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THE INTERACTION OF HAPTIC IMAGERY WITH HAPTIC PERCEPTION FOR SIGHTED AND VISUALLY IMPAIRED CONSUMERS

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ABSTRACT OF DISSERTATION

Shannon Bridgmon Rinaldo

The Graduate School

University of Kentucky

2008

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ABSTRACT OF DISSERTATION

A dissertation submitted in partial fulfillment
of the requirements for the degree of Doctor of Philosophy
in the College of Business and Economics
at the University of Kentucky

By Shannon Bridgmon Rinaldo

Lexington, KY

Director: Dr. Terry L. Childers, Professor of Marketing

Lexington, KY

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Consumers evaluate products in the market place using their senses and often form mental representations of product properties. These mental representations have been studied extensively. Imagery has been shown to interact with perception within many perceptual modalities including vision, auditory, olfactory, and motor. This dissertation draws on the vast visual imagery literature to examine imagery in the haptic, or touch, modality. Two studies were undertaken to examine the relationship between haptic imagery and haptic perception The first study is based on studies from cognitive psychology that have used similar methods for examining visual imagery and visual perception. In study 1, sighted and visually impaired participants were asked to evaluate objects haptically, to form a haptic image of that object during a short interval, and then to compare the haptic image to a second object. In Study 2, sighted and visually impaired participants listened to five radio advertisements containing imagery phrases from multiple modalities. After listening to the advertisements, participants were asked to recall the ad content and assess both the ad and the product while haptically evaluating the product in the ad. Though results were mixed and further exploration will be necessary, these studies offer broad implications for consumer use of haptic imagery in shopping environments. The implications for both sighted and blind consumers are discussed.

KEYWORDS: haptic imagery, visual imagery, blind consumers, haptic perception, haptic imagery scale

Shannon Bridgmon Rinaldo

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For Jason and Aidan

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CHAPTER 1

INTRODUCTION

INTRODUCTION

Human beings interpret the world around them by using their senses: sight, smell, sound, taste, and touch. When individuals examine objects, they form mental representations or replications of the object's properties. Forming mental representations of touch information is known as *haptic imaging* (Hollins 1986; Kaski 2002). Although visual imagery is the best understood form of mental imagery, individuals are able to construct images in multiple modalities and use those images in a variety of settings. *Haptic imagery* may be used in an array of marketing scenarios as a tool for engaging consumers, including ecommerce environments and print advertisements. This dissertation examines haptic imagery in the context of consumer product comparison.

The use of haptic product evaluation by consumers and the haptic salience of products is a relatively new area in marketing research (Peck and Childers 2003a; 2005; 2003b; Peck and Wiggins 2006). From this literature we know that consumers do, in fact, use touch to evaluate products, that individuals differ in their use of touch, that consumers can be frustrated when they are unable to touch products and may thus evaluate the product less favorably, and that touch with positive valence leads to positive marketing outcomes.

The vast visual imagery literature has demonstrated that visual imagery interacts with visual perception in a manner that sometimes changes the nature of and ability to perceive (Finke 1989). Other studies have shown similar effects in other modalities such as auditory imagery, olfactory imagery, and motor imagery (Farah and Smith 1983;

Gilbert et al. 1998; Halpern and Zatorre 1999; Okada and Matsuoka 1992). Researchers have recently been able to use neuroimaging techniques to investigate whether shared biological and cognitive structures activated in imagery and perception lead to imagery's altering of perception. This dissertation outlines a resource competition versus resource complementation paradigm based on neurological processes and behavioral outcomes to predict how haptic imagery will affect the consumer's ability to engage in haptic perception of a haptic salient product.

VISUALLY IMPAIRED CONSUMERS

A UNIQUE PERSPECTIVE

Most marketing research targets the average consumer for study, often employing the typical college student. As with most other studies, this dissertation seeks to examine the interaction between haptic imagery and haptic perception for the typical sighted consumer, but it also seeks to include another, more neglected sample, the visually impaired consumer.

Evidence in the behavioral and neurological literatures indicates that the visually impaired have unique abilities in the haptic modality (Davidson 1976). Not only is this population well practiced in both haptic perception and imagery, but evidence is growing that shows that their brains react differently to haptic stimuli and memories than do the brains of their sighted counterparts (Röder et al. 1997; Sadato et al. 2002). These facts allow for a unique comparison for the study of haptic imagery's use in consumer product evaluation.

A second reason for including the visually impaired consumer in the study of haptic perception versus haptic imagery is a strategy that the product design literature has called *contrarian sampling* (Carswell et al. 2005). Researchers who recruit outlier research participants for the purpose of a rare user advantage are expected to discover information they could not otherwise attain by observing typical consumer behavior in isolation. Proponents of contrarian sampling cite various benefits such as participants' increased motivation, accuracy, and use of novel strategies. An important principle for this study is that visually impaired consumers are known to differ from sighted consumers in both haptic perception and haptic imagery (Davidson 1976). By including both types of consumers, we seek to evaluate how haptic perception and haptic imagery interact in the marketing context.

A NEGLECTED POPULATION OF CONSUMERS

In addition to recognizing the exceptional haptic abilities of the visually impaired, this dissertation includes the visually impaired consumer for several other reasons. Only recently has the marketing literature begun to consider the needs of this previously neglected consumer segment, which deserves to be noticed. Baker (2006), in a qualitative study of consumer experiences in the lives of the visually impaired, discovered that this population has complex values, including conflicting needs: the need to be individual and the need to be accepted as normal. Baker refers to this construct as *consumer normalcy*.

An estimated 3.3 million Americans currently are considered blind. This figure is expected to increase to 5.5 million by the year 2020. The projected increase is almost entirely due to the effects of an aging baby boomer generation. Age-related visual impairment is due to such ailments as cataracts, macular degeneration, glaucoma, and diabetic retinopathy (Tanner 2004). As the number of visually impaired increase with the increased age of the population, more emphasis on serving the diverse needs of these consumers is necessary. According to *Business Week*, the 77 million baby boomers currently control over $2 trillion, almost 50% of consumer spending power (Lee and Kiley 2005). With the increased risk of a variety of challenges for this aging generation, including visual impairment, marketers should take interest in the effects of disabilities on consumer behavior.

OVERVIEW OF THIS DISSERTATION

This study seeks first to complement the few studies supporting the existence of a haptic memory store in the form of haptic imagery. Furthermore, both sighted and visually impaired consumers will engage in product evaluation tasks so that we may examine the effect haptic imagery has on haptic perception. The existing evidence outlining the biological processing mechanism for both types of information serves as a basis for explaining the predicted effects haptic imagery may have on perception for both groups. Contrasting sighted consumers with visually impaired consumers allows for additional predictions based on known differences of the two groups.

EXPECTED CONTRIBUTIONS

Besides the obvious contributions that have been stated, this study is likely to lead to a broad research stream. Specific to this study, imagery's interaction with perception is relevant to situations where consumers evaluate and compare haptic salient products. When consumers evaluate consecutively haptic salient products such as mattresses, sports equipment, or bed sheets, often the item presented first is no longer available when the second item is presented. We seek to understand how consumers form those haptic memories of the first product to compare with the second. Furthermore, future studies will examine how the order of presentation affects consumers' attitudes and behaviors toward products.

Understanding haptic imagery as a mnemonic allows marketers to understand not only how consumers use these mechanisms, but also to know in which situations imagery should be encouraged or discouraged. For example, do some consumers, particularly those high in *need for touch* or the visually impaired, use haptic imagery disproportionately to other average consumers? Another interesting area for the future is to examine how information from multiple senses interacts with imagery for an overall consumer experience.

PAPER LAYOUT

The next chapter offers an overview of the literature that serves as background to the conceptual framework presented in chapter 3. Chapter 2 reviews the haptics literature, the visual imagery literature, and the research regarding the visually impaired. Chapter 3 presents a conceptual discussion of haptic imagery and provides the logic on which specific hypotheses have been based. Chapter 4 outlines the proposed methodology designed to test these hypotheses and results of the pretests. Chapter 5 reveals the statistical testing and results of the data collected. Chapter 6 discusses the dissertation, the significance of the relationships observed, the contributions to the field, the limitations and future research.

CHAPTER 2

LITERATURE REVIEW

INTRODUCTION

Images are internal and, therefore, unobservable (Finke and Kurtzman 1981). They have also been described as inferred, hypothetical, and implicit (Childers and Houston 1983). Because of their nature, they have been difficult to study (Finke 1989) and at times debated. Paivio, who wrote on the subject for decades, stated that mental representations can be physical or mental, symbolic, and vary in abstractness (Paivio 1986). The accepted conceptual definitions of *imagery* within marketing have centered on the views of Richardson (1969), whose working definition was intended to cover all types of imagery:

> Mental Imagery refers to (1) all those quasi-sensory or quasi-perceptual experiences of which (2) we are consciously aware, and which (3) exist for us in the absence of those stimulus conditions that are known to produce their genuine sensory or perceptual counterparts, and which (4) may be expected to have different consequences from their sensory or perceptual counterparts.

Furthermore, Richardson (1969) differentiates the types of imagery into (1) after imagery, (2) eidetic imagery, (3) imagination imagery, and (4) memory imagery. These categories apply to the extent that an image is "vivid and controllable" (Childers and Houston 1983). In his forward to Sheikh (1983, pg. 15), Richardson explains that his definition still applies to imagery in the present context with the exception of the fourth requirement. As this dissertation shows, cognitive-behavioral and neurological based research has since demonstrated that not only do imagery and perception share processing mechanisms, the two overlap so greatly within a modality that it is sometimes difficult to discern the difference between them by examining neuroimaging data (Zimler and Keenan 1983).

Images can be visual, haptic, auditory, gustatory, olfactory (Childers and Houston 1983), and motor (Isaac, Marks, and Russell 1986). Most of the imagery research for both psychology and marketing has emphasized visual imagery. This is not surprising considering that the visual system is not only the most dominant sensory system for humans and the most developed, but is also considered the most important sensory system for adaptive behavior and survival (Kaski 2002; Thompson 1993). Perhaps more is known about the visual system than any other sensory modality.

This dissertation draws from the vast visual imagery literature and the few studies in other modalities to develop and test hypotheses concerning haptic imagery. The context here involves haptic memory imagery, which a consumer might use when evaluating and comparing a series of haptic salient products. In this scenario, the consumer might attempt to hold the feel (image) of the last product's texture in mind while evaluating the next product. Haptic imagery, as will be seen, involves more than texture. Other properties such as weight, size, shape, temperature, grip, and overall "feel" are also properties of products that are sensitive to haptic assessment (Klatzky et al. 1985).

This chapter reviews the literature that serves as background for this dissertation. It begins with a relatively new area of marketing research, *haptic perception*, and shows how haptics research has, in general, benefited the field. The next section reviews the visual imagery literature that served as an inspiration for this dissertation, where the core theory is developed. That section is followed by a discussion of the biological and behavioral similarities and differences between the visual system and the haptic system. Next comes a discussion of how visually impaired consumers offer distinct perspectives on haptics research as well as a great deal to consumer research in general.

REVIEW OF THE HAPTIC LITERATURE

The word *haptic* originated with Revesz and comes from a Greek word meaning *"to lay hold of"* (Davidson 1976; Révész 1950). *Haptic perception* has been defined as "the assessment of products by touch through the hands, as important for the evaluation of product attributes that vary in terms of their texture, hardness, temperature, and weight" (Peck and Childers 2003b). The *haptic system* is a perceptual system that uses information gathered from receptors in the skin, muscles, tendons, and joints (Lederman and Klatzky 1998).

Touch is said to be the most reliable of the sensory modalities, and more trustworthy than sight (Sekuler and Blake 2002). The modality of touch for information processing is relatively new to the marketing literature, but the case for its utility in consumer behavior is being demonstrated (Peck and Childers 2005). Current research has shown individual differences in the *need for touch* (NFT), whereas those with high NFT are drawn to use haptic perception when evaluating products. For high NFT consumers, situations that inhibit their ability to touch a product have been shown to increase frustration and decrease their confidence in their evaluation of haptic salient products (Peck and Childers 2003a). On the flip side, high NFT consumers were more likely to engage in impulse purchasing when touching products was encouraged (Peck and Childers 2003b). The research also shows that the product type facilitates haptic exploration. Material properties such as texture, hardness, temperature, and weight encourage haptic exploration during consumer product evaluation (Peck and Childers 2003b).

Research has shown that when consumers low in NFT were unable to physically contact a product, a picture of the product compensated for certain types of haptic information (Peck and Childers 2003b). Visual cues and pictures compensated for instrumental haptic information but less for autotelic haptic information, which has also been called *hedonic haptics*. This difference was even more pronounced for individuals high in NFT.

Most research on the use of haptics in marketing has centered on the benefits of touch in product evaluation and advertising. For example, Grohmann et al. (2007) found that haptic exposure influenced product evaluations when the haptic information offered information about product performance or quality. In another study, Peck and Wiggins (2006) mailed museum brochures that featured a touch element. Participants high in NFT were influenced more by the touch element, and all participants were negatively influenced by touch elements with a negative valence.

Other recently published research on touch involves the belief in and reaction to consumer contamination (Argo et al. 2006). In some cases, knowing that a product has been touched or used by others greatly increases the worth of the particular item. This is the case for heirlooms, antiques, or celebrity possessions. In other cases, consumers show an aversion to purchasing products that show obvious signs of having been touched. Evidence has shown that consumers decrease product evaluations and purchase intentions toward products that have been previously used or touched. Although consumers seem to need to touch products themselves and enjoy doing so, they are disgusted by products that have been contaminated by the touch of others (Argo et al. 2006).

How and Why Consumers Evaluate Haptically

Defining Active Touch. When individuals are being touched and, therefore are not actively collecting perceptual information from the environment, they are experiencing *passive touch* (Gibson 1962). The current project concerns only *active touch*, where the consumer deliberately uses touch to collect information from the environment. Active touch is an exploratory sense where the perception depends on both the movement of the hand and the object being perceived. Active touch has at times been referred to as *tactile scanning*, analogous to ocular scanning (Gibson 1962). One type of active touch involves the haptic system. The haptic system uses sensory tactile information as well as kinesthetic information from sensory receptors in muscles, tendons, and joints (Lederman and Klatzky 1998). Some literature has argued that the haptic system, and active touch in general, may involve many senses because at times it involves the entire skeleto-muscular system (Gibson 1962).

Collecting Haptic Information. With one touch of a product, whether passive or active, haptic information is perceived. For consumers to continue their haptic evaluations, they must move their hands over the product or move the product over their skin (Lederman and Klatzky 1998). Klatzky, Lederman, and Metzger (1985) showed that subjects could haptically identify familiar objects with almost perfect accuracy within only a few seconds.

Different types of haptic exploration, first examined by Lederman and Klatzky (1987) and later discussed as marketing applications by Peck and Childers (2003b), are used to gather different types of information about an object. A summary of the exploratory procedures used for specific object properties is given in Table 2.1. When a person seeks information pertaining to an object's texture, lateral motion of the hand over the surface of the object is most efficient. When collecting weight information, however, a person typically holds the object without support.

Table 2.1: Haptic Exploratory Procedures (Lederman and Klatzky 1998; Lederman and Klatzky 1987)

Haptic Information Sought	Haptic Exploratory Procedure Used
Substance Properties:	
Texture	Lateral motion
Hardness	Pressure
Temperature	Static contact
Weight	Unsupported Holding
Structural Properties:	
Weight	Unsupported Holding
Volume/Global Shape	Enclosure
Exact Shape	Contour Following

Further work in the area of haptic exploration has offered an abundance of information concerning how people collect haptic information in order to identify or evaluate objects. When individuals were constrained to using haptic information only, they tended to use a general-to-specific sequence of exploration, usually evaluating first the shape, then the size, and finally the texture of the object (Lederman and Klatzky 1990). When study participants were restrained further to only initial haptic contact with the object, they were able to extract coarse information about the object (Lederman and Klatzky 1992). In this first stage of exploration, general exploratory procedures were used to elicit information about object classification (Lederman and Klatzky 1993) and showed object identification accuracy significantly greater than guessing (Lederman and

Klatzky 1992). When individuals were permitted to continue exploring for specific haptic information, the researchers observed exploratory procedures most efficient for the object class (Lederman and Klatzky 1993). In this secondary stage, participants were more accurate and expressed higher confidence in their object identifications than in the first stage (Lederman and Klatzky 1992).

Peck and Childers (2003b) developed a taxonomy of touch in consumer behavior. The taxonomy is based on the consumers' goals. *Autotelic touch* is seen as an end in itself, where the goal is exploring of the product for the sensory experience or for pleasure. *Instrumental touch* involves one of three goals: the goal to purchase where no additional product information is gained, the goal to extract non-haptic product information, or to extract haptic product information (Peck and Childers 2003b). A consumer can be high or low in autotelic or instrumental need for touch.

Style of information processing depends on the goals of the consumer gaining perceptual information. Research examining the properties of haptics in the psychology literature has shown that observers use a top-down process for evaluating particular properties for a specific task (Lederman et al. 1996). *Top-down information processing* occurs when the observer knows what type of information is sought and organizes a perceptual method for extracting the sought information from the stimulus. In contrast, *bottom-up processing* occurs when the perception of the stimulus drives the information extraction. For example, when subjects were given unknown objects and were asked to haptically identify them, Lederman and Klatzky (1987) observed that subjects' exploratory procedures were driven by the nature of the object. This is bottom-up processing.

A study comparing products with known material properties versus geometric properties revealed that products with material properties possess haptic salience. The haptic salient products were shown to be touched more frequently than those with geometric properties (McCabe and Nowlis 2003). Autotelic touch may be driven by bottom-up processing to the extent that the goal is hedonistic in nature: the individual seeks a sensory/perceptual experience. Bottom-up processing is also implicated when high NFT consumers engage in impulse purchasing (Peck and Childers 2003b).

In top-down processing, the goal is known prior to information collection, as is the case in instrumental touch (Peck and Childers 2003b). Consumers high in instrumental need for touch use touch as a means of gathering specific information for judging products (Peck and Wiggins 2006). Lederman and Klatzky (1996) showed that when subjects were aware of perceptual goals, they used the most efficient exploratory procedures. When consumers engage in instrumental touch and therefore have a stated goal, they are more efficient in evaluating the product (Peck and Wiggins 2006). In some cases the goal is known prior to evaluation, and an image may be generated prior to the evaluation. In other cases, another product may be stored in haptic memory for comparison.

The area of haptics is a relatively new but popular area of study in the marketing literature. Unlike visual imagery, haptics imagery has not enjoyed as much attention. When sequentially comparing products, consumers' haptic imagery may influence product judgments, behavioral intentions, and other marketing outcomes. In stepping from the study of haptics as a marketing tool to the study of haptic imagery as a consumer tool, the visual imagery literature serves as a template for understanding the interaction of haptic imagery and haptic perception. The visual imagery literature and the origin for the conceptual framework of this dissertation is presented next.

THE VISUAL IMAGERY LITERATURE

Research is extensive on visual imagery in the area of psychology. Early on, the nature of imagery was broadly debated. Some argued that visual images are pictorial in nature, and that they behave biologically as a recollection or a recreation of a perceptual experience. The pictorialists viewed imagery as “seeing with the mind’s eye,” “hearing with the mind’s ear,” “feeling with the mind’s hand” (Kosslyn et al. 2001). Others argued that images are verbal representations processed in a general imagery processing area. The jury has been in for quite some time. For the most part, neuroimaging techniques have illustrated that the processing of imagery overlaps considerably with the processing of perception within a modality (Ganis et al. 2004), consistent with the pictorialist perspective.

A WORD OF CAUTION

Neuroscience offers us but a glimpse into the mystery of what is really going on within the brain. Neuroscientific methods indirectly measure the brain’s processes (Dingfelder 2007). When using neurological evidence, the researcher should be careful to point out that, as in all areas of research, the more we know about the human brain the more complicated it seems. Some may be tempted to assume that because fMRI or other neuroimaging techniques show activity in an area, this conclusively proves some phenomenon. Even this dissertation may seem to form such conclusions, but we do not assume that all questions are answered by neuroimaging. In this study we use the neurological evidence to illustrate not only that haptic imagery exists as a viable consumer tool, but that it shares resources with haptic perception, which may lead to information processing disruption.

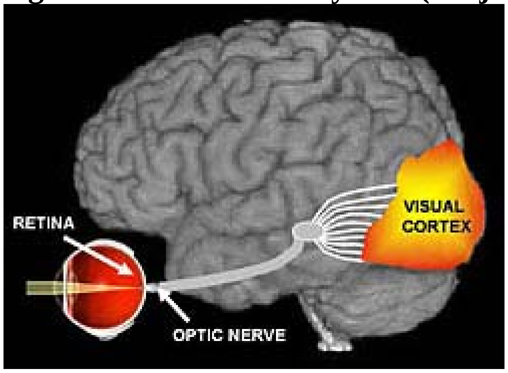
THE THEORY OF RESOURCE COMPETITION

Resource competition occurs when the same biological mechanisms are being used for simultaneous processes, leading to interference in the processing of simultaneous imagery and perception. Although not termed resource competition, similar observations by Unnava et al. (1996) and others (Finke 1985; Segal and Fusella 1970) suggest that visual imagery interferes with visual perception because of limited availability of neural resources shared by both. This supposition depends on having limited cognitive and biological resources available within a sensory processing subsystem such as the visual or haptic sensory processing systems. In essence, imagery interferes with perception because imagery is processed neurologically as a recreation of an earlier perceptual experience. Early studies in cognitive psychology examined visual imagery's interference with perception in support of the shared resource perspective. Contemporary neuroimaging studies have directly examined the processing overlap of imagery and perception and have shown considerable overlap in processing specific types of imagery and perception. To fully understand the phenomenon of resource competition, a brief overview of the visual system is necessary.

The Structure of the Visual System. Specific cortical regions of the brain process specific types of sensory information (Thompson 1993). Visual perception, as all perceptual systems, is often assumed to be a bottom-up process in that the information is projected from the retina to the visual cortex in the brain (Kaski 2002). Perceptual information enters the eye as light that is processed by photoreceptor cells on the retina.

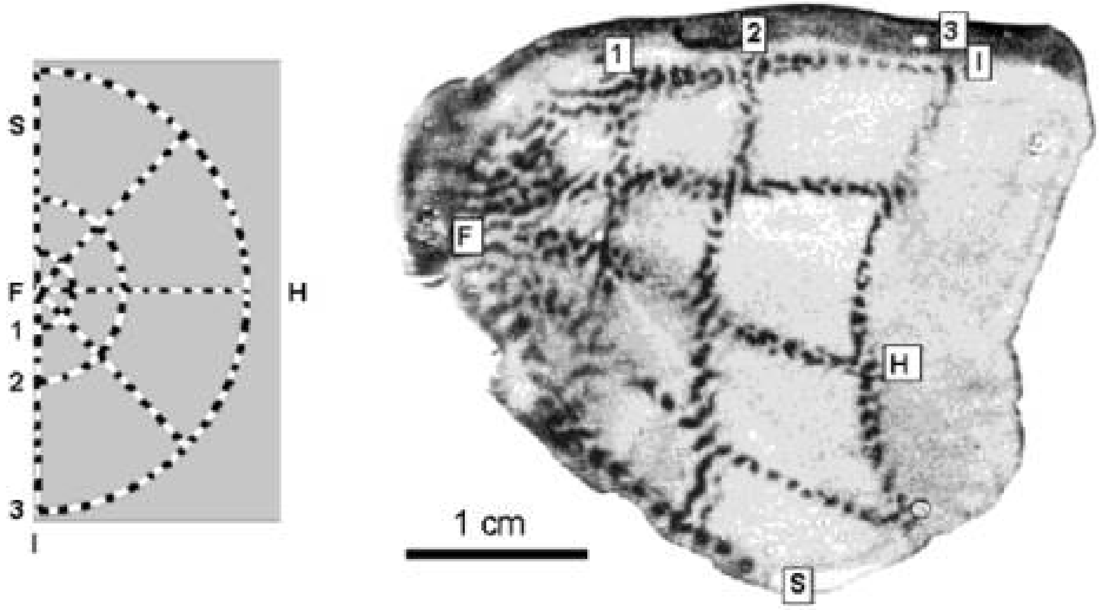
Cone cells, primarily in the fovea (i.e., center) of the retina, process color and detail. The rods are found on the periphery of the retina and process motion and low levels of light. Photoreceptors synapse to bipolar cells, which send the information to ganglion cells. The five different types of ganglion cells send action potentials to the brain, where the information is processed. Visual information with spatial properties (i.e., where an object is in relation to something else) takes a dorsal route through the occipital lobe at the rear of the brain (i.e., cortical areas V1, V2, and V3), and then sends the information for further processing to the medial temporal lobe (Area V5) before sending it to the parietal lobe. Visual information concerning color and detail follows what is known as the ventral stream through V1 to Area V4, then on to the inferior temporal lobe where object identification takes place (Carswell 2002). Although the basics seem simple enough, in the visual system contains many receptor types. Also, higher and lower visual areas are reciprocal in that information is often sent forward and backward during processing (Kaski 2002). Figure 2.1 illustrates the approximate path that visual information takes from the eye to the visual cortex.

Figure 2.1: The Visual System (Project 2006)



It is important to note that the visual cortex is to a large extent retinotopical. Light falls on the retina in the pattern in which the light enters the eye. The adjacent receptors that process each type of light on the retina are said to be processed in the same pattern of adjacent neurons in the visual cortex (Carswell 2002). See Figure 2.2 for an illustration of the retinotopy in the visual area of a macaque monkey. We know that early visual areas such as V1 and V2 tend to be organized retinotopically, but the status of the higher level visual areas is still under investigation (Wikipedia 2006). Many researchers of visual imagery today believe that visual mental images are also processed in topographically organized regions of the cortex in the same way that the corresponding perception would be processed, the difference being that visual images are derived from top-down rather than bottom-up processing (Kaski 2002).

Figure 2.2: Macaque Retinotopy (Tootell et al. 1982)



Resource Competition: Evidence From the Visual Modality Literature. Resource competition occurs when two simultaneous processes share a neural substrate, resulting in one process interfering with another. This phenomenon has been referred to as limited capacity processing (Reeves 1980) and assumes a finite pool of resources within a perceptual system. Resource competition has been illustrated when research subjects were asked to perceive multiple forms of visual information. When straight lines were presented in a similar location in the visual field and closely in time, this simultaneous visual perception conflicted, leading to more mistakes in identifying either of the two lines accurately (Craver-Lemley and Reeves 1987). In the same way that simultaneous perceptual processes within a modality have been shown to interfere with each other, the processing of visual imagery has been shown to compete with visual perception (Finke 1989).

Resource competition assumes a limited pool of resources available for a sensory system, and the literature provides ample evidence that imagery often imitates perception biologically. Studies using Positron Emission Tomography (PET), which measures cerebral blood flow, have shown that visual imagery, like visual perception, is processed along the dorsal visual route when evaluating spatial information of an image (Mellet et al. 1996). In addition, these studies showed that when the task shifted to mental visualization or object evaluation, the ventral route was activated, again consistent with activation during object recognition in visual perception (Mellet et al. 1996; Roland 1995).

Studies have shown processing interference between visual imagery and visual perception as operationalized by reaction time and accuracy. In a visuospatial task, researchers investigated perception's interference with imagery on a much more sophisticated level. Study participants were instructed to imagine a table display (that they had previously observed) from a new perspective. When the display (the target stimulus) was continually available, their accuracy suffered as they tried to mentally create the display view from the new perspective (Amorim et al. 1998).

Similar interference effects have been seen in tasks concerning identification of objects. Perky (1910) asked study participants to imagine a banana and describe the image while viewing a faint pictorial representation of a banana. While they described the image, participants confused their images with perceptual stimuli and were unable to discriminate the physical signal from the noise of the internal imagery. The "Perky effect" has since been interpreted to indicate that ongoing imagery uses low-level resources so that perceptual sensitivity is thereby decreased (Rebotier, Kirsh, and McDonough 2003).

Segal and Fusella (1970), whose work was based on the findings of Perky (1910), investigated whether imagery actually competes with perception or whether this "competition" is due to an attentional distraction. Their investigation involved both visual and auditory imagery. In two studies using a signal detection task, the researchers showed the same results. Participants were asked to construct either a visual image (e.g., a volcano) or an auditory image (e.g., a phone ringing) while they were presented with either visual or auditory perceptual stimuli. When participants engaged in imagery their detection of the perceptual stimulus suffered more than it did when they were given no imagery instructions. Furthermore, their ability to detect the percept also suffered when both the perception and imagery were in the same sensory modality (i.e., visual stimulus versus visual imagery) but not when modalities differed (i.e., visual stimulus versus auditory imagery) (Segal and Fusella 1970).

In the marketing literature, Unnava, Agarwal, and Haugtvedt (1996) replicated the findings of Segal and Fusella (1970) in the context of advertising messages. Study participants were presented with advertisements either auditory (on a tape recorder) or visually (on paper). Ads were shown to provoke either visual or auditory imagery in pretests. Results showed that when modality of ad presentation matched imagery modality, unaided recall of ad content suffered.

Significant evidence indicates that imagery acuity tasks, imagery contrast sensitivity tasks, and orientation tasks are also processed identically or very similarly to the way the corresponding perceptual tasks are processed (Craver-Lemley and Reeves 1987; D'Angiulli 2002). Craver-Lemley and Reeves (1987) investigated imagery's interference with perception in a series of studies from 1987 to the present (Arterberry et al. 2003). They showed the resilience of the Perky effect, ruled out other possible explanations of the findings, and tested various image-perceptual interactions to determine the factors most associated with the effect. In these studies, visual imagery's ability to reduce sensitivity to a target in a visual acuity task was investigated. Sensitivity reduction was most pronounced when the image and target overlapped temporally and spatially. Imagined lines mimicked the effects of real lines in that imagined lines reduced acuity when presented in close time and proximity to the acuity target (Craver-Lemley and Reeves 1987), suggesting retinotopic organization for both imagery and perception. In a more recent study, subjects were instructed to project an image either in front of or behind a target. Images were shown to interfere when imagined lines were “placed” in front of the target so that the subject had to “see through” the image in order to evaluate the stimulus (Craver-Lemley et al. 1997). In yet another study, Craver-Lemley, Arterberry, and Reeves (1999) showed that imagined figures, when paired with physical stimuli, induced illusory conjunctions (i.e., a grouping of items close in proximity), which suggests that visual imagery and perception correspond at the level of processing where illusory conjunctions occur, which is early in the visual processing system.

D'Angiulli (2002) used a Contrast Sensitivity Function (CSF), to further investigate imagery's biological overlap with perception. CSF is a method for determining the maximum frequency at which visual stimuli are discernable. Results are consistent with findings of Kosslyn (1975) and Craver-Lemley et al. (1997), in that when photopic vision (parvocells) was active, participants took longer to form and process image details. In contrast, when scotopic vision (magnocells) was in use, participants took longer to process imagery with little detail (D'Angiulli 2002). Photopic vision is processed by cones, which are responsible for detail and color and are active in bright light. Scotopic vision, on the other hand, is processed by rods, which are responsible for shading and motion, primarily used in low light conditions. D'Angiulli (2002) manipulated the activation of cones or rods with light and dark adaption and showed that when the cones (rods) were fatigued, detailed (low detail) images were harder to process. In contrast, when cones (rods) were not in use, detailed (low detail) images were easier to process.

