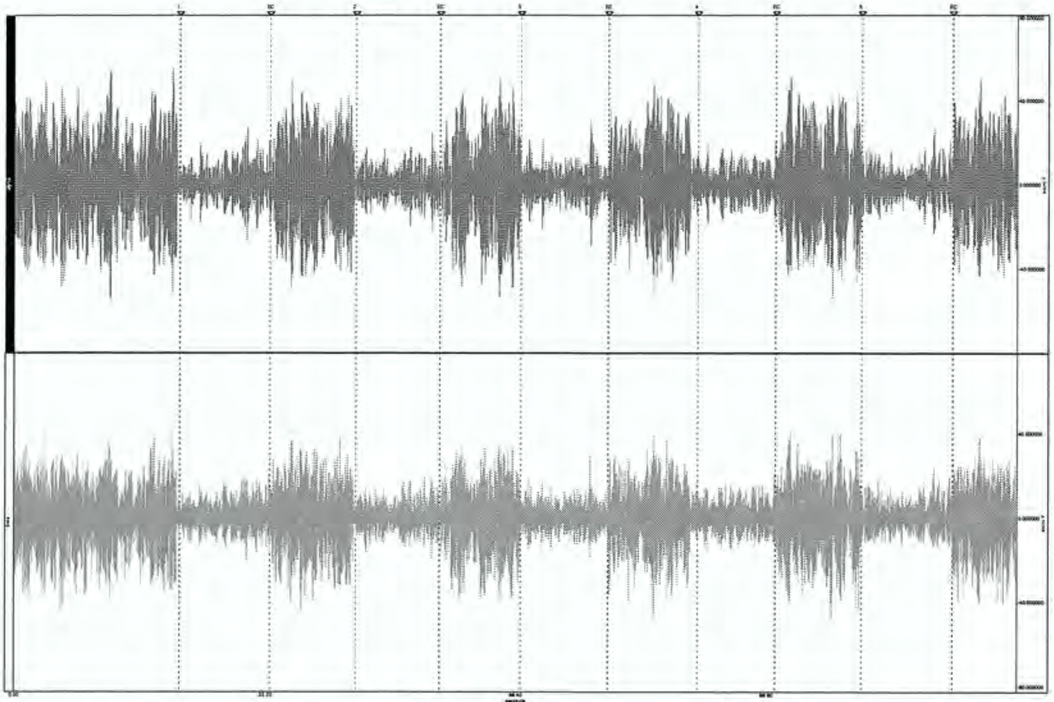


Figure 2.3: Changes in amplitude and area under the curve from baseline to treatment for alpha (red above) and beta (green below) waves in a participant exposed to stimuli. Vertical grid lines separate baseline (taller waves) from reaction to stimuli (smaller waves). Horizontal axis represents time (in sec) and the right vertical axis represents amplitude measures (micro Volts)

In a within-subjects and between-media design, Geske (2005) examined attentional differences using EEG across three different media — print, Cathode Ray Tube (CRT) monitors and flat screen (LCD) monitors. The study found significant differences in alpha wave patterns in the parietal lobes, indicating that participants paid more attention to reading materials in print and flat screens, when compared to CRT screens. Thus, there have been several studies (as reviewed in detail by Rothschild and Thorson, 1983; Ray and Olson, 1983) that reiterate the inverse relationship between the alpha rhythm and cortical activity seen during attention.

EEG in media and advertising studies

Rothschild and Thorson, (1983) specify three reasons why EEG can be considered a potential tool of measurement for advertisers and for those in the consumer research industry. One, EEG provides "continuous" real-time data. Two, audiences' immediate responses to a commercial message do not have to be put into words, as in verbal recall, instead EEG gathers implicit processing of commercial messages. Three, EEG can act as a good measure of response even if the audience shows only low level of involvement and learning towards the actual content of the message. Hence these authors conclude that, "EEG data have the intuitive appeal of being measurable under even lower conditions of involvement, in that attention can be measured (at least in theory) without the need for any questions to be asked (p. 240)."

EEG as a measure of consumer response has been examined in very few advertising studies, which are based more on empirical findings rather than popular conceptual frameworks. Krugman (1971) was one of the early researchers who examined the EEG responses of a single subject and concluded that television commercials evoked passive involvement (greater theta, medium alpha and lesser beta waves), whereas magazine ads evoked active involvement (greater beta and lower alpha waves). In his studies Krugman (1971) thus explored differences in the medium (television versus print), per se, rather than the content. However, in a recent study (under review) Geske and Bellur (2006) repeated and re-evaluated Krugman's 1971 study, has found results that run counter to Krugman's findings. In this study, a sample of 30 subjects showed greater attention, as in greater alpha suppression, to TV commercials than to magazine advertisements.

Similar to Krugman (1971), Weinstein, Appel and Weinstein (1980) also found that magazines generated more beta activity than television ads. The primary objective of this study by Weinstein and colleagues was to examine hemispheric differences, by proposing higher brain-wave activity in the left hemisphere for magazine advertisements. The study did not find significant results to support this assumption.

Reeves, Thorson, Rothschild, McDonald, Hirsch and Goldstein (1985), studied some of the basic characteristics of a visual message like "movements" and "edits" in a television commercial, and they found that these features created significant changes in alpha activity. Rothschild (1993) also found that overall alpha activity for commercials was significantly and negatively correlated with widely used measures of memory – recall and recognition.

While most EEG studies have examined EEG activity either by their frequency or amplitude measures, or as spectral measures or evoked-potential (EP) responses, this study will examine the waveform activity of alpha and beta (explained in detail in the Method section) as indicators of attention. Going by the properties of alpha and beta waves and the studies discussed above, the following research questions and hypotheses will be proposed in this study. These hypotheses will examine the brain wave responses of participants to print media advertisement stimuli designed with face and non-face forms and product images at the bottom-up (50ms) and top-down (250ms) attention framework.

RQ 1: Is there a difference between the responses evoked by stimuli of *human faces* vs. *non-facial forms and objects* at the 50ms time frame of bottom-up attention?

Hypotheses that emerge from RQ1 will be based on bottom-up mechanism and the assumption that attention to faces requires *more* sensory cues and *less* cognitive cues. Therefore the direction of hypotheses for the first set of hypothesis will be: ***Attention for Faces will be greater than attention for Non-Faces.***

RQ 2: Is there a difference between the responses evoked by stimuli of *human faces* vs. *non-facial forms and objects* at the 250 ms time frame of top-down attention?

Hypotheses that emerge from RQ2 will be based on top-down mechanism and the assumption that attention to non-face forms and objects require *more* cognitive cues and *less* sensory cues. Therefore the direction for the second set of hypotheses will be: ***Attention for Non-Faces will be greater than attention for Faces.***

To examine the differences within the non-face category, the following research question will be examined –

RQ 3: Within the category of non-face forms and objects, are there significant differences between the responses evoked by stimuli of *products, products-in-use and abstract drawings* both at the bottom-up and top-down attention frameworks?

All the above hypotheses and research questions will be tested separately for three main cortical regions in the brain related to visual processing areas, the occipital (O1 and O2) temporal (T5 and T6) and parietal (P3 and P4) lobes. The current study builds on an earlier pilot study (Bellur and Geske, 2006) that examined the differences between faces and objects of eleven participants who viewed photographic images (IAPS # 7175, 7009, 2493 and 2441) of *faces* as compared to *objects*. This pilot study did find significant differences in the alpha and beta wave patterns at the bottom-up attention stage of 50ms time frame for the face stimuli in the occipital lobe; whereas no significant differences were found in the top-down attention stage at 250ms. The current study expands the sample size, and uses stimuli designed to suit print media advertisement context as discussed in detail in the Methods section.

CHAPTER 3

METHOD AND MATERIAL

Most advertisers and marketers know that copy testing is an invaluable tool that can give feedback on what could make an advertisement work in the real world. In such situations that test the effectiveness of advertising messages and executions, most traditional advertising research methods have relied on attitude-based verbal responses, which Light (1993) thinks are inadequate predictors of behavior.

In contrast, an immediate physiological response such as brain wave (EEG) measures of attention helps in determining the effects of advertising stimuli more directly. As LaBarbera and Tucciarone (1995) note, physiological testing overcomes the rational processes of consumers and measures only their "involuntary physiological response". The strength of the psychophysiological approach as noted by McHugo and Lanzetta (1983) is that "bioelectric signals reflect the action of particular structures and processes in the human body and thus are as worthy of study as any other responses." These authors note that physiological measures provide a valid and reliable index to measure hypothesized constructs of mental states, such as attention or arousal. Additionally, physiological responses like EEG provide "continuous" rather than "discrete" data, which are less "reactive" and "less vulnerable to demand characteristics" as they are beyond the voluntary control of participants (McHugo and Lanzetta, 1983, p.630).

Sample

Most physiological responses, like brain waves, are autonomous and highly individualistic in nature. These autonomous responses occur within a few milliseconds and are more often than not, beyond the conscious control and manipulation of the subject being tested. Thus, an appropriate method for physiological response testing would be a repeated measures design where an experimenter tries to examine the effects of multiple manipulations and differing treatments on the same subject (Wimmer and Dominick, 2000). In this design, the effects of different experimental treatments will appear as variations within a single subject's performance rather than between groups, effectively making each subject his or her own control group. Two types of repeated measures design – several repetitions of a single treatment on a subject, or exposing a single subject to multiple treatments – are both know to reduce error variance. "Counterbalancing" the order of stimuli is said to control for some of the effects of repetition such as habituation of responses, carry-over effect between trials and sensitization (McHugo and Lanzetta, 1983).

Participants

When obtaining physiological responses, the researcher has to be aware of various limitations imposed by growth or developmental factors (both typical and atypical) that are largely beyond one's control. For example, age or genetically determined pathological conditions can directly impact the results of the study. (Fisch and Spehlmann, 1999).

To account for highly individualized nature of bodily responses and also in order to minimize extreme differences, the present study examined the brain wave responses of twenty participants (n= twenty, female = thirteen, male = seven) in the age group of 19 to 28 years, all belonging to the same ethnic group (Caucasian), with no known developmental, pathological or age-related abnormality. All the participants had normal or corrected-to-normal vision. The test materials were presented in English, the primary language of the subjects. Informed Consent was obtained from all subjects who participated in the study. The subjects were duly thanked and compensated for their participation.

EEG Recording

All testing took place in a physiologic testing laboratory approximately 12 feet by 16 feet, with white painted walls. The ceiling is a white drop-panel design with recessed fluorescent lights. The testing room is located in a quiet area removed from hallways or distracting audio stimuli. Subjects were allowed to adjust their position for comfortable reading distance but were otherwise instructed to remain still to minimize motion artifacts in the EEG recordings.

Disposable vinyl electrodes (Ag/ Ag Cl) were positioned on the scalp of participants with the help of a standard electrolyte gel. Three pairs of electrodes were placed on the scalp of the subject at the Occipital (O1 and O2), Temporal (T5 and T6) and the Parietal (P3 and P4) lobes. These scalp sites were lightly rubbed and prepared before placing electrodes, in order to ensure good contact. Three ground-electrodes were placed near each ear lobe and the mastoid area following the International 10-20 electrode placement system as proposed by the American Clinical Neurophysiology Society. This system is the most widely used method to describe the location of scalp electrodes. It is based on the relationship between the location of an electrode and the underlying area of cerebral cortex. Each site has a letter (to identify the lobe) and a number or another letter to identify the hemisphere location. The procedure is fully non-invasive, that is it does not involve any surgical procedure. It is performed on the external surface of the subject's scalp and skin.

All equipment was plugged into a single grounded electrical outlet to prevent any accidental shock. Electrode leads were clamped to the electrodes on the scalp, and a protective cap or wrap was placed on the subject's head so that the electrodes stay in touch with the scalp and give accurate information. Subjects were requested to remain still as much as possible and to minimize any conscious voluntary movement. In the first stage, the participant was asked to relax with his/her eyes closed for the duration of twenty seconds approximately. In the second stage, the subject was asked to open his / her eyes and to view the advertising stimuli placed in front. In the third and the last stage, the subject was requested to close his / her eyes back and to relax. Each stage lasted no more than 20 seconds.

Measurement of variables

Measurements were taken using a BIOPAC MP30 Unit (Version 3.6.1). In this study, attention was operationalized as a lessening in the area-under-the-curve of both alpha and beta waves. Thus, the baseline condition would have greater, (bigger area) alpha and beta waves, whereas in the treatment condition, these areas-under-the-curve would diminish, contingent upon and reflecting the relative intensity of cortical activity involved in attentional processing of the stimulus. Thus, the area-under-the-curve serves as a measure of activity, expressed in microvolts/sec. Comparisons of absolute values of alpha and beta activity were made between a 0 to 50 milliseconds epoch in the baseline and a 0 to 50 millisecond epoch soon after the presentation of the stimuli, thus enabling the recording of bottom-up attention response; and a 250 to 300 millisecond epoch after the presentation of the stimuli, thus enabling the recording of top-down attention response. Epochs are defined as, "an instance of behavior that emerges distinctly from surrounding time periods" (McHugo and Lanzetta, 1983). These fifty millisecond epochs were the basic units of data analysis.

Following the standard practice in most psychophysiological studies, a representative value in the resting or baseline condition was subtracted from a representative value in the experimental condition and a percentage increase over baseline was computed, yielding

relative values instead of **absolute values** (McHugo and Lanzetta, 1983). Since the study is interested in obtaining phasic responses (short-term changes in millisecond epochs) the resultant scores of individual participants could lead to a skewed distribution. Such phasic scores are known to violate the "*homogeneity of variance*" as there could be more variation from one subject to another, and in one experimental condition to the next treatment within the same subject. (McHugo and Lanzetta, 1983). Therefore, the Wilcoxon Signed Rank test, a non-parametric equivalent of the paired-samples t-test was used to test the hypotheses.

Stimuli

The study used four categories of stimuli, presented once in three sets (Sets 1, 2 and 3) resulting in 12 presentations of stimuli in total, per subject. The three sets of stimulus-presentation were rotated using a Latin-square thus controlling for any order effects. The four categories of stimuli, distinguishing chiefly between face and non-face forms and objects include – a) **faces**, b) **product-images**, c) **product-in-use,** and d) **abstract drawings** (see Appendix). The layout of the advertising stimuli followed a regular format of full-page (8.5 by 11 inches) color ads, as seen in popular consumer magazines. A pre-test (n=16) showed that the personal care product category was frequently (93 %) associated with human models and faces and therefore, face cream, hand cream and a mouth wash were chosen as the products to be advertised in the stimuli.

The **face** category stimuli consisted of close-up photographs of three female students belonging to similar age and ethnic groups (18 to 23 years, Caucasian). The faces wore a neutral to pleasant expression. These female students who acted as models for the ad-stimuli signed a personal release document and were unknown to the participants in the study, thus controlling for possible confounds of a known or a personally familiar face, as far as possible. In the second category of **product-images**, to control for brand-familiarity three fictitious brand names were created (*Almay, Lamay* and *Fresh Gel*). Photographs of these altered products (bottles, jars and holders) were used. In the third **product-in-use** category, the same products were shown along with the hands of the models holding or using the product being advertised. The fourth category of stimuli acted as a control as it showed **abstract drawings** taken from the International Affective Pictures System - IAPS # 7160, 7247 & 7249 - with neither a face nor a product as the primary visual element.

These four categories of stimuli were edited and designed on Adobe Photoshop to keep the copy (text) to the minimum. The stimuli were enclosed within a black frame to control for variations in background tone and texture across all the stimuli. The black frame also controlled for differences in hairstyles across the models used in the **faces**-category as hair patterns have been known to influence head perception rather than face perception (Wallis, 1999). For the **faces** category, the stimuli showed images of female, Caucasian models only. Examining the influence of intervening factors like gender and ethnicity of the faces used in the stimuli is beyond the scope of the current study and will have to be controlled for in future research.

Six paired comparisons were made that looked for differences in alpha and beta activity between the four categories of stimuli in the following combinations. Before the comparisons were made, an average was computed for the twelve items (three for each of the four categories) across Sets 1, 2 and 3.

The six, paired comparisons used in the Wilcoxon tests are as follows:

Pair 1: Faces – Product

Pair 2: Faces – Abstract

Pair 3: Faces – Product-in-use (Hand)

Pair 4: Product – Abstract

Pair 5: Product – Product-in-use (Hand), and

Pair 6: Abstract – Product-in-use (Hand)

At the end of the experimental session, participants were asked to provide an open-ended, verbal description to the visual elements that caught their attention the most. Although the revised Personal Involvement Inventory (Zaichowsky,1994) was also administered, separate responses to each stimulus category could not be obtained. Therefore, only an overview of mean responses to all the stimuli shown, is compiled in the appendix along with a list of open-ended responses given by all the participants.

Following the Literature Review and the Methods section, what follows is a summary of the specific research questions and hypotheses that were examined in this study.

RQ 1: Is there a difference between the responses evoked by stimuli of *human faces* vs. *non-facial forms and objects* at the 50ms time frame of bottom-up attention?

There are three sets of hypotheses, H1a, H1b; H2a, H2b and H3a and H3b, which emerge from Research Question 1. Findings for the following pairs of comparison – pair 1 (Faces and Products), pair 2 (Faces and Abstract drawings) and pair 3, (Faces and Product-in-use) will be tested for the above hypotheses at the bottom-up attention framework of 50 ms.

Pair 1: Faces – Products at 50ms

H1a: Alpha blocking for ad-stimuli with *faces* and alpha blocking for ad-stimuli with *products* will be significantly different, with alpha blocking for *faces* greater than that for *products.*

H1b: Beta activity for ad-stimuli with *faces* and beta activity for ad-stimuli with *products* will be significantly different, with beta activity for *faces* greater than that for *products.*

Pair 2: Faces – Abstract drawings at 50ms

H2a: Alpha blocking for ad-stimuli with *faces* and alpha blocking for stimuli with *abstract drawings* will be significantly different, with alpha blocking for *faces* greater than that for *abstract drawings.*

H2b: Beta activity for ad-stimuli with *faces* and beta activity for stimuli with *abstract drawings* will be significantly different, with beta activity for *faces* greater than that for *abstract drawings.*

Pair 3: Faces – Product-in-use (Hands) at 50ms

H3a: Alpha blocking for ad-stimuli with *faces* and alpha blocking for ad-stimuli with *product-in-use* will be significantly different, with alpha blocking for *faces* greater than that for *product-in-use.*

H3b: Beta activity for ad-stimuli with *faces* and beta activity for ad-stimuli with *product-in-use* will be significantly different, with beta activity for *faces* greater than that for *product-in-use.*

RQ 2: Is there a difference between the responses evoked by stimuli of *human faces* vs. *non-facial forms and objects* at the 250 ms time frame of top-down attention?

There are three sets of hypotheses, H4a, H4b; H5a, H5b and H6a and H6b, which emerge from Research Question 2. Findings for the following pairs of comparison– pair 1 (Faces and Products), pair (Faces and Abstract drawings) and pair 3, (Faces and Product-in-use) will be tested for the above hypotheses at the top-down attention framework of 250 ms.

Pair 1: Faces – Products at 250ms

H4a: Alpha blocking for ad-stimuli with *faces* and alpha blocking for ad-stimuli with *products* will be significantly different, with alpha blocking for *products* greater than that for *faces.*

H4b: Beta activity for ad-stimuli with *faces* and beta activity for ad-stimuli with *products* will be significantly different, with beta activity for *products* greater than that for *faces*.

Pair 2: Faces – Abstract drawings at 250ms

H5a: Alpha blocking for ad-stimuli with *faces* and alpha blocking for stimuli with *abstract drawings* will be significantly different, with alpha blocking for *abstract drawings* greater than that for *faces*.

H5b: Beta activity for ad-stimuli with *faces* and beta activity for stimuli with *abstract drawings* will be significantly different, with beta activity for *abstract drawings* greater than that for *faces*.

Pair 3: Faces – Product-in-use (Hands) at 250ms

H6a: Alpha blocking for ad-stimuli with *faces* and alpha blocking for ad-stimuli with *product-in-use* will be significantly different, with alpha blocking for *product-in-use* greater than that for *faces*.

H6b: Beta activity for ad-stimuli with *faces* and beta activity for ad-stimuli with *product-in-use* will be significantly different, with beta activity for *product-in-use* greater than that for *faces*.

RQ 3: Within the category of non-face forms and objects, are there significant differences between the responses evoked by stimuli of *products, products-in-use and abstract drawings* both at the bottom-up and top-down attention frameworks?

There are six research questions RQ3a to 3f, which emerge from Research Question 3.

Findings for the following pairs of comparison– pair 4 (Products and Abstract drawings), pair 5 (Products and Product-in-use) and pair 6, (Abstract drawings and Product-in-use) will be explored both bottom-up and top-down attention framework.

Pair 4: Products – Abstract drawings at 50ms and 250ms

RQ 3a: Is there a significant difference in alpha blocking for ad-stimuli with *products* and alpha blocking for stimuli with *abstract drawings at 50ms and 250ms*?

RQ 3b: Is there a significant difference in beta activity for ad-stimuli with *products* and beta activity for stimuli with *abstract drawings at 50ms and 250ms*?

Pair 5: Products –Product-in-use (Hands) at 50ms and 250ms

RQ 3c: Is there a significant difference in alpha blocking for ad-stimuli with *products* and alpha blocking for ad-stimuli with *product-in-use at 50ms and 250ms?*

RQ 3d: Is there a significant difference in beta activity for ad-stimuli with *products* and beta activity for ad-stimuli with *product-in-use at 50ms and 250ms?*

Pair 6: Abstract drawings - Product-in-use (Hands) at 50ms and 250ms

RQ 3e: Is there a significant difference in alpha blocking for ad-stimuli with *abstract drawings* and alpha blocking for ad-stimuli with *product-in-use at 50ms and 250ms?*

RQ 3f: Is there a significant difference in beta activity for ad-stimuli with *abstract drawings* and beta activity for ad-stimuli with *product-in-use at 50ms and 250ms?*

CHAPTER 4

RESULTS AND FINDINGS

The two dependent variables in this study – the **alpha** and **beta** waves – were examined at two time-dependent intervals, the 50 and 250 millisecond epochs, from the filtered EEG waveforms. A percentage change in the **area-under-the-curve** of both these waves from the baseline condition of **eyes closed** to the **twelve treatment conditions** (4 stimuli category X 3 sets) were considered as the basic score, and an **average** was calculated for all the three items in each category for the twenty participants.

TABLE 4.0: *Twelve treatment conditions by rotating three sets of stimuli in each category.*

Categories	Face	Product	Product-in-Use (Hand)	Abstract Drawings
Set 1	Face 1	Product 1	Hand 1	Abstract 1
Set 2	Face 2	Product 2	Hand 2	Abstract 2
Set 3	Face 3	Product 3	Hand 3	Abstract 3
Average for three sets	F1+F2+F3 / 3	P1+P2+P3 / 3	H1+ H2+H3 / 3	A1+A2+A3 / 3

Average scores were computed as shown in the table above across the **occipital, temporal and parietal** lobes. These were compared in **six pairs** using the Wilcoxon Signed rank test. The findings for each pair of comparison as they answer the research questions and hypotheses at 50 ms (bottom-up attention) and 250 ms (top-down attention), will be reported in this section. Complete tables of scores for all participants are reported in Appendix B.

RQ 1: Is there a difference between the responses evoked by stimuli of *human faces* vs. *non-facial forms and objects* at the 50ms time frame of bottom-up attention?

There are three sets of hypotheses, H1a, H1b; H2a, H2b and H3a and H3b, which emerge from Research Question 1. Findings for the following pairs of comparison – pair 1 (Faces and Products), pair 2 (Faces and Abstract drawings) and pair 3, (Faces and Product-in-use) will be tested for the above hypotheses at the bottom-up attention framework of 50 ms.

H1a: Alpha blocking for ad-stimuli with *faces* and alpha blocking for ad-stimuli with *products* will be significantly different, with alpha blocking for *faces* greater than that for *products*. This hypothesis will be further examined by each of the cortical regions examined – occipital, temporal and parietal lobes, H1a(i), H1a(ii) and Ha(iii) respectively.

Alpha Pair 1: Faces and Products at 50ms of bottom-up attention

H1a (i): In the **occipital** lobe, out of the 20 participants, 60 % (12) showed more **alpha** blocking to faces when compared to products (40 %). Wilcoxon tests showed that this difference was not significant (p = 0. 455). H1a (ii): In the **temporal** lobe, 55% showed more alpha blocking to faces than to products (45%). Wilcoxon tests showed that this difference was not significant (p = 0.709). H1a (iii): In the **parietal** lobe, 40 % showed alpha blocking to faces as compared to 12 (60%) for products. Wilcoxon tests showed that this difference was not significant (p = 0.433).

FIGURE 4.1a: *Percentage of alpha blocking for Faces and Products in the Occipital (Occ), Temporal (Temp) and Parietal (Par) lobes at 50 ms.*

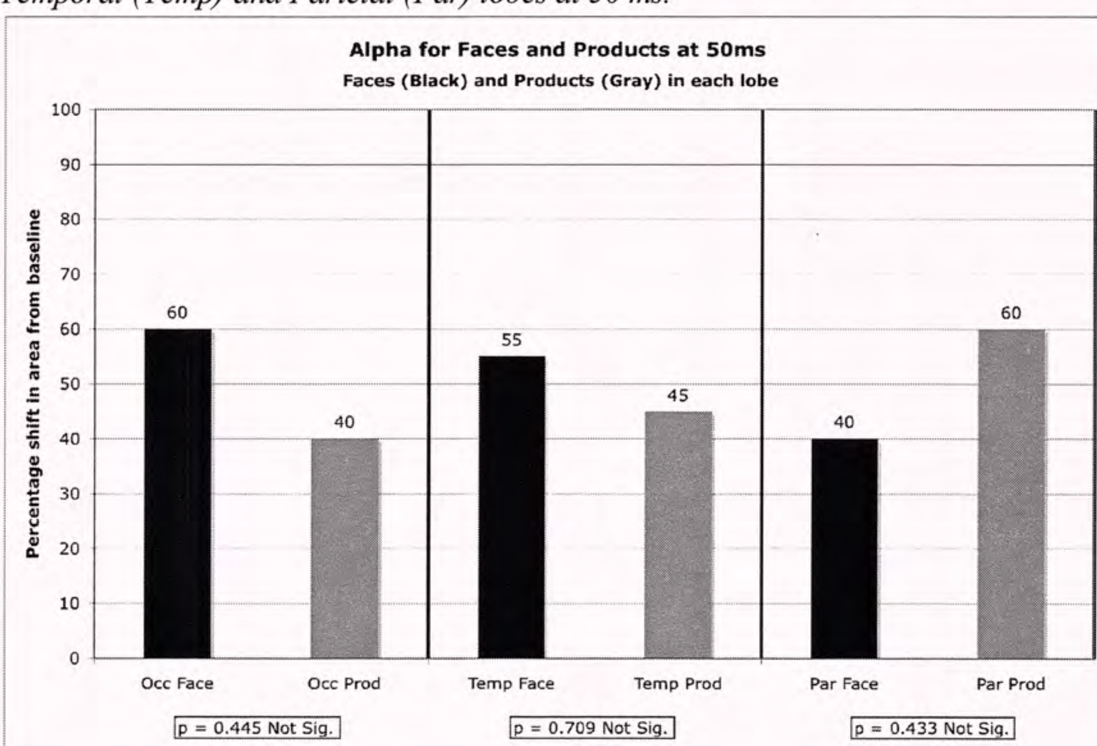


TABLE 4.1: Test of significance for Pair 1 Alpha

Pair 1 (Alpha) 50ms	AlphaOccProd-AlphaOccFace	AlphaTemProd-AlphaTemFace	AlphaParProd-AlphaParFace
Z	-0.747	-0.373	-0.784
Asymp. Sig. (2-tailed)	0.455	0.709	0.433

As Figure 4.1a shows, alpha blocking was slightly higher for faces than compared to products in the occipital and temporal lobes, whereas alpha blocking was more for products in the parietal lobe. But these differences were not significant. **Hence, Hypotheses 1a (i, ii and iii) are not supported.**

H1b: Beta activity for ad-stimuli with *faces* and beta activity for ad-stimuli with *products* will be significantly different, with beta activity for *faces* greater than that for *products*. This hypothesis will be further examined by each of the cortical regions examined – occipital, temporal and parietal lobes, H1b (i), H1b (ii) and H1b (iii) respectively.

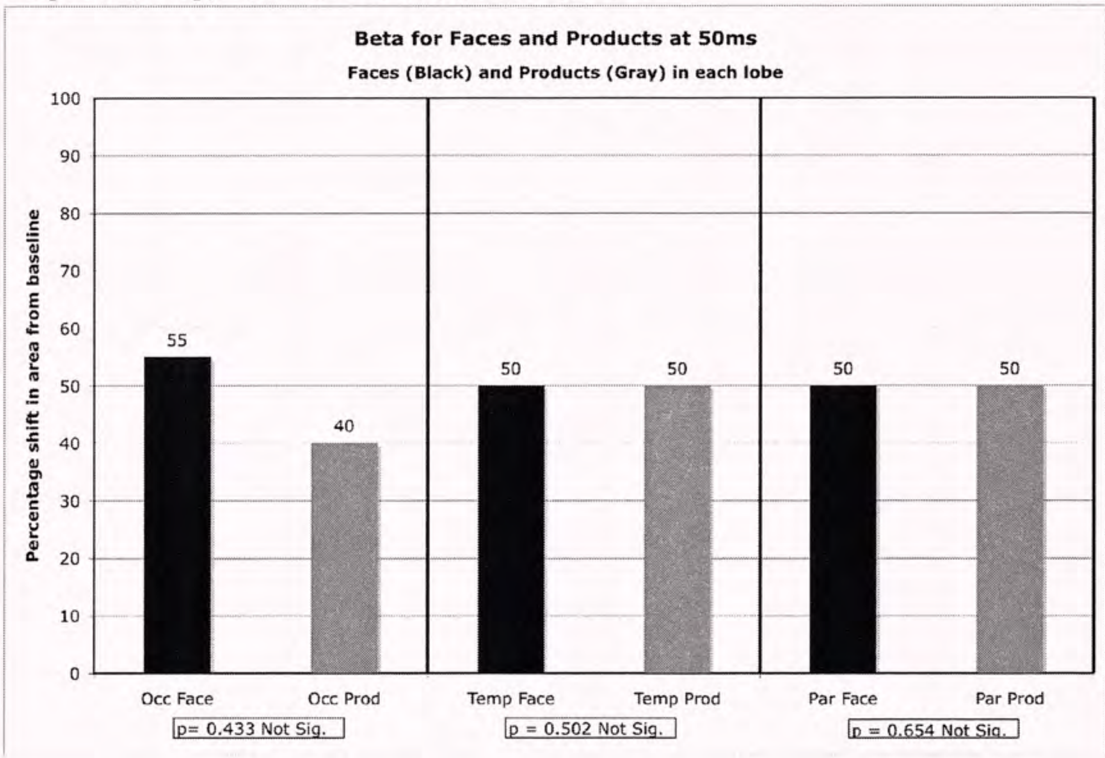
Beta Pair 1: Faces and Products at 50ms of bottom-up attention

H1b (i): In the **occipital** lobe, eleven participants (55 %) showed more **beta** activity to faces when compared to products (40%), with one participant showing increased, negative beta ($p = 0.433$). H1b (ii): In the **temporal** lobe, beta activity was similar to both faces (50%) and products (50%) and hence the result was not significantly different ($p = 0.502$). H1b (iii): **Parietal** lobe also showed similar beta activity to both faces (50%) and products (50%) with $p = 0.654$.

TABLE 4.2: Test of significance for Pair 1 Beta

Pair 1 (Beta) 50ms	BetaOccProd-BetaOccFace	BetaTemProd-BetaTemFace	BetaParProd-BetaParFace
Z	-0.784	-0.672	-0.448
Asymp. Sig. (2-tailed)	0.433	0.502	0.654

FIGURE 4.1b: *Percentage of beta activity for Faces and Products in the Occipital (Occ), Temporal (Temp) and Parietal (Par) lobes at 50 ms.*



As Figure 4.1b shows, beta activity was slightly higher for faces than products in the occipital lobe, but it was the same for both the categories of stimuli in the temporal and parietal lobes. These results were not significant. **Hence, Hypotheses 1b (i, ii and iii) are not supported.**

H2a: Alpha blocking for ad-stimuli with *faces* and alpha blocking for stimuli with *abstract drawings* will be significantly different, with alpha blocking for *faces* greater than that for *abstract drawings*. This hypothesis will be further examined by each of the cortical regions examined – occipital, temporal and parietal lobes, H2a (i), H2a (ii) and H2a (iii) respectively.

Alpha Pair 2: Faces and Abstract Drawings at 50 ms of bottom-up attention

H2a (i): In the **occipital** lobe, thirteen (65%) participants showed higher alpha blocking to abstract drawings than to faces (35%), and Wilcoxon test showed that this difference is significant for alpha waves at **p = 0.100** level. H2a (ii): In the **temporal** lobe, 60 % of the participants showed higher alpha blocking to faces than to abstract drawings (40%). This difference was not significant (p = 0.370). H2a (iii): In the **parietal** lobe (Table 2c), participants showed equal amount of alpha blocking to both faces (50%) and abstract drawings (50%), with a p-value of 0.881.

FIGURE 4.2a: *Percentage of alpha blocking for Faces and Abstract drawings in the Occipital (Occ), Temporal (Temp) and Parietal (Par) lobes at 50 ms.*

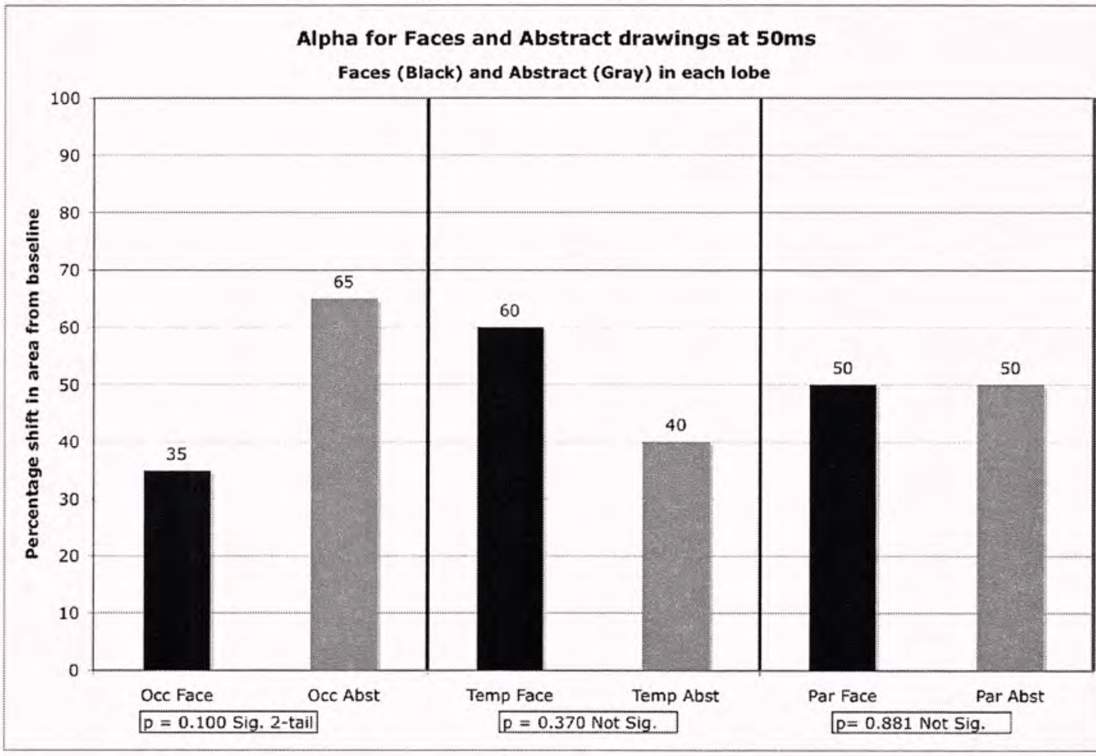


TABLE 4.3: Test of significance for Pair 2 Alpha

Pair 2 (Alpha) 50ms	**AlphaOccAbst-AlphaOccFace**	**AlphaTemAbst-AlphaTemFace**	**AlphaParAbst-AlphaParFace**
Z	-1.643	-0.896	-0.149
Asymp. Sig. (2-tailed)	**0.100**	0.370	0.881

As Figure 4.2a shows, alpha blocking was significantly different in the occipital lobes with abstract drawings evoking higher alpha block than faces. Although blocking for faces is higher than for products in the temporal lobes, this finding is not significant. Alpha in the temporal lobes responded the same to both the stimulus categories. **Thus, Hypothesis 2a (i) is partially supported for occipital lobe alone and in the opposite direction hypothesized. H2a (ii and iii) are not supported by the findings.**

H2b: Beta activity for ad-stimuli with *faces* and beta activity for stimuli with *abstract drawings* will be significantly different, with beta activity for *faces* greater than that for *abstract drawings*. This hypothesis will be further examined by each of the cortical regions examined – occipital, temporal and parietal lobes H2b (i), H2b (ii) and H2b (iii) respectively.

Beta Pair 2: Faces and Abstract Drawings at 50 ms of bottom-up attention

H2b (i): In the **occipital** lobe, 60 % showed higher beta activity to abstract drawings when compared to 40% for faces. H2b (ii): In the **temporal** lobe, 50 % showed more beta activity to faces than to abstract drawings (45%), with one participant showing negative beta (p =0.737). H2b (iii): In the **parietal** lobes, 60 % showed higher beta activity to faces than to products (40%) with a p-value of 0.654.

FIGURE 4.2b: *Percentage of beta activity for Faces and Abstract drawings in the Occipital(Occ), Temporal (Temp) and Parietal (Par) lobes at 50 ms.*

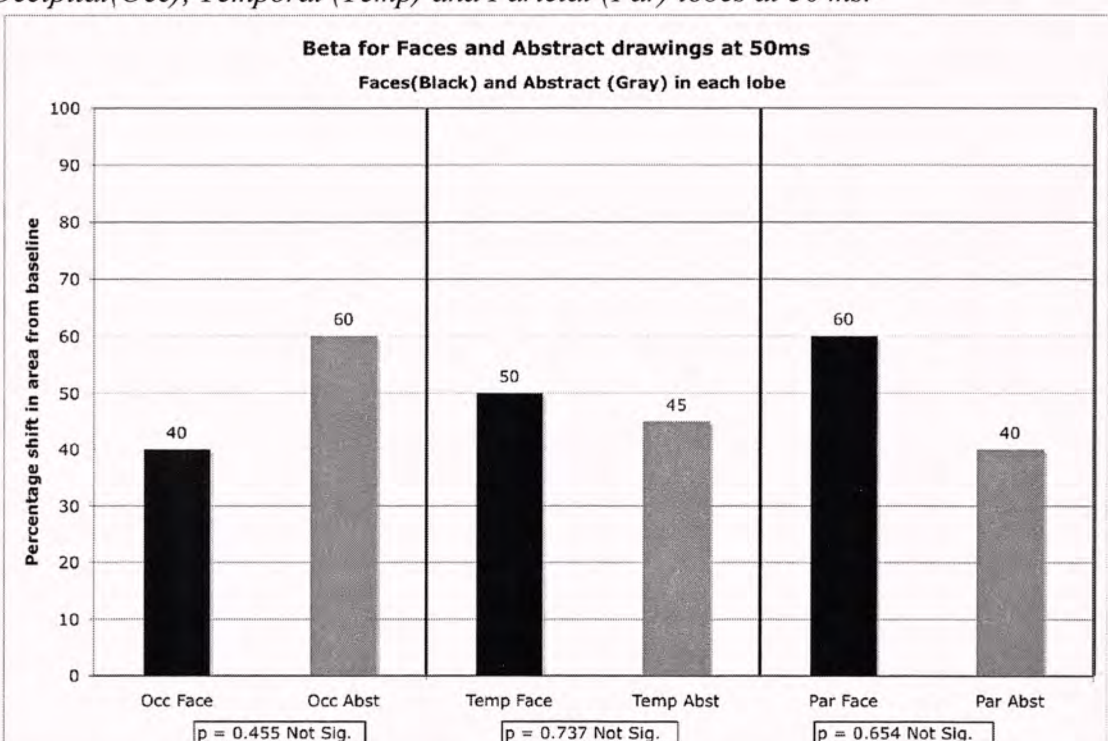


TABLE 4.4: Test of significance for Pair 2 Beta

Pair 2 (Beta) 50ms	**BetaOccAbst-BetaOccFace**	**BetaTemAbst-BetaTemFace**	**BetaParAbst-BetaParFace**
Z	-0.747	-0.336	-0.448
Asymp. Sig. (2-tailed)	0.455	0.737	0.654

As Figure 4.2b shows, beta activity was more for abstract drawings than for faces in the occipital lobe, and both in the temporal and parietal lobes, beta activity was slightly higher for faces. But these differences were not significant and hence **Hypothesis 2b (i, ii and iii) are not supported.**

H3a: Alpha blocking for ad-stimuli with *faces* and alpha blocking for ad-stimuli with *product-in-use* will be significantly different, with alpha blocking for *faces* greater than that for *product-in-use*. This hypothesis will be further examined by each of the cortical regions examined – occipital, temporal and parietal lobes H3a (i), H3a (ii) and H3a (iii) respectively.

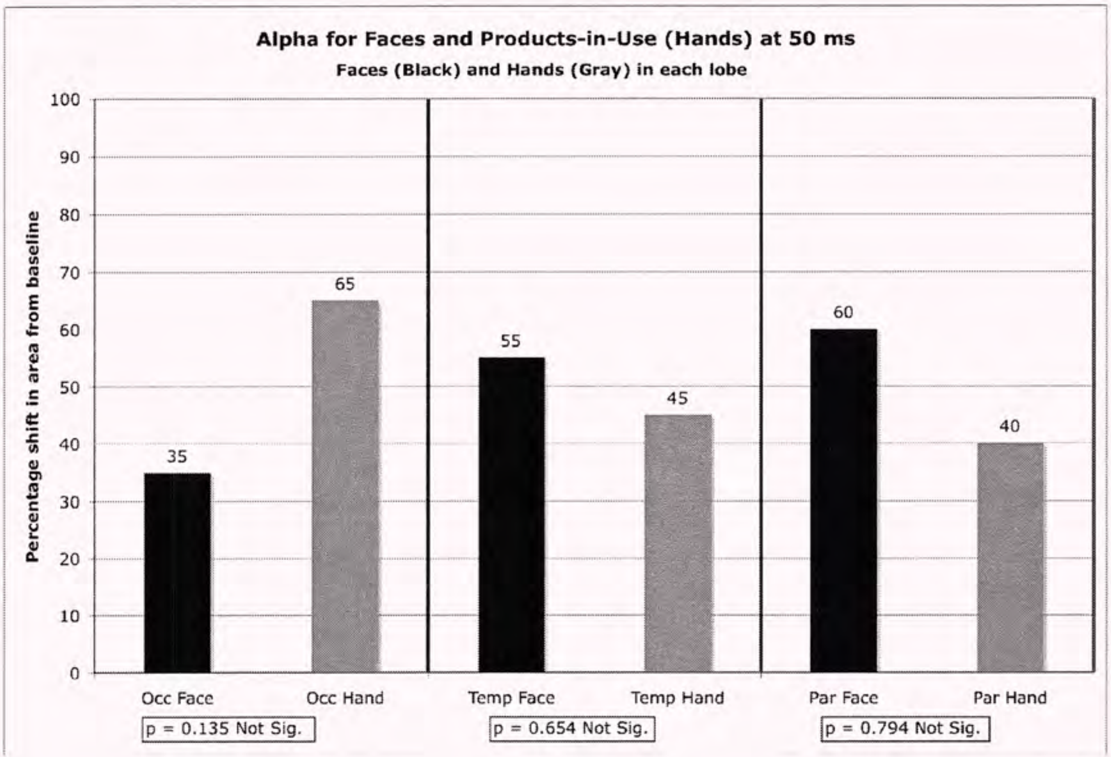
Alpha Pair 3: Faces and Product-in-Use (Hand) at 50 ms of bottom-up attention

H3a (i): In the **occipital** lobe, thirteen participants (65%) showed higher alpha blocking to the product-in-use than for the face (35%). Wilcoxon tests showed that these results were not significant (p = 0.135). H3a (ii): In the **temporal** lobe, faces evoked slightly more alpha blocking (55%) than product-in-use (45%) with p = 0.654. H3a (iii): In the **parietal** lobe, alpha blocking was higher for faces (60%) than for products-in-use (40%). These results were not significant (p = 0.794).