Researchers who have shown that imagery interferes with perception generally believe that this effect is due to a trade-off in processing resources. Many studies have shown that when resource overlap can be predicted, mutual trade-offs in the form of processing interference occur (Herdman and Friedman 1985). Regardless of where processing is occurring, when the processing area can be predicted to be the same for imagery and perception, interference occurs.

Resource Competition is Not Attentional Distraction. Interference due to resource competition is distinguishable from attentional interference in that the resource competition hypothesis assumes simultaneous draw on mental resources within the same modality. Distracting attention is a conscious choice to direct available cognitive resources elsewhere.

Attention has been defined as the conscious, controllable, selective allocation of resources during processing and response (Atwood 1989). While some studies have examined attentional distraction as a factor in sensory processing (Evans and Craig 1992), most of the findings reviewed in this dissertation are best explained within the resource competition hypothesis. The attentional explanation postulates that the consumer is choosing to allocate resources to one stimulus at the expense of another. The multiple stimuli in this case may be physical or imagined. If attention were the primary factor, studies would show selective interference across modalities that is manipulable by directing subjects to attend to different stimuli under different conditions.

In the visual literature, the findings of Segal and Fusella (1970) showed that visual imagery competed with visual perception, and auditory imagery competed with auditory perception, but visual imagery did not interfere with auditory perception and vice versa. Furthermore, Unnava, Agarwal, and Haugvedt (1996) replicated these findings in the marketing context, finding that within a modality, imagery interfered with perception, but facilitation occurred when visual imagery was paired with an auditory presentation. Again, if the explanation were diversion of attention, then auditory processing would interfere with visual and vice versa.

Craver-Lemley and Reeves (1987), previously discussed, demonstrated that imagined lines interfered just as they did when the experiments were completed using real lines. In a series of subsequent studies, these researchers outline a variety of findings that could not be easily explained with the attentional explanation. They ruled out attentional overload as a viable explanation by showing that image/stimulus complexity has no effect on the amount of interference observed (Reeves 1981) and that the interference effect does not dissipate with an interstimulus interval arithmetic task (Craver-Lemley and Reeves 1992).

Resource Complementation

The functional equivalence of imagery and perception has been established in both the cognitive-/ and neuroscience-based studies within the psychology literature (Bagnara et al. 1988; Finke 1985). In some puzzling cases researchers have found that imagery not only fails to interfere with perception as has been shown previously, but imagery sometimes facilitates perception. Theorists have attempted to explain imagery's facilitation effect on perception and have proposed a variety of explanations, all context-based. Imagery's facilitation of perception occurs when having an image in the mind enhances a person's ability to perceive a target stimulus. Finke (1989) cites two possible explanations for the phenomenon: (1) imagery provides a visual context through which perception can be carried out more efficiently, and (2) imagery readies the visual system by "priming" to prepare the mechanisms for receiving perceptual information. These two explanations, though qualitatively different, are not mutually exclusive. This dissertation offers a neurologically based alternative explanation for why imagery may sometimes facilitate perception.

Resource complementation occurs when mental resources are being recruited for the processing of multiple stimuli, physical or imagined. When imagery and perception are using sufficiently different pools of resources, or when the pool of resources is increased beyond its normal capacity, interference does not occur. The use of complementary mental resources eliminates the interference effects seen under resource competition conditions, and has resulted in imagery facilitating perception in some studies. The circumstances in which imagery has facilitated perception are of four types: across modalities, within a modality, sequential processing, and cross-plasticity. Each of these cases involves the widening of the resource pool to accommodate efficient processing and each is described below.

Across Modalities. The first condition under which resource complementation has occurred is when the imagery modality and the perceptual modality differ. Unnava et al. (1996) showed that auditory imagery did not interfere with visual perception so that subjects were better able to perform unaided recall of ad information when imagery and perception were not in the same modality. In their study, visual imagery interfered with visual perception, but when imagery and perception modality were mismatched, facilitation occurred. Because auditory imagery is processed primarily in the auditory cortex (the same area responsible for auditory perception), and visual perception is processed in the visual cortex (Thompson 1993), each process has its own pool of resources available. With two separate pools of resources working together, as opposed to multiple draw on one limited pool of resources, faster reaction times and more accurate responses have occurred.

Within a Modality. A second condition under which resource complementation has been observed is when the processing resources needed for imagery and perception qualitatively differ within a single modality. Under some conditions processes within the same modality will differ as to where in the cortex each activation is occurring. This explanation accounts for findings in which visual imagery has been shown to facilitate visual perception.

The visual system was previously shown to follow two general paths, a ventral route for color, detail, and object recognition and a dorsal route for spatial information. Visual imagery processing also follows these routes (Rueckl et al. 1989). PET studies have shown regional cerebral blood flow in both the parietal and temporal lobes during the learning of a visual stimulus, the recognition of the stimulus, and the spontaneous recall of the stimulus (Roland and Gulyas 1995). In a study implicating the dorsal route in spatial imagery tasks, subjects constructed images based on verbal descriptions of a series of connected blocks. When evaluating spatial information of the mental image, researchers observed an rCBF increase in the superior occipital and parietal regions that form the dorsal route. In contrast, when the task shifted to mental visualization of the object, the ventral route was activated (Mellet, Tzourio, Crivello, Joliot, Denis, and Mazoyer 1996). Additional studies have supported these findings that show a dichotomy between the dorsal (spatial) and ventral (object recognition) pathways, leading to a general consensus within the field. (For a complete discussion see Cocude et al. 1999; Mellet et al. 1998; Mellet et al. 2000).

As we are aware from our previous discussion on the visual system, ventral and dorsal tasks can have varying degrees of overlap in processing. There is less resource sharing (multiple resource pools are being used) between an object recognition imagery task and a spatial perception task; therefore, no interference is expected. In many of these cases, facilitation has been demonstrated. It can be the case, however, that two seemingly different processes within a modality overlap more than they otherwise might, and some interference may occur.

Sequential Versus Simultaneous Processing. Simultaneous processing refers to the coinciding cognitive processing of imagery and perception. Sequential processing in this case is when the imagery is processed, and then the perceptual information is processed at some later time. As has been established, imagery mimics perception in the brain. Imagery may imitate perception independently of perception, before, during, or after a perceptual experience. Many studies within the visual imagery literature have offered evidence that imagery's interference with perception is greatest when the two overlap in space and time (Craver-Lemley and Reeves 1987; Unnava et al. 1996). Under conditions where imagery is processed without a perceptual task, no interference effect occurs, simply because the imagery is the only information being processed. Under sequential processing conditions, the activation due to imagery processing has partially or totally dissipated by the time perceptual processing occurs. Interference is most likely to occur under conditions in which simultaneous processing of imagery and perception is necessary.

Cross-Plasticity. A fourth condition under which resource complementation has been observed is in the case of cortical cross-plasticity. Cross-plasticity refers to the adaptability of the brain, where neurons will reroute for processing information that those neurons were not originally designed to process (Amedi et al. 2005). Cross-plasticity has often been observed in brain-damaged patients but has been studied in multiple sensory disabilities. For example, cross plasticity is thought to be involved in language recovery after cochlear implantation (Giraud et al. 2001). Cortical adaptability has also been implicated in disorders of the vestibular system (Peng et al. 1994). By recruiting the relatively unused occipital lobe that processes visual perception in the sighted, blind persons increase their processing resources for evaluating haptic information (Sadato et al. 2002).

Cross-plasticity's role here is rather straightforward. If individuals or special consumer populations are able to draw on resources in excess of the resources available for the typical consumer, those able to expand their resources will be at an advantage when faced with conditions limiting their ability to evaluate products. In certain cases being examined in this dissertation, imagery is thought to limit a consumer's ability to perceive product information. When excess cognitive resources are being recruited, the pool is in essence widened, and processing becomes easier.

In the next section the haptic perceptual system is discussed. Some parallels between the visual and haptic systems are drawn to illustrate that much of the research pertaining to visual imagery may be used to draw conclusions about haptic imagery.

BIOLOGY OF TOUCH

THE SENSORY ORGAN: THE HAND

The hand is the primary organ of active touch. It contains thousands of *mechanoreceptors,*(analogous to the photoreceptors of the eye) that are sensitive to slight changes in the pressure or deformation of the skin. These receptors work in conjunction with the complex set of muscles and tendons used to explore objects. Mechanoreceptors are densely packed in some locations of the body, like the lips and fingertips, and less densely in other areas, like the stomach and back (Sekuler and Blake 2002).

The more dense the mechanoreceptors in a given location, the more tactile acuity in that specific area. Tactile acuity, a parallel with visual acuity, means the ability to tactually perceive detail from a given object. Mechanoreceptors are specialized similarly to photoreceptors, as previously described. The "four-channel" model of mechanoreceptors outlines four fiber types varying by two temporal properties (slowly adapting and rapidly adapting) and two spatial properties (punctate and diffuse fibers). Slowly adapting (SA) fibers fire when an object is first touched to the skin and then continue firing as long as the object is pressed to the skin. Rapidly adapting (RA) fibers fire only when there is a change, as when the object is first touched, when the object is removed, or when the object changes position on the skin. RA fibers tend to fire barely detectable touch, while SA fibers are activated with stronger tactile stimulation, such as localized indentation. Punctate fibers have small receptive fields with sharply defined boundaries, and are well suited for detailed spatial processing. These receptors might roughly parallel with the cones of the fovea. Diffuse fibers have large receptive fields with rough boundaries and are not suited for detail processing. If punctate fibers are the cones, diffuse fibers compare to rods. The four specific types of fibers are SA-Diffuse, SA-Punctate, RA-Diffuse, and RA-Punctate (Klatzky and Lederman 2001; Sekuler and Blake 2002).

Specific receptors have diverse structure and complexity, which drives functionality. Meissner corpuscles, receptors in the upper layer of skin, are innervated by two to six RA-punctate type nerve fibers. These receptors respond best to sensations produced when an object rubs against the skin or when the finger is moved across an object. A little deeper in the skin are the merkel disks, innervated by SA-punctate fibers, which fire with steady pressure of small objects. Ruffini endings are still deeper. A single SA-diffuse fiber may innervate several Ruffini endings. These receptors detect sensations caused by steady skin pressure and stretching. Pacinian corpuscles are the deepest skin receptors. They are innervated by a single RA-diffuse fiber and are extremely sensitive to minute indentations on the skin (Sekuler and Blake 2002).

THE SENSORY PATHWAY

Tactile information leaving the hand, via the mechanoreceptors, follows one of two paths (the visual system also has two primary paths) to the spinal cord, the ulnar nerve or the median nerve. These nerves are bundles of many axons (fibers) and originate at specific regions of the hand. The median nerve picks up information from the thumb, the index finger, the middle finger, half of the ring finger, and part of the palm. The ulnar nerve collects information from the little finger and the other halves of the ring finger and palm. The area of the skin within which stimuli can innervate either of these sensory pathways constitutes that nerve's receptive field (Sekuler and Blake 2002).

Once touch information moves from the receptor to the receptive fiber, it continues up the afferent nerve and enters the backside (dorsal) of the spinal chord. The type of touch information that we are concerned with travels along the lemniscal pathway, through the spinal cord, upward to the brain, and enters the brain at the stem. The sensory information continues by synapsing from one neuron to the next, traveling first to the thalamus in the opposite hemisphere, where inputs from the deep skin receptors (RA-diffuse and SA-diffuse information) and shallow skin receptors (RA-punctate and SA-punctate information) are segregated. Finally, both sets of neurons from the thalamus send the information to the somatosensory cortex (Sekuler and Blake 2002).

CORTICAL PROCESSING

Perceptual information from the right hand goes to the left hemisphere for processing, while information from the left hand goes to the right hemisphere for processing. Touch information, as in other modalities, is assembled in the brain and converted into meaningful representations of objects. Touch information is processed in the somatosensory cortex, which lies just posterior to the central sulcus in the parietal lobe of the brain. There are two somatosensory areas, SI which receives information from the thalamus, and SII which receives information not only from the thalamus but also from SI. Body parts are mapped topographically onto the somatosensory cortex so that, in general, neighboring areas of the body are processed in adjacent areas of the cortex. Areas of the body that contain the most detail-oriented receptors, such as the lips and fingertips, are designated disproportionate areas for processing. For example, the index finger is allocated as much or more of the cortex for processing than is allocated to the teeth, gums, and jaw combined. The topographical layout is reminiscent of the retinotopic layout of the primary visual system.

The secondary somatosensory cortex (SII) is referred to as the association somatosensory cortex and is also topographically organized, but to a lesser extent (Sekuler and Blake 2002). Just as the visual system is made up of a primary and secondary (association) cortex, other modalities are also processed in primary and secondary cortices. Haptic and other sensory information is no exception. As in other modalities, the literature has theorized the involvement of SII and to some extent SI in haptic imagery (Uhl et al. 1994).

Processing within SI and SII is less understood than are the primary and secondary visual areas, though many researchers are currently publishing articles describing the employment of neuroimaging techniques to understanding the somatosensory cortex. What is certain is that the somatosensory cortex can be further broken into sections in which specific types of tactile information, by orientation and direction of movement, is processed (Sekuler and Blake 2002), and there is some evidence that several areas work together to perceive specific sensations such as surface texture (Lederman 1985; Servos et al. 2001). Furthermore, these areas respond in conjunction with specific tactile activities where some neurons may continue to fire, while others decrease firing in anticipation of a particular sensation like movement of the hand (Nelson 1985).

In a study using fMRI techniques, Servos, Lederman, Wilson, and Gati (2001) asked subjects to identify shape, texture, and hardness for objects that varied systematically on these qualities. Neuroimaging showed that haptic perception of each object characteristic was processed in a specific area of the postcentral gyrus, previously referred to as SI. Both shape and texture perception were processed in similar areas of SI, while hardness judgments were processed in a relatively different area (Servos et al. 2001).

THE VISUALLY IMPAIRED

Over 28 million people over 40 years old in this country are at risk for vision loss and ultimately, blindness. Cataracts are expected to put 30.1 million people in the United

States at risk in the next 20 years. Other factors that cause blindness, also strongly linked with aging, are macular degeneration, glaucoma, and diabetes (Tanner 2004). As the aging baby boomers approach retirement and beyond, marketers should take advantage of opportunities to offer disability-sensitive customer service to these consumers.

The value of the disabled consumer is relatively new to the marketing literature. With this recently established area has come the recognition that consumers approach consumer behavior from many contexts. In a qualitative examination of the role of the shopping experience for blind consumers, Baker (2006) interviewed twenty-one people of varying visual impairment. The narratives revealed that these visually impaired consumers use retail shopping experiences to gain normalcy in one of three ways: the act of being in a public place such as the marketplace, establishing independence by exercising consumer choice, and gaining a sense of belonging through equality with other consumers (Baker 2006). These consumers are obviously gaining far more from being consumers than what appears on the surface. From my communications with the visually impaired community through participant contacts for this dissertation, it is clear that both this exceptional population and marketers could benefit from a closer examination of the unique obstacles these consumers may face.

Early researchers of the blind felt that because the blind lack visual perception, they were unable to engage in visual imagery (Carpenter and Eisenberg 1978; Kaski 2002). Since then, several studies have shown that visual imagery may be more effortful for the blind than for the sighted, but the visually impaired can engage in visual imagery. Probably the best and most straight forward example is a study by Bertolo (2005), who asked his blind participants to draw pictures of their dreams. EEG was used to monitor ten congenitally blind and nine normally sighted participants. When the EEG indicated that participants were dreaming, they were awoken and asked to draw the scenes from their dreams. The drawings of the blind versus the sighted were judged to be not significantly different by a test designed for this method.

Other researchers who have supported the blind's visualizing ability have shown that although the blind are able to engage in visual imagery, blind individuals do not perform as well as the sighted on tasks that require visual imagery. In both a pictorial task and a spatial task, blind participants were able to perform but made significantly more errors than their sighted counterparts (Aleman et al. 2001). Another notable finding has been that as length of time since becoming blind increases, visual imagery ability tends to decline and haptic imagery ability tends to escalate (Hollins 1985).

At least one researcher has suggested that such factors as practice may lead to the blind's superiority in haptics (Davidson 1976). Most have ignored the fact that practice and experience change the structure of the brain. For example, blind rats that were forced to engage in increased tactual experiences were examined posthumously. The weight of the somatosensory cortex for these rats weighed far more than the somatosensory cortex of the rats who were not intentionally blinded (Krech et al. 1963).

One factor that may account for the increased haptic ability in the visually impaired is the role that the occipital lobe seems to play in the evaluation of haptic information in this population. As previously discussed, cross plasticity occurs when the brain reorganizes itself so that one area adapts to assist in processing, assuming the task that typically takes place in another area. In a haptic mental rotation task of a meaningless pixel display, both blind and sighted participants showed neurological activity in the somatosensory areas, but only the blind exhibited activation in the occipital areas (Röder et al. 1997). Other studies suggest that although the recruitment of occipital function in haptic perception and imagery can occur at any age, with more sustained and reinforced compensation of this sort these structural changes are likely to become permanent (Amedi et al. 2005; Sadato et al. 2002).

SUMMARY OF CHAPTER 2

The goal of chapter 2 has been to summarize the literature that serves as background to the conceptual framework laid next in chapter 3. The chapter began by discussing the role that haptic perception serves for consumers. The visual imagery literature was then introduced to illustrate how haptic imagery may operate in conjunction with haptic perception when consumers attempt to evaluate haptic product information. The section that followed discussed the biological processes behind the haptic sensory system and pointed out parallels with the visual sensory system. Last, a cross section of literature pertaining to the visually impaired was offered to show not only that this unique population offers an interesting twist on the role of haptic imagery, but also to help educate marketers in their approach to serving this segment of consumers.

CHAPTER 3

CONCEPTUAL FRAMEWORK

INTRODUCTION

Haptic imagery is the ability to form a mental image of object properties examined by touch (Hollins 1986) and has been referred to as “the mind’s hand” (Blanco and Travieso 2003). The image could be a memory regarding weight, texture, hardness, temperature, shape (global or exact), or volume (Lederman and Klatzky 1998). In visual processing, the way something is perceived and remembered depends on the location and position of the object relative to the head/eyes. Likewise, the way an object is haptically perceived depends on the object’s position relative to the hand (Carpenter and Eisenberg 1978).

The haptic imagery/perceptual relationship is relevant for how consumers evaluate haptic information during product comparisons. When a consumer evaluates haptically salient products in succession, the haptic memory of the first product may interact with the perceptual evaluation of the second product being evaluated. People have been shown to have a *modality-encoding bias*, meaning that they know which modality (vision, touch, or other modality) is most effective at evaluating specific properties (Klatzky and Lederman 2001). Specific products likely possess haptic salience for a variety of reasons. Specialized products whose performance depends on haptic properties, such as tennis rackets or professional chef’s knives, are likely to be evaluated haptically by consumers. Other products such as mattresses or linens, which emphasize material properties and therefore haptic salience, enjoy everyday use by typical consumers (McCabe and Nowlis 2003).

To envision a product that is likely to be haptically evaluated by a consumer prior to purchase, consider the golf putter. Golf clubs are not primarily purchased based on visual properties. Following the general to specific method of haptic information extraction (Lederman and Klatzky 1990), the first haptic evaluation of a golf putter might be the grip. The grip might differ in texture (autotelic information) or utility (instrumental information). In addition, golfers must know the weight of the putter (which can be communicated numerically) and also properties that can only be “felt” in the swing. The golf industry has adopted a numerical scale called “swing weight,” which captures the proportion of weight in the head in relation to the rest of the club. The presence of such a metric demonstrates this haptic property’s importance to consumers. Another haptic property of golf clubs is in the “feel” when the head comes in contact with the ball. Experienced golfers testify that each brand of golf club has a different “feel.” In the same way that wine tasters might guess vintage by the wine’s bouquet, some expert golfers claim the ability to recall a club’s brand simply by judging this “feel” at the point of contact with the ball (Personal communication with Matthew T. Seevers, PGA Professional).

Many products serve specific purposes and require careful haptic evaluation. The literature shows that products vary in haptic material properties and that these properties affect the nature and degree of haptic exploration of products (Peck and Childers 2003b). For tennis players, the swing of the racket is important. For runners, the feel of the shoe is paramount. For chefs, the grip and comfort of cutlery is crucial. In these cases, the product’s performance depends in part on the product’s haptic properties. For the consumers of these products, the haptic evaluation is based more on optimal performance than on autotelic need for touch, discussed next.

In these examples, as well as for other products, there may be haptic evaluation of their material properties (McCabe and Nowlis 2003) or for hedonistic purposes (Peck and Wiggins 2006). The average consumer, particularly those high in need for touch (Peck and Childers 2003b), may find significant importance in the haptic salience of products for everyday use. Prior researchers have discussed the different haptic attributes of products within a product category. Peck and Childers (2003b) state that in the absence of haptic information for such products, consumers may rely on prior experience and choose by brand. The authors give stuffed animals as an example. While shopping online or through catalogs, a consumer may choose Gund, knowing that this brand has consistently produced soft toys in the past. This scenario assumes past experience with the brand. The existing research, however, does not consider the evaluation of a new brand under comparison with another brand.

HAPTIC PERCEPTION AND HAPTIC IMAGERY

The vast majority of research in the area of haptics focuses on haptic perception and haptic evaluation of products. Although visual imagery has been given due attention as a factor influencing vision, haptic imagery has not yet gained the same status. Few studies have evaluated the role of imagery in haptic processing. When comparing the haptics literature to the visual literature, many obvious and some not-so-obvious similarities are revealed. This parallel was the initial driving force behind the current project. Further investigation revealed that visually impaired individuals, known to be superior at haptic perception and imagery, offer advantages discussed in the previous chapters.

The current dissertation seeks to establish that a haptic memory store exists and that haptic imagery is a tool consumers engage in when comparing haptic properties of products. In addition, this dissertation draws on the few studies on haptic imagery and the vast research on visual imagery to investigate haptic imagery's interactions with haptic perception in the marketing context. Last but certainly not less significantly, the unique population of visually impaired consumers is compared with sighted consumers in an effort to investigate differences not only in how haptic imagery affects haptic perception but also to highlight the procedures that may help marketers to target this neglected population.

HAPTIC IMAGERY

In the modality of haptics, as in the visual imagery literature, considerable debate occurs about whether imagery involves a distinct cortical network non specific to modality or whether each form of imagery uses the same processes as the specified modality (Yoo et al. 2003). The question of whether imagery uses similar areas as perception for processing has long been debated in all perceptual modalities. In chapter 2, evidence was presented to show that visual perception and visual imagery share neural processing mechanisms. As in vision, evidence is mounting that haptic perception and haptic imagery employ shared resources as well, including the primary and association somatosensory cortices (Uhl et al. 1994) and in some cases the secondary motor cortex (Reed et al. 2004). The notion that imagery echoes a previous perceptual experience appears to be true for haptics as well as for vision.

As was reviewed in chapter 2, visual imagery without a doubt activates various areas of the visual cortex (Kosslyn et al. 1995), depending on various factors such as the task involved. Likewise, fMRI analysis in other modalities such as auditory and motor imagery has indicated overlap in resources with sensory processing (Gerardin et al. 2000; Halpern and Zatorre 1999; Yoo et al. 2001).

Haptic imagery involves the ability to form a mental image of haptic sensations (Hollins 1985). Much research specific to the study of haptic imagery has centered on spatial information (Blanco and Travieso 2003; Herman et al. 1983; Lederman et al. 1985) and the ability of blind versus sighted individuals to use haptic maps for navigating life-sized environments. Other studies have focused on the mental rotation of haptic information that compares the sighted and visually impaired (Hollins 1986), and a few have examined object recognition using haptic imagery (Bailes and Lambert 1986; Klatzky et al. 1991).

In an early study of haptic memory, Davidson et al. (1974) tested memory demand thresholds for sighted and blind research participants, finding that the groups differed in the threshold at which each could hold haptic imagery in a haptic buffer analogous to visual working memory (Davidson et al. 1974). Later research used fMRI to examine the brain processes of tactile imagery. Participants first experienced tactile stimulation and then were asked to elicit a mental image of the sensation previously experienced. In this study participants experienced passive touch: being brushed on the hand gently and at a steady rate. Results showed that contralateral primary and secondary somatosensory areas were activated, indicating that tactile perception and imagery overlap in their processing resources (Yoo et al. 2003). This haptic memory buffer, analogous to the visuospatial sketchpad and auditory loop, seems to decay over time and is susceptible to interference with succeeding haptic perceptions (Millar 1975). The conceptual framework and hypotheses presented in this chapter are based on the assumption of the haptic memory store. More formally,

P1: People hold haptic imagery in a haptic memory store for use later when that information is required for some task.

The psychology and neuroscience literatures have outlined some practical uses of haptic imagery research. Haptic imagery has clinical relevance to tactile hallucinations in schizophrenic patients (Ahsen 2003) and to the study of phantom limb syndrome (Dingfelder 2007). For the visually impaired, tactile imagery may be involved in learning and using Braille (Yoo et al. 2003). Although marketing has begun to study the area of the modality of haptics, no research has been completed to date in the area of haptic imagery and its relationship with haptic perception.

Along these lines, currently no research exists examining the interaction between haptic imagery related to a previous haptic product evaluation and a simultaneous haptic perception. Such research would answer the questions of how the consumer might hold a haptic image in mind while simultaneously evaluating the haptic properties of the immediate product. Thus, the issue remains as to whether a haptic mental image will interfere with or facilitate perception in the same way that has been shown in the use of visual imagery. Likewise, no studies have investigated how haptic imagery instructions in ad content affect the consumer's ability to objectively evaluate products.

HAPTIC IMAGERY COMPETES FOR RESOURCES WITH HAPTIC PERCEPTION

Resource competition occurs when the same biological mechanisms are being used for simultaneous processes, leading to imagery's interference with perception. This hypothesis assumes that a limited amount of resources are available within a sensory processing subsystem. Resource competition interference is distinguishable from attentional interference in that resource competition hypothesis assumes simultaneous draw on mental resources within the same modality (Unnava et al. 1996). Attention is distracted when an individual chooses to redirect cognitive resources at the expense of another.

Just as biological and behavioral evidence of resource competition exists in the visual imagery literature, biological evidence appears in the haptics literature, though to a lesser degree. Using repetitive transcranial magnetic stimulation (rTMS) in conjunction with neuroimaging techniques, researchers were able to disrupt texture processing by blocking activation of the somatosensory cortex in participants while they were haptically evaluating rough surfaces (Merabet et al. 2004). Another study using EEG revealed that the somatosensory cortex is activated during haptic perception as well as in haptic imagery of the same stimulus (Röder et al. 1997). Likewise, the study by Yoo and colleagues, previously discussed, also implicated primary and secondary somatosensory in both haptic perception and haptic imagery (Yoo et al. 2003).

Perhaps more convincing is research using fMRI that illustrated that tactile illusions are registered neurologically as if the touch were real. The same areas on the somatosensory cortex were activated when tactile stimulation had been applied as when the subject was experiencing a tactile illusion and the haptic sensation was not real

(Blankenburg et al. 2006). Although far less evidence exists relative to the overwhelming number of studies available in the visual literature, researchers are converging on the supposition that as in vision, haptic imagery shares biological processing mechanisms with haptic perception (Dingfelder 2007).

VISUAL IMAGERY WILL NOT COMPETE FOR RESOURCES WITH HAPTIC PERCEPTION

Resource complementation occurs when sufficiently different mental resources are being used for the processing of multiple stimuli, physical or imagined. The activation of complementary mental resources eliminates the interference effects in all cases and may have a facilitation effect in other cases. In the case of Unnava et al. (1996) mentioned previously, facilitation in processing can be explained by the resource complementation hypothesis, that visual imagery uses one pool of resources (i.e., the visual system), while auditory perception uses a different pool of resources (i.e., the auditory system).

Studies have shown that when haptic perception is not permitted, individuals high in need for touch grow frustrated and lose confidence in their judgment of the product (Peck and Childers 2003b). Further research reveals that touch can provide a positive affective response in those high in autotelic need for touch, leading to increased positive attitudes and purchase intentions (Peck and Wiggins 2006). This project seeks to determine haptic imagery's effects on such marketing outcomes as well as the effect of the interaction between perception and imagery on similar outcomes.

SUBSTANCE VERSUS STRUCTURAL RELATED PROPERTIES OF PRODUCTS

Chapter 2 briefly discussed the types of property information acquired through haptic perception. Substance properties are specific in nature, referring to such characteristics as texture, hardness, temperature, and weight. Structural properties are more global in nature having to do with the overall size or shape of an object (Lederman and Klatzky 1998; 1987). Evaluations of these properties are processed in different areas of the cortex.

Substance related properties of objects have been shown to activate specific areas of the somatosensory cortex in normally sighted individuals during haptic perception (Röder et al. 1997). These same areas are activated when participants are asked to form a haptic image of the same substance related property at a later time (Zhang et al. 2004). Shared processing resources are hypothesized to lead to imagery's interference with perception.

Structurally related properties of objects differ significantly from substance related properties when processed. Several studies have implicated SI and SII during haptic perceptions of shape (Servos et al. 2001). During imagery tasks involving these structural properties, however, the visual areas of the cortex (both primary and secondary) show activation (Reed et al. 2004; Sadato et al. 1996). Although the reason for occipital activation is unknown, two explanations for visual cortex activation during imagery of structural properties are outlined below.

The first explanation is that visual imagery is being used for processing structural properties. Klatzky et al. (1991) offer evidence that structurally related properties lend themselves better to visual imagery. Their study participants were seemingly more likely to report using visual imagery of their own hand evaluating the size and shape of an object than to use haptic imagery for this type of task. These findings are not surprising since cognitive psychology has long suspected that spatial properties are visual in nature

(Kaski 2002; Thinus-Blanc and Gaunet 1997). The spatial/visual connection has been further supported by a study using a cortical blocking technique called rTMS. Merabet et al. (2004) used this technique to test where in the cortex specific processes were being performed. By extinguishing processes in the somatosensory cortex, haptic perception of substance related properties were disrupted, while knocking out the occipital lobe disrupted haptic perception of spatial information. Knocking out the occipital lobe did not affect substance related perception, nor did somatosensory blocking disrupt the perception of the spatial information (Merabet et al. 2004).

Researchers have assumed a second reason that visually impaired individuals are unable to perform visual imagery. Because both sighted and blind individuals have shown activation in the visual cortex (though different levels of activation), these researchers have concluded that the visual areas process general object recognition and not visual information per se (Pietrini et al. 2004). The more recent evidence outlined in chapter 2, which negates the premise that the visually impaired are unable to visualize, makes the existence of a general spatial recognition processing area less likely.

If haptic perception of structural properties is processed in the areas of SI and SII, and a seemingly effective memory strategy for the task, visual imagery, is processed in the visual cortex, the resource pool would be much larger than for the perception and imagery concerning the substance related pairs discussed previously. Multiple pools of resources working together are hypothesized to lead to facilitation, as explained by resource complementation.

H1: When sighted participants are instructed to use haptic (visual) imagery in a haptic product comparison task, haptic (visual) imagery will interfere with the ability to make texture (shape) comparisons.

H2: When sighted participants are instructed to use haptic (visual) imagery in a haptic product comparison task, haptic (visual) imagery will facilitate the ability to make shape (texture) comparisons.

H3: In a product comparison task, when interference (facilitation) occurs, individuals will experience higher (lower) frustration with the task and less (higher) confidence in their judgment.

SIGHTED VERSUS VISUALLY IMPAIRED CONSUMERS

From studies focusing on perceptual differences between sighted and visually impaired individuals, we know that blind consumers have different memory abilities than do sighted consumers (Craig 1973). The visually impaired are skilled at haptic processing and as the following findings argue, they may be skilled for haptic memory as well. In a test of threshold for haptic memory demands, both sighted and blind research participants made more errors as memory demand increased. Blind participants, however, had a much higher threshold for the memory demand effects than did the sighted participants (Davidson 1976). Later research led investigators to speculate that the reasons for this haptic imagery superiority were physical differences, more efficient exploratory procedures, or recruitment of additional cortical regions for haptic processing (known as cross plasticity and discussed subsequently) (Davidson 1976; Röder et al. 1997).

Another important finding in this line of studies is that age at onset of blindness correlates with haptic processing ability. The earlier the onset of blindness, the better individuals perform in haptic imagery tasks (Davidson 1976; Davidson et al. 1974; Hollins 1986). Some researchers have assumed that the visually impaired are unable to form visual images, but other studies have contradicted this belief (Bertolo 2005; Carpenter and Eisenberg 1978). Although blind consumers are able to engage in visual imagery as an evaluation tool, we know that earlier onset of blindness is negatively correlated with visual imagery ability so that, in general, sighted subjects perform better than blind subjects in visual imagery tasks (Aleman et al. 2001; Hollins 1985). Including visually impaired consumers in the current dissertation lends special insight into the processing mechanisms used in haptic evaluation of products.

H4: Compared with sighted participants, visually impaired participants will show superior haptic imagery ability on an individual differences scale measuring haptic imagery ability.

H5: Length of time since onset of visual impairment will be positively correlated with haptic imagery ability.

H6: Length of time since onset of visual impairment will be negatively correlated with visual imagery ability.

Research supports that visually impaired consumers are superior at haptic perception and haptic imagery (Davidson 1976); thus, blind consumers are an ideal population to test for comparative effects in the haptic modality. It is also clear that these individuals have greater abilities than the sighted to hold and work with more haptic information in memory (Davidson et al. 1974). Because superior imagers are skilled at haptic imagery and perception, they may be more efficient in processing imagery, requiring less effort and fewer resources than the less skilled imager must be.

Furthermore, neuroimaging studies reveal that visually impaired individuals recruit additional cognitive resources (i.e., the visual lobe) to process haptic information, resulting in resource complementation (Röder et al. 1997). In chapter 2 this was referred to as cross-modal plasticity. Cross-modal plasticity is a term used to describe how the brain changes and adapts to input and output demands (Amedi et al. 2005). In this case, a relatively inactive occipital lobe is reorganized to allow additional processing capacity for an alternative sensory input, haptics. This cross-modal plasticity of the occipital lobe seems to be more prevalent for early blind individuals than for those who became blind after the age of sixteen (Sadato et al. 2002). The mechanisms behind cross-modal plasticity are currently unknown, but two hypotheses, thought to be related, exist. The first explanation is that connectivity shifts, so that neural connections are "rewired." The second explanation is that these functions do occur in the sighted individual's brain but are inhibited or masked, being revealed only in the absence of sight (Amedi et al. 2005). Under either explanation, the following is predicted.

H7: When visually impaired consumers are instructed to use haptic imagery in a haptic product comparison task, haptic imagery will interfere significantly less with the ability to make texture comparisons than in for the sighted participants.

H8: When visually impaired consumers are instructed to use haptic imagery in a haptic product comparison task, haptic imagery will facilitate the perception of shape properties.

As mentioned previously, the literature indicates that visually impaired consumers have more difficulty generating and using visual images in memory tasks (Aleman et al. 2001; Hollins 1985). Thus,

> *H9: When visually impaired consumers are instructed to use visual imagery in a product comparison task, visual imagery will interfere with perception, regardless of the properties the perceived product possesses.*

THE MARKETING CONTEXT

Another context where imagery has been shown to influence perception is in print advertising. Unnava et al. (1996) showed that when individuals visually examined visual imagery-evoking advertisements, message elaboration and recall were diluted. The same was found when individuals listened to auditory imagery-inducing ads. The researchers also showed that visual imagery facilitated learning when the ad was delivered auditorily.

This dissertation employs a similar context for investigating the competition and complementation effects in the haptic modality. Ad content that suggests imagery is likely to result in the specific type of imagery encouraged for the consumer (Unnava and Burnkrant 1991). Because haptically perceived substance properties compete with haptic imagery for neurological resources during simultaneous processing, evaluating substance properties of an ad-related product is likely to inhibit recall of haptic imagery ad content. Furthermore, evaluating structural properties should facilitate haptic imagery in the same way that auditory imagery facilitated the visual content in the Unnava et al. (1996) study. Comparing how these effects differ for sighted and visually impaired consumers adds a unique element to the study as well.

Marketing scholarship has shown that vividness of visual imagery affects marketing outcomes. Vivid imagery leads to positive attitudes toward advertisements and brands (Babin and Burns 1997; Burns et al. 1993), increases positive emotions (Miller and Marks 1997), enhances memory for advertisements (Childers and Houston 1984), enhances product evaluations (Petrova and Cialdini 2005), and increases the likelihood of purchase (Petrova and Cialdini In press). Furthermore, research has shown that individual differences in imagery ability moderate the effect that imagery has on these and other marketing outcomes (Bone and Ellen 1992; Petrova and Cialdini In press). In contrast, Kisielius and Sternthal (1984) manipulated imagery's effects on attitude by restricting the time available for message processing (Unnava et al. 1996).

In the same way, the interference effects described here between haptic imagery and haptic perception should affect marketing outcomes. Difficulty evaluating product information and recalling ad information about the product will affect individuals' attitudes, emotions, memory, and behavioral intentions. Interference in perception due to imagery presents difficulty in the consumer evaluation process. The interaction between imagery and perception is also likely to affect behavioral and attitudinal variables.

H10: When sighted participants are asked to evaluate an ad-related product with substance (structural) properties, recall of texture-related (shape-related) haptic imagery will be lower, attitude toward the product will decrease, frustration will be higher, confidence will be lower, and purchase intentions will decrease.

H11: When sighted participants are asked to evaluate an ad-related product with substance (structural) properties, recall of shape-related (texture-related) haptic *imagery will be higher, attitude toward the product will increase, frustration will be lower, confidence will be higher, and purchase intentions will increase.*

H12: When visually impaired are asked to evaluate an ad-related product with substance properties, recall of texture-related haptic imagery ad content, attitudes, frustration, confidence, and purchase intentions will be affected but significantly less so than was the case for the sighted participants.

H13: When visually impaired participants are asked to evaluate an ad-related product with structural properties, recall of texture-related haptic imagery will be higher, attitude toward the product will increase, frustration will be lower, confidence will be higher, and purchase intentions will increase.

H14: When visually impaired participants are asked to evaluate ad-related products, recall of shape-related imagery ad content will be lower, attitude toward the product will decrease, frustration will be higher, confidence will be lower, and purchase intentions will decrease, regardless of the properties possessed by the product being evaluated.

SUMMARY OF CHAPTER 3

This chapter outlined the conceptual framework for the relationship between haptic imagery and haptic perception. Based on the literature review in chapter 2, hypotheses were formed concerning how haptic imagery may interfere or facilitate haptic perception for both sighted and visually impaired consumers. Furthermore, predictions were made regarding how this relationship, in turn, affects marketing outcomes. Chapter 4 outlines the proposed methodology for testing these hypotheses.

CHAPTER 4

METHODOLOGY

Designed after the visual imagery literature, two studies test the relationship between haptic imagery and haptic perception. Study 1 tests the effects of different types of haptic stimuli containing substance related versus structural related properties. In study 1, if both processes compete for neurological and cognitive resources, evaluating matching haptic stimuli while engaging in haptic imagery will result in longer reaction times, inaccurate responses, decreased confidence, and increased frustration. This study also tests the predicted differences between the sighted and visually impaired participants. As previously discussed, visually impaired consumers have previously demonstrated superior haptic imagery and haptic evaluation as compared to sighted consumers (Hollins 1985). Study 2 extends this research to an advertising context for the proposed relationships between imagery and perception and addresses marketing outcomes that may be affected as well. Before addressing specifics of each study, several preliminary tests should be addressed. Results of the pretests are provided with the discussion of each. Methods for studies 1 and 2 are discussed in this chapter with results presented in chapter 5.

PRETESTS

The focus of the preliminary tests was threefold: stimulus development, length of interstimulus interval (ISI) and questionnaire modification.

STIMULUS DEVELOPMENT

Selection and Salience of Stimuli. For use in Study 1, shapes and textures were drawn from the research of Klatzky and Lederman (2001). These researchers used many stimuli including spheres, ovals, and popcorn shapes (Klatzky et al. 1991). For the current pretesting light weight, wooden cubes, eggs, and spheres were pretested for the shape salient objects. Different sandpaper grades and sheet thread counts were pretested for the texture salient objects, which have also been used in previous studies of texture (Grohmann et al. 2007). In the pretest, participants evaluated each stimulus through a cardboard partition, which obstructed vision. Participants were given the following instructions:

> “In this study, I will be giving you a series of objects to hold. You will not be able to see the objects, just hold them by putting your hand through this box. When you are given an object, evaluate that object long enough so that you will be able to later form a memory of how the object felt. When you feel that you have held the object long enough and have collected enough information to form a detailed memory of how the object felt, put the object down. This is the first part of the task, figuring out how long it takes to collect texture and shape information from an object when you cannot see the object. The second part of the study is figuring out how long it takes you to form an image of the information you have collected. You are probably most familiar with visual imagery, where you form an image of how an object looked after you have seen it. Since you are not seeing the objects today, you are being asked to form an image of how the object felt. After you are finished touching the object, I want you to try to remember how the object felt by forming an image in your mind of the sensation of the shape or texture in your hand. I want you to try to mentally recreate the sensation of the object in your hand after you are no longer holding

> the object. Once you feel that you have fully formed the image of the way the object felt to touch in your mind, I want you to tell me as quickly as possible. To make the instructions simpler, you will touch the object, put it down when you feel you have enough information to form your image, and then you will say as quickly as possible when your image has been formed."

The time it took the participant to evaluate each object was recorded. Participants were asked to indicate as soon as possible after the evaluation was complete, when the haptic image had been formed. The time between the end of the evaluation and the point at which the participant indicated a formed image was recorded as time necessary for imagery formation. Participants were then asked to rate each potential stimulus on a variety of questions, listed in Appendix A. The questionnaire was answered for each stimulus evaluated and imaged and contained 10 items. The ten items can be found in Appendix A. They are: quality and clarity of haptic image formed; ease of imaging the object; the texture versus shape salience during haptic evaluation; and the texture versus shape salience during haptic imagery. In addition to objects for study 1, handle grips for study 2 were also evaluated in the same manner as described above.

Twenty-nine undergraduate students recruited from the Research Experience Program (REP) at the University of Kentucky participated. Participants engaged in evaluation and imagery of eleven (11) stimuli for study 1 and six (6) stimuli for study 2. In some cases participants ran out of time and could not evaluate all stimuli intended, resulting in 390 observations from the 29 participants.

Study 1 objects tested were three shapes (i.e., cube, egg, sphere), three different thread count sheets (i.e., 200/300/400), and five sandpaper grades (i.e., 60/100/150/180/320). Study 2 objects tested were six grips, three of which were chosen for their shapeliness (GS1/GS2/ GS3) and three of which were chosen because they were void of shape but texture-rich (GT1/GT2/GT3). Participants judged each stimulus on the items asking about their ability to image, the salience of the object during evaluation, and the salience of the object during imagery formation using a 7-point Likert scale.

One-way ANOVA was used to determine if participants considered some stimuli to be more shape or texture salient during evaluation and imagery formation. The Bonferroni Post Hoc Multiple Comparisons Test was used to determine which stimuli were significantly different across categories. Stimuli differed significantly for all questions (see Table 4.1). Bonferroni Tests revealed which stimuli differed significantly on each of the items listed in Table 4.1. Those results can be found in Table 4.2.

Table 4.1: Stimulus x Participant Judgments

Item	F	p-value	Scale
Imagery was clear	8.185	<.0001	1= “strongly agree” 7= “strongly disagree”
Imagery was detailed	8.502	<.0001	1= “strongly agree” 7= “strongly disagree”
Imagery was fuzzy	7.467	<.0001	1= “strongly agree” 7= “strongly disagree”
Imagery was vague	7.851	<.0001	1= “strongly agree” 7= “strongly disagree”
I imagined the feel of the object	2.926	<.0001	1= “strongly agree” 7= “strongly disagree”

Table 4.1 (continued)

Item	F	p-value	Scale
This item is:	8.783	<.0001	1= "easy to image" 2= "difficult to image"
When evaluating, the shape was the first thing I noticed	16.974	<.0001	1= "strongly agree" 7= "strongly disagree"
When evaluating, the texture was the first thing I noticed	15.697	<.0001	1= "strongly agree" 7= "strongly disagree"
When I formed my image, shape was the salient factor	17.135	<.0001	1= "strongly agree" 7= "strongly disagree"
When I formed my image, texture was the salient factor	15.929	<.0001	1= "strongly agree" 7= "strongly disagree"

Selecting appropriate stimuli through data analysis was a two step process. First, shape stimuli had to differ significantly from texture stimuli in expected ways. Once it was determined which items were selected from that process, the items remaining in each category (shape versus texture) could not significantly differ from other stimuli in their category.

For the item, "When evaluating the object, the shape was the first thing I noticed," the three shape salient items (i.e., ball, cube, egg) differed significantly from all textures except for sandpapers with grades 150 and 320. Shapes did not significantly differ from other shapes. For the item, "When evaluating the object, the texture was the first thing I noticed," all textures except for sandpaper grade 320 significantly differed from shapes. Textures did not significantly differ from other textures. For the item, "When I formed my image, shape was the salient factor," shapes were not significantly different from other shapes and were significantly different from all textures except for sandpaper grades 150/180/320. For the item, "When I formed my image, texture was the salient factor," textures were not significantly different from other textures and were significantly different from shapes with the exception of sandpaper grade 320 failing to differ from each of the three shapes.

Due to time restraints on participants discussed earlier, some textures did not have as many observations as the other stimuli. While most stimuli were evaluated by all twenty-nine participants, sheet 300 was evaluated eleven times, sandpaper grade 150 seven times, and sandpaper grade 320 only four times. For this reason, these textures were eliminated from the stimulus set. Further, the researchers observed during administration that when participants were given the egg shaped wooden object, most of the time the person would comment that it felt like a wooden egg. Because of this, the wooden egg shape was eliminated from the stimulus set. The remaining two thread count sheets (200/400) were used for the study. As for sandpaper, grades 100 and 180 were selected from the remaining set. The chosen stimuli and their means are in Table 4.2.

Stimuli for study 2, as mentioned previously, were handle grips. These grips were purchased at bicycle shops and ordered through the internet and were selected based on their shapeliness or textures. Three were selected for pretesting in each category. All study 2 stimuli were evaluated and imaged by all 29 pretest participants. Grip shape #1 failed to differ from grip textures on shape salience during evaluation, texture salience during evaluation, shape salience during imagery, or texture salience during imagery and was, therefore, eliminated. The remaining two shape salient grips performed as expected in that they were significantly different from textures but not from other shapes on all evaluations. Textured grips were not significantly different from other textures but did differ from the remaining shaped grips. Since two shapely and two textured grips were to be used, GS2, GS3, GT1, and GT2 were chosen for use in the dissertation.

Table 4.2: Texture Versus Shape Salience of Studies 1 and 2 Stimuli

Salience During Haptic Evaluation		Mean	SD
Texture	Sheet 200 TC	1.48	.51
	Sheet 400 TC	1.58	.72
	Sandpaper 100	1.74	1.05
	Sandpaper 180	1.84	.52
Shape	Cube	1.43	1.26
	Ball	1.17	.47
Grips: Texture	GT1	1.93	1.56
	GT2	1.72	1.33
	GS2	2.45	1.4
Grips: Shape	GS3	2.86	1.71
Salience During Haptic Imagery		Mean	SD
Texture	Sheet 200 TC	1.6	.76
	Sheet 400 TC	1.75	.85
	Sandpaper 100	2.11	1.24
	Sandpaper 180	1.33	.82
Shape	Cube	1.57	1.32
	Ball	1.17	.47
Grips: Texture	GT1	2.03	1.52
	GT2	1.79	1.01
	GS2	2.72	1.6
Grips: Shape	GS3	2.83	1.75

Items asking of imagery quality taken from the Communication Evoked Imagery Scale (the first five items listed in Table 4.1) were combined to provide a composite imagery quality variable. These five items loaded on one factor and had a coefficient alpha of .856. The selected stimuli for study 1 differed in imagery quality (F = 9.691, p<.0001). Sheets 200/400 thread count differed from shapes (cube/ball). Sheets 200/400 thread count differed from sandpaper grades 100/180. Shapes did not significantly differ from other shapes, sheets 200 and 400 did not differ, and sandpaper grades 100 and 180 did not differ from one another in imagery quality. The selected stimuli for study 2 also differed in imagery quality (F=9.332, p<.0001). Shapely grips did not differ from other shapely grips in imagery quality, but did differ from the textured grips on this variable. As can be seen in Table 4.3, for study 1 stimuli, participants indicated that sheet textures were the most difficult items to image. For study 2 stimuli, also shown in Table 4.3, shapely grips were more difficult to image than textured grips.

Table 4.3: Means For Imagery Quality of Studies 1 & 2 Stimuli:

Stimulus		Mean Imagery Quality	SD
Study 1 Stimuli	Sheet 200	3.72	1.28
	Sheet 400	3.52	1.16
	Sandpaper 100	2.28	.92
	Sandpaper 180	2.24	.77
	Ball	2.10	1.08
	Cube	2.05	1.11
Study 2 Stimuli	GT1	2.40	1.14
	GT2	2.55	1.03
	GS2	3.95	1.33
	GS3	3.46	1.43

Auditory Advertisement Development. For use in Study 2, a target advertisement was constructed with arguments designed to generate texture- or shape-related haptic imagery. In the Unnava et al. (1996) study, the target ad was for a fictitious automobile. Another similar study used a camcorder (Unnava and Burnkrant 1991). In keeping with Unnava and Burnkrant (1991), and to minimize effects of prior knowledge, the product selected for the advertisement was relatively new with a fictitious brand name. For our purposes, the chosen product also possessed both texture and shape properties so that the passages focused on either of these properties would not seem strange to the participant.

Multipurpose handle grips were chosen for several reasons. First, the grips could be either texture salient or shape salient. Secondly, the concept of a multipurpose grip was expected to be obscure for the participants. Third, relevance to the participants could be created through the context of the advertisement by illustrating some of the variety of uses for the product.

In total, five advertisements were developed including the target advertisement and four distracter advertisements. The target advertisement was for a multipurpose handle grip and the filler ads were for: a multiuse spray bottle; a pen; an electronic tape measure; and a car washing glove. These items were chosen for the distracter advertisements because they are all useful products that fit and require use of the hand. In another study that used advertisements, each advertisement used contained four product features. Following the example of Childers and Jass (2002), the current study included three product features per advertisement. The simple nature of the products chosen for the current study made it difficult to include four features for each product, as the previous study had done.

The target advertisement contained two texture imagery instructions and two shape imagery instructions as well as non-imagery information. While imagery modality varies, each of the filler advertisements also contained 4 imagery instructions. The advertisements were auditorily recorded so that both sighted and visually impaired participants were able to evaluate the ads. Arguments for the ads were constructed using methods used in previous marketing studies (Peck and Childers 2003b). Both imagery evoking and non-imagery evoking phrasing focused on the overall design of the product, and were constructed from information currently being used by companies to market handle grips and the other products used. The final advertisements used are included in Appendix C.

First, the data concerning each imagery passage were analyzed. There are 21 imagery passages imbedded in the 5 ads. Undergraduate students (n=106) enrolled in a psychology course completed an online survey for extra credit. The students read each passage and then evaluated each on imagery provoking (1=imagery provoking; 7=not imagery provoking) and vividness (1=vivid; 7=dull) of the image generated. These items have been used in previous research (Unnava and Burnkrant 1991).

An ANOVA was conducted comparing the mean ratings for each passage on each question. This analysis indicated that differences observed were significant for imagery provocation (F=14.009, p<.0001) and vividness of the image (F=14.553, p<.0001). Post hoc tests were conducted (Bonferroni) to see which passages differed.

The Bonferroni test indicated that several of the 21 passages differed significantly from several others. Of these, further analysis of means revealed that passages 8, 12, 14, and 17 had means over 4.5 in their ability to provoke an image. None of these passages are contained in the target ad for grips (the target ad contained passages 1-4). The parallel analyses regarding vividness indicated that the same passages were significantly lower in vividness of the image provoked. See Table 4.4 for a summary of the means associated with the questionable passages as well as for the passages from the target ad.

Table 4.4: Mean Imagery Provoking and Vividness Per Passage

Passage #	Ad	Mean Imagery Provoking	Mean Vividness
8	Tape Measure	4.63	4.88
12	Car Wash Mitt	4.54	4.68
14	Spray Bottle	4.64	4.72
17	Pen	4.55	4.77
1	Grip (target)	4.01	4.13
2	Grip (target)	2.63	2.84
3	Grip (target)	3.57	3.70
4	Grip (target)	4.08	4.27

Second, the data concerning each of five complete advertisements were examined. This was done over two periods, where data were collected from two different samples. In the first collection, 106 undergraduates enrolled in a psychology course were offered extra credit to participate.

Past marketing research has suggested that vivid advertisements may require more resource allocation for processing than do non-vivid ads, resulting in differential outcomes (Keller and Block 1997). For the purposes of this dissertation, having matched resource allocation across the advertisements is important for comparing the resource competition effects of imagery on perception. Therefore, each ad was evaluated for vividness on four seven-point scales taken from Keller and Block (1997) asking participants to rate each as "difficult to comprehend/easy to comprehend," "required little effort/required a lot of effort," "difficult to follow/easy to follow," required a lot of attention/required little attention." In the study previously mentioned, these items loaded on one factor for an alpha of .93. In the current pretest, these items also loaded on one factor with alpha of .913.

Students read the ads and evaluated each on persuasion (1= "very persuasive"; 7= "very unpersuasive"), interest (1= "very interesting"; 7= "very boring"), required level of effort (1= "easy to comprehend"; 7= "difficult to comprehend"), ease of reading (1= "Required little effort"; 7= "Required a lot of effort"), and attention required for comprehension (1= "Easy to follow"; 7= "Difficult to follow"/ 1= "Required little attention"; 7= "Required a lot of attention"). Students also completed the Communication Evoked Imagery Scale (Babin and Burns 1998) for each ad.

Mean responses across advertisement were compared via ANOVA. The ANOVA indicated that the groups differed on the following variables: persuasion ($F=3.9$, $p<.01$); effort to comprehend ($F=2.957$, $p<.05$); Attention required for comprehension ($F=3.051$, $p<.05$). The Bonferroni Multiple Comparisons post hoc test indicated that one ad, the Spray Bottle ad, was the sole offender and differed systematically from one or more ads on the variables listed above. All other ads showed no difference on these variables.

When examining specific means, although the statistics indicate that the means differ significantly, all ads (including the spray bottle ad) performed well. Differences in means for the spray bottle ad significantly differed from other ads but the difference was less than .8 for all pairs. Further, although the spray bottle ad differed significantly on these variables from the means of other distracter ads, none of the distracter ads differed significantly from the target ad. See Table 4.5 for a summary of the means on each of these variables and the mean differences observed. Given that none of the distracter ads differed significantly from the target ad, that the mean differences do not exceed a value of 1.0 in any pair, and that all five ads had means of 4 or better on all scales, the spray bottle ad was not considered to be a substantial problem. To avoid potential problems, the researchers decided to rotate the distracter ads in their presentation during studies 1 and 2.

Table 4.5: Mean Differences for Advertisements on Persuasiveness and Attention Required

Advertisements Compared	Mean Persuasiveness	Mean Attention Required for Comprehension	Mean Difference*
Spray Bottle Tape Measure	3.52 2.78	2.48 3.09	.738/-.607
Spray Bottle Pen	3.52 2.92	N.S.	.592

*Significant at $p< .05$; results extracted from Bonferroni table

For the Communication Evoked Imagery Scale, the differences in means for all 5 ads were non-significant. The reliabilities for this scale were calculated for each ad using the Nunnally method for reliabilities for linear composites (Nunnally and Bernstein 1994). The reliability for the tape measure ad was .93, for the grip ad was .948, for the wash mitt ad was .943, for the spray bottle ad was .953, and for the pen ad was .963.

In a second phase of ad development data collection, 115 undergraduates were asked to read an ad and evaluate it on the strength of reasoning (1= “weak reasoning”; 7= “strong reasoning”) of arguments and persuasion (1= “unpersuasive”; 7= “persuasive”), for research credit in a business course. The items were selected from Peck and Childers

(2003b). ANOVA was performed examining the mean differences on each question. The sample included 115 undergraduates. All respondents viewed and evaluated the target ad (the grip ad) and two other ads. Half evaluated the pen and the spray bottle ads, while the other half evaluated the wash mitt and the tape measure ads. On both questions, a significant mean difference was indicated between the ads: reasoning strength (F=8.327; p<.0001) and persuasion (F=3.904; p<.01). Bonferroni Multiple Comparison Test evaluated where the mean differences were most prominent. For reasoning strength, two ad means (car wash mitt and pen) differed significantly from the target ad. For persuasion, distracter ads differed from one another but not from the target ad. Again, no mean differences with the target ad exceeded 1.0, see Table 4.6. Because the ads were not equal in all manners testing, it was possible that order of presentation around the target ad could affect the processing of the target ad. Therefore, the rotation schedule of ad presentation mentioned previously was expected to offset any effect of the differences between the advertisements.

Table 4.6: Mean Differences for Advertisements on Reasoning Strength and Persuasiveness

Advertisements Compared	Mean Reasoning Strength	Mean Persuasiveness	Mean Difference*
Grip (target ad) Car Wash Mitt	4.65 3.79		.863
Grip (target ad) Pen	4.65 3.60		1.04
Tape Measure Car Wash Mitt	4.81 3.79	4.86 3.98	1.018/.877
Tape Measure Spray Bottle	4.81 4.00		.807
Tape Measure Pen	4.81 3.60	4.86 4.00	1.20/.86

*Significant at p< .05; results extracted from Bonferroni table

In a separate portion of ad pretesting, the brand name of the grip was tested. Seven brand names were chosen as viable and participants rated each brand name as: void of texture or shape salience; non-specific; believable; previously unknown to the participant. The most believable, non-specific, unknown, generic brand name was chosen. The resulting brand name was the “Advanta Multipurpose Handgrip.”

SETTING THE INTERSTIMULUS INTERVAL

Studies examining visual imagery have determined that the appropriate interval between stimulus presentation must be sufficient to allow for imagery to occur but not so long that verbal category labels will be assigned to the stimuli by the participant (Viswanathan and Childers 2003). Literature in the visual imagery area has consistently indicated that an ISI length of 500 milliseconds is sufficient time for visual image generation (Bagnara et al. 1988). Other research cited by Viswanathan and Childers (2003) recommended 400 msec. ISI for processing and generating stimulus categories. It cannot be known without pretest whether haptic imagery will follow the same generation time as visual imagery. To find the optimal ISI, a qualitative examination of image generation was undertaken. This pretest was completed simultaneously with the stimulus salience pretest, described previously. In the pretest, participants (n = 29) evaluated and then formed an image of each proposed stimulus. Stimuli consisted of various shapes and textures as well as shape and texture salient hand grips. Participants were instructed to form a haptic image and were asked to indicate verbally as soon as possible when the image had been formed in their mind. Participants indicated that the image had been formed by saying, “ok” aloud. Sometimes participants had to be reminded of the task and/or to say “ok” when the image was formed. The researcher recorded the time needed to perform both the evaluation and the imagery task.

Haptic Imagery. Initial analyses revealed clear outliers in the data on time required for imagery. Therefore, scores beyond three standard deviations from the mean were eliminated from the analysis, resulting in N=40. Average time needed to form a haptic image was 3.32 seconds (M=3.32, SD=.695). In considering that the average time taken to perform the imagery, and in hoping to allow enough time for 90% of participants to form their imagery in the allotted timeframe, one standard deviation was added to the mean to construct a time frame of 4.0 seconds for the imagery formation period.

Haptic Evaluation. Initial analyses revealed clear outliers in the data. Scores beyond three standard deviations from the mean were eliminated from the analyses, resulting in N=41. Average time needed to haptically evaluate relevant stimuli and collect information to prepare for image generation was 2.43 seconds (M=2.43, SD=.406). In keeping with the time allotted for imagery formation, participants were given 4.0 seconds for haptic evaluation.

SCALE DEVELOPMENT

Individual differences in imagery ability were assessed for comparing the visually impaired group with the sighted group on imagery ability. The Questionnaire Upon Mental Imagery (QMI), developed by Betts (Betts 1909) contained 105 items that measure imagery in seven modalities: visual, auditory, cutaneous, kinesthetic, olfactory, gustatory, and organic (Isaac et al. 1986). For the purposes of this study, the haptic imagery ability section was used as a starting point for scale development. The haptic section of Betts’ QMI does not cover all aspects of the domain of haptic imagery.

Revision of the haptic imagery section of the QMI was based on several articles in the literature that have constructed and validated similarly revised questionnaires (Babin and Burns 1998; Childers et al. 1985; Isaac et al. 1986; Marks 1973; Sheehan 1967).

The original items for the haptic section of the QMI are listed in Appendix D. Betts' QMI includes three items concerning texture (i.e., sand, linen, and fur), one item concerning pain (i.e., prick of a pin), and one item concerning temperature (i.e., a tepid bath). A more complete measure of the domain of haptic imagery includes all of the following: texture, hardness, weight, pain, and temperature. This domain definition is derived from previous work in the area (Lederman and Klatzky 1987). The steps for scale development follow and resulting items for the modified QMI are listed in Appendix E.

STEPS AND ANALYSIS OF HAPTIC IMAGERY SCALE DEVELOPMENT

Item Generation. A convenience sample of nineteen participants completed an online survey designed for item generation. Participants were asked to list up to five items that they felt represented each of the five dimensions of haptic imagery (i.e., weight, texture, temperature, pain, and hardness). Of the 84 items generated, 36 were eliminated because of cross-listing with other categories. This resulted in 49 items from the online item generation survey: 10 representing hardness; 8 representing pain; 10 representing temperature; 12 representing texture; and 9 representing weight.

Sorting Task. Five expert raters were asked to sort the 48 items into each haptic category. Raters were instructed to sort each item into the category that best fit. If the rater felt that the item fit into more than one category, they were instructed to choose the category that was the best fit. Items were retained if 4 of the 5 raters agreed on the item category. This resulted in 34 retained items: 2 representing hardness; 6 representing pain; 11 representing temperature; 9 representing texture; and 6 representing weight.

Purification studies 1 & 2. Two hundred twenty undergraduates recruited from the Research Experience Program (REP) at the University of Kentucky completed the resulting 34-item survey online. In addition, the participants completed three other questionnaires: Style of Processing (Childers, Houston, and Heckler 1985); Need for Touch (Peck and Childers 2003a); Vividness of Visual Imagery (Marks 1972). Cronbach's alpha was used to assess internal reliability for the VVIQ and the dimensions within each scale. Nunnally's method for computing reliabilities for linear composites was used for the multidimensional scales (Nunnally and Bernstein 1994). See table 4.7 for those values.