TABLE 4.5: Test of significance for Pair 3 Alpha

Pair 3 (Alpha) 50ms	**AlphaOccHand-AlphaOccFace**	**AlphaTemHand-AlphaTemFace**	**AlphaParHand-AlphaParFace**
Z	-1.493	-0.448	-0.261
Asymp. Sig. (2-tailed)	0.135	0.654	0.794

Figure 4.3a: *Percentage of alpha blocking for Faces and Products-in-use (Hands) in the Occipital (Occ), Temporal (Temp) and Parietal (Par) lobes at 50 ms.*



As Figure 4.3a shows, although alpha blocking is higher for product-in-use than for faces in the occipital lobe, these differences are not statistically significant. In both the temporal and parietal lobes, alpha blocking is more for faces but again this finding is not significant. Hence, **Hypothesis 3a (i, ii and iii) are not supported.**

H3b: Beta activity for ad-stimuli with *faces* and beta activity for ad-stimuli with *product-in-use* will be significantly different, with beta activity for *faces* greater than that for *product-in-use*. This hypothesis will be further examined by each of the cortical regions examined – occipital, temporal and parietal lobes H3b (i), H3b (ii) and H3b (iii) respectively.

Beta Pair 3: Faces and Product-in-Use (Hand) at 50 ms of bottom-up attention

H3b (i): Beta activity was nearly similar for faces (50%) and product-in-use (45%) in the **occipital** lobe, with one subject showing negative beta ($p = 0.911$). H3b (ii): However in the **temporal** lobe, beta was higher for product-in-use (50%) than for faces (45%), with one participants showing negative beta (p = 0.881). H3b (iii): Beta activity was the same (50%) for both the categories of stimuli in the **parietal** lobe (p = 0.502).

FIGURE 4.3b: *Percentage of beta activity for Faces and Products-in-use (Hands) in the Occipital (Occ), Temporal (Temp) and Parietal (Par) lobes at 50 ms.*

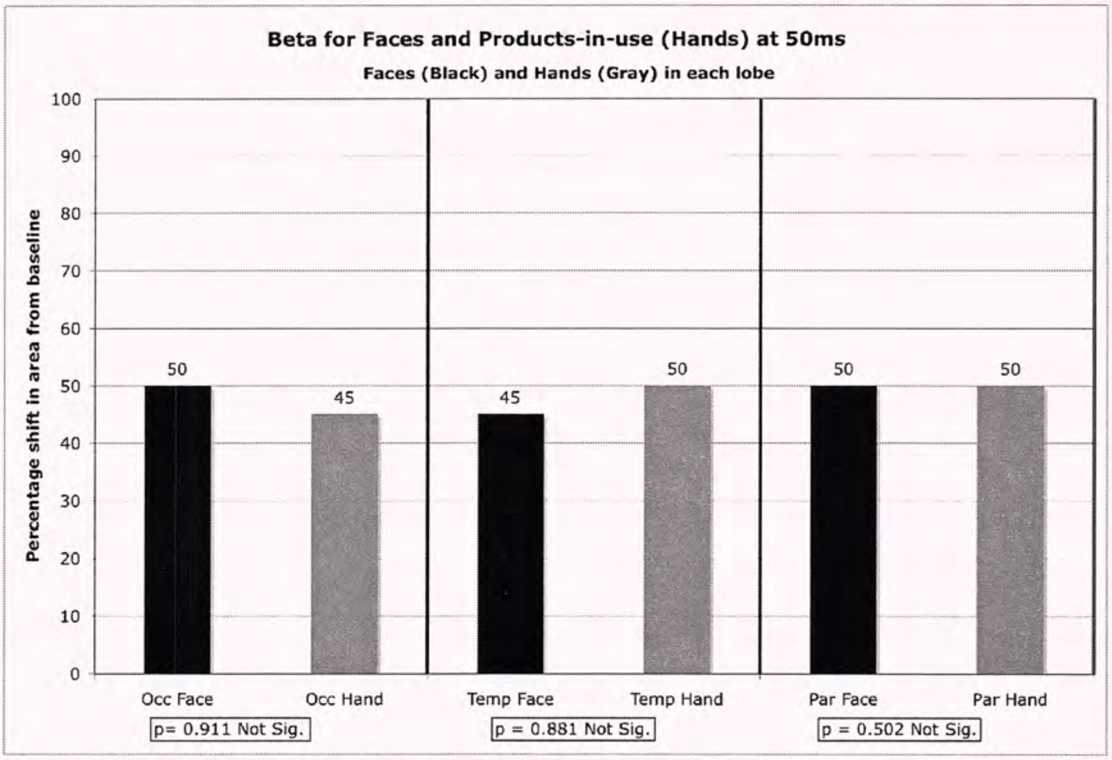


TABLE 4.6: Test of significance for Pair 3 Beta

Pair 3 (Beta) 50ms	**BetaOccHand-BetaOccFace**	**BetaTemHand-BetaTemFace**	**BetaParHand-BetaParFace**
Z	-0.112	-0.149	-0.672
Asymp. Sig. (2-tailed)	0.911	0.881	0.502

From Figure 4.3b, it is evident that beta activity was nearly the same for faces and products-in-use across all the three lobes, hence **Hypothesis 3b (i, ii and iii) are not supported.**

RQ 2: Is there a difference between the responses evoked by stimuli of *human faces* vs. *non-facial forms and objects* at the 250 ms time frame of top-down attention?

There are three sets of hypotheses, H4a, H4b; H5a, H5b and H6a and H6b, which emerge from Research Question 2. Findings for the following pairs of comparison– pair 1 (Faces and Products), pair 2 (Faces and Abstract drawings) and pair 3, (Faces and Product-in-use) will be tested for the above hypotheses at the top-down attention framework of 250 ms.

H4a: Alpha blocking for ad-stimuli with *faces* and alpha blocking for ad-stimuli with *products* will be significantly different, with alpha blocking for *products* greater than that for *faces*. This hypothesis will be further examined by each of the cortical regions examined – occipital, temporal and parietal lobes H4a (i), H4a (ii) and H4a (iii) respectively.

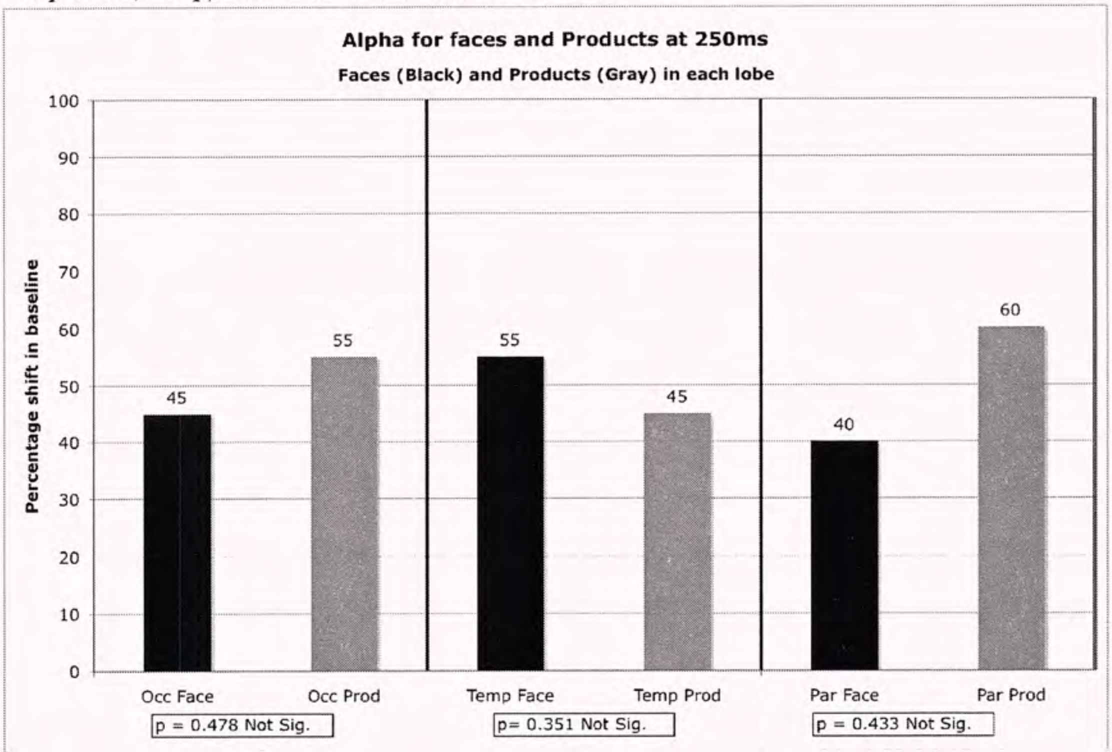
Alpha Pair 1: Faces and Products at 250ms of top-down attention

H4a (i): In the **occipital** lobe, eleven (55%) participants showed higher alpha blocking to products when compared with faces (45%). Wilcoxon tests showed that this difference was not significant. (p = 0. 478). H4a (ii): In the **temporal** lobe, faces evoked slightly higher (55%) alpha blocking than products (45%) with p = 0.351. H4a (iii): In the **parietal** lobe, products evoked higher alpha blocking (60%) than faces (40%) with p = 0.433.

TABLE 4.7: Test of significance for Pair 1 Alpha

Pair 1 (Alpha) 250ms	**AlphaOccProd-AlphaOccFace**	**AlphaTemProd-AlphaTemFace**	**AlphaParProd-AlphaParFace**
Z	-0.709	-0.933	-0.784
Asymp. Sig. (2-tailed)	0.478	0.351	0.433

FIGURE 4.4a: *Percentage of alpha blocking for Faces and Products in the Occipital (Occ), Temporal (Temp) and Parietal (Par) lobes at 250 ms.*



As is shown in Figure 4.4a, at 250ms, alpha blocking was slightly more for products in the occipital and parietal lobes, whereas in temporal lobes alpha blocking was higher for faces. But these differences were not significant. **Hence Hypotheses 4a (i, ii and iii) are not supported.**

H4b: Beta activity for ad-stimuli with *faces* and beta activity for ad-stimuli with *products* will be significantly different, with beta activity for *products* greater than that for *faces*. This hypothesis will be further examined by each of the cortical regions examined – occipital, temporal and parietal lobes H4b (i), H4b (ii) and H4b (iii) respectively.

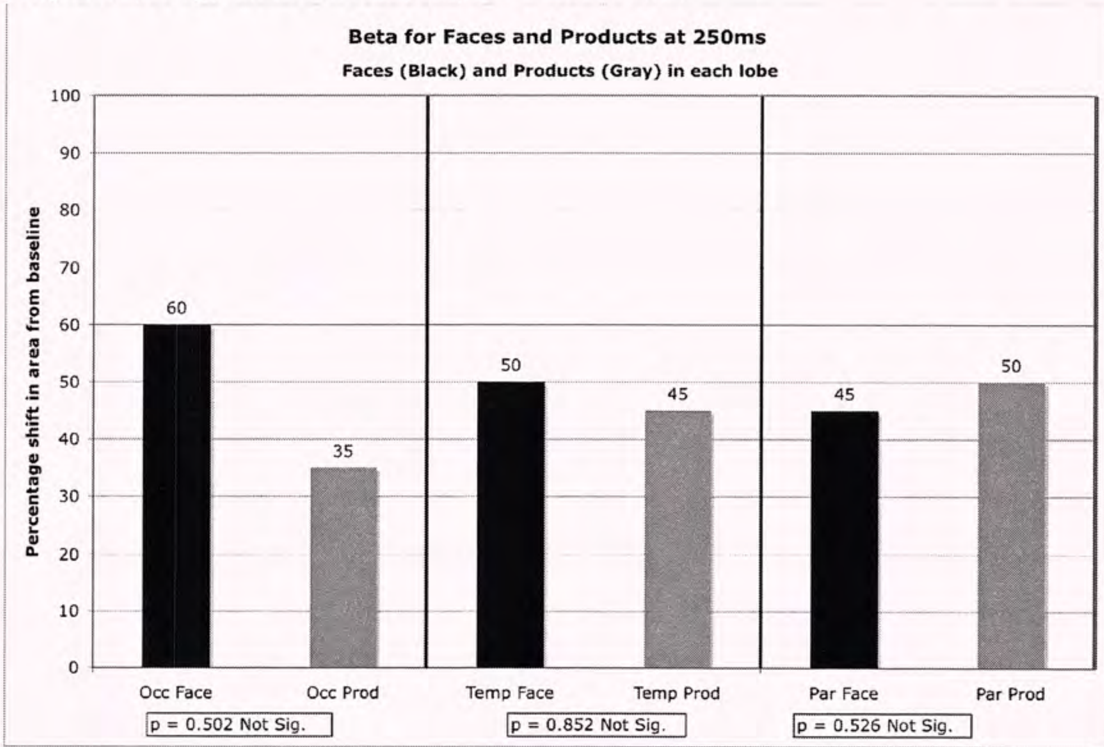
Beta Pair 1: Faces and Products at 250ms of top-down attention

H4b (i): In the **occipital** lobe, twelve participants (60 %) showed more **beta** activity to faces when compared to products (35%), with one participant showing increased, negative beta for products. (p = 0.502). H4b (ii): Beta activity in the **temporal** lobe was marginally higher for faces (50%) than products (45%) with p = 0.852. H4b (iii): In the **parietal** lobe, beta activity was also slightly more for products (50%) than for faces (45%), with one negative beta resulting in no significant differences (p= 0.526).

TABLE 4.8: Test of significance for Pair 1 Beta

Pair 1 (Beta) 250ms	**BetaOccProd-BetaOccFace**	**BetaTemProd-BetaTemFace**	**BetaParProd-BetaParFace**
Z	-0.672	-0.187	-0.635
Asymp. Sig. (2-tailed)	0.502	0.852	0.526

FIGURE 4.4b: *Percentage of beta activity for Faces and Products in the Occipital (Occ), Temporal (Temp) and Parietal (Par) lobes at 250 ms.*



As seen in Figure 4.4b, beta activity was slightly higher for faces in the occipital and temporal lobe. In the parietal lobe, beta was more for products. Wilcoxon tests showed these differences were not significant. **Thus, Hypotheses 4b (i, ii and iii) failed to find support.**

H5a: Alpha blocking for ad-stimuli with *faces* and alpha blocking for stimuli with *abstract drawings* will be significantly different, with alpha blocking for *abstract drawings* greater than that for *faces*. This hypothesis will be further examined by each of the cortical regions examined – occipital, temporal and parietal lobes H5a (i), H5a (ii) and H5a (iii) respectively.

Alpha Pair 2: Faces – Abstract drawings at 250ms

H5a (i): In the **occipital** lobe, abstract drawings (60%) evoked **significant** alpha blocking when compared to faces (40%). The Wilcoxon test showed significant difference for alpha at p = **0.086**. H5a (ii): In the **temporal** lobe, alpha blocking was more for abstract drawings (55%) than for faces (45%). The result was not significant (p = 0.765). H5a (iii): In the **parietal** lobe, alpha blocking was significantly higher for abstract drawings (65%) than for faces. Wilcoxon results were significant for alpha (p = **0.100).**

FIGURE 4.5a: *Percentage of alpha blocking for Faces and Abstract drawings in the Occipital (Occ), Temporal (Temp) and Parietal (Par) lobes at 250 ms.*

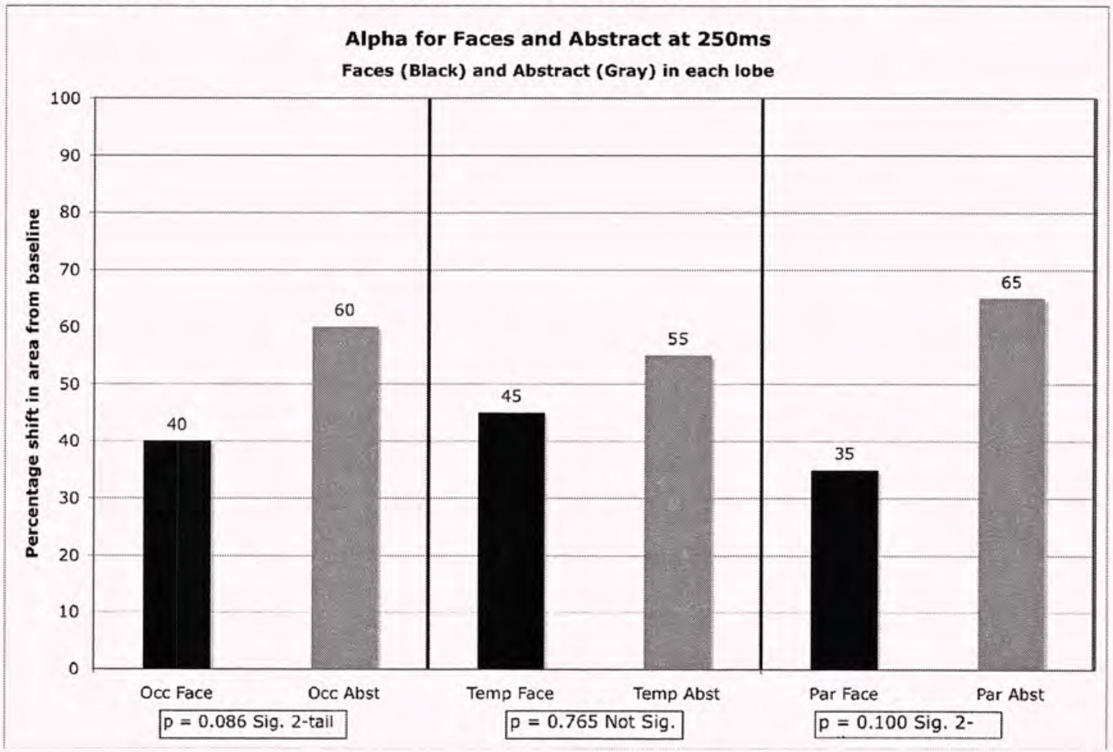


TABLE 4.9: Test of significance for Pair 2 Alpha

Pair 2 (Alpha) 250ms	**AlphaOccAbst-AlphaOccFace**	**AlphaTemAbst-AlphaTemFace**	**AlphaParAbst-AlphaParFace**
Z	-1.717	-0.299	-1.643
Asymp. Sig. (2-tailed)	**0.086**	0.765	**0.100**

As seen in Figure 4.5a, alpha blocking is significantly higher for abstract drawings when compared to faces both in the occipital and parietal lobes. While in the temporal lobe, abstract drawings do evoke more alpha block, it is not significant. **Hence Hypotheses H5a (i and iii) receive support, but not H5a (ii).**

H5b: Beta activity for ad-stimuli with *faces* and beta activity for stimuli with *abstract drawings* will be significantly different, with beta activity for *abstract drawings* greater than that for *faces*. This hypothesis will be further examined by each of the cortical regions examined – occipital, temporal and parietal lobes H5b (i), H5b (ii) and H5b (iii) respectively.

Beta Pair 2: Faces – Abstract drawings at 250ms

H5b (i): In the **occipital** lobe, beta activity was higher for abstract drawings (65%) than for faces (35%) with p = 0.550. H5b (ii): Beta activity in the **temporal** lobe was higher for faces (65%) when compared to abstract drawings (30%), with one negative beta. The results was significant with p = 0.455. H5b (iii): In the **parietal** lobe, beta was slightly smaller for faces (40%) when compared with abstract drawings (45%) with three participants showing negative beta (p = 0.654).

TABLE 4.10: Test of significance for Pair 2 Beta

Pair 2 (Beta) 250ms	**BetaOccAbst-BetaOccFace**	**BetaTemAbst-BetaTemFace**	**BetaParAbst-BetaParFace**
Z	-0.597	-0.747	-0.448
Asymp. Sig. (2-tailed)	0.550	0.455	0.654

FIGURE 4.5b: *Percentage of beta activity for Faces and Abstract drawings in the Occipital (Occ), Temporal (Temp) and Parietal (Par) lobes at 250 ms.*

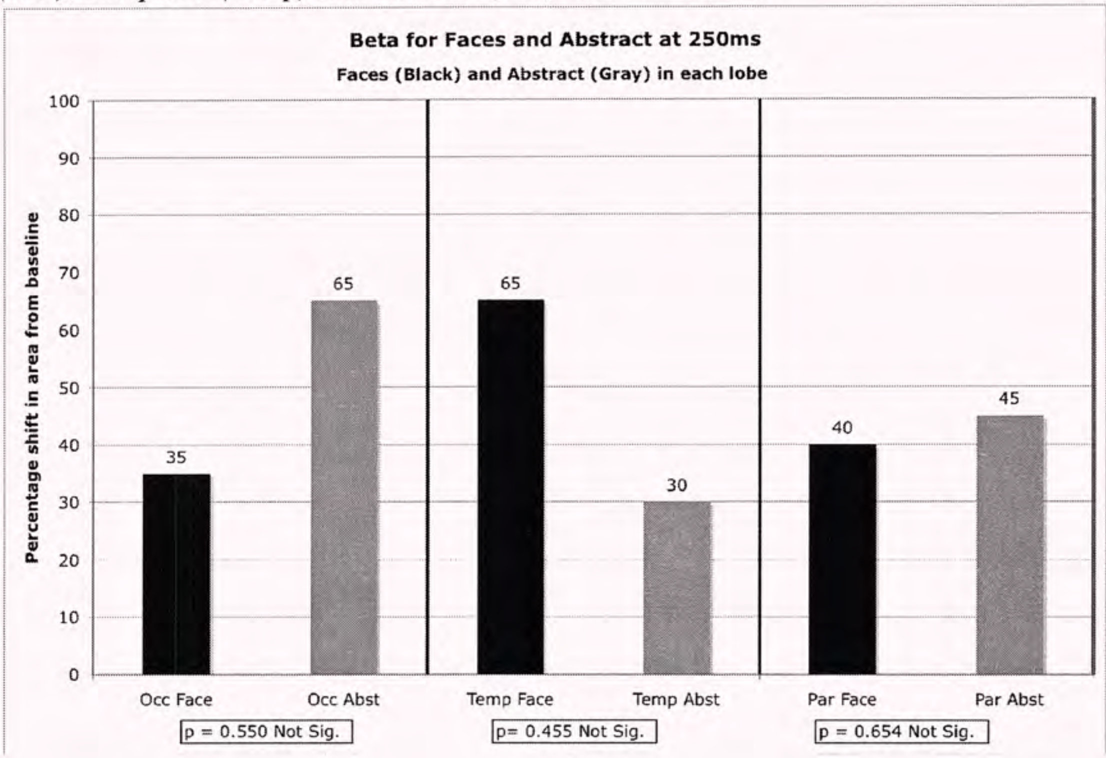


Figure 4.5b shows that beta activity was higher for abstract drawings in the occipital lobe, whereas it was lower in the temporal lobe with both the findings not statistically significant. In the parietal lobe beta activity was nearly similar for both the stimulus categories. **Hence, Hypotheses 5b (i, ii and iii) are not supported.**

H6a: Alpha blocking for ad-stimuli with *faces* and alpha blocking for ad-stimuli with *product-in-use* will be significantly different, with alpha blocking for *product-in-use* greater than that for *faces*. This hypothesis will be further examined by each of the cortical regions examined – occipital, temporal and parietal lobes H6a (i), H6a (ii) and H6a (iii) respectively.