Table 4.7: Scale Reliabilities

Scale	**Reliability**	**Number of Items**	**Scale Mean**	**Scale SD**
Haptic Imagery	.914	34	69.07	17.87
Style of Processing	.71	22	59.52	5.718
Verbal SOP	.667	11	25.25	3.963
Visual SOP	.659	11	34.26	3.91
Need for Touch	.952	12	9.79	14.49
Autotelic	.949	6	4.26	8.92
Instrumental	.877	6	5.53	7.01
Vividness of Visual Imagery	.869	16	31.9	8.94

Items with less than .50 item-total correlations were eliminated. A principal axis exploratory factor analysis with oblimin rotation was used and items with low factor loadings (below .30) were eliminated. Further, items that loaded on more than one factor or on a factor that was not as intended, were eliminated. None of the items eliminated for loading on an unintended factor had factor loadings exceeding .65. The analysis resulted in 17 items remaining. These items did not sufficiently represent the construct domain: 2 representing hardness; 3 representing pain; 5 representing temperature; 3 representing texture; and 4 representing weight.

The 16 resulting items were expanded from one word items to phrases, making them more similar to Marks' VVIQ (i.e., "ice" became "collecting ice from the freezer"). Additional items were constructed to comprise a 37-item scale. Items were chosen in an effort to measure all dimensions: hard/soft resistance to pressure; intense/moderate pain; hot/cold temperature; rough/soft texture; and heavy/light weight. Of the 37 items, 7 represented hardness; 8 represented pain; 8 represented temperature; 7 represented texture; and 7 represented weight.

In the second scale purification study, 115 undergraduates completed a series of online surveys that included the HIQ scale. Coefficient alpha for the 37 items was .94. An exploratory factor analysis using principle axis factoring with oblimin rotation resulted in five identifiable factors, although most items loaded weakly on any factor. Items with the highest factor loadings were examined and factors were labeled according to this method. Items with factor loadings greater than .7 on factor 1 were items intended to represent weight. On factor 2, the items were intended to represent pain. Factor 3 had the highest loadings from temperature items, factor 4 from hardness items, and factor 5 appeared to have primarily negative loadings (see Table 4.8).

Table 4.8 Factor Loadings for Remaining 25 Items

Item	Factor 1 (weight/ hard)	Factor 2 (pain)	Factor 3 (temp)	Factor 4 (hard)	Factor 5 (residual)
Run hand across pineapple (Tex)	-0.05	-0.10	0.24	-0.43	-0.25
Sifting beach sand (Tex)	0.33	0.04	0.44	-0.05	-0.18
Rubbing a Suede jacket (Tex)	-0.03	0.05	0.27	-0.51	0.22
Rubbing a Sponge (Tex)	0.34	0.05	0.10	-0.43	0.09
Petting a dog's fur (Tex)	0.66	-0.04	0.08	-0.02	-0.06
Run hand across fence post (Tex)	0.21	0.18	0.00	-0.49	-0.18
Rub rose petal (Tex)	0.08	0.01	-0.02	-0.74	-0.02
Holding a laptop computer (W)	0.79	-0.10	0.25	0.23	0.10
Lifting a bag of marbles (W)	0.41	0.19	-0.10	-0.33	0.06
Grasping a balloon (W)	0.43	-0.14	0.10	-0.45	-0.10
Lifting a book (W)	0.86	-0.17	0.07	0.01	0.02
Carrying Paper (W)	0.56	-0.16	-0.09	-0.39	-0.08
Picking up a brick (W)	0.51	0.34	-0.05	-0.13	-0.05
Gripping a Cell Phone (W)	0.75	-0.10	-0.18	-0.06	-0.03
Holding a snowball (Temp)	0.14	0.14	0.59	-0.12	0.12
Hand above boiling water (Temp)	0.14	0.30	0.06	-0.21	-0.16
Handful of ice (Temp)	0.02	0.11	0.71	0.02	-0.14
Holding a melting popsicle (Temp)	-0.07	0.23	0.22	-0.44	0.00
Run hand across candle flame (Temp)	0.19	0.35	0.09	-0.21	-0.19
Testing bath water (Temp)	0.49	-0.06	0.17	-0.08	-0.14
Reaching into oven (Temp)	0.25	0.13	0.14	-0.14	-0.21
Hand over Heat register (Temp)	-0.06	0.12	-0.03	-0.51	-0.08
Finger across knife (P)	-0.22	0.55	0.21	0.00	-0.26
Cardboard cut (P)	-0.20	0.30	0.39	-0.27	-0.03
Rubbing razorblade (P)	-0.05	0.77	0.06	0.03	-0.02
Sticking finger with needle (P)	-0.05	0.61	0.09	0.00	-0.18
Brushing a cactus (P)	-0.20	0.58	0.08	-0.19	-0.07
Hammering finger (P)	0.05	0.83	-0.12	-0.06	0.04
Slam finger in door (P)	0.08	0.65	0.16	0.10	0.11
Fingernail trimmed too short (P)	0.18	0.10	0.07	-0.03	-0.64
Press palm against concrete floor (H)	0.63	0.17	-0.02	-0.01	-0.13
Squeezing a foam ball (H)	0.48	0.13	0.05	-0.08	-0.31
Squeezing fruit (H)	0.47	0.09	0.02	-0.22	0.13
Pushing against marble wall (H)	0.45	0.39	-0.02	-0.27	0.21
Pushing keyboard keys (H)	0.65	0.03	-0.07	0.00	-0.29
Press screen mesh (H)	0.21	0.02	0.02	-0.60	-0.17
Squeeze bike tire (H)	0.53	0.28	0.00	-0.17	-0.03

Examination of individual items using factor loadings and cross loadings, communalities, and item-total correlations resulted in the elimination of 12 additional items (2 texture; 2 hardness; 3 pain; 2 weight; 3 temperature). The resulting 25 items had a coefficient alpha of .92 but again failed to load on the expected 5 factors.

After careful reconsideration of the factor structure from a theoretical perspective, the items intended to measure pain were dropped from the scale. The 20-items were tested as a 4-factor model with confirmatory factor analysis (CFA) using LISREL 8.8 software. Two models were tested, a more constrained first-order 4-factor model and a less constrained, second-order 4-factor model. Both models resulted in adequate overall fit. The chi-square difference test for nested models indicated that the first order model provided better fit for the data ($\chi^2(3)=15.2$, $p=.001$).

The overall results for the first-order 4-factor model indicated good fit ($\chi^2(164)=215.11$, $p=.0045$; root mean square error of approximation [RMSEA] = .066; normed fit index [NFI] = .96; non-normed fit index [NNFI] = .99; comparative fit index [CFI] = .99; root mean square residual [RMR] = .061; goodness of fit index [GFI] = .82; adjusted GFI = .77), as well as solid psychometric properties of the measures. All standardized factor loadings (derived from the Wald statistics) exhibit statistical significance at $p < .0001$, which indicates convergent validity. The factors failed to achieve discriminant validity in that the factors representing texture and hardness correlated at 1.0, while all other free parameters ranged from .64 to .92. Therefore, a 1-factor CFA was tested to determine whether treating the items as unidimensional would result in a better fit.

The 1-factor CFA, though significantly different from the previously tested model ($\chi^2(3) = 83.31, p < .0001$), did not result in better fit ($\chi^2(170)=313.62, p<.001$; root mean square error of approximation [RMSEA] = .11; non-normed fit index [NNFI] = .97; comparative fit index [CFI] = .97). Additional work is needed to investigate the scale structure as well as the specific items for evaluating the construct.

Construct Validity. Additional validity testing is necessary for further confirmation, but for now correlations are included in Table 4.9. Social desirability response bias has the potential to confound responses to the HIQ scale. As expected, HIQ did not correlate with the Crowne and Marlow (1960) social desirability measure.

The HIQ did converge with questionnaires containing imagery items. The original Bett's questionnaire was shortened and refined by Sheehan (1967), who found that individuals possess a general ability to image, regardless of modality. Based on this work, the researchers expected the VVIQ-2 and the HIQ to correlate. The visual imagery items on the Picture SOP scale were also likely to correlate with HIQ.

In addition, the scale achieved discriminant validity with the Need for Touch scale, which measures preferences for touch information (Peck and Childers 2003a), and Need for Cognition, which measures preference for cognitive engagement (Cacioppo and Petty 1982).

Table 4.9: Construct Validity Tests for Haptic Imagery Questionnaire (Correlation Coefficient r)

Type of Assessment	R
Response bias test: Social Desirability (Crowne and Marlow 1960)	.032
Convergent validity:	
Picture Style of Processing	.185*
Vividness of Visual Imagery	.449*
Discriminant validity:	
Need for Touch	.11
Need for Cognition	.051

*Statistically significant at $p<.05$.

STUDY 1

The purpose of study 1 was to test hypotheses 1-9. Goals were to illustrate shared resources of haptic imagery and haptic perception and to examine differences in processing between sighted and visually impaired participants. The focus of Study 1 was to test the difference in processing a structural related property as opposed to the substance property and to compare normally sighted and visually impaired consumers, since the interaction between imagery and perception is expected to differ between these two groups.

PARTICIPANTS

Sixty-two sighted participants and sixty-four visually impaired participants were paid $10 each to participate. Sighted participants were recruited through community organizations, a community psychological services center, and an MBA course at the

University of Kentucky. Visually impaired participants were eligible if they had the ability to read Braille. Determination of and extent of blindness was based on self-report and many of the materials were printed in Braille. Visually impaired Braille readers were recruited through The Bluegrass Council of the Blind, Independence Place, Kentucky School for the Blind Charitable Foundation, American Printing House, National Federation of the Blind of West Virginia, Cabell-Wayne Association for the Blind, The Chicago Lighthouse, National Federation of the Blind of Chicago, Office for the Blind in Daviess County, KY and word of mouth contacts and referrals.

Originally only right-handed participants were eligible but obtaining participants proved to be difficult and left handed participants were permitted. Handedness will be a covariate in the analyses to test whether there was an effect. This criteria is necessary because the resource competition/complementation paradigm is based on the use of similar biological structures. It is generally accepted that right and left-handed individuals often biologically process some types of information differently (Kosslyn et al. 1999).

MATERIALS AND EQUIPMENT

Structural versus Substance Related Stimuli. The distinction between structural and substance related properties in haptic imagery were discussed in chapter 3. The structurally related property chosen was shape, operationalized as the cube and sphere shapes determined via pretest and previously discussed. The chosen substance related property was texture, operationalized as varying grades of sandpaper (100/180) and different thread count sheets (200/400), also selected from pretests previously discussed. These texture salient products have been used in other studies (Grohmann et al. 2007).

Questionnaires. Questionnaires for the sighted were administered via paper and pencil. The visually impaired participants were given the option to complete questionnaires online, read the Braille versions and then give verbal answers, or have the researcher read the questionnaires, to which the participants responded verbally.

Participants completed self-report measures of haptic imagery ability (HIQ) and visual imagery ability (VVIQ-2). The measures are included in Appendices E and F. The Need for Touch Scale and Style of Processing Questionnaire were also administered. The Style of Processing scale is included in Appendix G.

The Vividness of Visual Imagery Questionnaire (VVIQ-2), a modified version of the original developed by Marks (Marks 1973) measures individual differences in visual imagery ability. This scale has shown a test-retest reliability of .74 and has been shown to be a valid measure of good and poor visualizing ability using a picture-memory task for comparison (Marks 1972).

After each experimental trial in study 1, each participant completed a Trial Assessment Questionnaire (TAQ- see Appendix H), modeled after Farah (1985). The questionnaire includes imagery manipulation checks asking the respondent to judge the clarity (item 4) and vividness (item 5) of their imagery as well as their ability to hold the image (item 6) and how successful they feel they were at holding the image in their mind (item 7). Responses were given on a seven point Likert type scale. The TAQ also asked participants to rate their confidence (items 1 and 2) and frustration (item 3) on each comparison trial. A third goal of the TAQ was that it provided a short rest period and distracter between trials, likely preventing carry over effects from one trial to the next.

A general demographic questionnaire (Appendix I) asked all participants for gender, age, handedness, and status of sight versus visual impairment. Further, visually impaired participants were asked to give the age at which they became blind (20/200) and to please give the reasons for their visual condition. Based on the work of Hollins (1985), participants are instructed to list the age that functional sight was lost if the loss was gradual (Hollins 1985).

Rotating Platform and Software. Equipment to present the stimuli was constructed by engineers at the University of Kentucky Center for Visualization and Virtual Environments. The stimulus presentation equipment consisted of a wooden rotating platform attached to a motor. A laptop used a program called Haptic Helper 1.0 written by the engineers to run the equipment based on Labview 8.5 software, manufactured by National Instruments. The software allowed the researcher to set the evaluation time; set the time between stimulus presentation; administer the audio prompts indicating that stimuli were to be touched; and to save the responses and response times on each trial.

PROCEDURE

Research design was a 2 between subjects (Sighted versus Visually Impaired Consumers) X 2 within subjects (Structural Property Pair versus Substance Property Pair) X 2 between subjects (haptic imagery versus visual imagery instruction) mixed repeated measures design. Imagery instructions and visual status was between participants. Each participant evaluated all possible combinations of pairs for both textures and shapes. Participants were given the appropriate imagery instruction, then performed 12 comparisons of objects where textures were compared with other textures and shapes were compared with other shapes. Participants indicated whether the items were the same or different by pushing a button on a computer mouse. Buttons were labeled with letters “s” and “d” in both large print and Braille. Table 4.10 shows an example of one stimulus presentation schedule used. As can be seen, for each property (i.e., sandpaper, sheet, shape) participants were presented with two pairs that were the same and two pairs that were different, resulting in four comparisons on each property. Study 1 procedure took approximately 15-20 minutes for the majority of participants.

Table 4.10: Example Stimulus Rotation Schedule

Trial Number	Object Presented First	Object Presented Second	Same/ Different
1	Sheet 400 TC	Sheet 200 TC	D
2	Cube	Ball	D
3	Sandpaper 180 Grade	Sandpaper 100 Grade	D
4	Ball	Cube	D
5	Ball	Ball	S
6	Cube	Cube	S
7	Sandpaper 100 Grade	Sandpaper 180 Grade	D
8	Sheet 400 TC	Sheet 400 TC	S
9	Sandpaper 180 Grade	Sandpaper 180 Grade	S
10	Sandpaper 100 Grade	Sandpaper 100 Grade	S
11	Sheet 200 TC	Sheet 400 TC	D
12	Sheet 200 TC	Sheet 200 TC	S

Participants sat behind a cardboard partition with a slot for the right hand. The partition inhibited visual evaluation for sighted or partially sighted participants and all participants used the partition. The left hand rested lightly on the computer mouse. A rotating platform attached to a laptop rotated to present objects. In each trial, participants were first presented with a stimulus A and were instructed to use either visual or haptic imagery as a strategy for remembering stimulus A. Visual perception is not necessary for the participant to construct a visual image of the object (Klatzky et al. 1991). Participants heard a tone through a headset, indicating that it was time to begin touching stimulus A. As stated during the discussion on pretesting evaluation time, participants had 4 seconds to touch the stimulus A. The participants heard a buzz when it was time to stop touching stimulus A. The platform rotated to present stimulus B. Participants again heard a tone to indicate that they could reach for stimulus B.

To avoid bias caused by an overlap with the experimental task and the questionnaires, some participants completed the questionnaires prior to being given instructions for the experimental tasks, while others completed the questionnaires at the end of the session. To accommodate for the blind sample, three methods for questionnaire administration were offered. Nine participants chose to complete the surveys online, one chose to read the Braille questionnaires and report answers verbally, and the remainder chose to have questionnaires read to them. Of those participants who had the questionnaires read to them, about half did so prior to the experiments and about half did so after the experiments. An assistant researcher greeted blind participants at the study location since most were familiar with the location. In many cases of blind participants, the assistant worked with the participant on questionnaire completion either before or after the experiment. When the assistant was not available, the researcher administering the experiment also administered the questionnaires. For sighted participants, roughly half completed the surveys before participating in the experiments and roughly half completed them afterward. Sighted participants completed surveys with pencil and paper. For most participants, questionnaire completion took 25-30 minutes.

Participant Instructions. General procedures are shown in Figure 4.1. Participants were brought in and seated at a table. Participants were read the following instructions:

> "The purpose of this experiment is to examine how consumers evaluate objects using their hands. Today you will be comparing lots of objects. Let me tell you what to expect and then we will practice a few times before we get started. On the other side of the partition in front of you is a rotating platform. The platform holds objects and will rotate to present each object to you. Objects will be presented in the same location each time. When an object is ready to be touched and evaluated, you will hear a tone. The tone tells you that it is ok to handle the object. The object will be attached to the platform, so you will not be able to move it around. You will be able to handle each object in place. When it is time to stop touching the object, you will hear a buzzing noise. When you hear the buzzer, you should stop touching the object. Once you let go of the object, I want you to form a memory of the object you handled. A few seconds later you will hear another tone. This is your cue that you are being presented with another object. You should touch the second object when you hear that tone. Once you touch the second object, you need to indicate as quickly as possible whether the second object is "the same as" or "different from" the first object. This will be done by pressing a computer mouse with your left hand. Pressing the right button indicates same and pressing the left button indicates different. You will need to give your answer as quickly as possible but without compromising your accuracy about whether the second object is the same or different. You will be asked to do

> this twelve times. On any given comparison, there is an equal possibility that the second object will be the same or different from the first object. After each comparison of pairs of objects, you will be asked to complete a short series of questions about the most recent comparison you have made. After you have completed all trials of product comparisons, you will be asked to answer a few more questions about your experience before moving on."

If the participant had questions about the instructions, the experimenter answered the questions or reread the instructions if necessary. Once the experimenter was sure that the participant understood the task, the researcher read the imagery instructions. Participants who were randomly assigned to the haptic imagery group heard the haptic imagery instructions, while the visual imagery group heard the visual imagery instructions. The specific instructions for each group are below.

Haptic Imagery Instructions Adapted from Segal and Fusella (1970):

> "Now that you know the general task in the experiment, I want to explain to you how to form the memory of the first object to use in your comparison of the pairs. One common strategy that is often used to remember an object is called touch imagery. You may be most familiar with other types of imagery like auditory imagery, like when you are remembering a song and it seems to be playing in your head. In the experiment today, we are concerned with touch imagery. Touch imagery is the memory of the sensation you felt when touching, holding, or picking up an object. For example, you might remember the sensation on your hand of soft leather or how it felt to lift a heavy bowling ball. While evaluating the first object in each trial, please form a touch image that represents the quality

> of the property you are trying to remember. Forming a touch image might help you to remember the object better. Try to hold the image in your mind while evaluating the second object. You will not be asked to report on your image until after each trial is completed, as we find it is easier for people to concentrate on their imagery when they remain silent during imagery formation. Once the second object has been presented, please remember to say as quickly as possible whether the second object is the same as or different from the first object."

Visual Imagery Instructions Adapted from Segal and Fusella (1970):

> "Now that you know the general task in the experiment, I want to explain to you how to form the memory of the first object to use in your comparison of the pairs. One common strategy that is often used to remember is visual imagery. While evaluating the first object in a trial, please form a visual image that represents the properties you are trying to remember. Forming a visual image could help you to remember the object better. Try to hold the image in your mind while evaluating the second object. You will not be asked to report on your image until after each trial is completed, as we find it is easier for people to concentrate on their imagery when they remain silent during imagery formation. Once the second object has been presented, please remember to say as quickly as possible whether the second object is the same or different from the first object."

Practice Session. Practice stimuli were two textured cylinder shaped hair rollers and two upholstery type material pieces. These objects, though similar to test stimuli, differed significantly. Participants practiced for several trials until there were no more questions. Participants were asked to form the imagery that they had been instructed on previously, evaluate the practice stimulus A, compare it with practice stimulus B, and then respond as to whether the two were the same or different by pressing the appropriate button. When the practice session was complete, the administrator said:

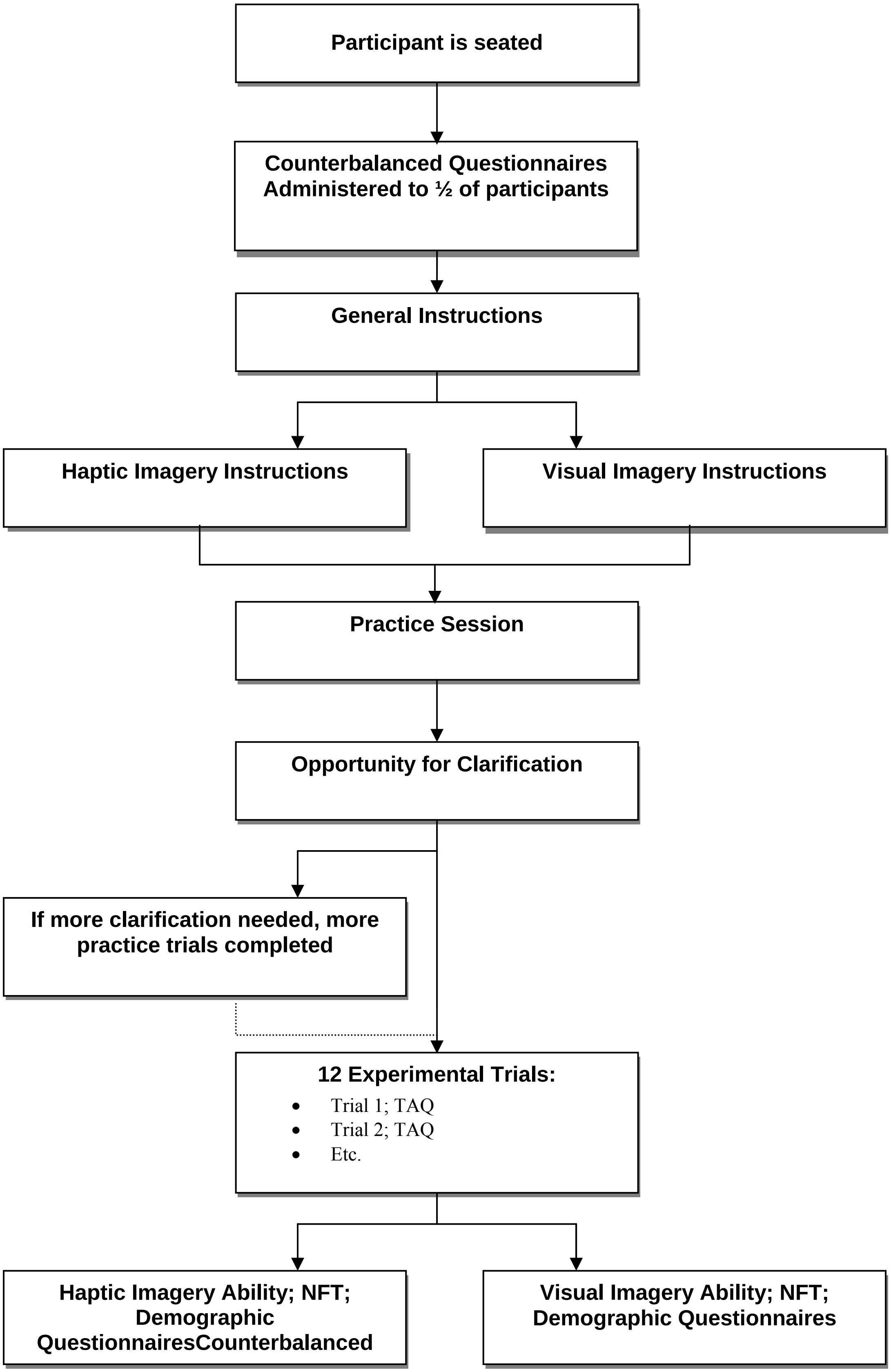
> “Now, do you have any questions about what it is that you are going to do? Would you like to hear the instructions again? Do you feel that you were able to form a mental image during the practice? Please remember to form your _______ image between the object presentation, to hold your image while evaluating the second object, and then to say whether the objects are the same or different as quickly as possible without compromising your accuracy.”

When the participant had no further questions and claimed to be able to form an image as instructed, 12 experimental trials followed. Additional practice was completed when participant indicated lack of understanding of the task. No participants indicated an inability to form a mental image.

Experimental Trials. With the right hand through the partition and the left hand ready to push the mouse button that corresponded with their decision, participants compared 12 pairs of stimuli. The rotating platform on the other side of the partition held the objects and the computer alerted the respondent via tones and buzzing through the headphones of when objects were to be touched or released. Participants had only 4 seconds to evaluate stimulus A but had as long as needed to evaluate stimulus B for comparison. The participant was told that they should push the button when they were sure of their decision and that they should push the button as soon as they had made their decision so that we could measure how long it took them to make their decision. Dependent variables, discussed in more detail subsequently, were response time, frustration, and confidence. After each trial (pair comparison) the participant completed the TAQ found in Appendix E before moving on to the next trial.

To avoid confounding stimulus exposure with experimental effects, order of repeated measures (presentation of stimulus pairs) were rotated on a Latin square design. The Latin square allows for testing and controlling for practice effects during analysis (Keppel and Wickens 2004).

Figure 4.1: Flow of Procedure Study 1 for Sighted and Visually Impaired



OPERATIONAL DEFINITIONS OF INDEPENDENT VARIABLES

Haptic Versus Visual Imagery. Imagery condition will be manipulated with instructions to the participant. The instructions have been based on the work of Segal and Fusella (1970) and were adapted for the needs of this study. Exact instructions are listed in the procedures section for Study 1.

MEASURING DEPENDENT VARIABLES

Interference/ Facilitation were defined as reaction time, frustration, and confidence in the task. These variables are symptoms of participant ability to access the needed cognitive information in order to perform the necessary task and have been used in other studies as indicators for interference and facilitation effects of imagery and perception (Segal and Fusella 1970; Farah and Smith 1983).

Reaction Time. Response latency was measured as the time between the tone alerting the participant that stimulus A was ready to be evaluated and the point that the participant pushed the button to indicate “same/different.” The button press sent a signal to the laptop, which recorded the time in milliseconds.

Accuracy of Judgment. Participants pushed a button on a computer mouse that corresponded with their judgment of whether the stimuli in a given trial were the same or different. The button press sent a signal to the laptop and the participant’s selection was recorded. This judgment was used to calculate accuracy.

Confidence and Frustration. After each comparison trial, participants completed the TAQ, where they were asked to rate their confidence and frustration level for each trial. For specific items concerning this dependent variable, see the TAQ in the Appendix H.

STUDY 2

Study 2 was drawn from the methodology of Unnava et al. (1996) to test hypotheses 10-14. Here the interaction effects that have been observed between visual imagery and perception were extended to haptic imagery and perception.

PARTICIPANTS

The same sixty-two sighted and sixty-four visually impaired participants who participated in study 1 also participated in study 2. Each received $10 for participation in both studies.

MATERIALS

Auditory Advertisements. The auditory advertisements discussed in the pretest section and included in Appendix C were used in this study. As was stated earlier, the target ad contained two texture imagery instructions and two shape imagery instructions, as well as additional non-imagery inducing product information. The method for ad construction was based on the work of Unnava and colleagues (Unnava et al. 1996; Unnava and Burnkrant 1991). Participants listened to the ads via headphones. The target advertisement was always the third ad presented and the four distracter advertisements were presented to participants around the target ad in a Latin square design. Participants listened to five advertisements in total.

Perceptual Stimuli. After participants listened to all five advertisements, they were instructed to haptically evaluate a multipurpose handle grip from the target ad by placing their hand through the partition in the same way that they had in the previous study. The handle grip presented was either texture salient (i.e., substance property) or shape salient (i.e., structural property). As previously discussed, the handles were pretested for texture or shape salience. Each participant evaluated only one grip.

Questionnaires. Each participant completed the same questionnaires that were administered in Study 1. An Advertisement Assessment Questionnaire (AAQ) can be found in Appendix J.

The AAQ asks questions regarding attitude toward the ad (items 1 and 6), attitude toward the product (item 8), participants' frustration (item 2) and confidence levels (item 3) with the free recall task, and purchase intentions (item 7). The items measuring these dependent variables were adapted from previous work in the marketing literature (Argo et al. 2006; Grohmann et al. 2007; Peck and Childers 2003b; Peck and Wiggins 2006). Also, taken from Unnava et al. (1996), questions were added for measuring the extent and type of imagery induced by the advertisement heard (items 4 and 5).

The Communication-Evoked Mental Imagery Scale (Included in Appendix K) was included with the AAQ to measure the nature and extent of mental imagery evoked by the auditory advertisement (Babin and Burns 1998).

GENERAL PROCEDURE

Design was 2 between-subjects (sighted versus visually impaired) X 2 between-subjects (substance versus structural property perception) design. Interference in this study was defined as fewer passages recalled from the ad, more negative attitudes toward the ad, increased frustration with the recall task, decreased confidence with the recall task, and lower purchase intentions than in the baseline condition. Facilitation was defined as higher recall, more positive attitudes, decreased frustration, increased confidence, and increased purchase intentions.

General procedures are shown in Figure 4.2. The participant will be seated at a table across from the researcher. The researcher read aloud the following instructions:

> "In this next part of the study we are asking you to evaluate and judge advertisements for their effectiveness. These advertisements are still in the developmental phase, so they may not sound like the majority of the advertisements that you might be familiar with. You will listen to five advertisements for five different products. After you listen to all of the advertisements, one advertisement will be randomly selected by the computer for you to evaluate the product in that advertisement. You will touch the product from the ad in the same way you touched the objects in the previous task but you will only touch one object. While you are evaluating the product from the ad, you will be asked to recall as much information from the advertisement as possible. It is important that you try to remember as much from each ad as you can, as it is impossible to know which product and ad you will asked to evaluate. Do you have any questions? Can you tell me what it is that you are going to do in this part of the study? If you are ready, we can get started."