Alpha Pair 3: Faces – Product-in-use at 250ms

H6a (i): In the **occipital** lobe, product-in-use evoked higher alpha blocking (65%) than faces (35%) with p = 0.126. H6a (ii): In the **temporal** lobe, alpha blocking for faces was lesser (45%) compared to products-in-use (55%) with no significant difference (p = 0.709).

H6a (iii): In the **parietal** lobe, alpha blocking was significantly higher for products-in-use (70%) than for faces (30%). Wilcoxon results showed significance for alpha. **(p = 0.086).**

Figure 4.6a: *Percentage of alpha blocking for Faces and Products-in-use (Hands) in the Occipital (Occ), Temporal (Temp) and Parietal (Par) lobes at 250 ms.*

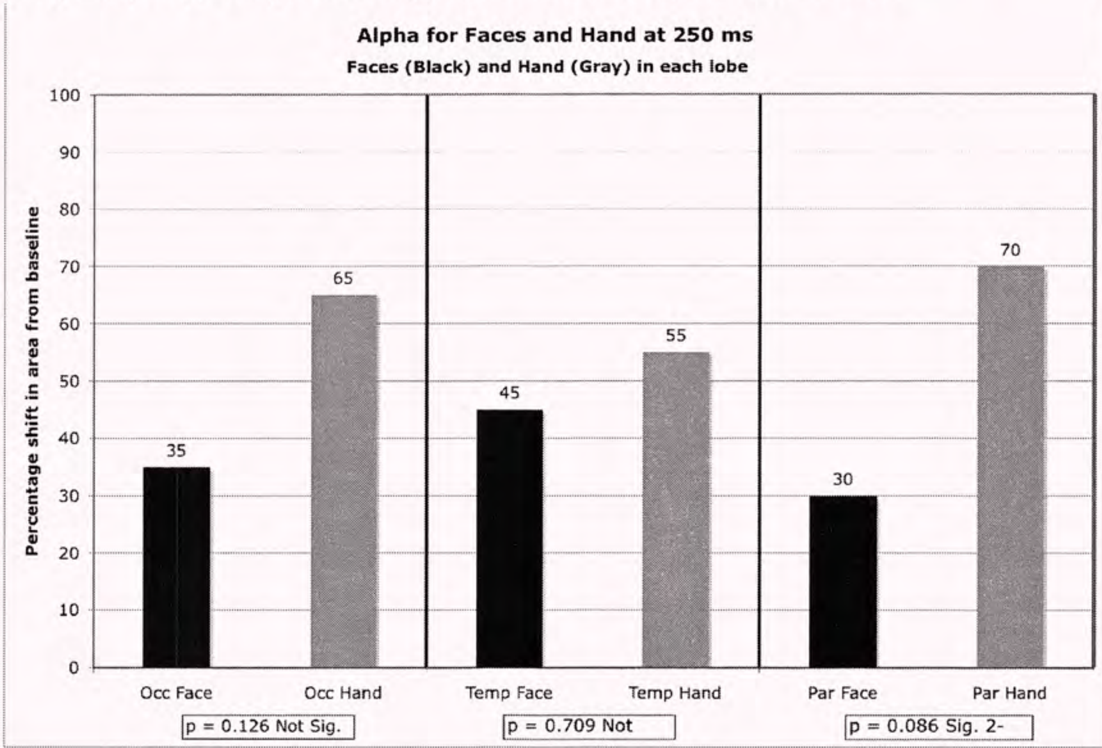


TABLE 4.11: Test of significance for Pair 3 Alpha

Pair 3 (Alpha) 250ms	**AlphaOccHand -AlphaOccFace**	**AlphaTemHand-AlphaTemFace**	**AlphaParHand-AlphaParFace**
Z	-1.531	-0.373	-1.717
Asymp. Sig. (2-tailed)	0.126	0.709	**0.086**

Figure 4.6a shows that alpha blocking was higher for product-in-use (hand) than for faces in all the three lobes. However, the difference was statistically significant only in the parietal lobe. **Hence Hypotheses 6a (iii) receives support but not 6a (i and ii).**

H6b: Beta activity for ad-stimuli with *faces* and beta activity for ad-stimuli with *product-in-use* will be significantly different, with beta activity for *product-in-use* greater than that for *faces*. This hypothesis will be further examined by each of the cortical regions examined – occipital, temporal and parietal lobes H6a (i), H6a (ii) and H6a (iii) respectively.

Beta Pair 3: Faces – Product-in-use at 250ms

H6b (i): In the **occipital** lobe, beta activity was significantly higher for products-in-use (70%) when compared to faces (30%). Wilcoxon results were significant at **p = 0.079.** H6b (ii): In the **temporal** lobe, beta activity was the same (50%) for both the categories of stimuli resulting in no significant results (p = 0.852). H6b (iii): Beta activity in the **parietal** lobe was more for faces (55%) than for products-in-use (40%) but with p = 0.823 the result was not significant.

FIGURE 4.6b: *Percentage of beta activity for Faces and Products-in-use (Hands) in the Occipital (Occ), Temporal (Temp) and Parietal (Par) lobes at 250 ms.*

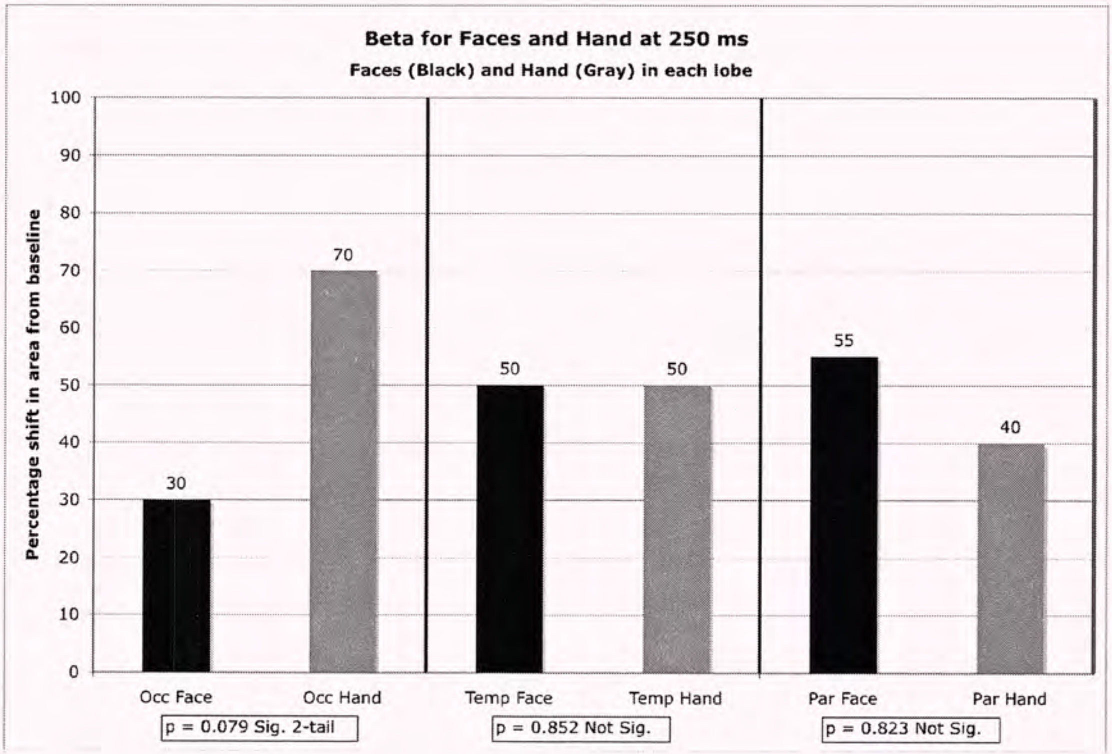


TABLE 4.12: Test of significance for Pair 3 Beta

Pair 3 (Beta) 250ms	BetaOccHand-BetaOccFace	BetaTemHand-BetaTemFace	BetaParHand-BetaParFace
Z	-1.755	-0.187	-0.224
Asymp. Sig. (2-tailed)	**0.079**	0.852	0.823

As Figure 4.6b shows, beta activity was significantly higher for product-in-use in the occipital lobe. In the temporal lobe, beta activity was the same for both the stimulus categories. In the parietal lobe beta activity was slightly more for faces. **Hypotheses 6b (i) receives support but not 6b (ii and iii).**

RQ 3: Within the category of non-face forms and objects, are there significant differences between the responses evoked by stimuli of *products, products-in-use and abstract drawings* both at the bottom-up and top-down attention frameworks?

There are six research questions RQ3a to 3f, which emerge from Research Question 3. Findings for the following pairs of comparison– pair 4 (Products and Abstract drawings), pair 5 (Products and Product-in-use) and pair 6, (Abstract drawings and Product-in-use) will be explored both at bottom-up and top-down attention framework.

RQ 3a: Is there a significant difference in alpha blocking for ad-stimuli with *products* and alpha blocking for stimuli with *abstract drawings at 50ms and 250ms*? This research question will be further examined by each of the cortical regions studied – occipital, temporal and parietal lobes RQ3a (i), RQ3a (ii) and RQ3a (iii) respectively.

Alpha Pair 4: Products and Abstract drawings at 50 ms

RQ3a (i): In the **occipital** lobe, seventeen (85%) out of the twenty participants showed higher alpha blocking to abstract drawings than to product images (15%). Wilcoxon test showed that the result for alpha was significant at **p = 0.007**. RQ3a (ii): In the **temporal** lobe, 60 % of the participants showed higher alpha blocking to abstract drawings with only

40 % showing alpha blocking to products. Wilcoxon tests showed no significance (p = 0.823). RQ3a (iii): In the **parietal** lobe, 70 % of the participants showed higher alpha blocking to products when compared to abstract drawings (30%) with p = 0.232.

FIGURE 4.7a: *Percentage of alpha blocking for Products and Abstract drawings in the Occipital (Occ), Temporal (Temp) and Parietal (Par) lobes at 50 ms.*

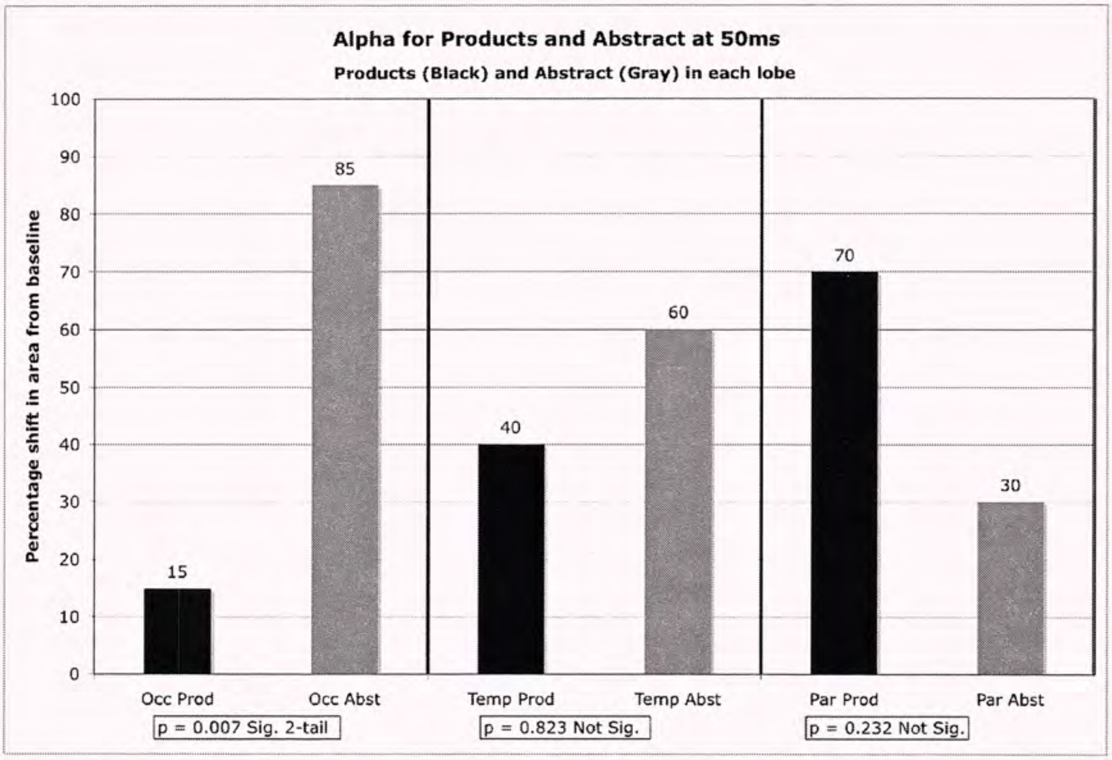


TABLE 4.13: Test of significance for Pair 4 Alpha at 50ms

Pair 4 (Alpha) 50ms	**AlphaOccAbst-AlphaOccObj**	**AlphaTemAbst-AlphaTemObj**	**AlphaParAbst-AlphaParObj**
Z	-2.688	-0.224	-1.195
Asymp. Sig. (2-tailed)	**0.007**	0.823	0.232

At 50ms, Figure 4.7a shows that alpha blocking is significantly higher for abstract drawings than for products in the occipital lobe. In the temporal lobe, although alpha blocking is more for abstract drawings, this difference is not significant. In the parietal lobe, alpha blocking is higher for products, but is not significant.

Alpha Pair 4: Products and Abstract drawings at 250 ms

RQ 3a(i): In the **occipital** lobe, fourteen participants showed significantly higher alpha blocking to abstract drawings (70%) than to product-images (30%) with p = **0.025.** RQ3a (ii): In the **temporal** lobe, significantly higher alpha blocking was evoked by abstract drawings (65%) than products (35%) with p = **0.073.** RQ3a (iii): In the **parietal** lobe, fourteen participants showed higher alpha blocking to abstract drawings (70%) when compared to products (30%). Wilcoxon test shows this result was not significant (p = 0.332).

FIGURE 4.8a: *Percentage of alpha blocking for Products and Abstract drawings in the Occipital (Occ), Temporal (Temp) and Parietal (Par) lobes at 250 ms.*

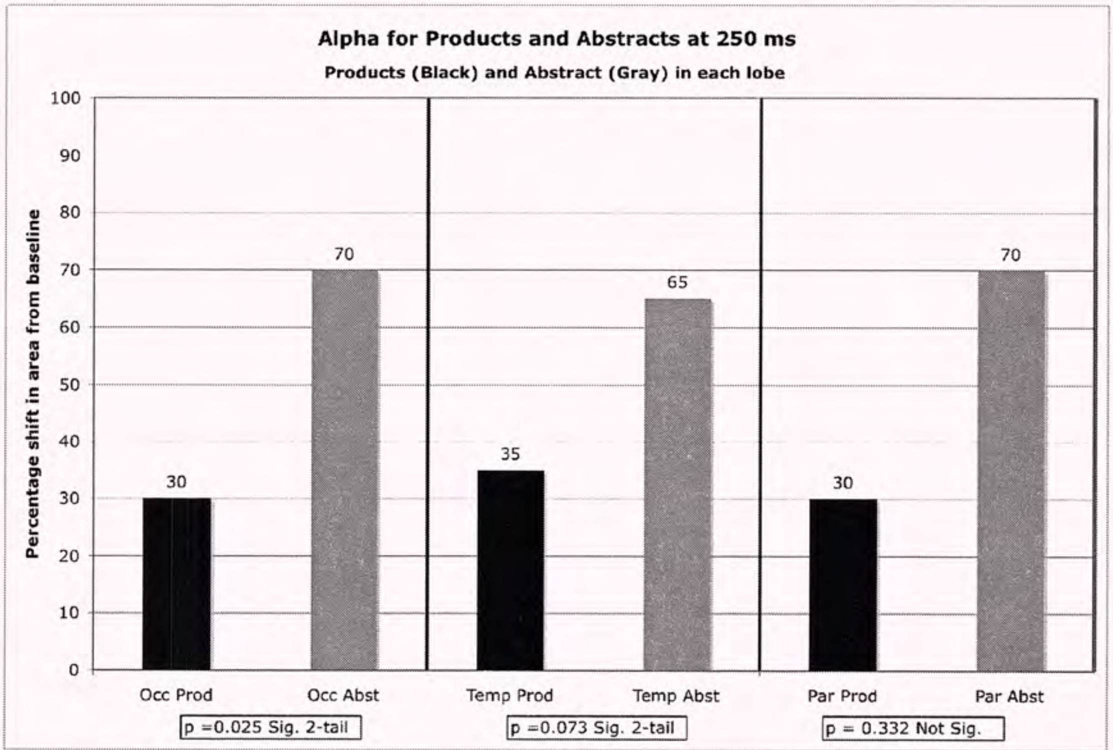


TABLE 4.14: Test of significance for Pair 4 Alpha

Pair 4 (Alpha) 250ms	**AlphaOccAbst-AlphaOccProd**	**AlphaTemAbst-AlphaTemProd**	**AlphaParAbst-AlphaParProd**
Z	-2.240	-1.792	-0.971
Asymp. Sig. (2-tailed)	**0.025**	**0.073**	0.332

At 250ms, as Figure 4.8a shows, alpha blocking was significantly higher for abstract drawings both in the occipital and temporal lobes. Although parietal lobe also showed a similar difference between categories, the finding was not significant.

RQ 3b: Is there a significant difference in beta activity for ad-stimuli with *products* and beta activity for stimuli with *abstract drawings at 50ms and 250ms*? This research question will be further examined by each of the cortical regions studied – occipital, temporal and parietal lobes RQ3b (i), RQ3b (ii) and RQ3b (iii) respectively.

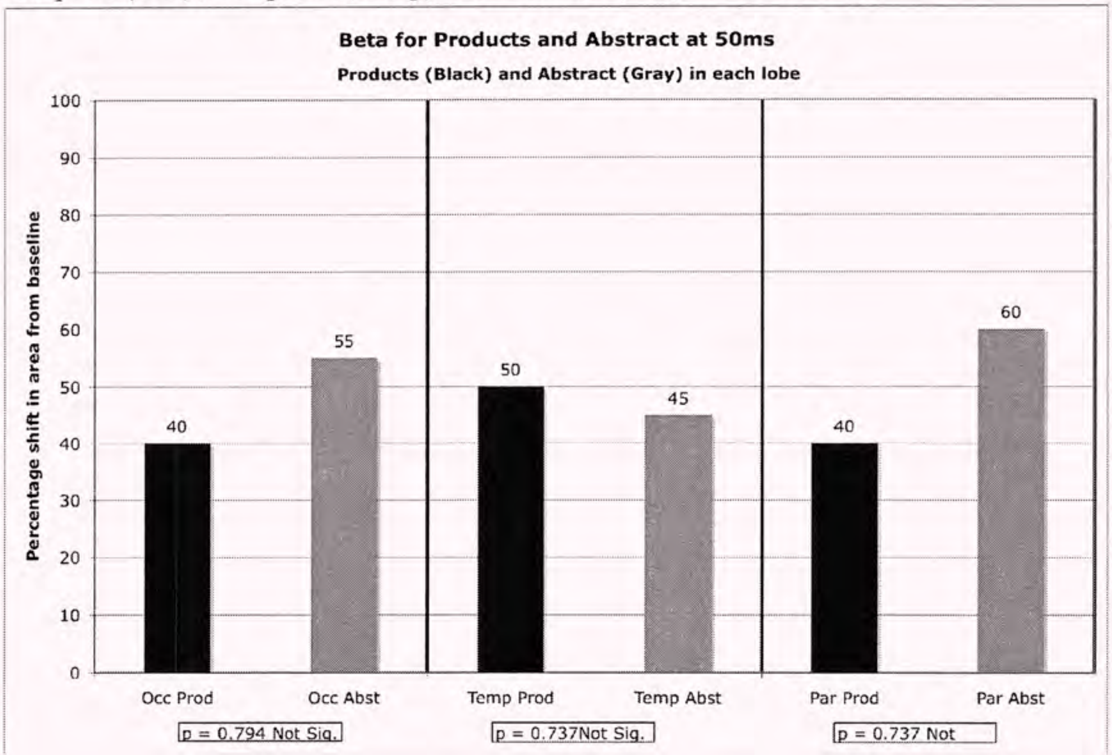
Beta Pair 4: Products and Abstract drawings at 50 ms

RQ3b (i): In the **occipital** lobe, eleven participants showed higher beta activity to abstract drawings (55%) when compared to eight who showed higher beta activity to products (40%), with one participant showing negative beta ($p = 0.794$). RQ 3b(ii): In the **temporal** lobe, products evoked slightly higher beta activity (50%) when compared to abstract drawings (45%), with one negative beta ($p = 0.737$). RQ3b (iii): Beta activity in the **parietal** lobe was more for abstract drawings (60%) than for products (40%). These results were not significant ($p = 0.737$).

TABLE 4.15: Test of significance for Pair 4 Beta

Pair 4 (Beta) 50ms	**BetaOccAbst-BetaOccObj**	**BetaTemAbst-BetaTemObj**	**BetaParAbst-BetaParObj**
Z	-0.261	-0.336	-0.336
Asymp. Sig. (2-tailed)	0.794	0.737	0.737

FIGURE 4.7b: *Percentage of beta activity for Products and Abstract drawings in the Occipital (Occ), Temporal (Temp) and Parietal (Par) lobes at 50 ms.*



At 50ms, as seen in Figure 4.7b, beta activity was not significantly different between products and abstract drawings in any of the lobes examined.

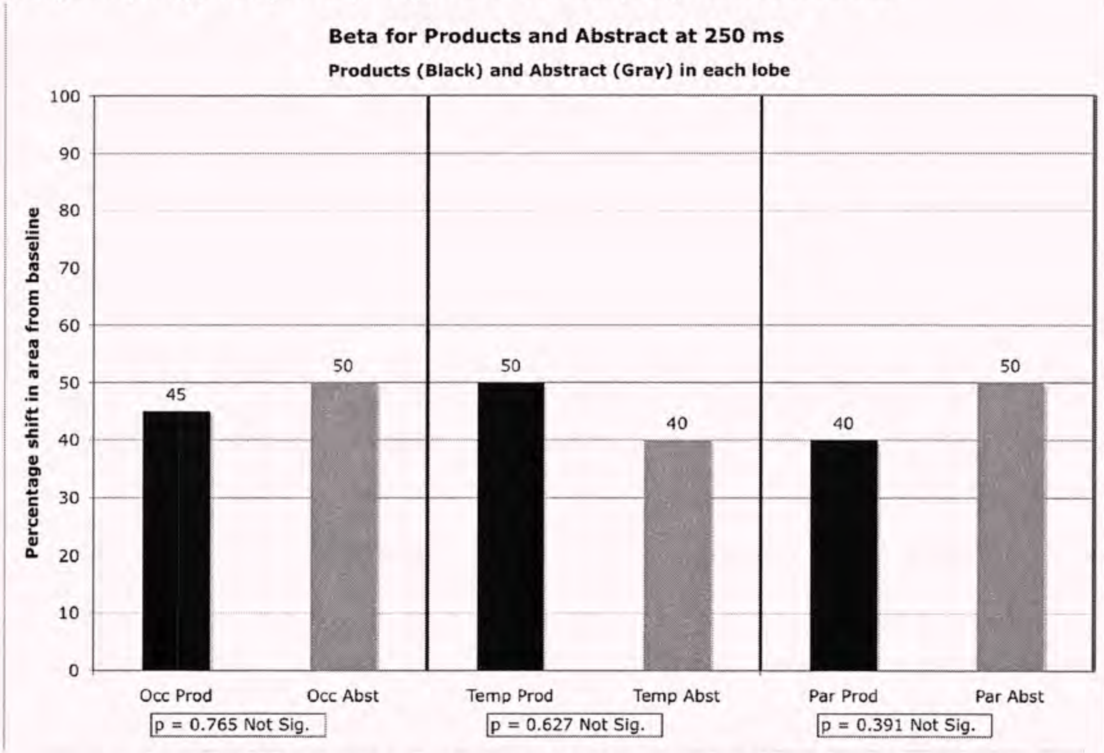
Beta Pair 4: Products and Abstract drawings at 250 ms

RQ3b (i): In the **occipital** lobe, beta activity was slightly higher for abstract drawings (50%) when compared to products (45%) with one negative beta resulting in no significant difference with p = 0.765. RQ3b (ii): Beta activity in the **temporal** lobe was slightly higher for products (50%) than for abstract drawings (40%) with two participants showing negative beta (p = 0.627). RQ3b (iii): In the **parietal** lobe, beta activity was slightly more for abstract drawings (50%) than products (40%) with two negative betas. The finding was not significant with p = 0.391.

TABLE 4.16: Test of significance for Pair 4 Beta

Pair 4 (Beta) 250ms	**BetaOccAbst-BetaOccProd**	**BetaTemAbst-BetaTemProd**	**BetaParAbst-BetaParProd**
Z	-0.299	-0.485	-0.859
Asymp. Sig. (2-tailed)	0.765	0.627	0.391

FIGURE 4.8b: *Percentage of beta activity for Products and Abstract drawings in the Occipital (Occ), Temporal (Temp) and Parietal (Par) lobes at 250 ms.*



As Figure 4.8b suggests, beta activity was not significantly different between products and abstract drawings in any of the lobes examined.

RQ 3c: Is there a significant difference in alpha blocking for ad-stimuli with *products* and alpha blocking for ad-stimuli with *product-in-use at 50ms and 250ms?* This research question will be further examined by each of the cortical regions studied – occipital, temporal and parietal lobes RQ3c (i), RQ3c (ii) and RQ3c (iii) respectively.

Alpha Pair 5: Products and Product-in-use at 50 ms

RQ3c (i): In the **occipital** lobe, 14 participants showed higher alpha blocking to product-in-use (70%) than for the product image (30%). Wilcoxon test showed significant results for alpha at p = **0.028.** RQ3c (ii): In the **temporal** lobe, both products and product-in-use evoked the same amount of alpha blocking (50%) with p = 0.550. RQ3c (iii): In the **parietal** lobe, products evoked higher alpha blocking (60%) when compared to products-in-use (40%) but the difference was not significant (p = 0.433).

FIGURE 4.9a: *Percentage of alpha blocking for Products and Products-in-use (Hand) in the Occipital (Occ), Temporal (Temp) and Parietal (Par) lobes at 50 ms.*

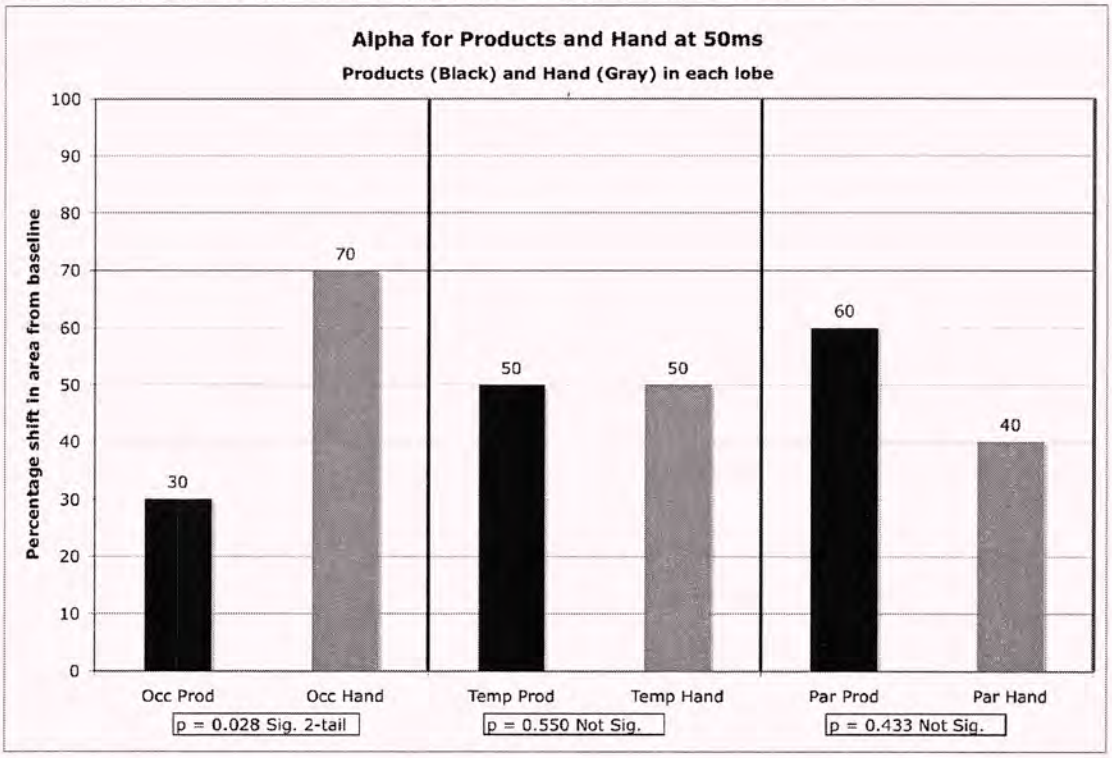


TABLE 4.17: Test of significance for Pair 5 Alpha

Pair 5 (Alpha) 50ms	**AlphaOccHand-AlphaOccObj**	**AlphaTemHand-AlphaTemObj**	**AlphaParHand-AlphaParObj**
Z	-2.203	-0.597	-0.784
Asymp. Sig. (2-tailed)	**0.028**	0.550	0.433

At 50ms, as seen in Figure 4.9a, alpha blocking was significantly higher for product-in-use in the occipital lobe. Temporal lobe showed no difference, whereas in the parietal lobes, products evoked more alpha block but the finding was not significant.

Alpha Pair 5: Products and Product-in-use at 250 ms

RQ3c (i): In the **occipital** lobe, fourteen participants showed higher alpha blocking to product-in-use (70%) than for product images alone (30%) but the difference was not significant with p = 0.232. RQ3c (ii): In the **temporal** lobe, product-in-use (55%) evoked slightly higher alpha blocking than products (45%) with p = 0.204. RQ3c (iii): In the **parietal** lobe, product-in-use (70%) evoked significantly higher alpha blocking than products (30%) with **p = 0.067**.

FIGURE 4.10a: *Percentage of alpha blocking for Products and Products-in-use (Hand) in the Occipital (Occ), Temporal (Temp) and Parietal (Par) lobes at 250 ms.*

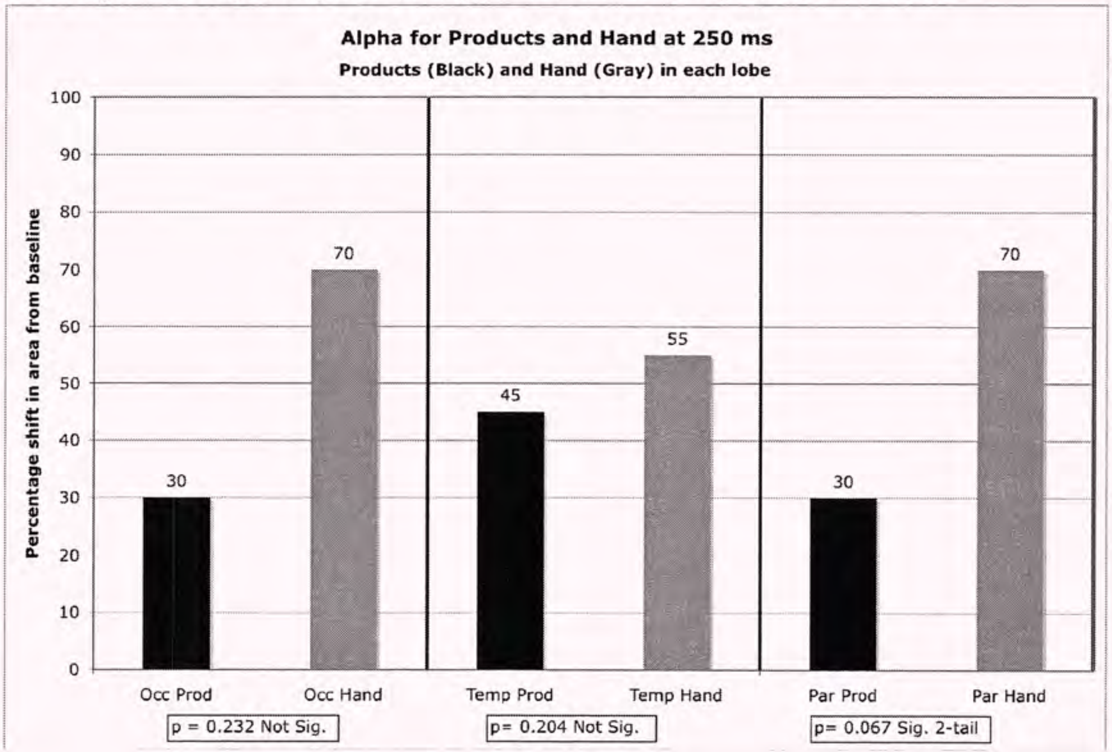


TABLE 4.18: Test of significance for Pair 5 Alpha

Pair 5 (Alpha) 250ms	AlphaOccHand-AlphaOccObj	AlphaTemHand-AlphaTemObj	AlphaParHand-AlphaParObj
Z	-1.195	-1.269	-1.829
Asymp. Sig. (2-tailed)	0.232	0.204	**0.067**

At 250ms, as seen in Figure 4.10a, alpha blocking was not significantly different between products and product-in-use in the occipital and temporal lobes. However, alpha blocking was significantly higher for product-in-use in the parietal lobe.

RQ 3d: Is there a significant difference in beta activity for ad-stimuli with *products* and beta activity for ad-stimuli with *product-in-use at 50ms and 250ms?* This research question will be further examined by each of the cortical regions studied – occipital, temporal and parietal lobes RQ3d (i), RQ3d (ii) and RQ3d (iii) respectively.

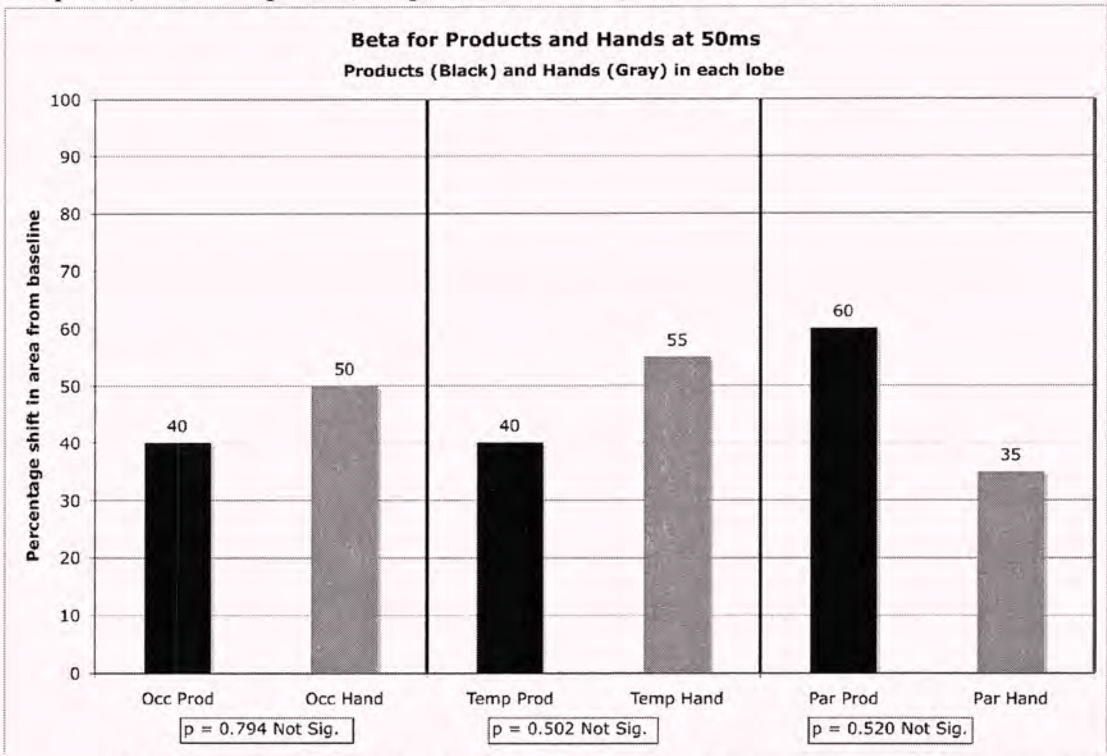
Beta Pair 5: Products and Product-in-use at 50 ms

RQ3d (i): Beta activity in the **occipital** lobe was slightly more with product-in-use (50%) than with products (40%) with two participants showing negative beta ($p = 0.794$). RQ3d (ii): In the **temporal** lobe, beta activity was slightly greater for products-in-use (55%) than for the products (40%). The result was not significant ($p = 0.502$). RQ3d (iii): In the **parietal** lobe, products showed higher beta activity (60%) when compared to product-in-use (35 %), with one tied score. The difference was not significant with $p = 0.520$.

TABLE 4.19: Test of significance for Pair 5 Beta

Pair 5 (Beta) 50ms	**BetaOccHand-BetaOccObj**	**BetaTemHand-BetaTemObj**	**BetaParHand-BetaParObj**
Z	-0.261	-0.672	-0.644
Asymp. Sig. (2-tailed)	0.794	0.502	0.520

FIGURE 4.9b: *Percentage of beta activity for Products and Products-in-use (Hand) in the Occipital (Occ), Temporal (Temp) and Parietal (Par) lobes at 50 ms.*



As Figure 4.9b shows, at 50ms, there is no significant difference in beta activity between products and product-in-use across the three lobes examined.

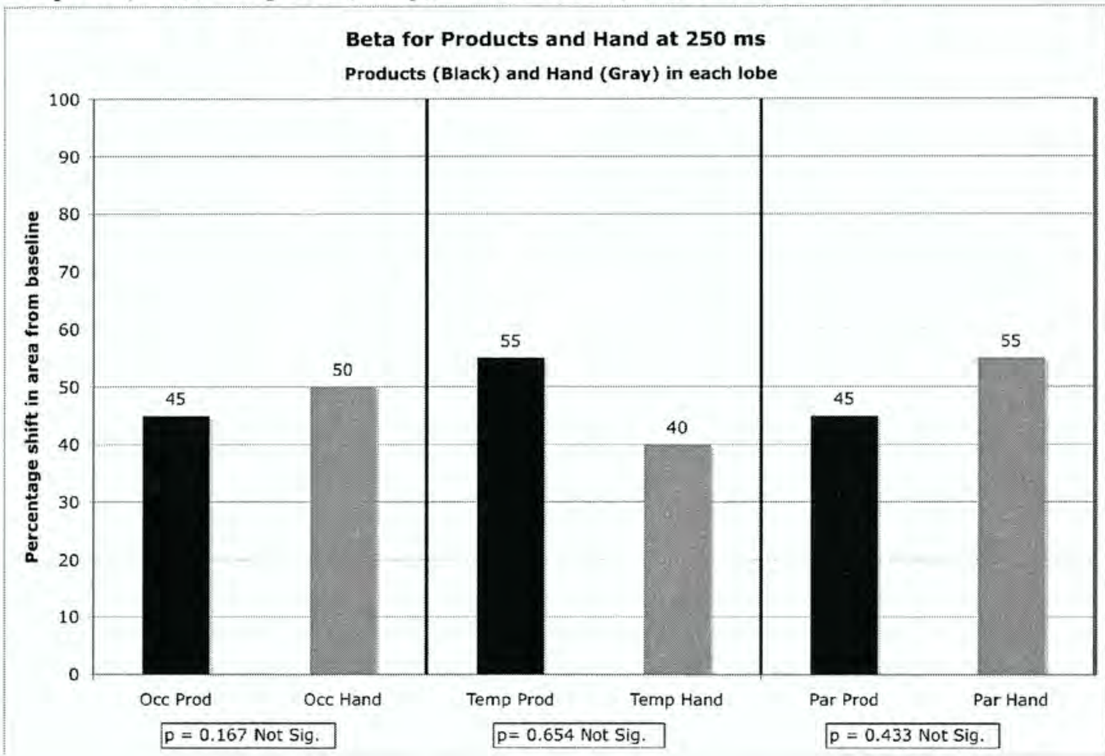
Beta Pair 5: Products and Product-in-use at 250 ms

RQ3d (i): In the **occipital** lobe, beta activity was slightly higher for products-in-use (50%) than products (45%) with one negative beta ($p = 0.167$). RQ3d (ii): Beta activity in the **temporal** lobe was higher for products (55%) than for products-in-use (40%) but the difference was not significant ($p = 0.654$). RQ3d (iii): In the **parietal** lobe, beta activity was slightly more for products-in-use (55%) than for products (45%) with $p = 0.433$.

TABLE 4.20: Test of significance for Pair 5 Beta

Pair 5 (Beta) 250ms	**BetaOccHand-BetaOccObj**	**BetaTemHand-BetaTemObj**	**BetaParHand-BetaParObj**
Z	-1.381	-0.448	-0.784
Asymp. Sig. (2-tailed)	0.167	0.654	0.433

FIGURE 4.10b: *Percentage of beta activity for Products and Products-in-use (Hand) in the Occipital (Occ), Temporal (Temp) and Parietal (Par) lobes at 250 ms.*



At 250ms, as shown by Figure 4.10b, beta activity was not significantly different between products and product-in-use in any of the lobes examined.

RQ 3e: Is there a significant difference in alpha blocking for ad-stimuli with *abstract drawings* and alpha blocking for ad-stimuli with *product-in-use at 50ms and 250ms?* This research question will be further examined by each of the cortical regions studied – occipital, temporal and parietal lobes RQ3e (i), RQ3e (ii) and RQ3e (iii) respectively.

Alpha Pair 6: Abstract drawings and product-in-use at 50ms

RQ3e (i): In the **occipital** lobe, alpha blocking was slightly more for abstract drawings (55%) than for products-in-use (45%) with p = 0.823. RQ3e (ii): In the **temporal** lobe, participants showed an equal amount of alpha blocking (50%) for both abstract drawings and products-in-use (p= 0.970). RQ3e (iii): In the **parietal** lobe, alpha blocking was slightly more for products-in-use (55%) than for abstract drawings (45%) with p = 0.970.