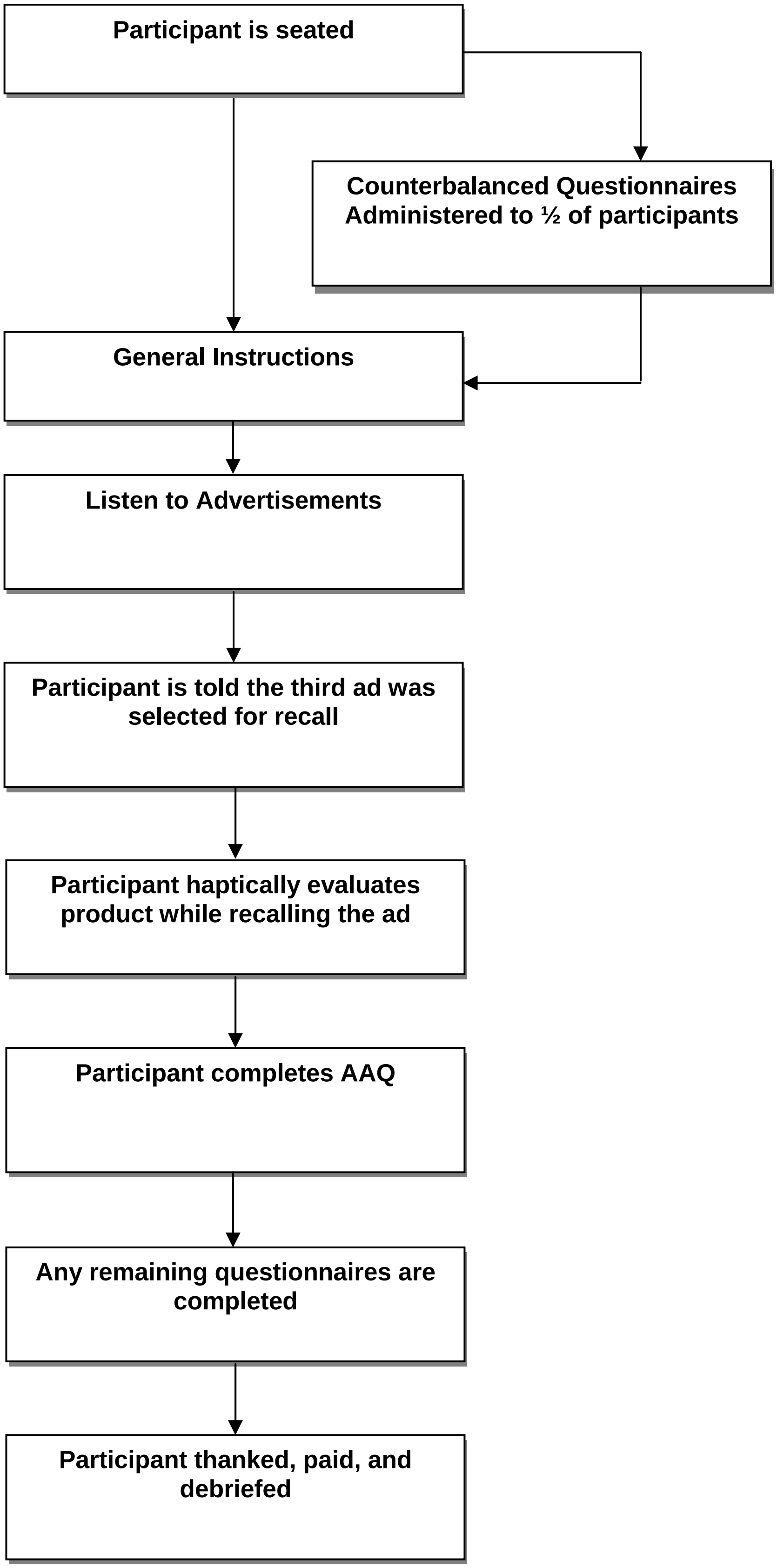
If questions arose, participants were told that viewing products out of context could bias them. Once instructions had been given, participants listened to the pre-recorded advertisements. The target ad was always third, in order to avoid recency or primacy effects (Unnava et al. 1996). The other advertisements were presented in a Latin Square Design. After all ads had been heard, the participant was instructed to remove the headphones. The researcher told the participant, "The computer has selected the third ad you heard, which was for the multipurpose handle grip. I'll put the product up on the other side. Whenever you are ready, please take the grip and just say out loud everything that you can remember from that advertisement." The researcher put the pre-selected grip in position to be evaluated and the participant took hold of the grip. Depending on the preselected condition for the participant, the grip was either texture or shape salient. The participants were videotaped and their responses were later transcribed by the researcher. One participant would not allow his response to be videotaped. For that participant, the researcher typed the response into the computer as the person spoke. The AAQ was completed after the recall was complete. Sighted participants answered those questions using paper and pencil, while the visually impaired participants were given the option to either read Braille and answer verbally or have the questionnaire read to them and answer verbally, as described previously. Study 2 took 12-15 minutes for most participants and was always completed after study 1. Participants were always offered a break between studies 1 and 2. Participants who did not complete the questionnaires prior to the experiments did so at the end of study 2. Participants were thanked, paid, and debriefed.

Dependent Variables. Interference and facilitation in this study were operationalized as number and type of imagery information recalled from the ad during perception. Results were called interference when perception inhibited access to memory content and called facilitation when perception made access to memory easier. Other studies have used imbedded ad content as imagery instructions in this way (Unnava et al. 1996).

Recall of ad content was scored following the procedures laid out in previous literature (Unnava et al. 1996; Unnava and Burnkrant 1991). The researcher transcribed the verbal responses from the computer, which were downloaded from a Mini DV camcorder. Three independent coders were given text of the target advertisement with phrases partitioned and labeled as “texture imagery,” “shape imagery,” and “non-imagery.” Key words were also provided to help the coders determine how phrases should be labeled. Instructions given to coders are presented in Appendix L. Any additional information that was provided by the respondent was coded as “additional information.” Also, if respondents talked about the item that they were touching or compared the item with the advertisement, those phrases were coded as “product/advertisement comparisons.” Statistics related to coding will be discussed in Chapter 5 with all other statistics related to studies 1 and 2.

Other dependent variables: attitude, frustration, confidence, and purchase intentions were measured by self-report with the AAQ. Items for these DVs were based on previous studies (Argo et al. 2006; Peck and Childers 2003b; Peck and Wiggins 2006).

Figure 4.2: Flow of Procedure Study 2



SUMMARY OF CHAPTER 4

This chapter outlined the methodology used for testing the hypotheses that were conceptualized in chapter 3. The chapter began by describing the methods used and results of preliminary tests concerning stimuli, interstimulus intervals, and questionnaire modification. A description for the procedures were presented for study 1, which tested haptic imagery's relationship with perception by demonstrating that haptic imagery interacts with haptic perception differently depending on the salience of the haptic property involved. Study 1 also sought to determine the differences in these relationships for visually impaired versus sighted consumers. Study 2 extended the research to an advertising context and demonstrated the effect imagery's interaction with perception has on marketing outcomes.

CHAPTER 5

ANALYSIS OF RESULTS

INTRODUCTION

This chapter summarizes the results from studies 1 and 2 as outlined in chapter 4. These studies were conducted to evaluate the role of haptic imagery in haptic processing as discussed in the previous chapters. The first sections of this chapter discuss the demographics of the sample as well as the psychometric properties of the self report measures. Results from hypotheses testing are then discussed, followed by a summary of the chapter.

SAMPLE CHARACTERISTICS

Sixty-two sighted participants were recruited from a church congregation in Western Kentucky, staff at a spousal abuse center, word of mouth referrals, and students from the University of Kentucky. This group consisted of 45 women and 17 men, fifty seven of which were right handed. The mean age for the group was 38.43 with a range of 18-65 years old.

Sixty-four blind participants were recruited from various organizations serving the blind in Lexington, Owensboro, Louisville, Huntington and Chicago. Twenty-six men and thirty-eight women were recruited, fifty-four of which were right handed. The mean age was 47.2 with a range of 18-72 years old.

PSYCHOMETRIC PROPERTIES OF SCALES USED

Table 5.1: Reliability Statistics for All Scales Administered

Scale	Sighted	Blind	All Participants
Need for Touch	.906	.815	.891
Autotelic NFT	.857	.765	.875
Instrumental NFT	.855	.811	.827
Style of Processing	.814	.810	.818
Word SOP	.784	.747	.773
Picture SOP	.865	.859	.861
VVIQ-2	.961	.971	.972
Haptic Imagery Scale	.972	.943	.964

STYLE OF PROCESSING

The Style of Processing Scale had an overall reliability for linear combinations of .818, which is lower than the previously observed .88 reliability for this scale (Childers, Houston, and Heckler 1985). Shown in Table 5.1, the scale yielded a .814 for sighted participants and .81 for blind participants. Further, the verbal dimension of the SOP scale had an overall .773 alpha (sighted .784; blind .747). For the visual component, an overall alpha of .861 (sighted .865; blind .859) was observed. Previously, the alpha of .81 for the verbal and .86 for visual has been reported (Childers, Houston, and Heckler 1985). In these two samples, the overall alpha and the verbal component alpha were slightly lower than previously reported but the visual component alpha overall and for both groups was consistent with previous research.

An exploratory factor analysis using principle axis factoring with an oblimin rotation revealed the expected factor structure. Analysis of the sighted versus blind samples, however, showed some differences in the factor structure for the responses of each group. Sighted participants, most similar to those in the existing literature, showed the expected factor structure. For the blind sample, item 3, “I can never seem to find the right word when I need it,” loaded predominantly on the visual dimension, although the factor loading on the verbal dimension was .433, only slightly lower than the .490 loading on the visual factor. Also with the blind sample, there were low factor loadings for items 8 (“I enjoy learning new words.”), 12 (“I prefer to read about how to do something before I try it myself.”), and 19 (“I seldom picture past events in my mind.”). The nature of the items may reflect a difference in the challenges faced by this specific sample. The variability of Braille reading ability could be influencing the three verbal items. Likewise, the differences in visual imagery ability could also affect question #19.

Table 5.2: Style of Processing Factor Structure (Oblimin Rotation)

Item	Visual	Verbal
1		.630[a] .630[b] .558[c]
2	.598[a] .455[b] .656[c]	
3	.490[c]	.366[a] .416[b]
4		.601[a] .528[b] .573[c]
5	.646[a] .727[b] .574[c]	
6		.582[a] .523[b] .628[c]

Table 5.2 (continued)

Item	Visual	Verbal
7	.587[a] .598[b] .632[c]	
8		.571[a] .709[b] .353[c]
9	.591[a] .671[b] .632[c]	
10	.556[a] .619[b] .512[c]	
11	.797[a] .707[b] .811[c]	
12		.257[a] .247[b] .282[c]
13		.395[a] .506[b] .430[c]
14	.615[a] .529[b] .690[c]	
15		.566[a] .626[b] .448[c]
16	.798[a] .775[b] .791[c]	
17		.695[a] .611[b] .757[c]
18		.494[a] .439[b] .495[c]
19	.175[a] .453[b] .006[c]	
20	.824[a] .778[b] .830[c]	

[a] All participants; [b] Sighted participants only; [c] Blind participants only

NEED FOR TOUCH SCALE

The Need for Touch Scale (Peck and Childers 2003a) had an overall reliability for linear combinations (Nunnally and Bernstein 1994) of .891, with .875 for the autotelic dimension and .827 for the instrumental dimension. As can be seen in Table 5.1, reliabilities for the overall scale as well as the two dimensions differed slightly for sighted and blind participants.

As can be seen in Table 5.3, the basic factor structure of an exploratory factor analysis using principle axis factoring with an oblimin rotation, is consistent with the factor structure shown by Peck and Childers (2003a). The table shows the factor loadings for all participants and for sighted and blind participants separately. There are some differences to note between the factor loadings for the two groups. Factor loadings for sighted participants tend to be higher than those for blind participants. Further, for sighted participants the first factor was the autotelic dimension, while instrumental NFT was the first factor for the blind sample. This finding shows that for the blind consumers, instrumental NFT accounts for the most variance in their responses to the NFT scale. This is not so surprising given that for a blind consumer, most information gathered about a product would involve goal-directed touch.

Table 5.3: Need for Touch Scale Factor Structure (Oblimin Rotation)

Item	Autotelic	Instrumental
1	.819[a] .893[b] .790[c]	
2	.448[a] .752[b] .034[c]	
3		.656[a] .734[b] .585[c]

Table 5.3 (continued)

Item	Autotelic	Instrumental
4		.706[a] .679[b] .724[c]
5	.670[a] .791[b] .484[c]	
6		.643[a] .630[b] .637[c]
7	.653[a] .786[b] .495[c]	
8		.743[a] .924[b] .640[c]
9	.891[a] .987[b] .770[c]	
10		.632[a] .554[b] .695[c]
11		.634[a] .653[b] .703[c]
12	.893[a] .977[b] .872[c]	

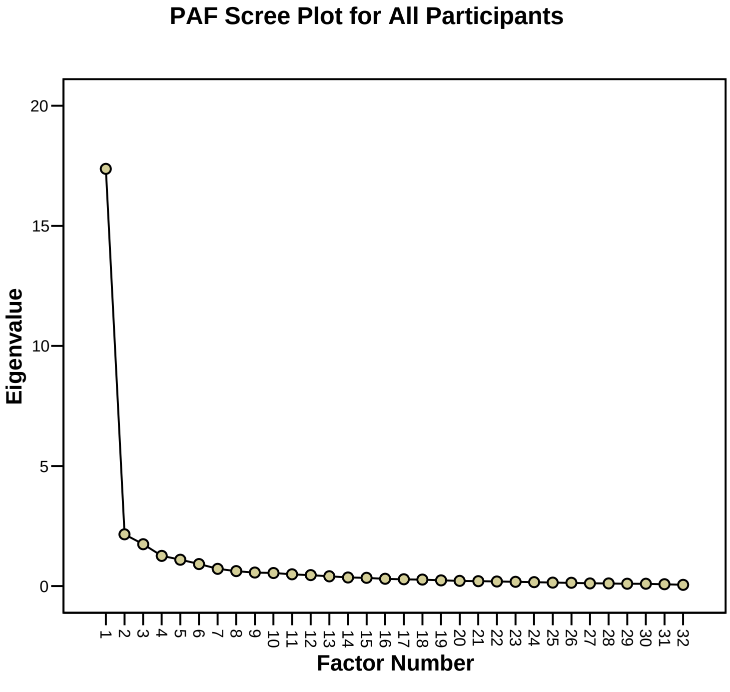
[a] All participants; [b] Sighted participants only; [c] Blind participants only

VIVIDNESS OF VISUAL IMAGERY QUESTIONNAIRE-2

The VVIQ-2 is a modified version of Marks' (1972) original VVIQ. As can be seen in Table 5.1, acceptable alphas were observed overall and for both samples independently. Past literature using the original VVIQ reported alphas ranging from .91 to .94 (Childers, Houston, and Heckler 1985). The observed alphas for this study are slightly higher (.972 overall; .961 sighted; .971 blind), which might be expected given that the modifications for the VVIQ-2 were meant to improve various types of reliability.

The VVIQ and the VVIQ-2 have been assumed to have a one-factor structure and there is some evidence that this is true (Childers, Houston, and Heckler 1985). The exploratory factor analysis using principal axis factoring with oblimin rotation was conducted with the current data. Analysis of all data revealed that 54.3% of the variance was accounted for by one factor. An examination of the scree plot in Figure 5.1 shows a steep slope from the first factor and a flat slope for all remaining factors. Analysis of the sighted and blind samples separately revealed that one factor accounted for 46.79% and 53.15%, respectively and scree plots similar to Figure 5.1.

Figure 5.1: Scree Plot for VVIQ-2 Exploratory Factor Analysis



HAPTIC IMAGERY QUESTIONNAIRE

The 20-item HIQ had an overall reliability of .964, as can be seen in Table 5.1. This was an improvement over the reliability of .934 obtained during pretesting of the scale (see chapter 4). The sighted and blind groups also had acceptable reliabilities of .972 and .943, respectively.

The data collected on the HIQ were examined with an exploratory factor analysis using principle axis factoring with oblimin rotation for 4 factors. Data were examined with all participants, for sighted participants only, and for blind participants only. The resulting structure matrix was used in conjunction with the pattern matrix to determine the factor loadings on each of the 4 factors shown in Table 5.4.

Table 5.4: Haptic Imagery Questionnaire Factor Structure for 4 Oblique Factors

Item	Factor 1	Factor 2	Factor 3	Factor 4
Holding laptop computer (W)			.62[a]	.63[b] .69[c]
Holding a snowball (Temp)	.59[a]	.68[c]		.78[b]
Pressing palm against concrete floor (H)	.72[a]		.78[c]	.68[b]
Sifting through beach sand (Tex)	.68[a] .75[b]	.61[c]		
Holding hand above boiling water (Temp)			.62[a] .69[c]	.81[b]
Collecting handful of ice (Temp)		.83[c]	.52[a]	.85[b]
Holding a melting popsicle (Temp)	.80[a]	.80[c]		.79[b]
Rubbing a sponge (Tex)	.86[a] .85[b]		.76[c]	
Petting a dog’s fur (Tex)		.38[c]	.74[a] .92[b]	
Grasping a balloon (W)	.75[a] .79[b]		.72[c]	
Running fingers across a candle’s flame (Temp)	.69[a] .74[b]		.48[c]	.48[c]
Squeezing a foam ball (H)	.74[a] .75[b]		.75[c]	
Pushing against a marble wall (H)	.76[a] .71[b]		.68[c]	
Lifting a book (W)		.85[c]	.53[a]	.49[b]
Carrying a piece of paper (W)	.60[a] .83[c]			.43[b]

Table 5.4 (continued)

Item	Factor 1	Factor 2	Factor 3	Factor 4
Gripping a cell phone (W)	.75[c]		.79[a] .75[b]	
Running hand across a fence post (Tex)	.75[a] .83[b]			.65[c]
Pressing fingers against screen mesh (H)	.73[c]		.78[a] .87[b]	
Rubbing a rose petal (Tex)			.55[a] .65[b]	.63[c]
Squeezing a bicycle tire (H)			.65[a] .77[b]	.82[c]

[a] All participants; [b] Sighted participants only; [c] Blind participants only

The 4 factor model differed by sighted versus blind participants and analyzing the groups separately allows for detection of which sample is driving the overall factor structure for all participants. A summary of the factor labels is given in Table 5.5. The first factor when all participants are included appears to be driven by items concerning texture and temperature, although the factor also contains loadings above .70 for weight and hardness items. Likewise, the third factor was attributable to weight and hardness items, but also contained loadings exceeding .60 for texture and temperature items. The overall factor structure revealed the second and fourth factors as having high negative loadings on all items, indicating that the items were negatively correlated with this factor. This may indicate that these two factors are residual variance of the other two factors. The second factor appears to have been primarily due to the sighted sample, as large negative loadings appeared on the second factor for the sighted sample but this phenomenon did not occur for the blind sample. For sighted participants, texture items loaded on the first factor and for blind participants, these items loaded on the fourth factor and the first factor was comprised of weight items. Therefore, sighted participants had far more variability in the ability to image texture items than did the blind sample, although for blind participants weight imagery showed the most variability.

Table 5.5: Labels For Each Sample on 5 Factors

Sample	Factor 1	Factor 2	Factor 3	Factor 4
All Participants	Texture/Temperature	Negative Factor Loadings	Weight/Hardness	Negative Factor Loadings
Sighted	Texture	Negative Factor Loadings	Hardness	Temp.
Blind	Weight	Temperature	Hardness	Texture

Given that responses of blind participants had somewhat different factor structures, this could be evidence that blind individuals experience both the perception of touch and the imagery of touch differently than sighted individuals. Less is known about the information processing patterns of blind populations than is known of the sighted. In general, the blind sample performed somewhat differently on the HIQ scale than did the sighted sample. While this EFA highlights differences between the two groups regarding performance on the HIQ, more investigation is needed to develop this scale further.

Table 5.6 provides the correlations of the scales used. Consistent with the pretests using sighted participants, HIQ significantly correlated with VVIQ-2. For this sighted sample the correlation was much higher than was the VVIQ/HIQ correlation for the pretest sample (.748 versus .449), probably because the VVIQ-2 is an expansion of the VVIQ for the purpose of improving reliability. The significance of the correlation did not hold, however, for the blind sample. This is probably due to the nature of the VVIQ-2 and its reliance on visual ability. It may also indicate that sighted imagers are less able to cleanly separate haptic imagery from visual imagery than could blind participants who have less visual experience. Sheehan (1967) suggested that questionnaires on imagery should correlate due to a general imagery modality. This finding could suggest that imagery is a multisensory experience rather than separately processed according to modality.

Inconsistent with pretests, HIQ failed to correlate with either verbal or picture styles of processing for either sample. HIQ did, however, discriminate from need for touch, as those scales were also not significantly related. An unexpected significant correlation between the VVIQ-2 and the verbal style of processing for the blind sample is most likely related to the blind participant's ability to use descriptions to create visual scenes.

Table 5.6 Scale Correlations

Scale	HIQ	VVIQ	WSOP	PSOP	ANFT	INFT
HIQ	1.0					
VVIQ-2	.248[a] .748[b] N.S.[c]	1.0				
WSOP	N.S.[a] N.S.[b] N.S.[c]	.183[a] N.S.[b] .285[c]	1.0			
PSOP	N.S.[a] N.S.[b] N.S.[c]	.499[a] .314[b] .598[c]	N.S.[a] -.260[b] N.S.[c]	1.0		
ANFT	N.S.[a] N.S.[b] N.S.[c]	N.S.[a] N.S.[b] N.S.[c]	N.S.[a] N.S.[b] .297[c]	.209[a] .357[b] N.S.[c]	1.0	
INFT	N.S.[a] N.S.[b] N.S.[c]	N.S.[a] N.S.[b] N.S.[c]	N.S.[a] N.S.[b] N.S.[c]	.320[a] .250[b] .422[c]	.358[a] .536[b] N.S.[c]	1.0

[a] All participants; [b] Sighted participants only; [c] Blind participants only

ANALYSIS FOR STUDY 1

INVESTIGATING OUTLIERS OF STUDY 1 DATA

Outlier data points were investigated within each group, sighted versus visually impaired. The dependent variable of reaction time had clear outliers in both groups. After studying the distribution of this variable and comparing the group distributions, a rejection cut off of 3.0 standard deviations from the overall mean was chosen (Keppel and Wickens 2004). This cut-off resulted in 10 outliers rejected in the sighted sample: 2 for shape comparisons, 4 for sandpaper comparisons, and 4 for sheet comparisons. The cut-off resulted in 13 outliers for the blind group: 3 for shape comparisons, 3 for sandpaper comparisons, and 7 for sheet comparisons. For both groups texture comparisons resulted in most of the outliers. It was the case that participants were exposed to twice as many textures than shapes, but the number of outliers for textures was more than twice the number for shapes. Of the 13 reaction time outliers for the blind sample, 8 came from one participant. Further examination of that participant revealed that the participant did not behave consistently with the other participants and was, therefore, eliminated from analysis. The remaining 5 outliers for the blind sample and the 10 outliers from the sighted sample were eliminated from the analysis.

Further investigation of outliers in other dependent variables within each group were identified for confidence, frustration, clarity of imagery, vividness of imagery, and how well the respondent claimed to hold the mental image as instructed. Careful evaluation of the distributions of these variables revealed a clear ceiling effect for these variables. Eliminating the found outliers would only further restrict the variance. Therefore, these outliers were accepted as necessary for analyses.

PERCENT CORRECT

A recommendation from the dissertation proposal meeting was to achieve at least 80% correct responses in all conditions in an effort to avoid reaction time/accuracy trade-offs. Although this was achieved for comparisons of shapes (91.8%), this minimum was not achieved in the sheet (59.7%) or sandpaper (52.4%) texture comparison conditions. Percent correct was treated as a dependent variable in the data analysis.

COMPARISON TASK ANALYSES

Each participant engaged in 12 trials comparing four combinations of two shapes, four combinations of two sandpaper blocks, and four combinations of two sheet samples. For a sample comparison trial and list of stimuli refer to Table 4.10 in the previous chapter. Photos of stimuli can be seen in Appendix B.

Analyses determined that there were no significant value differences within each type of comparison, the four combinations in each category were averaged to develop three general comparison levels of shape comparison, sandpaper comparison, or sheet comparison. Data were reconfigured so that each participant had a dependent variable judgment along each of the three types of comparison (i.e., shape, sandpaper, and sheet). Table 5.7 shows descriptive statistics of the data collected. Reaction times are given in milliseconds. Percent correct was calculated so that if a person obtained a correct (same versus different) response for one of the four comparisons made, the individual participants' percent correct on that comparison type would be .25, or 25%. All other variables were 7 point Likert scales (1 = "strongly disagree"; 7 = "strongly agree"). Participants consistently reported shape comparisons as the easiest task, evident by comparison of the dependent variables across comparison type. Shape comparisons had the lowest average reaction time and highest accuracy rate. Likewise, participants reported higher confidence, lower frustration, higher image quality, and higher ability to hold the image throughout the task. For the two texture comparison types, participants consistently performed better on sandpaper comparisons with lower reaction times, higher confidence, lower frustration, higher image quality, and higher ability to hold the image. For the texture comparisons participants had higher accuracy rates when comparing sheet samples, however. Statistical analysis of comparison type on DVs are presented and discussed with Tables 5.11 and 5.12.

Table 5.7: Mean, Standard Deviation, and Range of Each Variable

Variable	Shape	Sandpaper	Sheet
Reaction Time (MS)	M = 3260.85 SD = 1810.19 R = 10299.00	M = 4621.84 SD = 2304.10 R = 13969.25	M = 5605.24 SD = 2572.61 R = 15334.83
Percent of Trials Correct	M = .918 SD = .15 R = .75	M = .524 SD = .196 R = 1.00	M = .597 SD = .227 R = 1.00
Confidence in Comparison Task	M = 6.71 SD = .402 R = 1.75	M = 6.234 SD = .91 R = 4.0	M = 5.66 SD = 1.08 R = 5.50
Sure of Comparison Task	M = 6.69 SD = .40 R = 1.5	M = 6.17 SD = .95 R = 4.5	M = 5.54 SD = 1.09 R = 5
Frustration in Comparison Task	M = 1.18 SD = .39 R = 3.0	M = 1.55 SD = .84 R = 4.75	M = 1.92 SD = 1.07 R = 4.5
Clarity of Image Obtained	M = 6.56 SD = .69 R = 4.75	M = 6.20 SD =.984 R = 3.75	M = 5.62 SD = 1.08 R = 4.25
Vividness of Image Obtained	M = 6.45 SD = .89 R = 5.50	M = 6.08 SD = 1.10 R = 3.75	M = 5.49 SD = 1.16 R = 4.5
Ability to Hold the Image	M = 6.64 SD = .61 R = 4.0	M = 6.32 SD = .93 R = 4.0	M = 5.79 SD = 1.08 R = 4.50
Success in Holding the Image	M = 6.61 SD = .59 R = 3.0	M = 6.26 SD = .98 R = 4.0	M = 5.71 SD = 1.12 R = 5.0

Dependent variables were aggregated for the purposes of hypothesis testing. Participant confidence was obtained by averaging items 1 and 2 on the TAQ (see Appendix H), which were referred to as confidence and sure in Table 5.7. These two items were significantly correlated ($r = .933$, $p < .0001$). Frustration was a one item measure, item 3 on the TAQ. Imagery quality was obtained by averaging items 4 and 5 on the TAQ, referred to in Table 5.7 as clarity and vividness of the image obtained. These items were significantly correlated ($r = .675$, $p < .0001$). Imagery ability was obtained by averaging items 6 and 7 on the TAQ, referred to in Table 5.7 as ability to hold the image and success in holding the image. These variables also correlated ($r = .877$, $p < .0001$). The resulting dependent variables significantly correlated and those correlations are given in Table 5.8.

The correlation table and the trends within are easiest to examine when we break up the variables as within/between type of comparison made and within/between dependent variable measured. In general, confidence was negatively correlated with frustration, positively correlated with imagery quality, and positively correlated with ability to hold the image throughout the task. Frustration was also negatively correlated with image quality and the ability to hold the image, while image quality and the ability to hold the image were positively correlated with one another. Without exception, the strongest correlations between dependent variables lies within comparison type made. For example, confidence in shape comparison was more strongly negatively correlated with frustration with the shape comparison than with other types of comparisons. This trend was consistent for each dependent variable.

In examining within dependent variables and between comparison type, when participants were confident in one task they tended to be confident in all tasks. This is evident in that confidence in one type of comparison was consistently correlated with confidence in the other comparison tasks. Note that the correlations between texture comparisons (i.e., sandpaper and sheets) were stronger than were correlations between textures and shapes, indicating that the texture comparisons were more similarly scored than were the shape comparisons.

Table 5.8: Correlated Dependent Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1 Confidence in Shape Comparison	.											
2 Confidence in Sandpaper Comparison	.471***	.										
3 Confidence in Sheet Comparison	.279**	.629***	.									
4 Frustration in Shape Comparison	-.662***	-.474***	-.25**	.								
5 Frustration in Sandpaper Comparison	-.279**	-.737***	-.46***	.503***	.							
6 Frustration in Sheet Comparison	-.237**	-.514***	-.76***	.334***	.643***	.						
7 Quality of Shape Image	.51***	.454***	.213*	-.435***	-.359***	-.233*	.					
8 Quality of Sandpaper Image	.37***	.819***	.541***	-.397***	-.656***	-.497***	.644***	.				
9 Quality of Sheet Image	.227*	.619***	.762***	-.261**	-.474***	-.597***	.474***	.711***	.			
10 Ability to hold Shape Image	.557***	.541***	.287**	-.528***	-.355***	-.213*	.812***	.644***	.459***	.		
11 Ability to hold Sandpaper Image	.421***	.845***	.55***	-.394***	-.538***	-.408***	.58***	.908***	.652***	.696***	.	
12 Ability to hold Sheet Image	.311***	.632***	.828***	-.335***	-.488***	-.666***	.449***	.697***	.881***	.521***	.705***	.

***$p<.0001$

**$p<.01$

*$p<.05$

OVERALL MODEL

The data were analyzed using GLM Repeated Measures MANCOVA. The independent variables were: type of stimuli being compared (i.e., shape, sandpaper, sheet), imagery instructions given (i.e., haptic imagery versus visual imagery), and visual status (blind versus sighted). Covariates were: gender of participant, age of participant, handedness (left versus right), and age of blindness onset. Dependent variables were: reaction time, percent accurate, confidence, frustration, imagery quality, and imagery ability in each comparison task. Three covariates were not statistically significant. These were participant gender (F=1.519, p=.193, df=6); handedness (F=.36, p=.90, df=6), and age of blindness onset (F=.612, p=.72, df=6). Therefore, these variables were eliminated and the model run a second time without the insignificant covariates in an effort to preserve degrees of freedom.

Main Effects. Results of the overall model after eliminating insignificant covariates are given in Table 5.9. Main effects were found for age of respondent, visual status, and type of comparison task. Interactions were not significant but also lacked sufficient power.

Table 5.9: Main Effects and Interactions for Repeated Measures MANCOVA

	Variables	F	Df	P-value	Power
Main Effects	Age	4.231	6	<.0001	.974
	Imagery Instructions	.996	6	.432	.379
	Visual Status	5.418	6	<.0001	.995
	Type of Comparison Task	6.099	12	<.0001	1.0
Interactions	Imagery Instruction * Visual Status	.328	6	.921	.138
	Type of Comparison*Age	1.469	12	.149	.757

Table 5.9 (continued)

	Variables	F	Df	P-value	Power
	Type of Comparison*Instruction	.949	12	.502	.520
	Type of Comparison*Visual Status	1.444	12	.159	.748
	Type of Comparison*Imagery Instruction*Visual Status	.891	12	.559	.489

Hypothesized Relationships. The conceptual arguments given in chapter 3 outlined hypotheses for testing. Specifically, it was hypothesized that the blind and sighted participants would perform differently on product comparison tasks where haptic imagery and processing were required. Performance was measured with two objective measures (reaction time and accuracy rate) and four subjective measures (confidence, frustration, imagery quality, and imagery ability) as administered from the TAQ, discussed previously. The main effects for visual status were statistically significant, as can be seen in Table 5.9. Consequently, the data were split by visual status and the two groups were analyzed within group as well as compared. The overall model results by visual status are presented in Table 5.10.

Table 5.10: Overall Model by Visual Ability

	Variables	F	Df	P-value	Power
Main Effects	Age	4.047^{a} 2.239^{b}	6^{a} 6^{b}	$.002^{a}$ $.054^{b}$	$.956^{a}$ $.734^{b}$
	Imagery Instructions	$.862^{a}$ $.745^{b}$	6^{a} 6^{b}	$.529^{a}$ $.616^{b}$	$.308^{a}$ $.268^{b}$
	Type of Comparison Task	5.338^{a} 1.922^{b}	12^{a} 12^{b}	$<.0001^{a}$ $.057^{b}$	1.0^{a} $.833^{b}$
Interactions	Type of Comparison*Age	1.888^{a} $.786^{b}$	12^{a} 12^{b}	$.063^{a}$ $.662^{b}$	$.822^{a}$ $.382^{b}$

Table 5.10 (continued)

	Variables	F	Df	P-value	Power
	Type of Comparison*Instruction	.86a .863b	12a 12b	.591a .588b	.417a .421b

[a]Sighted; [b]Blind

As can be seen in Table 5.10, both groups had significant main effects for age and comparison type, although both variables were only marginally significant for the blind group. Imagery instructions did not show significant main effects for either group, but this could be due to lack of power and may show significance with the inclusion of additional participants in the future. A post-hoc power analysis conducted with an online power analysis calculator for ANOVA designs indicated that 50 additional participants are needed of for an effect size as small as .25 (http://euclid.psych.yorku.ca/cgi/power.pl). Also showing nonsignificant effects were the interaction of comparison type with age and the interaction of comparison type with imagery instructions. Lack of power was also at issue with these interactions.

Age as a Covariate. Tests of within and between subjects effects averages dependent variables across comparison task. This analysis revealed further information. For sighted participants, age did not significantly covary with reaction time (F=.330, p=.568) or accuracy rate (F=.000, p=.991). Age did significantly covary with confidence on sheet (B = .034, p = .003) and sandpaper (B = .033, p = .001) tasks (F=12.055, p=.001, eta = .18), frustration on sheet (B = -.030, p = .011) and sandpaper (B = -.028, p = .003) tasks (F=7.291, p=.009, eta = .117), imagery quality on sheet (B = .042, p < .0001) and sandpaper (B = .039, p < .0001) tasks (F=18.828, p<.0001, eta = .255), and imagery ability on sheet (B = .034, p = .001) and sandpaper (B = .027, p = .006) tasks (F=9.444, p=.003, eta = .147). Again, imagery instructions had no significant effects on any dependent variables: reaction time (F=1.54, p=.22); accuracy rate (F=1.899, p=.174); confidence (F=.038, p=.847); frustration (F=.002, p=.966); imagery quality (F=.189, p=.666); or imagery ability (F=.121, p=.73).

The within and between subjects effects for blind showed different results. For this group, age did not significantly covary with any of the dependent variables averaged across task: reaction time (F=.000, p=.999), accuracy rate (F=.033, p=.857), confidence (F=.01, p=.92), frustration (F=.207, p=.651), imagery quality (F=.707, p=.404), and imagery ability (F=.472, p=.495). As was the case for the sighted group, imagery instructions had no significant effects on any dependent variables: reaction time (F=.076, p=.784); accuracy rate (F=1.494, p=.227); confidence (F=.152, p=.698); frustration (F=.207, p=.651); imagery quality (F=.707, p=.404); or imagery ability (F=.472, p=.495).

To further explore the covariance of age within each sample, correlation difference tests were performed. Table 5.11 gives the correlations between age and each of the dependent variables for each sample (blind versus sighted) and it gives the results of the correlation difference tests.

Table 5.11: Age Correlation Difference Tests Between Sighted and Blind

Dependent Variable		$R_{age, DV}$ Sighted	$R_{age, DV}$ Blind	R Difference Test
Shape	Reaction Time	.04, p = .77	.00, p = 1	Z = .22, p = .83
	Accuracy	-.02, p = .87	-.01, p = .91	Z = -.05, p = .96
	Confidence	.02, p = .89	-.01, p = .93	Z = .16, p = .87
	Frustration	.01, p = .95	.03, p = .83	Z = -.11, p = .91
	Imagery Quality	.21, p = .10	.09, p = .47	Z = .66, p = .51
	Imagery Ability	.07, p = .58	-.1, p = .46	Z = .92, p = .36
Sandpaper	Reaction Time	-.07, p = .58	.07, p = .59	Z = -.76, p = .45
	Accuracy	-.05, p = .69	.02, p = .89	Z = -.38, p = .70
	Confidence	**.44, p < .001**	-.06, p = .64	**Z = 2.88, p = .004**
	Frustration	**-.39, p < .001**	.03, p = .81	**Z = -2.39, p = .02**
	Imagery Quality	**.47, p < .001**	.01, p = .95	**Z = 2.7, p = .007**
	Imagery Ability	**.37, p < .001**	-.08, p = .56	**Z = 2.53, p = .01**

Table 5.11 (continued)

Dependent Variable		$R_{age, DV}$ Sighted	$R_{age, DV}$ Blind	R Difference Test
Sheet	Reaction Time	.01, p = .96	-.04, p = .73	Z = .27, p = .79
	Accuracy	.08, p = .57	-.11, p = .40	Z = 1.02, p = .15
	Confidence	**.38, p < .001**	-.02, p = .87	**Z = 2.25, p = .02**
	Frustration	**-.32, p = .01**	.02, p = .86	**Z = -1.89, p = .058**
	Imagery Quality	**.52, p < .001**	.08, p = .57	**Z = 2.66, p = .007**
	Imagery Ability	**.41, p < .001**	-.1, p = .43	**Z = 2.87, p = .004**

Age was differentially correlated with dependent variables for the sighted sample with regard to confidence, frustration, imagery quality, and imagery ability for texture comparisons only. These differences were not shown for shape comparisons. Further analysis will be necessary to fully understand the affect age has on this and/or other sighted samples.

Comparison Type as a Predictor. For sighted participants, all dependent variables significantly differed by type of comparison. These were reaction time (F = 7.676, p = .001, M_{shape} = 2613.79, $M_{sandpaper}$ = 3923.53, M_{sheet} = 4680.92); accuracy rate (F = 8.732, p < .0001, M_{shape} = .943, $M_{sandpaper}$ = .545, M_{sheet} = .612); confidence in judgment (F = 22.62, p < .0001, M_{shape} = 6.674, $M_{sandpaper}$ = 6.083, M_{sheet} = 5.315); frustration with the task (F = 16.518, p < .0001, M_{shape} = 1.218, $M_{sandpaper}$ = 1.676, M_{sheet} = 2.111); imagery quality during the task (F = 22.003, p < .0001, M_{shape} = 6.412, $M_{sandpaper}$ = 5.97, M_{sheet} = 5.155); and the ability to hold the image (F = 21.953, p < .0001, M_{shape} = 6.553, $M_{sandpaper}$ = 6.166, M_{sheet} = 5.395). Table 5.12 gives the results of a pairwise comparison of marginal means. In the table see that the lowest reaction times, highest confidence, lowest frustration, highest reported imagery quality, highest reported imagery ability, and highest percent correct were for shape comparisons, indicating that shapes were easiest for participants to compare. In comparing the two textured stimuli, the highest reaction times, lowest confidence, highest frustration, lowest reported imagery quality, and lowest ability to hold the imagery materialized for sheet comparisons. Means resulting from sandpaper comparisons fell in the middle of the shape and sheet comparisons on all variables with the exception of accuracy rate. Further, as shown in Table 5.12, most mean differences were significant except for the mean difference in reaction time between the two textures. That different was only marginally significant (MD = .067, p = .09). Participants overall had fewer correct responses for sandpaper than for any other type of comparison. This analysis indicates that sheet comparisons were the most difficult for sighted participants to make, while shapes were the easiest comparisons. This is regardless of imagery instructions given. Sighted participants' marginal means are given in Table 5.12 and the blind group's are given in Table 5.13.

Table 5.12: Pairwise Comparisons of Marginal Means by Comparison Type For Sighted Participants Only

Variable	**Comparison Task**	**Marginal Mean**	**Mean Differences**	**Significance Level**
Reaction Time (ms)	**Shape**	2613.79	(1-2) -1309.74	<.0001
	Sandpaper	3923.53	(2-3) -757.39	.001
	Sheet	4680.92	(1-3) -2067.129	<.0001
Accuracy Rate (%)	**Shape**	.943	(1-2) .398	<.0001
	Sandpaper	.545	(2-3) -.067	.09
	Sheet	.612	(1-3) .331	<.0001
Confidence	**Shape**	6.674	(1-2) .591	<.0001
	Sandpaper	6.083	(2-3) .768	<.0001
	Sheet	5.315	(1-3) 1.359	<.0001
Frustration	**Shape**	1.218	(1-2) -.458	<.0001
	Sandpaper	1.676	(2-3) -.434	.002
	Sheet	2.111	(1-3) -.893	<.0001
Imagery Quality	**Shape**	6.412	(1-2) .442	<.0001
	Sandpaper	5.970	(2-3) .815	<.0001
	Sheet	5.155	(1-3) 1.257	<.0001

Table 5.12 (continued)

Variable	Comparison Task	Marginal Mean	Mean Differences	Significance Level
Imagery Ability	**Shape**	6.553	(1-2) .387	<.0001
	Sandpaper	6.166	(2-3) .771	<.0001
	Sheet	5.395	(1-3) 1.158	<.0001

1=Shape; 2=Sandpaper; 3=Sheet

Many of the same variables were significant for type of comparison for the blind sample as well: reaction time ($F = 3.875$, $p = .024$, $M_{shape} = 3820.64$, $M_{sandpaper} = 5284.28$, $M_{sheet} = 6592.25$); accuracy rate ($F = 5.017$, $p = .008$, $M_{shape} = .898$, $M_{sandpaper} = .505$, $M_{sheet} = .573$); confidence in judgment ($F = 3.220$, $p = .04$, $M_{shape} = 6.732$, $M_{sandpaper} = 6.322$, $M_{sheet} = 5.901$); imagery quality during the task ($F = 2.734$, $p = .06$, $M_{shape} = 6.603$, $M_{sandpaper} = 6.303$, $M_{sheet} = 5.908$). In univariate tests, frustration with the task ($F = 1.7$, $p = .187$) and ability to hold the image ($F = 1.323$, $p = .27$) were not significant for the blind participants.

The marginal means difference test revealed similar results for the blind sample as with the sighted sample. Sheet comparison resulted in the highest reaction times, lowest confidence, highest frustration, lowest imagery quality reported, and lowest imagery ability. Like in the sighted sample, accuracy for sheet comparisons was higher than for sandpaper comparisons. Shape comparisons resulted in the lowest reaction times, highest percent correct, highest confidence, lowest frustration, highest imagery quality, and highest imagery ability. Table 5.13 shows the marginal means for these variables and the significance values for the Mean Difference Test.

Table 5.13: Pairwise Comparisons of Marginal Means by Comparison Type For Blind Participants Only

Variable	Comparison Task	Marginal Mean	Mean Difference	Significance Level
Reaction Time (ms)	**Shape**	3820.64	(1-2) -1463.63	<.0001
	Sandpaper	5284.28	(2-3) -1307.97	<.0001
	Sheet	6592.25	(1-3) -2771.61	<.0001
Accuracy Rate (%)	**Shape**	.898	(1-2) .394	<.0001
	Sandpaper	.505	(2-3) -.068	.115
	Sheet	.573	(1-3) .326	<.0001
Confidence	**Shape**	6.732	(1-2) .411	<.0001
	Sandpaper	6.322	(2-3) .421	<.0001
	Sheet	5.901	(1-3) .831	<.0001
Frustration	**Shape**	1.127	(1-2) -.309	<.0001
	Sandpaper	1.436	(2-3) -.277	.002
	Sheet	1.713	(1-3) -.586	<.0001
Imagery Quality	**Shape**	6.603	(1-2) .30	.001
	Sandpaper	6.303	(2-3) .395	<.0001
	Sheet	5.908	(1-3) .695	<.0001
Imagery Ability	**Shape**	6.73	(1-2) .324	<.0001
	Sandpaper	6.406	(2-3) .309	<.0001
	Sheet	6.098	(1-3) .633	<.0001

1=Shape; 2=Sandpaper; 3=Sheet

Hypotheses 1-3 and 7-9. As presented in Chapter 3, hypotheses 1-3 predicted that when sighted participants engaged in a product comparison task, they would have a more difficult time when using haptic imagery for evaluating texture stimuli and when using visual imagery for evaluating shape stimuli (H1). Also, when using haptic imagery for evaluating shape stimuli and when using visual imagery for evaluating textured stimuli, sighted participant performance was predicted to be facilitated (H2). Likewise, interference was expected to decrease confidence and increase frustration, while facilitation was expected to increase confidence and decrease frustration (H3). The blind sample was predicted to have differing results from the sighted participants. For the blind, haptic imagery was expected to interfere with texture evaluations but not as much as with the sighted sample (H7). As in the case of the sighted, blind participants use of haptic imagery was expected to facilitate the evaluation of shape stimuli (H8). Differing from the predictions for the sighted, and due to the diminished visual imagery ability of the blind, visual imagery use was expected to interfere with all types of stimuli evaluation, whether textured or shaped (H9). In testing these specific hypotheses for both the sighted and the blind participants, correlations showing general trends are presented, followed by specific F-tests and a discussion of mean differences.

Preliminary correlations revealed general trends. Sighted participants reaction times within a stimulus comparison type were correlated as would be expected. Specifically, for sighted participants making shape comparisons, longer reaction times were significant with lower overall confidence in the task ($r = -.44$, $p < .001$). In sandpaper comparisons longer reaction times were significant with lower confidence ($r = -.51$, $p < .001$) and higher frustration ($r = .34$, $p = .01$). In sheet comparisons, longer reaction times were significantly correlated with lower confidence ($r = -.33$, $p < .01$) higher frustration ($r = .43$, $p < .001$). Interestingly, longer reaction times were not significantly correlated with percent correct within each task: reaction time and percent correct on shape comparisons ($r = -.14$, $p = .29$); reaction time and percent correct on sandpaper comparisons ($r = -.11$, $p = .42$); reaction time and percent correct on sheet comparisons ($r = -.02$, $p = .90$).

Main effect for imagery instructions (haptic vs. visual imagery instructions), which was a between participant variable, was not found to be significant for either the sighted ($F = .862$, $p = .529$, $(1-\beta) = .308$) or the blind ($F = .745$, $p = .616$, $(1-\beta) = .268$), although this could be due to lack of power in both cases. Further, there was no significant effect for (comparison type * imagery instructions) interaction for either sighted (F = .86, p = .591, (1-β) = .417) or blind (F = .863, p = .588, (1-β) = .421) participants.

Although there were no significant effects for imagery instructions and no statistical support for H1-H3 or H7-H9, Table 5.14 gives values of the dependent variables within each condition. In each texture comparison cell the first number represents the mean for sandpaper comparisons, while the second represents the sheet comparisons. The shape comparison cells contain only one mean because there was only one type of shape comparison task. The values in the expected direction have been highlighted and labeled to show trends. The corresponding hypothesis is also referenced.

Table 5.14: Non-Significant Trends for Sighted

Type of Comparison	Variable	Haptic Imagery Instruction	Visual Imagery Instruction
Texture Comparison: Sandpaper 100/180 Sheet 200/400	RT (sand/sheet)	3773.45/ 4449.29	4076.64 / 4914.1
	Confidence	6.0[c] / 5.3	6.15[c] / 5.3
	Frustration	1.72[c] / 2.08	1.64/ 2.14
	Imagery quality	6.06/ 5.05	5.88/ 5.25
	% Correct	.51[a] / .61	.58[b] / .61
Shape Comparison: ball/cube	RT	2343.8[b]	2884.63[a]
	Confidence	6.57[c]	6.77
	Frustration	1.31	1.12
	Imagery quality	6.39	6.43
	% Correct	.93[b]	.96

[a] Consistent with H1; [b] Consistent with H2; [c] Consistent with H3

As shown in Table 5.14, using haptic imagery while making texture comparisons (compared to when visual imagery was used) led to faster reaction times for both types of textured stimuli (M = 3773.45 vs. 4076.64 for sandpaper; M = 4449.29 vs. 4914.1 for sheet), which is inconsistent with H1. It was predicted that participants would be slower in conditions where the haptic resource areas were being used simultaneously. Using haptic imagery for sandpaper comparisons did result in lower confidence (M = 6.0 vs. 6.15), higher frustration (M = 1.72 vs. 1.64), and lower percent correct (M = .51 vs. .58), which were consistent with H1 and H3. Sheet comparisons, however, did not show these same trends. For sheet comparisons confidence was the same across both types of imagery used (M = 5.3 vs. 5.3), frustration was higher when using visual imagery (M = 2.08 vs. 2.14), and accuracy rate (M = .61 vs. .61) was the same for both conditions. Using visual imagery during texture comparisons led to slower reaction times than when visual imagery was used for shape comparisons (M = 4076.64/4914.1 vs. 2884.63), also inconsistent with H1. No other dependent variables showed trends predicted by H3. Using visual imagery versus haptic imagery when making shape comparisons led to slower reaction times (M = 2884.63 vs. 2343.8) and higher confidence (M = 6.77 vs. 6.57), inconsistent with H2 and H3. Also inconsistent with prediction, when using haptic imagery for making shape comparisons percent correct was higher than when using visual imagery (M = .96 vs. .93).

As with the sighted, preliminary correlations of the data provided by the blind sample revealed general trends. Reaction times within a stimulus comparison type were correlated similarly to what was seen with the sighted sample. For blind participants making shape comparisons, longer reaction times were significant with lower overall confidence in the task ($r = -.37$, $p < .001$) as well as higher frustration ($r = .30$, $p < .05$). In sandpaper comparisons longer reaction times were significant with lower confidence ($r = -.46$, $p < .001$) and frustration was marginally significant ($r = .22$, $p = .08$). In sheet comparisons, longer reaction times were significantly correlated with lower confidence ($r = -.31$, $p < .05$). Frustration was not significant ($r = .19$, $p = .15$). Consistent with sighted findings, longer reaction times were not significantly correlated with percent correct within task: reaction time and percent correct on shape comparisons (r = -.07, p = .58); reaction time and percent correct on sandpaper comparisons (r = -.10, p = .44); reaction time and percent correct on sheet comparisons (r = -.08, p = .54).

As was given above for the sighted sample, Table 5.15 provides values for trends provided by the blind sample within each imagery condition. Again, in each texture comparison cell the first number represents the mean for sandpaper comparisons, while the second represents the sheet comparisons. The shape comparison cells contain only one mean because there was only one type of shape comparison task. H7 was not supported with regard to the comparison against the interference shown for the sighted sample in regards to reaction time (M = 3773.45 vs. 5411.74 and M = 4449.29 versus 6487.53) or accuracy (M = .51 vs. .48 and M = .61 versus .53). H8 was supported in that within the haptic imagery condition, reaction times were faster for shape comparisons (M = 3551.43) than for either type of texture comparison (M = 5411.74 and 6487.53). Likewise, within the haptic imagery condition, confidence was higher in the shape comparison (M = 6.77) than in either texture comparison (M = 6.23 and 5.87). Frustration was lower in the shape comparison (M = 1.13) than in either texture comparison (M = 1.43 and 1.63). Imagery quality was higher in the shape comparison (M = 6.52) than in either texture comparison (M = 6.18 and 5.85). These findings are consistent with H8.

Table 5.15: Non-Significant Trends for Blind

Type of Comparison	Variable	Haptic Imagery Instruction	Visual Imagery Instruction
Texture Comparison: Sandpaper 100/180 Sheet 200/400	**RT (sand/sheet)**	5411.74/6487.53	5156.98/6696.91[c]
	Confidence	6.23 /5.87	6.41/5.94
	Frustration	1.43 /1.63	1.44/1.80[c]
	Imagery quality	6.18 /5.85	6.42/5.97
	% Correct	.48/.53	.53/.61
Shape Comparison: ball/cube	**RT**	3551.43	4089.73[c]
	Confidence	6.77	6.69
	Frustration	1.13	1.13
	Imagery quality	6.52	6.69
	% Correct	.90	.90

[a] Consistent with H7; [b] Consistent with H8; [c] Consistent with H9

H9 predicted that in any condition where blind participants used visual imagery to make comparisons, performance would suffer compared with the performance of sighted participants. Blind participants did have higher reaction times when using visual imagery than did the sighted for all conditions including sandpaper (M = 5156.98 versus 4076.64), sheet (M = 6696.91 versus 4914.1), and shape (M = 4089.73 versus 2884.63) comparisons. Likewise, blind participants had lower accuracy rates than did the sighted for sandpaper (M = .53 versus .58) and shape (M = .90 versus .96) but not for sheet (M = .61 versus .61) comparisons. These trends are consistent with H9. However, in the visual imagery condition the blind sample reported higher confidence in texture comparisons ($M_{sandpaper}$ = 6.41 versus 6.15; M_{sheet} = 5.94 versus 5.3) but not shape comparison (M = 6.69 versus 6.77). Likewise, the blind reported lower frustration in both types of texture comparisons than did the sighted ($M_{sandpaper}$ = 1.44 versus 1.64; M_{sheet} = 1.8 versus 2.14) but there was no difference in the shape comparison (M = 1.13 versus 1.12). As in the other cases, the blind sample reported higher imagery quality than did the sighted sample in texture comparisons ($M_{sandpaper}$ = 6.42 versus 5.88; M_{sheet} = 5.97

versus 5.25). In this case, the blind also reported higher imagery quality in the shape comparison (M = 6.69 versus 6.43). The blind sample did have an accuracy rate lower than sighted for sandpaper comparisons when using visual imagery (M = .53 versus .58) , but the accuracy rate for sheet comparisons was the same as that of the sighted persons (M = .61). In essence, the objective measures of reaction time and accuracy were in the predicted direction but subjective, self report measures revealed that the blind participants self reported more favorably than the sighted sample.

Hypothesis 4. Hypothesis 4 stated that blind individuals would show superior haptic imagery ability as measured by the Haptic Imagery Questionnaire. A one-way ANOVA was used to assess the mean differences of blind (M = 4.33) and sighted (M = 3.93) participants on the haptic imagery scale, which measures haptic imagery ability. The differences were significant (F = 8.234, p = .005), and H4 was supported in the expected direction.

Additional Analyses of Haptic Imagery Instruction Condition. As a follow-up, a median split was performed with the HIQ scale (median = 4.275) this was included in a 2 x 2 ANOVA analysis using visual status (blind versus sighted, which was between subjects) and HIQ (low versus high-between subjects).

There was a main effect for visual status on reaction time (F = 4.152, p = .01), so that the blind took longer to respond (M_{shape} = 3613.87; $M_{sandpaper}$ = 5408.44; M_{sheet} = 6391.84) than the sighted (M_{shape} = 2371.95; $M_{sandpaper}$ = 3789.63; M_{sheet} = 4459.77) in all tasks. There was also a main effect on imagery quality (F= 3.051, p = .036) so that the blind reported higher imagery quality (M_{shape} = 6.52; $M_{sandpaper}$ = 6.18; M_{sheet} = 5.85) than did the sighted (M_{shape} = 6.42; $M_{sandpaper}$ = 6.1; M_{sheet} = 5.13). There was a main effect for visual status on the reported ability for the participant to hold the image during the task (F = 2.916, p = .043) so that the blind reported that they were more able to hold the image in their minds (M_{shape} = 6.65; $M_{sandpaper}$ = 6.3; M_{sheet} = 6.09) than did the sighted (M_{shape} = 6.53; $M_{sandpaper}$ = 6.25; M_{sheet} = 5.42) for the duration of each task. No main effects for visual status were found for accuracy (F = 1.012, p = .395), confidence (F = 1.665, p = .186), or frustration (F = .967, p = .415).

A main effect for High/Low HIQ was found for confidence (F = 3.204, p =.03) in that those with high haptic imagery ability reported higher confidence (M_{shape} = 6.83; $M_{sandpaper}$ = 6.47; M_{sheet} = 5.91) than those with low haptic imagery ability (M_{shape} = 6.54; $M_{sandpaper}$ = 5.80; M_{sheet} = 5.33). There was a main effect on imagery quality (F = 4.832, p = .005) in that those with high haptic imagery ability consistently reported higher imagery quality (M_{shape} = 6.79; $M_{sandpaper}$ = 6.58; M_{sheet} = 5.86) than those with low haptic imagery ability (M_{shape} = 6.14; $M_{sandpaper}$ = 5.69; M_{sheet} = 5.11) in all tasks. There was a main effect for high/low haptic imagery ability on the reported ability for the participant to hold the image during the task (F = 3.849, p = .014) so that those high in haptic imagery ability reported that they were more able to hold the image in their minds (M_{shape} = 6.80; $M_{sandpaper}$ = 6.64; M_{sheet} = 6.14) than those with low haptic imagery ability (M_{shape} = 6.37; $M_{sandpaper}$ = 5.9; M_{sheet} = 5.37) for the duration of each task. No main effect for High/Low HIQ was found for reaction time (F = 1.422, p = .246), accuracy (F =.465, p =.708), frustration (F = 2.10, p = .111). There were no significant interaction effects for high/low HIQ by visual status on any of the dependent variables.

In summary, blind participants took longer to respond than sighted participants, which could be explained in a number of ways. Blind participants may have taken longer to push the response buttons because the correct response was more difficult for them to discern (sighted participants had visual button labels, which blind participants were forced to feel the Braille labels, which takes longer) or because the blind participants were processing more elaborately, which would take more time. The blind participants also reported higher imagery quality and higher ability to hold the haptic image in their minds while performing the task. This is reasonable given that the blind participants were expected to outperform sighted in the haptic imagery task. Also as expected, participants who scored high on the haptic imagery questionnaire (HIQ), were faster in their responses, reported being more confident and less frustrated, reported their imagery quality and ability to hold their imagery higher than those who scored low on the HIQ.

Task Induced Haptic Imagery. Although the blind participants scored better than sighted on the HIQ, their results on the comparison tasks were mixed. A one-way ANOVA assessed the mean differences for those using only haptic imagery across comparison types. This analysis provided a synopsis of performance differences for those participants using haptic imagery in the tasks and does not include those who were instructed to use visual imagery.

The most interesting findings were with the sheet comparison tasks, which were previously discussed as the most difficult comparisons when using either haptic or visual imagery. The blind did not perform better than the sighted with haptic imagery when comparing sheets when measured objectively: reaction time (M = 6391.84 versus 4459.77, F = 8.628, p = .005) and accuracy rate (M = .53 versus .62, F = 2.12, p = .151), but the blind sample did report feeling marginally significantly more confident (M = 5.78 versus 5.37, F = 3.802, p = .056), marginally significantly less frustrated (M = 1.63

versus 2.03, F = 3.264, p = .076), having significantly higher imagery quality (M = 5.85 versus 5.13, F = 6.713, p = .012) and ability to hold the imagery throughout the task (M = 5.42 versus 6.09, F = 6.575, p = .013). Perhaps blind participants expected that previous haptic experience would show significantly better performance than what resulted from the task. Results for this ANOVA are given in Table 5.16.

Table 5.16: One-Way ANOVA Comparing Sighted and Blind for Use of Haptic Imagery

Dependent Variable		Sighted Mean/SD	Blind Mean/SD	F	Df	P-value	SS
Shape	Reaction Time (ms)	M=2333.73 SD=1068.65	M=3613.87 SD=1741.91	11.578	1	.001	24554101
	Accuracy	M= .93 SD= .13	M= .90 SD= .14	.627	1	.432	.012
	Confidence	M= 6.59 SD=.52	M= 6.77 SD= .29	2.779	1	.101	.484
	Frustration	M= 1.29 SD= .62	M= 1.14 SD= .26	1.644	1	.205	.365
	Imagery Quality	M= 6.42 SD= .73	M= 6.53 SD= .88	.255	1	.615	.168
	Imagery Ability	M= 6.53 SD= .65	M= 6.65 SD= .68	.511	1	.478	.227
Sandpaper	Reaction Time	M=3789.96 SD=1993.68	M=5408.44 SD=2524.63	7.525	1	.008	39248152
	Accuracy	M= .51 SD= .17	M= .48 SD= .22	.42	1	.52	.016
	Confidence	M= 6.05 SD=1.26	M= 6.24 SD= .76	.510	1	.478	.544
	Frustration	M= 1.68 SD= 1.08	M= 1.45 SD= .59	1.06	1	.308	.789
	Imagery Quality	M= 6.1 SD=1.06	M= 6.19 SD= .93	.123	1	.727	.122
	Imagery Ability	M= 6.25 SD= .97	M= 6.32 SD= .89	.081	1	.776	.07
Sheet	Reaction Time	M=4459.77 SD=1739.11	M=6391.84 SD=3061.20	8.628	1	.005	54917688
	Accuracy	M= .62 SD= .21	M= .53 SD= .23	2.12	1	.151	.103
	Confidence	M= 5.37 SD= 1.1	M=5.87 SD= .84	3.802	1	.056	3.627

Table 5.16 (continued)

Dependent Variable		Sighted Mean/SD	Blind Mean/SD	F	Df	P-value	SS
Sheet	Frustration	M= 2.03 SD= 1.05	M= 1.63 SD= .65	3.264	1	.076	2.473
	Imagery Quality	M= 5.13 SD=1.14	M= 5.85 SD= 1.0	6.713	1	.012	7.662
	Imagery Ability	M= 5.42 SD= .99	M= 6.09 SD= 1.0	6.575	1	.013	6.523

Additional Analyses of Visual Imagery Instruction Condition. A median split was performed with the VVIQ-2 scale (median = 3.50) and as done with the HIQ analyses discussed previously, this was included in a 2 x 2 ANOVA analysis using visual status (blind versus sighted, which was between subjects) and VVIQ-2 (low versus high- between subjects).

There was a main effect for visual status on reaction time (F = 3.041, p = .038), so that the blind took longer to respond (M_{shape} = 4229.49; $M_{sandpaper}$ = 5328.40; M_{sheet} = 6825.6) than the sighted (M_{shape} = 2917.88; $M_{sandpaper}$ = 3942.71; M_{sheet} = 4879.86) in all tasks. There was a main effect for visual status on the reported ability for the participant to hold the image during the task (F = 2.742, p = .05) so that the blind reported that they were more able to hold the image in their minds (M_{shape} = 6.79; $M_{sandpaper}$ = 6.48; M_{sheet} = 6.10) than did the sighted (M_{shape} = 6.59; $M_{sandpaper}$ = 6.31; M_{sheet} = 5.63) for the duration of each task. No main effects for visual status was found for accuracy (F = 1.48, p = .231), confidence (F = 1.276, p = .293), frustration (F = .40, p = .754), or imagery quality (F= 1.615, p = .197) were found.