FIGURE 4.11a: *Percentage of alpha blocking for Abstract drawings and Products-in-use (Hand) in the Occipital (Occ), Temporal (Temp) and Parietal (Par) lobes at 50 ms.*

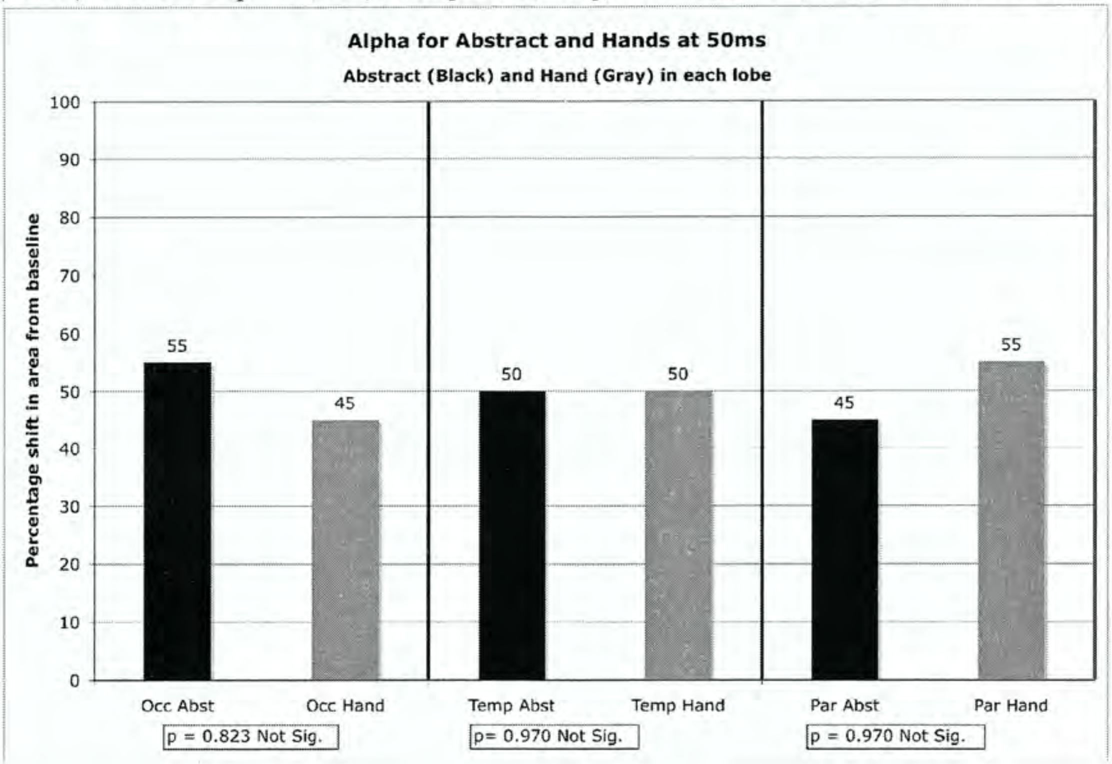


TABLE 4.21: Test of significance for Pair 6 Alpha

Pair 6 (Alpha) 50ms	**AlphaOccAbst-AlphaOccHand**	**AlphaTemAbst-AlphaTemHand**	**AlphaParAbst-AlphaParHand**
Z	-0.224	-0.037	-0.037
Asymp. Sig. (2-tailed)	0.823	0.970	0.970

At 50ms, according to Figure 4.11a, alpha blocking was not significantly different between abstract drawings and product-in-use in any of the lobes studied.

Alpha Pair 6: Abstract drawings and product-in-use at 250ms

RQ3e (i): In the **occipital** lobe, alpha blocking was slightly more for abstract drawings (55%) than for products-in-use (45%) with p = 0.391. RQ3e (i): In the **temporal** lobe, alpha blocking was more for abstract drawings (55%) than for products-in-use (45%). The finding was not significant (p = 0.779). RQ3e (iii): In the **parietal** lobe, twelve participants showed higher alpha blocking for product-in-use (60%) when compared to abstract drawings (40%) with p = 0.370.

FIGURE 4.12a: *Percentage of alpha blocking for Abstract drawings and Products-in-use (Hand) in the Occipital (Occ), Temporal (Temp) and Parietal (Par) lobes at 250 ms.*

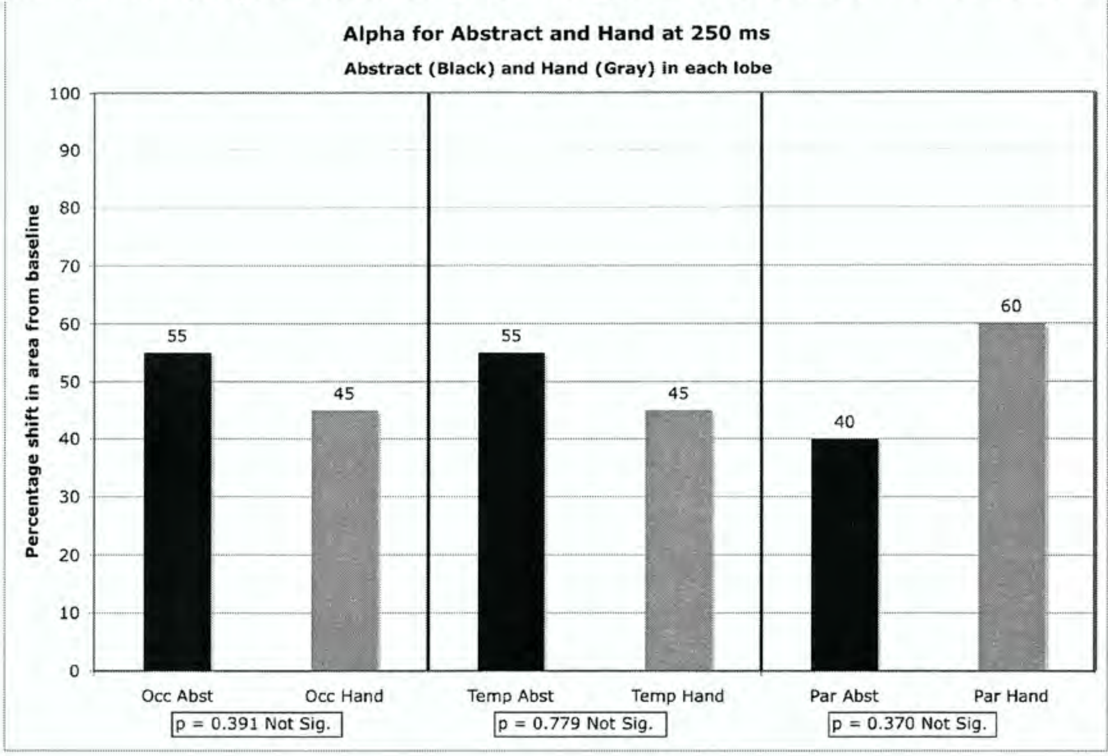


TABLE 4.22: Test of significance for Pair 6 Alpha

Pair 6 (Alpha) 250ms	**AlphaOccAbst-AlphaOccHand**	**AlphaTemAbst-AlphaTemHand**	**AlphaParAbst-AlphaParHand**
Z	-0.859	-0.280	-0.896
Asymp. Sig. (2-tailed)	0.391	0.779	0.370

At 250ms, according to Figure 4.12a, alpha blocking was not significantly different between abstract drawings and product-in-use in any of the lobes studied.

RQ 3f: Is there a significant difference in beta activity for ad-stimuli with *abstract drawings* and beta activity for ad-stimuli with *product-in-use at 50ms and 250ms?* This research question will be further examined by each of the cortical regions studied – occipital, temporal and parietal lobes RQ3f (i), RQ3f (ii) and RQ3f (iii) respectively.

Beta Pair 6: Abstract drawings and product-in-use at 50ms

RQ3f (i): In the **occipital** lobe, ten participants showed more beta activity for product-in-use (50%) when compared to nine who showed more beta activity to abstract drawings (45%), with one negative beta. (p = 0.550). RQ3f (ii): In the **temporal** lobe, participants showed an equal amount of beta activity (45%) for both abstract drawings and products-in-use with one subjects showing negative beta for both the stimulus categories resulting in no significance (p = 0.794). RQ3f (iii): Beta activity in the **parietal** lobe was slightly more for abstract drawings (55%) when compared to products-in-use (45%) with p = 0.709.

FIGURE 4.11b: *Percentage of beta activity for Products and Products-in-use (Hand) in the Occipital (Occ), Temporal (Temp) and Parietal (Par) lobes at 50 ms.*

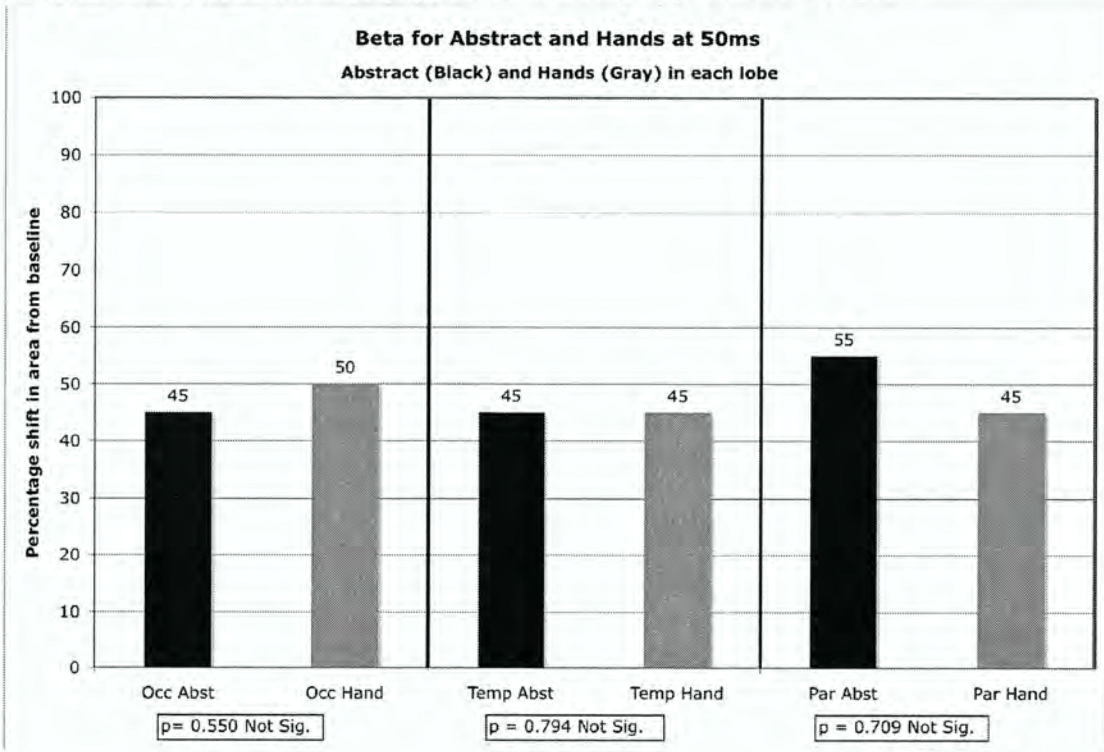


TABLE 4.23: Test of significance for Pair 6 Beta

Pair 6 (Beta) 50ms	**BetaOccAbst-BetaOccHand**	**BetaTemAbst-BetaTemHand**	**BetaParAbst-BetaParHand**
Z	-0.597	-0.261	-0.373
Asymp. Sig. (2-tailed)	0.550	0.794	0.709

At 50ms, as figure 4.11b demonstrates, there are no significant differences in beta activity, between abstract drawings and product-in-use in any of the lobes examined.

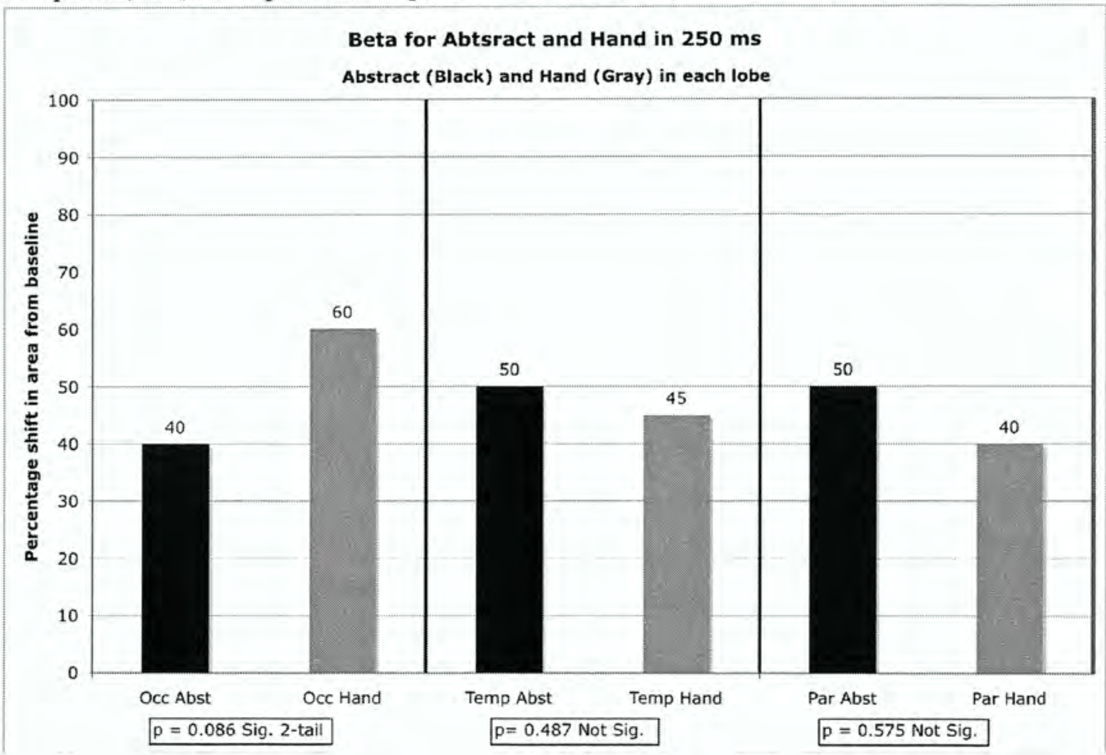
Beta Pair 6: Abstract drawings and product-in-use at 250ms

RQ3f (i): Beta activity in the **occipital** lobe was significantly higher for products-in-use (60%) when compared to abstract drawings (40%), with one negative beta. Wilcoxon test showed significance with p = **0.086**. RQ3f (ii): In the **temporal** lobe, beta activity was slightly different between abstract drawings (50%) and products-in-use (45%) with no significant difference (p = 0.478). RQ3f (iii): In the **parietal** lobe, beta was slightly more for abstract drawings (50%) than for products-in-use (40%) with p = 0.575.

TABLE 4.24: Test of significance for Pair 6 Beta

Pair 6 (Beta) 250ms	**BetaOccAbst-BetaOccHand**	**BetaTemAbst-BetaTemHand**	**BetaParAbst-BetaParHand**
Z	-1.717	-0.709	-0.560
Asymp. Sig. (2-tailed)	**0.086**	0.478	0.575

FIGURE 4.12b: *Percentage of beta activity for Products and Products-in-use (Hand) in the Occipital (Occ), Temporal (Temp) and Parietal (Par) lobes at 250 ms.*



At 250 ms, as Figure 4.12b shows, beta activity was significantly higher for product-in-use than for abstract drawings in the occipital lobe. However, there were no significant differences between the two stimulus categories in the temporal and parietal lobes.

Summary of results for hypotheses tests and research questions

RQ1: Is there a difference between the responses evoked by stimuli of human faces vs. non-facial forms and objects at the 50ms time frame of bottom-up attention?

H1: Faces > Products

H1a (i, ii and iii) are not supported as alpha blocking is not significantly different between faces and products in any of the lobes.

H1b (i, ii, and iii) are not supported as beta activity is not significantly different between faces and products in any of the lobes.

H2: Faces > Abstract drawings

H2a (i) is supported as alpha blocking in the occipital lobe is significantly ($p = 0.100$) different, but in the direction opposite to what was hypothesized. Findings from this sample show that alpha blocking was greater for abstract drawings than for faces in the occipital lobe at 50ms.

H1a (ii and iii) do not find support.

H2b (i, ii and iii) are not supported as beta activity is not significantly different between faces and abstract drawings in any of the lobes.

H3: Faces > Product-in-use (Hands)

H3a (i, ii and iii) are not supported as alpha blocking is not significantly different between faces and products-in-use in any of the lobes at 50ms.

H3b (i,ii and iii) are not supported as beta activity is not significantly different between faces and products-in-use in any of the lobes.

RQ2: Is there a difference between the responses evoked by human stimuli of human faces vs. non-facial forms and objects at the 250ms time frame of top-down attention?

H4: Products > Faces

H4a (i, ii and iii) are not supported as alpha blocking is not significantly different between faces and products in any of the lobes.

H4b (i, ii, and iii) are not supported as beta activity is not significantly different between faces and products in any of the lobes.

H5: Abstract drawings > Faces

H5a (i) is supported as alpha blocking is significantly different ($p = 0.086$) between faces and abstract drawings in the occipital lobe at 250ms. The direction of the hypothesis is also supported with abstract drawings evoking significantly higher alpha blocking than faces.

H5a (ii) is not supported as alpha blocking is not significantly different in the temporal lobe between the two categories.

H5a (iii) is supported as alpha blocking is significantly different ($p = 0.100$) between faces and abstract drawings in the parietal lobe at 250ms. The direction of the hypothesis is also supported with abstract drawings evoking significantly higher alpha blocking than faces.

H5b (i, ii and iii) are not supported as beta activity is not significantly different between faces and abstract drawings at 250ms in any of the lobes.

H6: Product-in-use (Hands) > Faces

H6a (i and ii) are not supported as alpha blocking is not significantly different between hands and faces in the occipital and temporal lobes at 250ms.

H6a (iii) is supported as there is significant ($p = 0.086$) alpha blocking in the parietal lobe at 250ms. As hypothesized, alpha blocking is significantly more for products-in-use than for faces.

H6b (i) is supported as there is significant (p = 0.079) beta activity in the occipital lobe at 250ms. As hypothesized, beta activity is significantly more for products-in-use than for faces.

H6b (ii and iii) are not supported as beta activity is not significantly different between the two stimulus categories in the temporal and parietal lobes.

Answers to the Research Questions

RQ 3a: Is there a significant difference in alpha blocking for ad-stimuli with *products* and alpha blocking for stimuli with *abstract drawings at 50ms and 250ms*?

At 50ms: Yes, there is a significant (p = 0.007) difference in alpha blocking in the occipital lobe at 50ms with abstract drawings evoking significantly higher alpha blocking than products.

At 250ms: Yes, there is a significant difference in alpha blocking both in the occipital (p = 0.025) and temporal (p = 0.073) lobes at 250ms with abstract drawings evoking significantly higher alpha blocking than products.

RQ 3b: Is there a significant difference in beta activity for ad-stimuli with *products* and beta activity for stimuli with *abstract drawings at 50ms and 250ms*?

No, both at 50 and 250 ms there is no significant difference in beta activity between products and abstract drawings in any of the three cortical regions examined.

RQ 3c: Is there a significant difference in alpha blocking for ad-stimuli with *products* and alpha blocking for ad-stimuli with *product-in-use at 50ms and 250ms?*

At 50ms: Yes, there is a significant (p = 0.028) difference in alpha blocking between products and products-in-use in the occipital lobe at 50ms with products-in-use evoking significantly higher alpha blocking than products.

At 250ms: Yes, there is a significant ($p = 0.067$) difference in alpha blocking between products and products-in-use in the parietal lobe at 250ms with products-in-use evoking significantly higher alpha blocking than products.

RQ 3d: Is there a significant difference in beta activity for ad-stimuli with *products* and beta activity for ad-stimuli with *product-in-use at 50ms and 250ms?*

No, both at 50 and 250 ms there is no significant difference in beta activity between products and products-in-use in any of the three cortical regions examined.

RQ 3e: Is there a significant difference in alpha blocking for ad-stimuli with *abstract drawings* and alpha blocking for ad-stimuli with *product-in-use at 50ms and 250ms?*

No, both at 50 and 250 ms there is no significant difference in alpha blocking between abstract drawings and products-in-use in any of the three cortical regions examined.

RQ 3f: Is there a significant difference in beta activity for ad-stimuli with *abstract drawings* and beta activity for ad-stimuli with *product-in-use at 50ms and 250ms?*

At 50ms: No, there is no significant difference in beta activity between abstract drawings and products-in-use at 50ms in any of the lobes examined.

At 250ms: Yes, there is a significant ($p = 0.086$) difference in beta activity in the occipital lobe at 250ms with product-in-use evoking significantly higher beta activity than abstract drawings.

CHAPTER 5

DISCUSSION AND CONCLUSION

The objective of this study was to examine how the human brain deploys its attentional resources to human faces and non-face forms and objects when they are placed as primary visual elements in basic print media advertisement layouts. Based on two-component attention framework and saliency model, this study employed a repeated measures design to examine research questions and hypotheses at the pre-attentive, bottom-up and attentive, top-down attention frameworks using EEG, specifically alpha blocking and beta activity, as dependent variables.

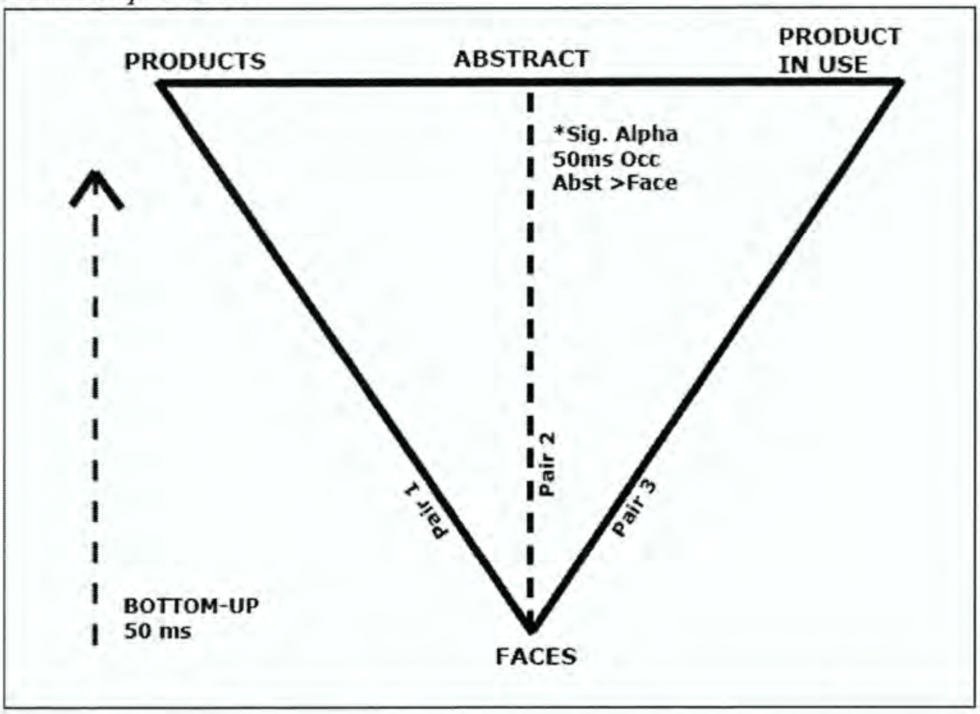
The main finding of the study is that **abstract drawings** and **products-in-use** were the two categories of stimuli that evoked most attention. This finding was consistent across the six pairs of comparisons made at 50ms and 250ms, in three primary visual processing areas of the brain – the occipital, temporal and parietal lobes.