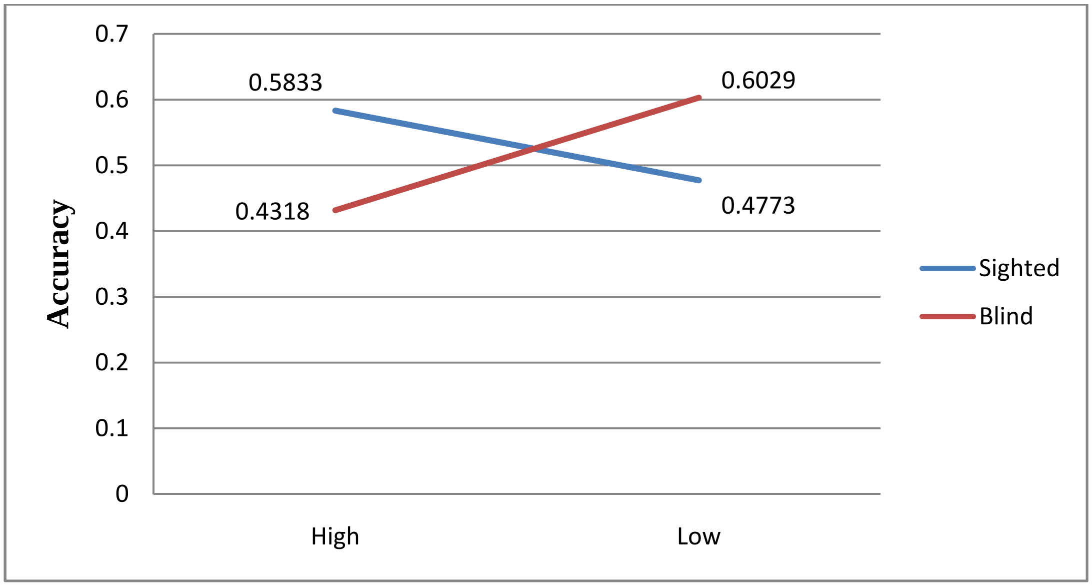
No main effects for High/Low VVIQ-2 was found for reaction time (F = .774, p = .514), accuracy (F =.639, p =.594), confidence (F = 1.616, p =.197), frustration (F =

1.164, p = .333), imagery quality (F = .575, p = .634),or reported ability for the participant to hold the image during the task (F = .822, p = .488).

There was a significant interaction effect for high/low VVIQ-2 by visual status on accuracy (F = 5.071, p = .004). Further examination revealed that this significant finding was driven by accuracy on the sandpaper task (F = 11.18, p = .002). Figure 5.2 charts the interaction and gives the means represented. A univariate general linear model was used to explore the relationships in Figure 5.2.

The data were split to reveal the differences between sighted and blind within the high VVIQ condition and within the low VVIQ condition. Mean accuracy for sandpaper tasks performed by those with high visual imagery ability differed significantly between the sighted and the blind (F = 4.184, p = .051, $M_{sighted}$ = .5833, M_{blind} = .4318). Likewise, significant differences were found for the sighted versus blind in the low visual imagery ability category (F = 4.861, p = .037, $M_{sighted}$ = .4773, M_{blind} = .6029).

Figure 5.2: Visual Status x Visual Imagery Ability Interaction on Accuracy



In summary, as was the case for the haptic imagery instruction condition discussed previously, the blind participants took significantly longer to respond than sighted participants. A number of explanations for that finding were previously suggested including more elaborate processing on the part of the blind participants or more difficulty in discerning the response options. Also consistent with the haptic imagery instruction condition, blind participants reported significantly higher ability to hold the image during the task, although they did not report higher imagery quality in this condition. These findings may indicate that although their visual imagery quality may not be superior to that of the sighted, the blind participants' ability to hold the image may indicate a longer memory store, a byproduct of the necessity for the blind to mentally store information for longer periods. There were no main effects for high/low visual imagery ability. Evidence that visual imagery ability interacts with visual status did emerge. Sighted participants with higher visual imagery ability were more accurate than blind participants with high visual imagery ability, but blind participants with low visual imagery ability were more accurate than the sighted with low visual imagery ability on tasks comparing sandpaper. This finding suggests that perhaps the blind participants were not using visual imagery to perform the sandpaper comparison tasks.

Task Induced Visual Imagery. A one-way ANOVA assessed the mean differences for those using only visual imagery across comparison types. This analysis provided a synopsis of performance differences for those participants using visual imagery in the tasks and does not include those who were instructed to use haptic imagery.

As in the haptic imagery condition, the blind did not perform better than the sighted with visual imagery when comparing sheets when measured objectively: reaction time (M = 4878.86 versus 6696.91, F = 9.462, p = ..003) or accuracy rate (M = .63 versus ..61, F = .081, p = ..778), and the blind sample again reported feeling significantly more confident (M = 5.87 versus 5.3, F = 4.091, p = .047), having significantly higher imagery quality (M = 5.96 versus 5.3, F = 6.465, p = .014) and ability to hold the imagery throughout the task (M = 6.05 versus 5.45, F = 4.734, p = .033). Imagery quality and imagery ability measures did not significantly differ on the other comparison tasks. Results for this ANOVA are given in Table 5.17.

Table 5.17: One-Way ANOVA Comparing Sighted and Blind for Use of Visual Imagery

Dependent Variable		Sighted Mean/SD	Blind Mean/SD	F	Df	P-value	SS
Shape	Reaction Time (ms)	M= 2959.94 SD=1311.64	M= 4085.76 SD= 2385.02	5.435	1	.023	1.996
	Accuracy	M= .95 SD= .10	M= .89 SD= .20	2.729	1	.104	.069
	Confidence	M= 6.75 SD= .31	M= 6.66 SD= .42	1.002	1	.321	.137
	Frustration	M= 1.13 SD= .27	M= 1.16 SD= .31	.196	1	.659	.017
	Imagery Quality	M= 6.41 SD= .73	M= 6.67 SD= .50	2.836	1	.097	1.114
	Imagery Ability	M= 6.56 SD= .59	M= 6.76 SD= .42	2.354	1	.13	.625
Sand-paper	Reaction Time	M= 3968.46 SD= 1734.9	M= 5287.92 SD= 2484.69	6.004	1	.017	2.741
	Accuracy	M= .58 SD= .21	M= .53 SD= .17	.889	1	.349	.033
	Confidence	M= 6.18 SD= .82	M= 6.34 SD= .82	.61	1	.438	.413
	Frustration	M= 1.61 SD= .94	M= 1.46 SD= .70	.498	1	.483	.343
	Imagery Quality	M= 5.89 SD= 1.16	M= 6.38 SD= .89	3.493	1	.066	3.761
	Imagery Ability	M= 6.14 SD= 1.04	M= 6.45 SD= .89	1.647	1	.204	1.548
Sheet	Reaction Time	M=4878.86 SD=1857.86	M=6696.91 SD=2758.5	9.462	1	.003	5.102

Table 5.17 (continued)

Dependent Variable		Sighted Mean/SD	Blind Mean/SD	F	Df	P-value	SS
Sheet	Accuracy	M= .63 SD=.2	M= .61 SD= .26	.081	1	.778	.004
	Confidence	M= 5.3 SD= 1.24	M= 5.87 SD= .97	4.091	1	.047	5.134
	Frustration	M= 2.13 SD= 1.32	M= 1.87 SD= 1.12	.72	1	.399	1.08
	Imagery Quality	M= 5.3 SD=1.13	M= 5.96 SD= .92	6.465	1	.014	6.913
	Imagery Ability	M= 5.45 SD= 1.2	M= 6.05 SD= .99	4.734	1	.033	5.794

Exploring the Statistical Significance of Accuracy. In an effort to examine which factors affected accuracy of the comparison task, a series of regressions were performed. In these analyses, items from the TAQ were tested for their prediction of accuracy within each type of comparison. TAQ items did significantly predict accuracy for comparing shapes (F = 6.443, p < .0001) but not sandpaper (F = 1.027, p = .396) or sheets (F = 1.397, p = .24). Specifically, confidence was the only variable from the TAQ items that significantly predicted accuracy (β= .539, t = 4.549, p < .0001). All other variables were non-significant: frustration (t = .788, p = .432), imagery quality (t = .152, p = .88), and imagery ability (t = 1.213, p = .228).

Hypotheses 5 & 6. Hypotheses 5 and 6 predicted that the longer a person had been blind, the higher they would score on the haptic imagery scale and the lower they would score on the visual imagery scale. Each of these scales is purported to measure respondent ability on their perspective imagery modality. Of the 63 blind participants who revealed their age since losing sight to the point of legal blindness, 60% (N = 38) were blind since birth. Ten were over the age of 18 at the point of blindness, and the remaining 15 became blind sometime between a year old and the age of 17. As predicted by H6, length of time since the onset of blindness was negatively correlated with visual imagery ability as measured by the VVIQ ($r = -.52$, $p < .0001$). Contrary to prediction by H5, however, scores on the haptic imagery ability measure did not significantly correlate with length of time since becoming blind ($r = .118$, $p = .35$). Curiously, in the product comparison task the blind individuals consistently reported higher imagery quality when asked to use visual imagery than when asked to use haptic imagery in each type of task, even though the visual imagery ability measure was negatively related to length of blindness (see Table 5.15).

ANALYSIS FOR STUDY 2

The same participants for study 1 also participated in study 2. For participant characteristics, please see the beginning of this chapter. In study 2 participants listened to five advertisements and were told that one would be randomly selected to recall at a later time. The third advertisement heard, for a multipurpose handle grip, was the target ad and the other four advertisements were rotated in presentation order around the third ad (See ads in Appendix C). Participants then touched grips with either texture or shape salient properties while recalling information from the advertisement. The grips were pretested for salience on each property (See pretest analyses in chapter 4). Two texture grips were used and 2 shapely grips were used for this study, but each participant only touched one grip with the property of their assigned condition.

Questionnaires. In addition to the questionnaires already described, study 2 used the 14-item Communication Evoked Imagery Scale (CEI) (Babin and Burns 1998) and a 12-item Advertisement Assessment Questionnaire (AAQ). Since the CEI and AAQ

Scales were used only in study 2, the psychometric properties will be discussed in a subsequent section. The CEI Scale assessed the imagery of the target advertisement and had reliability of linear combinations equal to .942 for both sighted and blind, .951 for sighted only, and .936 for blind only. The Advertisement Assessment Questionnaire contained items with multiple response options. All items for both questionnaires were presented with a 7-point Likert scale.

The AAQ contained items from various sources. The assessment of "overall feeling regarding the advertisement" was anchored with "very favorable" to "very unfavorable" and "very bad" to "very good" and "very negative" to "very positive" (Peck and Wiggins 2006) and had an alpha of .934. Frustration was measured with one item anchored with "not at all frustrated" to "extremely frustrated." Confidence was assessed with two questions anchored with "not at all confident" to "extremely confident" and "not at all sure" to "extremely sure" (Peck and Childers 2003b) with an alpha of .913. Six imagery related items were asked to assess clarity ("not at all clear" to "extremely clear") and vividness ("not at all vivid" to "extremely vivid") of the imagery, two items assessing visual imagery, and two items assessing haptic imagery (Unnava et al. 1996) had an alpha of .913. Attitude toward the advertisement was assessed with a 10-item measure taken from Voss, Spangenberg, and Grohmann (2003), which had alpha of .947, asked participants to rate the advertisement as: ineffective/effective; not enjoyable/enjoyable; unhelpful/helpful; not thrilling/thrilling; not functional/functional; not delightful/delightful; unnecessary/necessary; dull/exciting; impractical/practical; not fun/fun. Likelihood of purchase was assessed with an item from Argo et al. (2006) "not at all likely" to "extremely likely." Also taken from Argo, et al. (2006), overall product evaluations were measured with five items: bad/good; undesirable/desirable; unfavorable/favorable; worthless/worthwhile; useless/useful. These items had alpha of .958.

Recall. Other dependent variables were the number and type of recall statements given by the participants. As previously discussed, coders were given instructions and asked to determine the types of statements given in the free recall of the advertisements. Coder instructions are included in Appendix L. Types of recall statements that coders were asked to determine were texture imagery statements, shape imagery statements, non-imagery statements, additional statements, and comparative statements. Once the final number of each type of statement was determined for each participant, an overall total number of statements was calculated for each participant. The texture imagery, shape imagery, and non-imagery statements were predefined as the advertisement was being constructed (see chapter 4). Every attempt was made to keep the number of texture and shape imagery statements equal. The target advertisement contained 2 passages to elicit texture imagery, 2 passages to elicit shape imagery, and 2 passages to elicit non-imagery product information (See chapter 4 for the pretests of imagery elicitation). Additional statements included any statements about the advertisement that did not fit into the other three categories. Comparative statements were defined as any statement where the respondent compared the grip touched with what was expected from the advertisement. Since participants were asked to recall everything they could remember from the advertisement, most did not engage in comparisons. Table 5.18 gives the descriptive statistics for each measure, while Table 5.19 shows the correlations between dependent variables. Significant correlations are on the bottom diagonal, while non-significant values are given in the top diagonal. Marginally significant correlations are included with significant correlations on the bottom diagonal.

Table 5.18: Descriptive Statistics

Variable	Mean	Standard Deviation	Range
Texture Imagery Statements	.96	1.15	0-6
Shape Imagery Statements	1.56	1.25	0-7
Non-Imagery Statements	2.26	1.28	0-6
Additional Statements	.55	1.03	0-7
Comparison Statements	.43	1.19	0-7
Total Statements	5.72	3.1	1-21
CEI Vividness	4.5	1.44	1-7
CEI Quantity	3.61	1.9	1-7
CEI Elaboration	4.2	1.67	1-7
Overall CEI	4.17	1.27	1-7
Overall Feeling Toward Ad	4.81	1.48	1-7
Frustration with Recall Task	4.35	1.7	1-7
Confidence with Recall Task	4.04	1.44	1-7
Clarity of Imagery	4.64	1.8	1-7
Vividness of Imagery	4.52	1.77	1-7
Visual Imagery	4.93	1.60	1-7
Haptic Imagery	5.08	1.86	1-7
Attitude Toward Ad	4.01	1.33	1-6.6
Likelihood of Purchase	2.95	1.82	1-7
Product Evaluation	4.35	1.63	1-7

Overview of Notable Correlations. From Table 5.19, participant ratings of the advertisement's ability to evoke imagery were positively correlated with overall feeling and attitude toward the ad and confidence with the recall task as measured by the

Communication Evoked Imagery Scale dimensions of vividness, quantity, and elaboration as well as by the AAQ items measuring clarity and vividness of participant-specific imagery. The same variables were negatively associated with frustration with the recall task, indicating that when imagery was vivid and clear during the task (according to self report), participants were more confident, less frustrated, and had a better overall feeling and attitude toward the advertisement.

The HIQ was positively associated with the three dimensions of the CEI Scale as well as AAQ items measuring visual and haptic imagery evoked by the ad. The VVIQ-2 was significantly and positively correlated with the vividness dimension of the CEI and marginally significantly associated with the quantity dimension. The VVIQ-2 did not significantly correlate with the elaboration dimension or the AAQ measure of haptic imagery evoked by the ad. Further, the HIQ scores were positively correlated with likelihood of purchase but the VVIQ-2 was not. The HIQ/likelihood to purchase correlation could not be attributed to an effect of visual impairment versus sighted, as vision was not correlated with likelihood of purchase. These results may indicate that haptic imagery led to more elaborate imagery, which may have affected other variables of interest. This will be discussed later in this chapter.

Likelihood of purchase was positively associated with imagery clarity, vividness, and elaboration. Also related were overall feeling toward the ad and confidence in the recall task. Frustration with the recall task was negatively correlated with likelihood of purchase.

As for which variables were related to the quantity and type of statements recalled from the ad, the results were mixed. The number of textured imagery statements recalled was positively correlated with the number of shape imagery statements, CEI vividness and elaboration, clarity and vividness of imagery as measured on the AAQ. Texture statements were negatively correlated with frustration in the recall task. The number of shape imagery statements recalled was positively correlated with CEI elaboration, confidence with the recall task, clarity and vividness of the imagery as measured on the AAQ, and haptic imagery evoked from the ad. In general, having higher numbers of both texture and shape imagery recall from the advertisement related positively with responses indicating vivid, elaborate, and clear imagery evoked from the ad. Those with more shape imagery recall, however, indicated that they were more confident in recall and that the advertisement led to haptic imagery. Also, those with more texture imagery recall statements indicated that they were less frustrated with the recall task.

Table 5.19: Correlations for Dependent Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Texture Imagery Statements	.		.06 p= .49	.05 p=.61	.11 p=.21			-.09 p=.34		.15 p=.11		.08 p=.37			.13 p=.14
2 Shape Imagery Statements	.18*	.	.11 p=.24	-.04 p=.68			.14 p=.12	.13 p=.16		.08 p=.36	-.10 p=.25				
3 Non-Imagery Statements	N.S.	N.S.	.	-.08 p=.39	-.04 p=.69			.11 p=.22			-.13 p=.15		.14 p=.12		
4 Additional Statements	N.S.	N.S.	N.S.	.			-.10 p=.28	-.06 p=.5	.00 p=.96	-.07 p=.44	.04 p=.66	-.02 p=.81	-.10 p=.30	-.07 p=.44	-.09 p=.36
5 Comparison Statements	N.S.	.35**	N.S.	.21*	.		.11 p=.23			-.08 p=.39			.12 p=.19		
6 Total Statements	.53**	.66**	.43**	.38**	.66**	.		.13 p=.18		.08 p=.41					
7 CEI Vividness	.18*	N.S.	.25**	N.S.	N.S.	.21*	.								
8 CEI Quantity	N.S.	N.S.	N.S.	N.S.	.21*	N.S.	.3**	.					.11 p=.23	.09 p=.31	
9 CEI Elaboration	.25**	.28**	.26**	N.S.	.18*	.35**	.66**	.39**	.						
10 Overall Feeling Toward the Ad	N.S.	N.S.	.24*	N.S.	N.S.	N.S.	.4**	.18*	.36**	.					
11 Frustration with Recall Task	-.16 p=.07	N.S.	N.S.	N.S.	-.16 p=.08	-.18*	-.22*	-.17 p=.05	-.25**	-.33**	.	.	-.10 p=.25		
12 Confidence with Recall	N.S.	.23*	.32**	N.S.	.21*	.32**	.34**	.26**	.46**	.39**	-.48**	.			

Table 5.19 (continued)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
13 Clarity of Imagery From Ad	.18*	.18*	N.S.	N.S.	N.S.	.17 p=.06	.68**	N.S.	.43**	.28**	N.S.	.35**	.		
14 Vividness of Imagery from Ad	.21*	.26**	.18*	N.S.	.17 p=.06	.27**	.64**	N.S.	.47**	.25*	-.19*	.42**	.9**	.	
15 Visual Imagery Evoked by Ad	N.S.	.16 p=.07	.28**	N.S.	.16 p=.07	.22*	.78**	.3**	.72**	.35**	-.22*	.43**	.62**	.59**	.
16 Haptic Imagery Evoked by Ad	N.S.	.26**	.27**	N.S.	.21*	.28**	.69**	.35**	.85**	.37**	-.24*	.5**	.49**	.53**	.77**
17 Attitude Toward Ad	N.S.	N.S.	.25*	N.S.	N.S.	N.S.	.49**	.22*	.51**	.78**	-.29**	.47**	.33**	.32**	.51**
18 Likelihood of Purchase	.17 p=.05	N.S.	N.S.	N.S.	N.S.	N.S.	.39**	N.S.	.42**	.53**	-.19*	.29**	.24*	.24*	.39**
19 Product Evaluation	N.S.	N.S.	.28**	N.S.	-.17 p=.052	N.S.	.43**	N.S.	.39**	.6**	-.16 p=.08	.34**	.26**	.23*	.46**
20 HIQ Score	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	.30**	.16 p=.07	.27**	.23*	N.S.	.21*	N.S.	N.S.	.28**
21 VVIQ-2 Score	N.S.	N.S.	N.S.	.16 p=.08	N.S.	N.S.	.18*	.15 p=.09	N.S.	N.S.	N.S.	N.S.	.16 p=.08	N.S.	.26**
22 WSOP Score	N.S.	-.24*	N.S.	N.S.	N.S.	N.S.	N.S.	-.22*	N.S.	N.S.	N.S.	-.21*	N.S.	-.16 p=.07	N.S.
23 PSOP Score	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	.33**	.27**	.26**	N.S.	N.S.	N.S.	.2*	.19*	.35**
24 ANFT Score	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
25 INFT Score	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
26 Visual Ability	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	.18*	N.S.	.24*	-.19*	-.36**	N.S.	N.S.	N.S.

Table 5.19 (continued)

Variable	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
1 Texture Imagery Statements	.14 p=.11	.06 p=.54		-.05 p=.57	-.08 p=.41	-.11 .24	.03 p=.78	.03 p=.78	-.02 p=.83	.06 p=.54	-.08 p=.4
2 Shape Imagery Statements		.09 p=.35	.07 p=.42	-.01 p=.95	-.06 p=.53	-.1 .28		.00 p=.98	-.08 p=.4	.07 p=.44	-.01 p=.91
3 Non-Imagery Statements			.14 p=.11		.137 p=.13	-.09 p=31	-.09 p=.33	-.02 p=.8	.03 p=.72	.09 p=.3	.15 p=.11
4 Additional Statements	-.10 p=.28	-.04 p=.68	.01 p=.94	-.07 p=.44	.09 p=.37		.04 p=.64	-.14 p=.15	-.05 p=.59	-.07 p=.45	-.13 p=.16
Variable	16	17	18	19	20	21	22	23	24	25	26
5 Comparison Statements		.04 p=.64	.09 p=.33		.02 p=.85	.05 p=.58	-.07 p=.45	.04 p=.69	-.02 p=.81	-.05 p=.58	.00 p=.96
6 Total Statements		.12 p=.22	.15 p=.10	-.05 p=.57	.03 p=.78	-.05 p=.62	-.14 p=.12	.01 p=.91	-.01 p=.89	.04 p=.64	-.03 p=.74
7 CEI Vividness							-.04 p=.65		.02 p=.84	.15 p=.10	.03 p=.71
8 CEI Quantity			.14 p=.12	.15 p=.10					.01 p=.92	-.04 p=.63	
9 CEI Elaboration						.13 p=.17	-.04 p=.62		.04 p=.7	.06 p=.47	.14 p=.11
10 Overall Feeling Toward the Ad						.03 p=.77	.14 p=.14	-.08 p=.38	.07 p=.43	.01 p=.88	
11 Frustration with Recall Task					-.11 p=.216	.04 p=.68	-.02 p=.82	.07 p=.44	-.04 p=.68	.09 p=.32	
12 Confidence with Recall						-.08 p=.38		.05 p=.56	.13 p=.17	-.05 p=.61	
13 Clarity of Imagery From Ad					.14 p=.12		-.13 p=.14		-.05 p=.56	.01 p=.89	-.08 p=.37
14 Vividness of Imagery from Ad					.08 p=.391	.15 p=.10			-.08 p=.40	-.01 p=.94	-.07 p=.45

Table 5.19 (continued)

Variable	16	17	18	19	20	21	22	23	24	25	26
15 Visual Imagery Evoked by Ad							-.01 p=.9		-.01 p=.92	.05 p=.59	.10 p=.26
16 Haptic Imagery Evoked by Ad	.					.13 p=.16	-.12 p=.18		.03 p=.78	.12 p=.19	
17 Attitude Toward Ad	.51**	.				.06 p=.51		.04 p=.63	.04 p=.65	.04 p=.64	
18 Likelihood of Purchase	.42**	.67**	.			.08 p=.37	.11 p=.22	.02 p=.79	-.09 p=.31	.06 p=.51	.11 p=.24
19 Product Evaluation	.43**	.76**	.61**	.		.01 p=.88	.04 p=.66	-.02 p=.86	-.12 p=.19	-.05 p=.59	
20 HIQ Score	.34**	.24*	.23*	.2*	.		-.14 p=.13	.03 p=.78	.14 p=.13	.08 p=.36	
21 VVIQ-2 Score	N.S.	N.S.	N.S.	N.S.	.25*	.			-.02 p=.87	.01 p=.88	
22 WSOP Score	N.S.	.15 p=.09	N.S.	N.S.	N.S.	.18*	.	-.06 p=.52	.08 p=.4	-.02 p=.85	
23 PSOP Score	.26**	N.S.	N.S.	N.S.	N.S.	.5**	N.S.	.			
24 ANFT Score	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	.21*	.		
25 INFT Score	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	.32**	.36**	.	.14 p=.12
26 Visual Ability	.19*	.29**	N.S.	.24*	.28**	-.42**	-.24*	-.17*	.17 p=.06	N.S.	.

Psychometric Properties of the Communication Evoked Imagery Scale. As was previously stated, the overall reliability for linear combinations equaled .942 with the sighted group reliability being .951 and the blind group reliability being .936. The individual reliabilities for dimensions of vividness, quantity, and elaboration of imagery were also computed. For the vividness dimension the entire sample alpha was .925, the sighted was .916, and the blind was .931. For the quantity dimension the full sample alpha was .869, the sighted was .91, and the blind was .825. For the elaboration dimension the entire sample was .807, the sighted was .856, and the blind was .776.

An exploratory factor analysis of the Communication Evoked Imagery Scale using Maximum Likelihood revealed different factor structures for the sighted versus blind samples. Although previously in the dissertation PAF was used to evaluate the factor structures of scales, here ML was chosen in an effort to replicate Babin and Burns (1998).

As can be seen in Table 5.20 for the sighted sample the items load on three factors for vividness (items 1-8), quantity (items 9-11), and elaboration (items 12-14). The overall factor structure is consistent with Babin and Burns (1998), although there were differences between the two samples. With the blind sample the items measuring quantity of images loaded consistently with those of the sighted sample on factor 3. Some of the vividness items loaded with those of the sighted, yet some loaded on factor 2. Also, the items measuring elaboration of imagery loaded on the first factor with vividness items. The factor loadings can be seen in Table 5.19.

Table 5.20: Maximum Likelihood EFA for CEI

Item	Factor 1:	Factor 2:	Factor 3:
1. Imagery was clear	.763[a] .579[b] .633[c]	.58[b]	
2. Imagery was detailed	.815[a] .756[b] .772[c]		
3. Imagery was weak*	.671[a]	.643[b] .624[c]	
4. Imagery was fuzzy*	.671[a]	.671[b] .738[c]	
5. Imagery was vague*	.738[a]	.994[b] .897[c]	
6. Imagery was vivid	.703[a] .815[b] .714[c]		
7. Imagery was sharp	.809[a] .876[b] .824[c]		
8. Imagery was well-defined	.832[a] .715[b] .749[c]		
9. Only experienced one image*			.751[a] .601[b] .675[c]
10. Imagined a number of things			.961[a] .940[b] .929[c]
11. Many images came to my mind			.844[a] .857[b] .86[c]
12. Fantasized about the product	.537[b] .539[c]	.589[a]	
13. Imagined using product	.655[b] .681[c]	.771[a]	
14. Imagined the feel of the product	.616[b] .696[c]	.761[a]	

[a] Sighted sample; [b] Blind Sample;[c]All participants; * Reversed scored item

The differences between sighted and blind participants in factor loadings for items on the vividness dimension were probably due to the reversed scoring method. The only items on the vividness dimension that loaded on a separate factor were reversed scored items. The most noteworthy factor for discussion is the elaboration dimension. Babin and Burns (1998) defined elaboration as “the activation of stored information in the production of mental images beyond what is provided by the stimulus” (p. 266). The finding that for blind participants these items were closely associated with the vividness items may suggest that blind persons image differently than sighted persons. Perhaps the activation of the stored information used in the imagery is not beyond the stimulus in the same way as it is for the sighted. Perhaps the blind individuals naturally create a vivid image that incorporates the use of and feel of the product in a manner that sighted persons do not. Further research is needed to establish this further, but clearly these analyses leave the question to be explored.

Coding. Participants were asked to recall aloud everything that they could remember from the advertisement for the multipurpose handle grip. The 125 videotaped responses and one typed response were transcribed by the researcher. The researcher and two independent coders used predefined guidelines for coding the free recall data (see Appendix L). Instructions asked coders to label and count the number of phrases from each recall. Coders were provided with definitions of each category as well as key words to help with coding. Texture imagery statements were those from the texture-oriented phrases of the ad, shape imagery statements were those from the shape-oriented phrases of the ad, and non-imagery statements were any statements from the ad that were not related to imagery. Comparative statements were any statements in which participants compared the object they were physically touching with the content of the ad. Additional statements were defined as statements made pertaining to the advertisement that did not fit into one of the other categories. Typically these were statements that were attributed to the ad but were not actually in the target ad.

Intraclass correlation coefficients were used to assess interrater reliability (Shrout and Fleiss 1979) for each statement category. For texture imagery recall statements IRR was .882; for shape imagery recall statements IRR was .854; for non-imagery recall statements IRR was .849; for additional statements IRR was .724; and for comparative statements IRR was .931. The data were examined for the individual participants. When at least two raters were in agreement, the value was obtained for each statement type. In cases where coders differed, the coded transcriptions were examined by the researcher and individual phrase labels were compared across coders to determine and settle disagreements.

Overall Model

A GLM was completed with all participants included in the analysis. The independent variables were type of stimulus evaluated during recall and visual status. Dependent variables were counts of texture imagery statements, shape imagery statements, non-imagery statements, additional ad related statements, comparison statements, and total number of statements. Additional dependent variables were ratings of the advertisement heard as measured by the CEI Scale and the AAQ, as listed in Table 5.21. Visual status (F = 2.218, p = .011) was significant in the multivariate model but stimulus was not (F = 1.279, p = .23). See Table 5.20 for a summary of results.