Bottom-up Attention. The first research question and the set of hypotheses that followed, assumed that faces would evoke significantly higher bottom-up attention than non-face forms and objects. But these hypotheses were not supported by the data coming from the sample of twenty participants who participated in this study. When **faces** were compared with **products** (Pair 1), although it was hypothesized that faces would evoke higher bottom-up attention, there was no significant difference in the attention responses at the 50ms timeframe. When **faces** were compared with **abstract drawings**, (Pair 2) the findings were significant, but contrary to the direction hypothesized with abstract drawings evoking significantly higher bottom-up attention than faces. When **faces** were compared with **product-in-use** (Pair 3) there was no significant difference in attention patterns at 50ms.

These findings indicate that faces did not evoke significantly higher bottom-up attention as hypothesized. Although the pilot study (Bellur and Geske, 2006) with a smaller sample (n=11) did show significant differences between images of faces and objects at the 50ms frame of bottom-up attention, the same results were not found in this study. This could be explained chiefly by differences in the type of stimuli used. While the pilot study employed photographic images of faces and objects (IAPS # 7009, 7175, 2493 and 2441) with no text, the current study placed *faces*, *products*, *abstract drawings* and *product-in-use* in a full-page (8.5 X 11) color advertisement layout with a minimum amount of text to indicate the product being advertised. Hence, findings from this study suggest that applied or mediated stimulus-design could have led to differing results in the current study when compared to the findings of the pilot study. While in the pilot study, there were no significant differences found in the top-down attention framework, the current study did find several significant differences (discussed below) in the top-down attention mechanism (at 250ms) indicating perhaps that media stimuli evoke significant top-down processing of information.

From Figure 5.1, it can be observed that out of the three pairs (1, 2 and 3) of comparison made at 50ms, only the second pair showed significant difference, with abstract drawings evoking significantly higher bottom-up attention than faces. Faces, when compared with products or product-in-use showed no significance. This suggests that at the very early stage of visual attention (50ms) in the visual processing areas of the brain, attributes such as color, shape and orientation present in stimuli with faces, products and products-in-use were processed rapidly in a *pre-attentive* manner, and were subsequently categorized into pre-existing mental maps or representations. However, abstract drawings because of their unique attributes with respect to their shape and orientation demanded significant bottom-up (sensory) attention before being processed and categorized as an unfamiliar and novel stimulus, vis-à-vis a familiar stimulus like a human face.

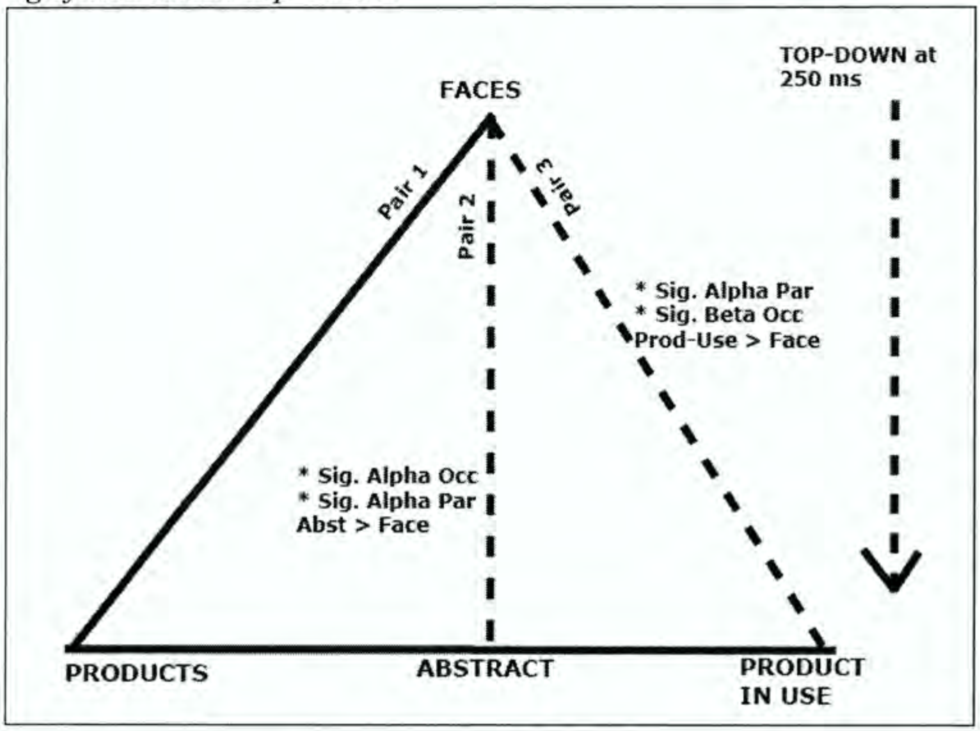
FIGURE 5.1: Hypotheses tests for bottom-up attention (50ms). Dashed lines show significant results at $p \leq 0.100$.



Top-down attention. The second research question and the set of hypotheses that followed, assumed that non-face forms and objects would evoke significantly higher top-down attention than faces. Some of the hypotheses that followed this assumption received support and were accepted at a critical value of **p less than or equal to 0.100 (2-tailed).**

When **faces** were compared with **products** (Pair 1) at the 250ms timeframe, although it was hypothesized that products would evoke higher top-down attention, there were no significant differences in the attention responses of the twenty participants. However, when **faces** were compared with **abstract drawings** (Pair 2), there were significant differences. As hypothesized, abstract drawings evoked significantly higher top-down attention than faces. Exposure to stimuli with abstract drawings resulted in higher alpha blocking and higher beta activity at the occipital and parietal lobes at 250ms. When **faces** were compared with **product-in-use** (Pair 3), there were significant differences that supported the hypothesis that product-in-use would evoke higher top-down attention than faces. Alpha activity in the occipital lobe and beta activity in the parietal lobe were higher for ad-stimuli with product-in-use.

FIGURE 5.2: Hypotheses tests for top-down attention (250ms). Dashed lines show significant results at $p \leq 0.100$.



Therefore, as shown in Figure 5.2, out of the three pairs (1, 2 and 3) of comparison made, pairs 2 and 3 were significant in evoking top-down attention. This suggests that when compared against a familiar stimulus like human face, complex and unfamiliar stimuli like abstract drawings and products-in-use are processed in a serial fashion with the help of cognitive cues from higher regions in the brain as pre-existing mental maps for such novel stimuli are not readily available. Hence, these significant differences occur at a later representation stage, with a time lag of 200ms or more, after exposure to the stimulus, in keeping with the top-down attention mechanism. The presence of minimal text in all the categories of stimuli could have also triggered top-down processing to comprehend what the visual and the message meant, again reiterating that mediated stimuli quickly initiate top-down processing of the message.

Therefore, among the four types of stimuli examined in this study (faces, abstract drawings, products and product-in-use), lack of significance in bottom-up processing of face ads suggests that processing of such sensory information might be more implicit and holistic when such stimuli are juxtaposed with more complex forms of stimuli like abstract drawings and products-in-use, which, due to their complexity, call forth not just sensory cues but also cognitive cues (prior-learning and memory) and analytic coding, thereby resulting in significant differences as seen in the top-down attention mechanism. Thus face ads, when compared with products, evoked neither significant bottom-up nor significant top-down attention because face stimuli might have been processed pre-attentively, and achieved "early representation" as described in the Koch and Ullman model.

This finding can also be seen in the light of Tanaka and Farah's (2003) holistic face hypothesis – When compared with more complex stimuli, faces were rapidly and holistically coded and therefore no significant differences were found even in the bottom-up attention timeframe. Whereas complex non-face forms and objects were broken down into component parts before being coded in an analytic fashion, thus evoking significant differences only later in the top-down attention timeframe. Face perception perhaps becomes a less daunting task to the visual processes in the brain when face stimuli are compared with or juxtaposed against more complex forms of stimuli like products-in-use and abstract drawings. This observation was also evident in some of the open-ended responses that participants gave for elements that caught their attention the most. Some participants noted:

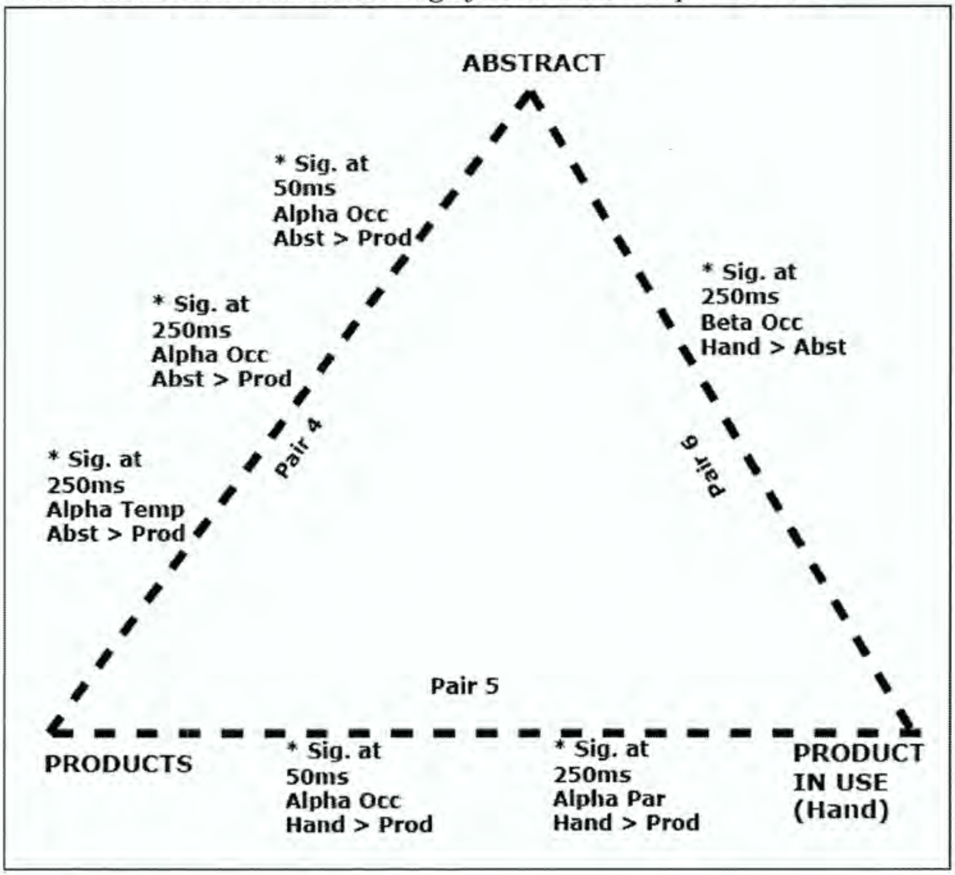
> "The ones that I wasn't sure what they were at first or from looking at the picture. I didn't know what it was representing." (Sub 003)
>
> "The pic(ture) of the green squiggly lines was cool and the blue tinted art work caught my attention…" (Sub 004)
>
> "The art pieces left the most impact. I can't even really remember what products were shown." (Sub 011)

Comparisons within non-face category of stimuli. The third research question was exploratory in nature as it examined how the non-face category of stimuli viz. *products*, *product-in-use* and *abstract drawings* differed when compared with each other at the 50ms and 250ms timeframes.

Findings showed that when **products** were compared with **abstract drawings** (Pair 4), abstract drawings evoked significantly higher attention, both bottom-up and top-down. When **products** were compared with **product-in-use** (Pair 5) the latter evoked significantly higher bottom-up and top-down attention. When **abstract drawings** were compared with **product-in-use** (Pair 6), there were no significant differences in bottom-up attention, but at the top-down attention framework product-in-use evoked higher beta activity than abstract drawings.

As Figure 5.3 shows, all the three pairs of comparison (4, 5 and 6) showed significant differences. Stimuli with abstract drawings and products-in-use evoked significant attention both in the bottom-up and top-down framework.

FIGURE 5.3: Results for research questions within non-face category of stimuli both at 50ms and 250ms. Dashed lines show significant results at $p \leq 0.100$.



Significant attention shown towards abstract drawings can also be examined in future research in the purview of *Distinctiveness Theories* (Gati & Tversky, 1987; Diao and Sundar, 2004), which state that if the features of a stimulus make it unique or *distinctive* in comparison to other stimuli in a given visual environment, then the distinctive stimulus is more likely to catch and sustain viewers' attention. Although the stimuli used in the present study were all static, the significant bottom-up and top-down attention shown toward the product-in-use with a dominant visual of hands in motion (demonstrating the use of product being advertised) can be understood and further examined in terms of *motion-effect theories* (Goldstein, 1989; Reeves and Nass, 1996; Diao and Sundar, 2004).

Prior research (Reeves, Thorson, McDonald, Hirsch and Goldstein, 1985; Lang, 1990; Lang, Bolls, Potter and Kawahara, 1999; Lang, Borse, Wise and David, 2002) has also shown how structural features of media can evoke involuntary physiological responses like the orienting response, alpha blocking and allocation of automatic attention to moving stimuli. Therefore, static images of hands as part of human anatomy may be classified as any other non-face object (Neibur and Koch, 1998), but hands indicating motion or movement evoked significant attention in this study.

In sum, out of the six pairs of comparisons made both at 50ms and 250ms, there were **three** pairs that were significant in evoking bottom-up attention (pairs 2, 4 and 5), and there were **five** pairs that evoked significant top-down attention (pairs 2, 3, 4, 5 and 6) thus indicating a greater proclivity towards top-down processing of the stimuli presented to this sample of twenty participants. Among individual categories of stimuli, **abstract drawings** and **product-in-use** emerge as the "winners" that evoked significantly higher bottom-up and top-down attention in comparison to all other groups of stimuli. These findings do not necessarily suggest that non-face stimuli were more salient than face-stimuli, but they do suggest that complex stimuli took precedence in the brain's allocation of attentional resources. Additionally, it is the nature of these stimuli that holds the key to understanding the basic question in this study – given a range of stimuli, what catches our attention the most? The answer seems to be, that more than those stimuli, which are simple photographic images and representations (faces and products), stimuli that are novel, intriguing, and carry even a hint of action (abstract drawings and product-in-use) are more successful in not only catching but also holding attention long enough (250ms or more) to comprehend what a message means in a given context, in this case, advertising.

Type of attention and cortical areas examined. Findings from this study indicate that in the bottom-up attention framework of 50ms, significant differences in attention responses emerged only from the occipital lobe. However, in the top-down attention framework significant differences emerged both in the occipital and parietal lobes. This suggests that complex stimuli like *abstract drawings* and *product-in-use* that evoked significant top-down attention not only involved the primary visual processing area of the occipital lobe but also involved the next higher cortical area, the parietal lobe that deals with spatial vision (locating objects in space) and grasping and reaching movements in conjunction with the MT cortex. (Mishkin, Ungerleider and Macko,1983; Wallis,1993). These findings support the argument of Zeki (1993) that the ventral (*what*) and dorsal (*where*) streams are "hierarchically organized" with the occipital lobes involved in the initial bottom-up attention stage or the *what* stage and the top-down involvement with parietal lobes coming later in the timeframe associating attention with the *where* stage.

The inferotemporal (IT) cortex has been associated exclusively with perception of faces and objects (Wallis, 1993; Niebur and Koch, 1998) and the fusiform face area (FFA) within the temporal cortex has been well documented (Kanwisher, et al., 1997; Ishai et al.,1999; Tong et al, 2000) to respond exclusively to faces. Yet, this study did not find any significant differences emerging from the temporal lobe between face and non-face categories of stimuli. In the current study, as compared with the contrary findings in studies mentioned above, lack of significant findings in the temporal lobe can be attributed to chief differences in the measurement methods employed. Studies (Kanwisher, eta.al.,1997; Ishai et al.,1999; Tong et al, 2000) employing functional Magnetic Resonance Imagery (fMRI) and advanced brain-imagery techniques have been the most successful in localizing and definitively pointing out the involvement of the fusiform face area in face perception.

Among, evoked potential studies that have employed brain wave measures there have been some studies (Botzel, et al., 1995; Herzmann, et al., 2004; Watanabe et al., 2005) suggesting significant temporal lobe involvement for face perception. However, there are other evoked-potential studies (Botzel and Grusser, 1989; Paller et al., 1999) that failed to find face-specific responses in the T5 and T6 areas of the temporal lobes, but similar to this study, reported significant findings in the occipital and parietal lobes instead. Botzel and Grusser (1989) further note that face-specific responses could also occur in limbic areas (hippocampus and amygdala) or perhaps deeper in the temporal cortex, which would be hard to reach with the non-invasive procedure of recording scalp activity used in this study.

There are other methodological variations in the experimental procedures, measurement of dependent variables and differences in stimuli that make it harder to compare results from the wide array of research being pursued in this area. To overcome this limitation, future research needs to corroborate and collate responses to the same stimuli from more than one measurement method (EEG and fMRI). Within the same sample, repeated trials would be necessary to obtain more reliable and accurate attentional responses. EEG, like most physiological signals is known for varying widely between individuals but has been considered a dynamic "process variable" that can be a stable indicator of responses within subjects (Gale and Edwards, 1983). Nevertheless, one of the primary concerns in the broader field of psychophysiology has been to find "valid, reliable, and sensitive measure" of the physiological states hypothesized by researchers (McHugo and Lanzetta, 1983). Thus, there is need for a large number of empirical findings that can be shared and compared to strengthen physiological tools and methods of measurement.

Prior EEG research (Rothschild and Thorson, 1983, Reeves, et al., 1993; Mullholland, 1978) has established occipital and parietal alpha waves, and the phenomenon of alpha blocking as strong physiological correlates of attention. This is mainly because alpha waves in these posterior parts of the brain are not prone to muscle and eye-movement artifacts that could otherwise pollute the raw EEG waveform (Rothschild and Thorson, 1983). This study has found data to further add to this reliability of alpha blocking as nearly all the significant findings, except for one, emerged from alpha waves in the occipital (bottom-up) and parietal (both bottom-up and top-down) lobes. Among the several hypotheses and research questions examined, only in two cases, significant beta activity was found in the occipital lobe at the top-down attention framework. This could be mainly attributed to the limited choice of three recording sites (occipital, temporal and parietal) that could be employed in the study. The objective of this study was to look at the very initial responses (within milliseconds) shown to different types of visual stimuli. Therefore, it explored only the primary visual processing areas and also focused on responses to faces and non-face responses in temporal lobe. However, future research with multiple channel EEG recording capabilities should look into beta activity in the central, frontal and pre-frontal sites where beta waves are said to be pervasive when participants are involved in higher cognitive activities (Doyle, Ornstein and Galin 1974; Rothschild and Thorson, 1983).

The EEG waveforms coming from the central nervous system are known to respond in two ways – phasic (short-term) and tonic (long-term) changes (Sharpless and Jasper, 1956; Ray and Olson, 1983). This study examined phasic responses in epochs that lasted 50ms.

Future research could also explore longer time-windows in the response pattern of a wave and also its rate of recovery to baseline levels or habituation (Ray and Olson, 1983). For instance, alpha wave to some stimuli might habituate quickly, whereas for other stimuli, habituation may occur more slowly. These habituation responses could indicate either the level of interest a stimulus holds and/or the amount of mental work it demands.

Additionally, a noted information-processing model, the Limited Capacity Model of Mediated Message Processing (Lang, 2000), proposes three "subprocesses" – *encoding*, *storage* and *retrieval* – that audiences are said to perform on the stimuli they receive and their "mental representation" of such stimuli. This study has specifically examined the *encoding* stage and the automatic (involuntary) attention responses that occur when a message is transmitted off of a medium into a receivers' visual system and the brain's response to this process. Future research will have to move further into this information-processing model and examine cortical responses during the *storage* (memory) and *retrieval* (reactivation) stages, too. This will enable researchers to understand the effects of advertisements more comprehensively, and from a cognitive electrophysiological perspective. Apart from information processing, there are other variables that determine advertising effectiveness, variables such as level of involvement with the product, prior knowledge, communication situation, attitude towards the ad and towards the brand, purchase intention and so on (Wells, 1997). Thus, future research will have to complement cognitive psychophysiological measures with affective and behavioral responses too.

A limitation of this study with respect to face category stimuli is that the three stimuli used were all photographic images of young women with neutral to pleasant expression. Gender, age and ethnicity are factors that can affect participant's attention responses. These factors would have to be considered while designing stimuli in further studies and also in choosing a larger, wider and more heterogeneous sample of participants. Above all, study of facial emotions and expressions and their role in social and interpersonal communication situations is a widely researched area (Kraut, 1982; Berry, 1991; Damasio, 1999). The current study examined the brain's pre-attentive and attentive responses to human faces purely as a structural element, as a category of stimuli different from other non-face, object and figure categories. There is a vast expanse of ongoing research on how brain perceives facial emotions. (George, Ketter, Gill, Haxby, Ungerleider, Herscovitch and Post, 1993; Adolphs, Damasio, Tranel, and Damasio, 1996; LeDoux, 2000). Future research would have to incorporate both cognitive and affective dimensions of face perception and how they interact as variables of advertising effectiveness.

As McHugo and Lanzetta (1983) note, some of the drawbacks of psychophysiological studies and experiments in general, is that they can be intrusive, the laboratory setting may be novel and require getting used to, the stimuli and the task at hand may be complex and all this could result in very different responses in each participant. Yet, they believe that such "exteroceptive" factors can be controlled to a very large extent by the researcher, however the "interoceptive" factors or the internal responses are beyond the control of both the subject and the researcher, and herein lies the strength of psychophysiology with its ability to gather and record immediate and original responses to a stimulus or to a communication situation. Mass media research could benefit from this approach of using measurable, bodily responses because a mere observation of overt media behavior may not always explain the interactive processes that occur between a human being and a medium. These early interactive processes when recorded and captured in real time, could give us an inkling of the factors that could tell us how attention moderates our responses to messages at later stages of the communication process.

Implications for advertising. Wright-Isak, Faber and Homer (1997) draw a distinction between studies of advertising **effects** and studies of advertising **effectiveness.** Most academic research carried out in experimental settings examine advertising **effects**, where the focus is on specific elements and particular variables that are consciously manipulated within an ad and how this influences the viewers' response. Studies of advertising **effectiveness** on the other hand looks at the long term contribution or value-addition made by a campaign to a company or a brand. The authors also present four criteria for demonstrating effectiveness, in which one of the criteria stresses on the role of the creative , or the ad-design itself. The creative also forms the mainstay of effects research where both specific elements and the entire campaign are considered important variables that can affect ad effectiveness as a whole. This study, therefore contributes a physiological perspective to studies of advertising effects that examine how individuals' attention responses differ with differing elements in an ad-design.

A typical complaint by advertisers is that consumers do not pay attention to advertising messages and that in their everyday environment, consumers are carrying out multiple activities (eating, talking, reading, driving, etc.) even when they are surrounded by persuasive messages across different media (Shapiro, Heckler and MacInnis, 1997). McGuire (1973) also notes that exposure to mass media could in many instances be accidental or controlled by external circumstances but this does not obviate the existence and influences of internal processes that are a crucial part of audiences response patterns. In their work on attention to television, Reeves, Thorson and Schleuder (1986) note that attention to media can no longer be considered a certainty; instead it is now recognized that audience attention is a very transient and dynamic state. Wells (1997) contends that post-exposure measures of memory such as recall and recognition alone cannot act as sufficient measures. Instead advertising effects must be examined as they happen, and the internal factors that occur cause or mediate such effects.

Shapiro and colleagues (1997) discuss widespread research in psychology, which has shown that overt conscious attention is not necessary for a message to be processed; and that even "outside the focus of attention" messages are being processed (paid attention to) at a pre-attentive level. These authors discuss empirical findings in advertising research that has shown that "pre-attentively processed stimuli can affect consumer judgments about an ad or brand." (Shapiro, et al., 1997, p. 28). Additionally, they distinguish three offshoots of advertising effects with one stream dedicated to **conscious processing** where the respondent is fully conscious that he or she has to pay attention to the ad presented. The other is **preconscious processing**, which is related more closely to subliminal advertising where the respondent is conscious of attending to certain information but that information itself is altered, degraded, presented at a very fast rate, or is below a clear perceptual threshold. The third stream emphasizing on **pre-attentive processing** is defined as "*processing* of information that is just outside their (consumers') focus of attention." (Shapiro et al., 1997, p. 29). Other researchers (Janiszewski, 1988, 1993; Shapiro and MacInnis, 1992) have shown that not only ads but also brands that are processed pre-attentively, are evaluated more favorably even when the consumer cannot remember if he or she paid attention to the advertising message or not. The current study examined what types of stimuli evoke pre-attentive (bottom-up) and attentive (top-down) processing using a neurological and physiological framework. The next step would be to relate such attentional responses to attitudes towards the ad and the brand.

Olshavsky and Kumar, (1997) draw interesting parallels using similar information processing terminologies as used in this study to delineate three ways that consumers employ to arrive at brand choices – top-down, bottom-up and stimulus based-approaches. They note that in the **top-down approach**, consumers have a specific goal in mind for what they want to buy and they rely heavily on many sources of information right from their prior learning, memory and experience, opinion of friends and agents, to market and industry reports. In the **stimulus-based approach** to brand-choice, the consumer is said to base his attitude towards the ad and the brand purely on the information presented by an advertiser in a single ad. Most advertising effect studies carried out in laboratories are said to adopt this stimulus-based approach to understand brand choices, attitudes and related behavior. The **bottom-up approach** is said to come between the top-down and the stimulus-based approaches, where the consumer starts out at the stimulus-based end, with basic information coming from an ad (stimulus), but then the consumer also shapes and modifies this information before making a final brand choice. Contrary to the top-down approach, consumers in the bottom-up approach do not have predetermined goals (buying) in advance.

The present study, going by the stimulus-based approach, examined participants' bottom-up and top-down attentional responses to different visual elements present in the advertising design (copy). Future research ought to examine how these varied approaches to processing information can influence participants' attitudes and brand choices.

Conclusion. This study has shown that within the first few milliseconds of exposure, at the attentive stage (top-down) participants showed significant differences to abstract, novel and action-oriented stimuli. However, at the pre-attentive stage, significant attention was shown mainly to abstract stimuli, while the other categories of stimuli (faces, products and products-in-use) showed no significant pre-attentive activity.

The main finding of the study is that **abstract drawings** and **products-in-use** were the two categories of stimuli that evoked most attention. What makes responses to these two categories significantly different is that the stimuli in them are novel or distinct, they indicate a sense of action, they call forth both cognitive and sensory cues, they involve both the occipital and parietal lobes, and show significant differences in both alpha and beta waveforms. Therefore, results from this study support the notion that the brain gives "high priority" to stimuli that are novel, unexpected and complex (Corbetta and Shulman, 2002, p.201), than those stimuli that are simpler and more familiar.

Seen in the light of advertising effects, it can be concluded that ads and stimuli with complex images invoked immediate, attentive or top-down processing of the advertised message. However, ad-stimuli with faces and products evoked no significant responses either in the pre-attentive or in the attentive stage suggesting that any differences that might have occurred while processing these familiar stimuli might have been neutralized or submerged by significant cortical activity evoked by more abstract, complex and novel (non-familiar) stimuli.

One of the limitations of the study is that it does not examine differences between the responses of males and females in the sample. Future research needs to take into account differences in gender, and further diversify the sample not only by gender but also by different ethnic backgrounds. Additionally, faces were seen more from a structural viewpoint. A direction for future research would be to move towards examining not just the structure but also the role of moods and emotions, and how these affective factors mediate responses to faces. The stimuli in this study were limited to print media alone. Examining differences between media, for instance, television and virtual environments, which provide richer sensory and perceptual experiences, could also lead to interesting findings on how face and non-face information are processed by the brain, across a variety of media platforms.

In conclusion, it can be said that when exposed to different categories of stimuli, by virtue of innumerable psychological and physiological resources available to them, participants demonstrate a wide range of responses that could be simple, subtle, discreet and / or sophisticated. Such responses are no different than the everyday responses media audiences demonstrate. This study therefore, is an attempt to link empirical findings and physiological data with hypothesized attentional processes that advertising stimuli evoke, with the objective of understanding short-term *effects* of individual variables in an ad-design that could eventually lead to understanding the long-term *effectiveness* of entire advertisement campaigns as a whole.

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APPENDIX A

HUMAN SUBJECTS REVIEW APPROVAL

For IRB Use Only	Modification Approval Date 2/21/06 Continuing Review Approval Date Approval Expiration Date: 2/6/07	IRB FEB 21 2006

ISU HUMAN SUBJECTS CONTINUING REVIEW AND/OR MODIFICATION FORM

TYPE OF SUBMISSION: ☐ Continuing Review ☒ Modification ☐ Continuing Review and Modification

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Project Title: Brain wave measures of attention to faces and objects in print media advertisements.		
IRB ID: 06-004		Date of Last Continuing Review: 02/06/2007
IF STUDENT PROJECT		
Name of Major Professor: Dr. Joel Geske		Phone: 515-294-0477
Department: Journalism and Mass Communication		Campus Address: 209 Hamilton Hall, Greenlee School of Journalism, ISU, Ames, IA 50010.
		E-mail Address: geske@iastate.edu

FUNDING INFORMATION:

☐ External Grant/Contract ☐ Internal Support (no specific funding source) or Internal Grant (indicate name below)	
Name of Funding Source:	OSPA Record ID on Gold Sheet:
☐ Part of Training, Center, Program Project Grant – Director:	Overall IRB ID No:

CONFLICT OF INTEREST

The proposed project or relationship with the sponsor require the disclosure of significant financial interests that present an actual or potential conflict of interest for investigators involved with this project. By signing this form, all investigators certify that they have read and understand ISU's Conflict of Interest policy as addressed by the ISU Faculty Handbook and made all disclosures required by it. (http://www.provost.iastate.edu/faculty .)

Do you or any member of your research team have a conflict of interest? ☐ Yes ☒ No
If yes, has the appropriate disclosure form been completed? ☐ Yes ☒ No

ASSURANCE

I certify that the information provided in this application is complete and accurate and consistent with proposal(s) submitted to external funding agencies. I agree to provide proper surveillance of this project to insure that the rights and welfare of the human subjects are protected. I will report any adverse reactions to the IRB for review. I agree that modifications to the originally approved project will not take place without prior review and approval by the Institutional Review Board, and that all activities will be performed in accordance with state and federal regulations and the Iowa State University Federal Wide Assurance.

Saraswathi BT 02/20/2006
Signature of Principal Investigator Date

Student Projects: Faculty signature indicates that this application has been reviewed and is recommended for IRB review.

Joel Geske 02/20/06 Dianne Anderson 2/21/06
Signature of Supervising Faculty Date IRB Approval Signature Date

For IRB Use Only	EXPEDITED per 45 CFR 46.110(b) 4, Category ____, Letter ____ STUDY REMAINS EXEMPT per 45 CFR 46.101(b) ____ WAIVER of SIGNED CONSENT per 45 CFR 46.117(c) ____ WAIVER of ELEMENTS of Consent per 45 CFR 46.116 ____ VULNERABLE POPULATION per 45 CFR 46.____

APPENDIX B

INFORMED CONSENT

ISU IRB #1	06-004
Approved Date:	February 7, 2006
Expiration Date:	February 6, 2007
Initial by	gc

INFORMED CONSENT DOCUMENT
Brain wave measures of attention to faces and objects in print media

Principal Investigator: Saraswathi T Bellur, Graduate Student, Greenlee School, ISU
Major Professor and Advisor: Dr. Joel Geske, Associate Professor, Greenlee School, ISU.
Research Personnel: Megan Schuller, Junior, ISU.

INTRODUCTION

Dear Student:

We are conducting a study to examine attention processes evoked by print media (mostly magazines and newspapers) advertisements. It could have been your experience that even as you are reading your favorite magazine or browsing the pages of a newspaper, your attention could be suddenly drawn to unique visual elements of a particular advertisement such as a novel product, or well-known celebrity, eye-catching headline, exclusive images and so on. This study explores how our brain, as part of a complex visual system in human beings, responds to such advertisements.

This is a research study. Please take your time in deciding if you would like to participate. Please feel free to ask questions at any time.

PROCEDURE

The study will progress in four steps.

Step 1: At the outset, you'll be asked to read through the Informed Consent document in detail, ask questions, clarify doubts and upon agreeing to participate, you'll be asked to sign the Informed Consent document. Following this you would be asked to provide basic demographic information (age, gender, occupation, etc.)

Step 2: Once inside the Physio Media Lab, you would be seated in a comfortable chair facing various media (computer terminals). The research personnel in the lab will then explain how they would be using simple equipment to gather data.

Step 3: Following a safe, non-invasive process, the personnel will then place electrodes on your scalp and begin recording your brain wave responses. Initially, you would be asked to close your eyes and relax. Later, you would be asked to open your eyes and read or view the material placed in front of you.

Step 4: In the last step, you would be asked to provide pencil-and-paper responses to the media messages shown to you earlier in the study.

To be a participant in this study, the following requirements HAVE to be met. Kindly review the criteria of participation listed below. You can be a participant in this study only if you meet all the following requirements:

1. Must be in the age group of 18 to 45 years
2. Must have no history of epilepsy, brain trauma or other disorders (related to brain, heart or lung).

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Initial by	ge

3. Must be primarily right-handed
4. Must not be on mind-altering drugs or medications.
5. Both males and females are needed.
6. Persons with diverse ethnic background are encouraged to participate.

We will be conducting the tests in early February, and a time convenient for you will be arranged. The time needed to collect and record data in both the stages will not exceed more than one and one-half hour. The tests will be conducted in the Physio Media Lab at Hamilton Hall.

RISKS

The testing procedures followed in the lab to obtain bodily responses will be non-invasive and non-clinical. Except for slight discomfort while removing disposable self-adhesive electrodes, we do not foresee, at this point of time, any pain or risk of injury involved in the process. Electrodes will be placed on the scalp and the skin with the use of latex free gloves, thus standard hygiene procedures will be strictly followed. Since any time electrical equipment is being used there is a very remote chance of shock, the equipment is plugged into a grounded outlet and also uses breaker connections to prevent accidental shock.

COSTS and COMPENSATION

You will not have any costs from participating in this study. Upon successful completion of the data collection monetary compensation in the form of a $ 15 gift card will be given.

PARTICIPANT RIGHTS

You may change your mind and withdraw from the experiment at any time. If you decide to not participate in the study or leave the study early, it will not result in any penalty or loss of benefits to which you are otherwise entitled.

RESEARCH INJURY

Emergency treatment of any injuries that may occur as a direct result of participation in this research is available at the Iowa State University Thomas B. Thielen Student Health Center, and/or referred to Mary Greeley Medical Center or another physician or medical facility at the location of the research activity. Compensation for any injuries will be paid if it is determined under the Iowa Tort Claims Act, Chapter 669 Iowa Code. Claims for compensation should be submitted on approved forms to the State Appeals Board and are available from the Iowa State University Office of Risk Management and Insurance.

CONFIDENTIALITY

Records identifying participants will be kept confidential to the extent permitted by applicable laws and regulations and will not be made publicly available. However, federal government regulatory agencies and the Institutional Review Board (a committee that reviews and approves human subject research studies) may inspect and/or copy your records for quality assurance and data analysis. These records may contain private information. To ensure confidentiality to the extent permitted by law, the following

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Initial by	ge

measures will be taken - all information gathered will be strictly confidential and your name will in no way be attached to the data. The data will be stored in the Principal Investigator's Office, in a password-protected computer. Only the Principal Investigator and the Co-Investigators will have access to the data. The data will be retained for a year's duration from the date of the study. If the results are published, your identity will remain confidential. This study may provide important information on how we attend to various advertising messages. It may provide useful information on how our brain responds to visual elements and hence benefit those studying consumer responses and behavior in the academic arena, media industry and interested populace in the public sphere. I hope you will consider participating in this project.

Sincerely,
Saras Bellur
For more details and information please contact:
Saraswathi Bellur
Graduate Research Assistant
4B Hamilton Hall,
Greenlee School of Journalism, ISU
Phone: 515-294-5561. sarasbt@iastate.edu

Dr. Joel Geske
Associate Professor,
209 Hamilton Hall,
Greenlee School of Journalism, ISU
Phone: 515-294-0477. geske@iastate.edu

If you would like to be a study participant and schedule a day and time for testing, please contact: Megan Schuller at physiomedia@iastate.edu
If you have any questions about the rights of research subjects or research-related injury, please contact Ginny Austin Eason, IRB Administrator, (515) 294-4566, austingr@iastate.edu , or Diane Ament, Research Compliance Officer (515) 294-3115, dament@iastate.edu
****

SUBJECT SIGNATURE

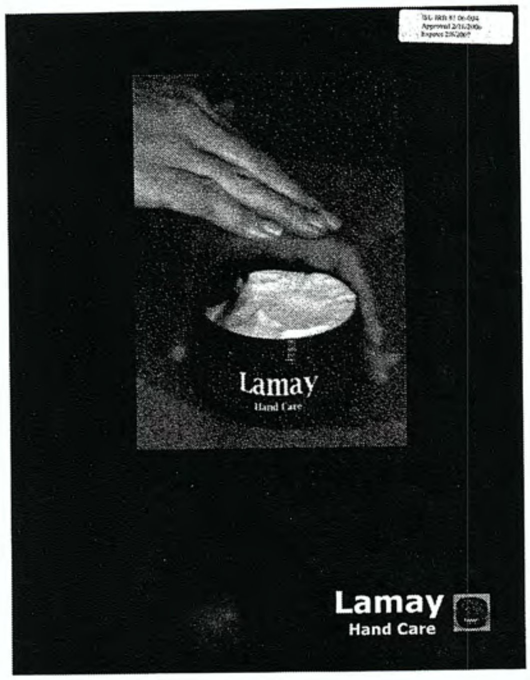
Your signature indicates that you voluntarily agree to participate in this study, that the study has been explained to you, that you have been given the time to read the document and that your questions have been satisfactorily answered. You will receive a copy of the signed and dated written informed consent prior to your participation in the study.

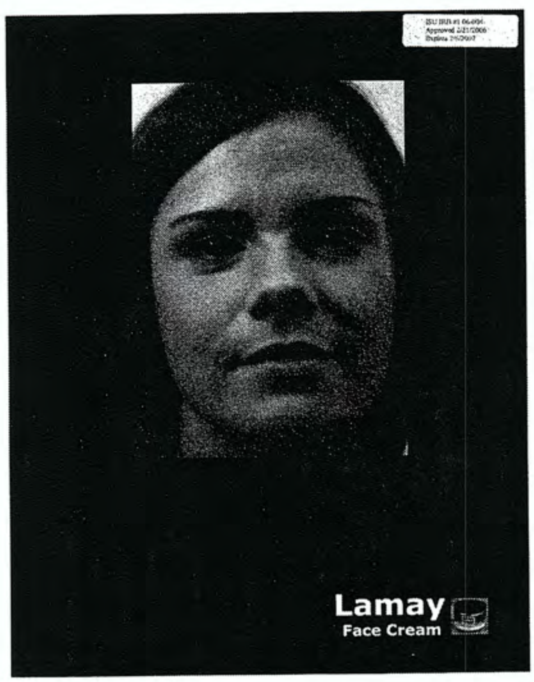
Subject's Name (printed) ____

____________________________________ ____________________
(Subject's Signature) (Date)

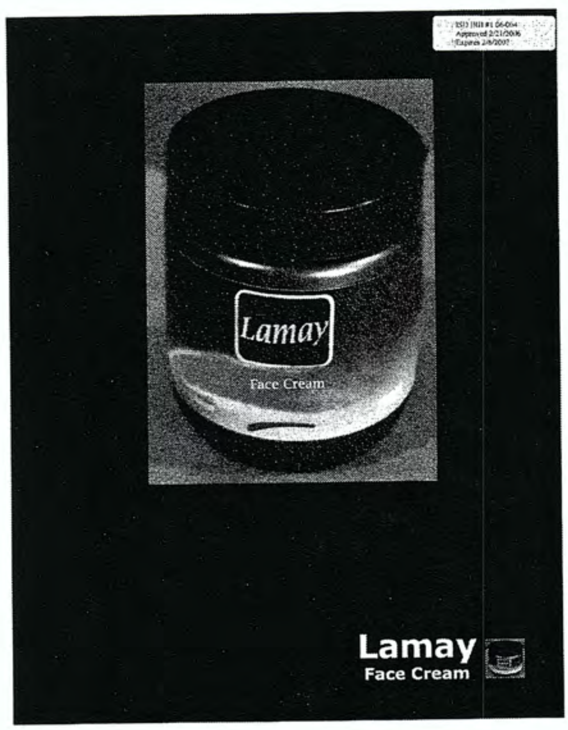
APPENDIX C

SET OF STIMULI






Swoops


Lamay
Face Cream
Lamay
Face Cream

APPENDIX D

PENCIL-PAPER RESPONSES

Among the stimuli shown, please describe in a few words what visual elements caught your attention the most.

"The hand cream, the hands looked really soft and what I would want my hands to look like. Face cream was the same, I would want my face to look like that. Toothpaste wasn't exciting, I have no desire to use it..."

"Almay cream, people, jar, faces"

"The ones that wasn't sure what they were at first or from looking at the picture. I didn't know what it was representing."

"The ads for the face cream were just big faces of girls with no zit problems, just average ladies, they weren't all that stimulating. The pic(ture)s of the green squiggly lines was cool and the blue tinted art work caught my attention as well – looked like big bars wrapping around another bar."

"Colors, how the product was held, name on boards."

"Faces – I'm more drawn to them. I think I knew one of the girls – that caught my attention. Also the ones with hands more than just bottles alone. The abstract ones didn't hold my attention for super long."

"bright colors, products without hands, larger products'

"Things with color and intricate design. The faces one looked unhappy or was squished. Hands in the picture for cream caught my eye more than the cream alone."

"The bright colors, up close images of faces or / and products stood out on backgrounds."

"The art pieces left the most impact. I can't even really remember what products were shown."

"The tooth paste and Lamay face cream. The swirls were interesting too."

"The blue total toothpaste bottle with the hands I noticed that right away."

"The plain tube of toothpaste and the orange jar of the face cream. The faces always kind of threw me off but I think that was because it just felt strange to open my eyes and have someone staring back at me. The least attention I felt was to the jar of open cream (and) the hands in the picture."

"Facial expressions, smiles or solemn"

"The thing that caught my eye the most was the color. I really like the purple, and the green and blue."

"The faces"

"Color—bright colors added interest. Uniqueness—interesting pictures—not boring and mundane."

"The more abstract images, or human faces."

Mean Responses for ten-items on the 7-pint Personal Involvement Inventory (PII) scale for all the categories of stimuli shown.

Important --- Unimportant = 3.9

Relevant --- Irrelevant = 4.3

Exciting --- Unexciting = 2.1

Appealing --- Unappealing = 3.1

Fascinating --- Mundane = 3.1

Involving --- Uninvolving = 3

Boring --- Interesting = 3.1

Means Nothing --- Means a lot to me = 3.4

Worthless --- Valuable = 4.1

Not needed --- Needed = 4.7