Table 5.21: Multivariate Test of Between-Subjects Effects

Tests of Between-Subjects Effects

Source	Dependent Variable	Sum of Squares	df	Mean Square	F	Sig.	Observed Power[b]
StimulusPresented	Texture Imagery Statements	.439	1	.439	.358	.551	.091
	Shape Imagery Statements	.475	1	.475	.297	.587	.084
	Non-Imagery Statements	1.174	1	1.174	.723	.397	.134
	Additional Statements	.882	1	.882	.870	.353	.152
	comparison Statements	2.434	1	2.434	2.181	.143	.310
	Total statements	13.025	1	13.025	1.508	.222	.230
	CEI Vivid	2.712	1	2.712	1.319	.253	.207
	CEI Quantity	3.846	1	3.846	1.105	.296	.181
	CEI Elaboration	4.210	1	4.210	1.502	.223	.229
		2.534	1	2.534	1.602	.208	.241
	Attitude toward Ad from AAQ	1.264	1	1.264	.634	.428	.124
	Confidence in Recall	.043	1	.043	.023	.881	.053
	Vividness from AAQ	.047	1	.047	.015	.903	.052
	Overall Ad Rating from AAQ	5.056	1	5.056	3.340	.070	.441
	Overall Product Rating from AAQ	5.411	1	5.411	2.302	.132	.324
	Imagery Caused from AAQ	.240	1	.240	.097	.756	.061
	Haptic imagery caused from AAQ	1.928	1	1.928	.563	.455	.115
Visual Status	Texture Imagery Statements	1.331	1	1.331	1.086	.300	.178
	Shape Imagery Statements	.014	1	.014	.009	.925	.051
	Non-Imagery Statements	6.496	1	6.496	4.001	.048	.509
	Additional Statements	.916	1	.916	.903	.344	.156
	comparison Statements	.238	1	.238	.213	.645	.074
	Total statements	.650	1	.650	.075	.784	.059
	CEI Vivid	.849	1	.849	.413	.522	.098

Table 5.21 (continued)

Visual Status	CEI Vivid	.849	1	.849	.413	.522	.098
	CEI Quantity	11.146	1	11.146	3.202	.076	.426
	CEI Elaboration	5.066	1	5.066	1.807	.182	.266
		2.826	1	2.826	1.787	.184	.263
	Attitude toward Ad from AAQ	13.174	1	13.174	6.610	.011	.722
	Confidence in Recall	28.172	1	28.172	14.847	.000	.968
	Vividness from AAQ	1.606	1	1.606	.508	.477	.109
	Overall Ad Rating from AAQ	19.419	1	19.419	12.830	.001	.944
	Overall Product Rating from AAQ	20.635	1	20.635	8.778	.004	.836
	Imagery Caused from AAQ	5.073	1	5.073	2.052	.155	.295
	Haptic imagery caused from AAQ	14.860	1	14.860	4.342	.040	.542
StimulusPresented * Visual Status	Texture Imagery Statements	5.325	1	5.325	4.347	.039	.542
	Shape Imagery Statements	1.382	1	1.382	.866	.354	.152
	Non-Imagery Statements	.005	1	.005	.003	.955	.050
	Additional Statements	.007	1	.007	.007	.933	.051
	comparison Statements	1.453	1	1.453	1.302	.256	.205
	Total statements	20.524	1	20.524	2.376	.126	.333
	CEI Vivid	.006	1	.006	.003	.956	.050
	CEI Quantity	1.532	1	1.532	.440	.508	.101
	CEI Elaboration	9.069	1	9.069	3.234	.075	.430
	Attitude toward Ad from AAQ	.176	1	.176	.088	.767	.060
	Confidence in Recall	1.060	1	1.060	.558	.457	.115
	Vividness from AAQ	.005	1	.005	.002	.968	.050
	Overall Ad Rating from AAQ	.004	1	.004	.003	.958	.050

Table 5.21 (continued)

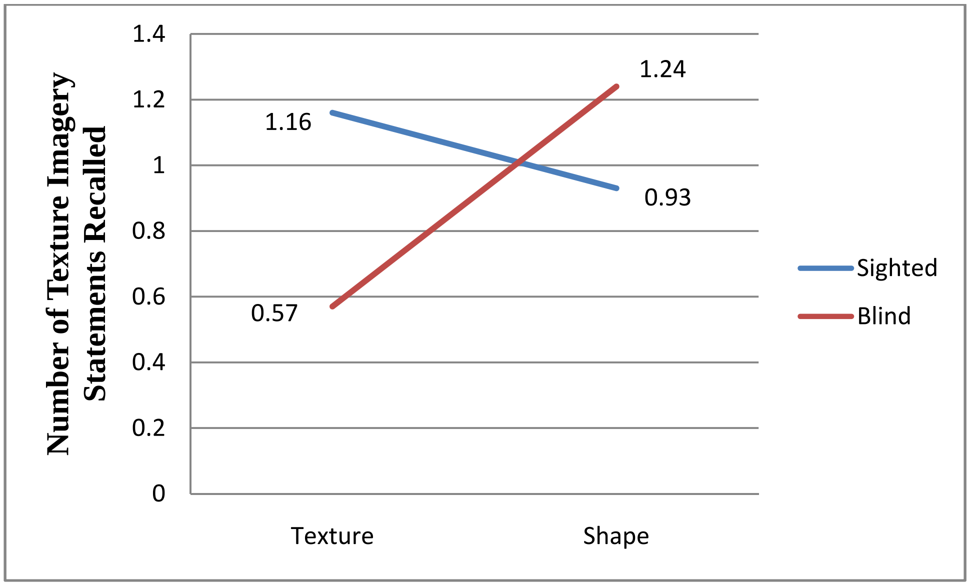
StimulusPresented * Visual Status	Overall Product Rating from AAQ	.019	1	.019	.008	.929	.051
	Imagery Caused from AAQ	.207	1	.207	.084	.773	.059
	Haptic imagery caused from AAQ	4.959	1	4.959	1.449	.231	.222
b. Computed using alpha = .05							

With both sighted and blind participants included in the overall model (Table 5.21), stimulus presented was only marginally significantly related to overall participant rating of the target ad (F = 3.34, p = .07, M_{texture} = 4.21, M_{shape} = 3.73). Visual status, however, was significantly related to the number of non-imagery statements (F = 4.0, p = .048, M_{sighted} = 1.98, M_{blind} = 2.48), quantity of imagery evoked by the target ad (F = 3.202, p = .076, M_{sighted} = 3.28, M_{blind} = 3.93), attitude toward the target ad (F = 6.610, p = .011, M_{sighted} = 4.4, M_{blind} = 5.1), confidence in recall (F = 14.847, p< .0001, M_{sighted} = 3.52, M_{blind} = 4.52), overall rating of the ad (F = 12.83, p = .001, M_{sighted} = 3.51, M_{blind} = 4.37), overall rating of the product (F = 8.778, p = .004, M_{sighted} = 3.85, M_{blind} = 4.73), and haptic imagery evoked by the ad (F = 4.342, p = .04, M_{sighted} = 4.63, M_{blind} = 5.36). In summary, the ad was rated more favorably by those participants who evaluated the textured grips. Blind participants recalled significantly more non-imagery related information from the advertisement, had better attitudes toward the ad, were more confident in their recall of the ad, and rated the product higher than the sighted participants. The blind participants also reported experiencing more imagery in general and more haptic imagery in particular.

An interaction between the type of stimulus presented and visual status had a significant effect on the number of texture imagery statements recalled (F = 4.347, p = .039) as well as a marginally significant effect on the elaboration of the imagery evoked by the target ad (F = 3.234, p = .075). See Figures 5.3 and 5.4 for the visual depiction of these interactions. The influence of visual status lends support to the hypotheses concerning the differences in processing of sighted versus visually impaired participants. The data were, therefore, split in order to observe these differences.

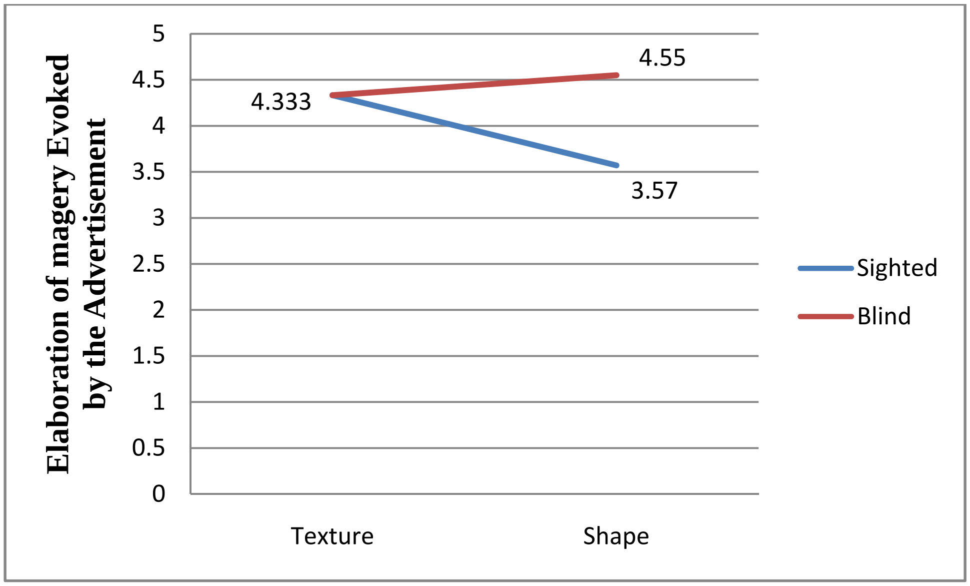
To further explore the interaction shown in Figure 5.3, the means of the number of texture imagery statements recalled when participants were evaluating textured products were examined and the differences between sighted and blind were significant (F = 6.544, p = .013, $M_{sighted}$ = 1.16, M_{blind} = .57). Differences between the two groups within the shape condition were not significant (F = .805, p = .373, $M_{sighted}$ = .93, M_{blind} = 1.24).

Figure 5.3: Interaction of Visual Status X Stimulus Presented On Number of Texture Imagery Statements Recalled



To further explore the interaction in Figure 5.4, the means for the elaboration for imagery evoked by the advertisement when participants were evaluating textured products were examined and there was no difference between sighted and blind (M = 4.333). Differences between the two groups within the shape condition were significant (F = 5.13, p = .027, $M_{sighted} = 3.57$, $M_{blind} = 4.55$).

Figure 5.4: Interaction of Visual Status X Stimulus Presented On Elaboration of Imagery Evoked by the Advertisement



SPECIFIC HYPOTHESES

Hypotheses predicted, in general, that when participants were evaluating stimuli while recalling imagery elements from an advertisement, properties of the stimulus touched would interact with the nature of the imagery ad content recalled. Because visual status was significant in the overall GLM provided previously, the data were split by visual status and an overall test of effect was conducted. Those results are presented in the next paragraph.

In line with Unnava et al. (1996), a t-test was performed to test the overall effects of match/mismatch of stimulus evaluated with imagery statements. This is essentially a contrast of recall means when stimulus quality matched the recall statement modality (Texture/Texture or Shape/Shape) versus when modalities did not match (Texture/Shape or Shape/Texture). Results indicated that there was a significant difference in both groups but not in the intended direction. The sighted participants recalled significantly more imagery statements when there was a modality match (M = 1.57 vs. M = 1.04; t = 11.306, p < .0001). Blind participants results followed the same trend where a modality match resulted in more imagery recall statements (M = 1.55 vs. M = .88; t = 8.826, p < .0001). These results did not support the general hypothesis or the work of Unnava et al. (1996) that a modality match would result in interference. To further investigate and test the specific hypotheses for study 2, tables 5.22 and 5.23 were constructed and a series of analyses were conducted to test differences among the four conditions presented.

Table 5.22: Study 2 Hypothesized Results for Sighted

Stimulus Evaluated	Recall Statements	
	Texture Imagery Recall	Shape Imagery Recall
Textured Grip	37^a M = 1.15 N = 32	54^c M = 1.68 N = 32
Shapely Grip	27^b M = .93 N = 29	42^d M = 1.45 N = 29

Hypotheses 10 & 11. Simple t-tests were used to evaluate the within subjects effect of stimulus evaluated on number of different recall statements. As predicted, textured grip evaluation did suppress texture imagery recall (H10) significantly more than it suppressed shape imagery recall statements (H11), as evident in the significant differences in cells “a” and “c” (t = 8.117, p < .0001). Contrary to prediction, shapely grip evaluation facilitated shape imagery recall (H10), indicated by a significant difference between cell "d" and "b" (t = 7.92, p < .0001) (H11). Therefore, H10 and H11 were both supported for the texture condition but not for the shape condition. Regardless of the stimulus evaluated, there were significantly more shape imagery statements recalled than texture imagery statements.

Significant mean differences between cells "a" and "b" as well as cells "c" and "d" would tell to what extent recall statements differed between those who touched textured grips and those who evaluated shapely grips. These differences on texture imagery recall were not significant (F = .99, p = .324), nor were they significant for shape imagery recall (F = .733, p = .395). Significant results were found for both comparison statements and total number of statements. Sighted persons who evaluated textured grips (M = .78, sd = 1.43) recalled significantly more comparison statements than those who evaluated a shapely grip (M = .04, sd = .19) (F = 7.768, p = .007). Likewise, total number of statements differed significantly between those who evaluated the textured grip (M = 6.86, sd = 2.93) and those who evaluated the shapely grip (M = 4.74, sd = 1.95) (F = 9.87, p = .003).

Table 5.23: Study 2 Hypothesized Results for Blind

Stimulus Evaluated	Recall Statements	
	Texture Imagery Recall	Shape Imagery Recall
Textured Grip	20[a] M = .57 N = 35	53[c] M = 1.51 N = 35
Shapely Grip	36[b] M = 1.24 N = 29	46[d] M = 1.58 N = 29

Hypotheses 12, 13 & 14. In Table 5.23, cell "a" gives the total number of texture recall statements, the mean recall statements, and the number of blind persons in the textured grip condition. As predicted, textured grip evaluation did suppress texture imagery recall (H12) significantly more than shape imagery recall statements (H13), as evident in the significant differences in cells "a" and "c" ($t = 3.824$, $p = .001$). As with the sighted sample, shapely grip evaluation, facilitated shape imagery recall (H14), ($t = 6.591$, $p < .0001$). H12 and H13 were both supported in the expected direction, but H14 was significant in the opposite direction than predicted. These results are consistent with the results shown in the sighted sample in that regardless of the type of stimulus being evaluated, participants consistently recalled more shape imagery statements.

In comparing imagery recall means between textured versus shaped grip condition, differences were found for the blind participants. Participants who evaluated the textured grip recalled significantly fewer texture imagery statements than those who evaluated shapely grips ($M = .57$, $sd = .88$ versus $M = 1.24$, $sd = 1.7$, $F = 4.09$, $p = .047$). This finding lends additional support to H12, which predicted that evaluating a textured grip would suppress the recall of texture imagery statements. No differences were found for these two groups for shape imagery statements ($F = .04$, $p = .84$), non-imagery statements ($F = .11$, $p = .74$), additional statements ($F = .69$, $p = .41$), comparison statements ($F = .28$, $p = .6$), or total number of statements ($F = .06$, $p = .80$).

Haptic and Visual Imagery Ability as Moderators. A 2 (visual status blind versus sighted) X 2 (haptic imagery ability high versus low) ANOVA was performed evaluating mean differences in each of the dependent variables. Direct effects of visual status has been previously discussed. The main effect of haptic imagery ability as measured by the

HIQ was not significant (F = 1.312, p = .207). The interaction between visual status and haptic imagery ability was also not significant (F = .852, p = .624).

A 2 (visual status) X 2 (visual imagery ability high versus low) ANOVA was performed evaluating mean differences in each of the dependent variables. Direct effects due to visual status have been previously discussed. The main effect of visual imagery ability was not significant (F = 1.085, p = .381). The interaction between visual status and visual imagery ability was also not significant (F = 1.416, p = .152).

POST HOC ANALYSES

The theory presented in chapters 2 and 3 began with the core premise that visual imagery is a distinct process from haptic imagery. This premise has been based in the work of (Unnava and Burnkrant 1991). As was stated earlier in this dissertation, some have argued that there are components of haptic imagery that appear to be related to visual imagery. Klatzky, Lederman and Matula (1991) found that participants reported simultaneous visual imagery when they'd been instructed to construct a haptic image. FMRI researchers have questioned whether the activation of blind people's occipital lobes during haptic imagery is due to cross plasticity or if, in the absence of sight, the activation of the visual cortex also occurs in sighted persons but goes undetected (Servos et al. 2001). In the absence of evidence that haptic and visual imagery operate as two distinct and separate processes, additional analyses were completed in order to disprove the alternative theory that visual and haptic imagery overlap and work together in some way.

Curiously, in the zero order correlation analysis the visual imagery ability measure (VVIQ-2) and the haptic imagery ability measure (HIQ) both correlated with items referring to the presence of visual imagery during the task but only the haptic imagery ability measure correlated with items referring to the presence of haptic imagery during the task. The two measures (VVIQ2 and HIQ) did correlate with one another (r = .25, p < .01). See Table 5.19.

For example, the VVIQ-2 correlated with the vividness dimension of the Communication Evoked Imagery Scale that assessed the imagery evoked by the target ad. The VVIQ-2, however, did not correlate with the other two dimensions, quantity of imagery and elaboration of imagery. The HIQ did correlate with these dimensions. Given the past literature suggesting that haptic imagery may involve a component of visual imagery, a hierarchical regression was performed wherein the variance attributable to the correlation between the VVIQ-2 in the HIQ score was extracted. The quantity and elaboration dimensions of the CEI were regressed on the HIQ residual. The zero order correlation of HIQ and elaboration CEI was r = .272, p =.002. With the variance for visual imagery ability extracted from the HIQ measure, the relationship remained at r = .259, p = .004 (F = 8.64, p < .01, SS = 2971.559). Therefore, there is evidence of a unique relationship between haptic imagery ability and reporting an elaborate image. The marginally significant zero order correlation of HIQ and quantity CEI was r = .161, p = .07. After variance due to visual imagery ability was extracted from the haptic imagery ability measure, there was no significant correlation between HIQ and the quantity CEI dimension (r = .134, p = .141). Haptic imagery ability did not have a unique relationship with imagery quantity apart from visual imagery ability.

The Klatzky, Lederman and Matula (1991) participants reported a two step process for haptic imagery. First, the spatial (shape) properties were evaluated, often reported as a visual image. In a further phase of the imagery, the haptic property of texture was imaged. In the task in study 1 participants consistently took longer to use haptic imagery as opposed to visual imagery. In addition, in the study 2 task participants consistently recalled more shape imagery statements. This could be due to a sequential processing where participants first engage in visual or spatial imagery processing, followed by haptic imagery processing. Further, haptic imagery and other modalities may consistently begin with the visual image and operate to enhance the overall imagery experience, making it more rich, complex, and elaborate that it might otherwise have been as a simple visual image.

A few further analyses also lend support to this post hoc discussion. Participants who reported having both visual imagery and haptic imagery from the target ad (as measured by the AAQ) had significantly better overall attitudes toward the ad itself (F = 25.595, p < .0001, SS = 64.307). A hierarchical regression removed variance attributable to the visual imagery item in the haptic imagery item. The residual variance of the haptic imagery item was regressed on attitude toward the ad and the relationship was significant apart from the portion attributable to the visual imagery question (F = 8.847, p = .004, SS = 206.608). The same was true for likelihood of purchase (F = 6.82, p = .01, SS = 401.869) and for attitude toward the product (F = 7.409, p = .007, SS = 315.077).

SUMMARY OF CHAPTER 5

This chapter presented the findings from two studies investigating the relationship between imagery and perception. The chapter began with sample characteristics, followed by analyses of the scales used. Analyses for study 1 revealed type of imagery did not have a significant effect on differences in performance, but visual status and type of comparison were significant factors for both sighted and blind participants.

In general, texture-based comparisons (operationalized as sheet and sandpaper comparisons) appeared to be more difficult to perform than shape comparisons. This is apparent from the consistently and significantly higher reaction times, lower accuracy rate, lower confidence, higher frustration, lower imagery quality, and lower imagery ability for texture-based comparisons. Specific hypotheses for study 1 were not supported, but general trends were discussed.

Study 2 results were mixed. Significant results of t-tests revealed that evaluating a textured grip resulted in fewer texture imagery statements recalled than shape imagery statements. Evaluating shapely grips, however, did not lead to recalling significantly fewer shape imagery statements, as predicted. These results were consistent for both sighted and blind participants, suggesting that the interaction between imagery and perception may follow similar trends in both populations. Also presented were results of post-hoc analyses suggesting visual imagery may play a larger role in haptic imagery than previously credited. Chapter 6 follows with a summary of the dissertation and follow up discussion of the results. Contributions, future research, and limitations are also presented.

CHAPTER 6
DISCUSSION

Haptic Imagery is the mental representation of touch information. Consumers use touch information, and therefore, haptic imagery to collect and process product information in the marketplace. Visually impaired consumers, in particular, rely on tactile information, although perhaps with different purposes than sighted people do. This dissertation draws from the vast literature in visual imagery and visual perception to begin a research stream examining the use of imagery in product information processing.

This dissertation began by introducing the related literature of haptic information processing. The area of haptic information processing has provided a wealth of scholarship suggesting that consumers need touch information in the marketplace. By allowing consumers to touch products, attitudes and evaluations of products can be affected (Peck and Childers 2003a). Further, touch has been shown to lead to impulse purchasing (Peck and Childers 2003b).

A summary of the vast imagery literature was also provided, with the primary focus on visual imagery. The relationship between imagery and perception has been extensively studied and theory continues to be challenged, particularly in the visual modality. The interactions seen in researching visual imagery and perception were used to postulate how haptic imagery and perception might also interact in product comparison and advertisement recall experiments.

Theoretical insights on imagery formation come from research by Segal and Fusella (1970) which was extended to marketing by Unnava et al. (1996). The theory of resource competition postulates that within a modality there is considerable processing similarity between imagery and perception and that this overlap limits processing capacity for either perception or imagery (Reeves 1980). FMRI researchers were unable to discriminate between the activation data of perception versus imagery.

The theory of resource complementation has been cited as the explanation for studies in which visual imagery appears to have facilitated perception. This dissertation offered the explanation that facilitation occurs when there may be some but not entire overlap in imagery and perceptual processing. In these cases the expanded processing has a complimentary effect rather than a competition effect that occurs with limited resource allocation. Resource complementation was expected to occur during the haptic processing of blind participants because of the expectation of cross plasticity, discussed subsequently.

Based on the support presented for resource competition versus resource complementation in the visual imagery literature, hypotheses were constructed predicting how haptic imagery would interact with haptic perception in either a sighted or blind sample. Specifically, sighted participants were expected to show considerable interference when instructed to use haptic imagery during the perception of textured stimuli. It was also postulated that when sighted participants were instructed to use visual imagery, the processing of shape information would suffer. In line with resource complementation, however, it was predicted that haptic imagery processing with shapes and visual imagery processing with textures would show a facilitation effect.

The blind sample was expected to differ somewhat from the sighted sample as the result of cross plasticity. Cross plasticity is a type of cortical adaptability wherein neurons reroute to process information they were not originally intended to process. Specifically, neuroimaging studies have suggested that the occipital lobe will sometimes adapt in blind persons to be used in the processing of haptic information (Amedi et al. 2005). In recruiting resources for haptic processing, it was predicted that although blind participants may have some interference within a modality, as was predicted for the sighted sample, the blind sample would show less interference than would occur for the sighted sample. Therefore, blind participants were expected to show less interference than the sighted sample when instructed to use haptic imagery while perceiving textures. The blind sample was expected to show considerable interference when instructed to use visual imagery in any task, simply because visual imagery is expected to be difficult for blind persons.

In summary, the dissertation set out to investigate whether a haptic memory store exists as a tool for consumers to use when comparing haptic properties of products. Research was conducted to explore what role haptic imagery plays in the task of recalling and remembering texture and shape properties of products. Visually impaired consumers were recruited to examine potential differences in how imagery interacts with perception for the two populations and also to highlight sample characteristics that may offer unique perspectives to marketing researchers.

SUMMARY OF METHODS AND RESULTS

Two studies were conducted to test the hypotheses concerning the interaction between imagery and perception. In both studies results differed from expectations. Study 1 was set up to test the theory in a product comparison task. Participants were instructed to use either haptic or visual imagery to compare textured or shaped objects. In study 2 participants were asked to recall an advertisement that had been embedded with both haptic and visual imagery statements while touching textured or shapely products referred to in the advertisement.

Expectations in Study1 were that under haptic imagery, texture comparisons would be more difficult (resulting from resource competition) and shape comparisons would be less difficult (resulting from resource complementation). Further, when visual imagery was used for shape comparisons, interference was expected more so than when visual imagery was used to make texture comparisons. The blind sample was expected to show less interference when using haptic imagery to make textured comparisons than expected for the sighted sample. Blind participants were expected, however, to show interference when using visual imagery, as visual imagery was predicted to be most difficult for the blind participants. No significant results were found for the effects due to the type of imagery participants were instructed to use in the comparison tasks. Overall it was clear that texture-based comparisons were more difficult to perform in the absence of vision than shape-based comparisons for both groups.

Expectations for study 2 were that when evaluating a textured grip, participants would recall significantly fewer texture imagery statements than shape imagery statements. In both the sighted and blind samples, this did occur. When evaluating a textured grip, participants did suppress the number of textured imagery statements recalled.

Further, when evaluating a shapely grip, participants were expected to recall fewer shape imagery statements than texture imagery statements. Significant effects were contrary to this hypothesis. When evaluating shapely grips, participants in both groups recalled significantly more shape imagery statements than texture imagery statements. Overall, in study 2 participants found it more difficult to recall texture imagery statements, regardless of which product they evaluated, textured or shapely. This was consistent with the findings in study 1 that texture was the more difficult quality to image.

DISCUSSION AND EXPLANATION OF RESULTS

There are several possible reasons that the resource competition/ resource complementation effects were not observed in these studies. The first explanation focuses on the misspecification of theory. The theory driving the predictions of imagery/perception interaction within and between modalities has focused almost entirely on the visual modality. Other researchers have repeatedly shown significant interactions between visual imagery and visual perception (Perky 1910, Segal and Fusella 1970, Unnava et al. 1996). This dissertation attempted to draw a parallel between the visual modality and the haptic modality. Results of this study suggest that the overall premise that these two imagery modalities are distinct may be misguided. Perhaps subsequent studies should focus on the inseparability of visual and haptic imagery and how the two work together, resulting in more elaborate imagery.

Limitations in the methodology and operationalization of constructs could be an alternative explanation for insignificant results in Study 1. This fails to explain, however, the results from study 2. The general trends from study 1 agree with the significant effects of study 2. Although additional participants would make significant results more likely in study 1 (as discussed in chapter 5), these results still may follow the existing trends, which agree with study 2 results and neither study supported the theory put forth.

OTHER INTERESTING FINDINGS

The assumption that sensory systems are distinct has long been debated and studied. Many have predicted that just as perception is processed distinctively according to modality, so is imagery processing (Finke 1980). Other researchers have postulated that cross-modal interactions between haptic and visual imagery may exist, at least in the case of sighted individuals (Sathian and Zangaladze 2002). Studies examining the brain scan data of blind participants have led researchers to believe that occipital lobe activity during haptic imagery was evidence of cross plasticity, a recruitment of processing resources from relatively unused areas of the cortex (Roder, Rosler, and Hennighausen 1997). The researchers who concluded that their findings were evidence of cross plasticity acknowledged an inability to effectively compare sighted participants on the same measure, since their visual ability could allow them to determine how activated occipital resources might be allocated to visual processes as opposed to haptic imagery processes. Sathian and Zangaladze (2002) used TMS to block occipital lobe processing in their participants, revealing interference with haptic spatial processing (macrogeometric properties) but not with haptic grating detection (microgeometric features).

Post hoc analyses revealed some evidence that haptic and visual imagery may have more significant overlap than previously thought. The haptic imagery ability questionnaire, developed for this dissertation as described in chapter 4, is purported to measure a person's ability to mentally recreate the haptic sensations described in each of the scale items. Marks' (1995) VVIQ-2 has been used extensively in both its current and previous form to measure visual imagery ability. The interaction of scores on these two measures and their performance with other variables in the data led to speculation that haptic and visual imageries may be more interactive than separate.

Specifically, visual imagery ability was found to be related to vividness of imagery experienced as measured by both the AAQ and the Communication Evoked Imagery Scale (Babin and Burns 1998). Haptic imagery ability was found to be related to visual imagery ability as well as the other visual imagery items. Haptic imagery ability also was found to have a unique relationship with imagery elaboration, suggesting that perhaps imaging haptic information is a two-step process as described by Klatzky, Lederman, and Matula (1991). Perhaps as in their study, the participants in our study 1 were first visually imaging the macrogeometric property of shape and then haptically imaging the microgeometric property of texture (Sathian and Zangaladze 2002). Additional research will be necessary to further explore this explanation.

CONTRIBUTIONS

This dissertation introduces the nature of haptic imagery and potential use by consumers in marketplace behavior. Both studies provide additional questions regarding the nature of the interaction between imagery and perception within and across modalities. The results of both studies seem to suggest that within modality imagery may enhance perception, more in line with the work of Farah who found, among other studies, that imagined auditory tones facilitated the detection of perceived matching tones (Farah and Smith 1983). Future research in this area should involve alternative modalities. Theory related to sub-threshold perceptual experiences and how those experiences are enhanced by imagery formation may also be beneficial for further explaining the facilitative effects shown in these studies.

Study 2 provides evidence that including haptic imagery in advertisements may enhance the overall imagery effects on the consumer. Results revealed not only that haptic imagery ability had a unique relationship with elaboration of imagery experienced, but participants who reported having experienced haptic imagery while listening to the advertisement in study 2 reported better overall attitudes toward the advertisement and a higher likelihood of purchase. Future studies should more closely examine and manipulate specific types of haptic imagery evoking passages in advertising.

Another contribution is the unique perspective provided by the blind consumers. Results indicated in both studies that the blind participants performed much in the same way as the sighted consumers. This was surprising given the vast research suggesting that blind consumers are unique, but perhaps to the typical blind consumer this would not be as surprising. When working with this sample and in attending a variety of meetings of organizations, I learned that most blind consumers assume that they are very similar to their sighted counterparts with only a few exceptions.

Having a sample of blind consumers completing the standard surveys previously only used with sighted persons revealed that some of the surveys took on a different factor structure when blind participants completed them. This was particularly true for the imagery related questionnaire factor structures. Further research is needed to determine the drivers of this phenomenon, but it’s likely that this is due to different imagery structures. For example, the dominant modality for sighted people is vision, while the dominant modality for blind people is touch. For the sighted, we approach objects that we see with a gestalt perspective. We may not evaluate the shape of an object, then it’s size, then other characteristics. We most likely first determine what it is before moving on to specific characteristics. When faced with a haptic evaluation, perhaps sighted people are less familiar with this procedure and will break up the evaluation into distinct parts. Blind people, however, likely approach haptic evaluation in a similar way to how sighted people evaluate objects that they see, leading to differences in the way haptic information is used by each sample.

Yet another contribution of this dissertation is the Haptic Imagery Questionnaire (HIQ) that was developed, tested, and applied in the dissertation studies. This questionnaire should undergo additional data collection to evaluate the true structure as well as investigate the nature of the items measuring the construct, this preliminary version has shown significant worth.

FUTURE RESEARCH

There are many contributions to future research to which this study may contribute. Many of those have been highlighted in the previous sections. In addition to those already mentioned, several others have emerged throughout the duration of this dissertation. While administering the haptic imagery ability questionnaire to blind participants during data collection, several participants physically moved their hands while haptically imaging the items read to them. The movements appeared to correspond with the exploratory procedures laid out by Lederman and Klatzky (1987), which were discussed in chapter 2. These hand movements could correspond to eye movements during visual imagery, which have been explored as possibly affecting visual imagery ability (Finke 1989).

Individual differences in cross modality imagery preference warrants additional research. Just as individuals possess different cognitive styles (Childers, Houston, and

Heckler 1985), they may prefer one type of imagery over another. The only research evaluating imagery preference has focused on the use of imagery for individuals high or low in hypnotizability. For example, Carli, Cavallaro, and Santarcangelo (2007) recently showed no difference in the visual imagery ability, but that those who were more easily hypnotized were better at using tactile imagery. Therefore, we can assume individual differences in imagery preference. The specifics of those differences is yet to be discovered.

Another avenue for research related to this body of work is in the role emotion and affect might play in the imagery/perception interaction. There has been some discussion by Paivio (1990) concerning the likelihood that emotional arousal leads to motivation for imagery use and may affect the consequences of the imagery formed. These issues have implications for whether consumers engage in imagery to evaluate products and/or advertising as well as how that imagery affects consumer preferences.

LIMITATIONS

This dissertation is not without its limitations. As previously mentioned, the HIQ requires additional work regarding structure and items. Also previously stated, study 1 would benefit from additional participants to test specific hypothesis analysis that lacked power. Because of the nature of the participants, sighted adults from the community as well as blind adults, locating and paying interested people was very difficult. Further, data collection involved 45-75 minutes with each individual, making each participant expensive in both time and money. Finding additional adults to take part in the study may be possible in the future in an effort to increase the power of the analysis for study 1.

Obtaining blind participants, however, will be a much more difficult task. Fifty additional blind participants may only be possible in the long term.

This dissertation was based on the theoretical foundation put forth by Unnava et al. (1996) postulating that neurological overlap may contribute to processing interference or facilitation. This dissertation did not precisely follow the methodology of Unnava et al or others (Segal and Fusella 1972). Instead, an approximate recreation was attempted incorporating the haptic modality, based on results from pretests. In this dissertation the 2 X 2 factorial in study 3 involved spatial versus texture properties of products paired with visual versus haptic imagery contained within the advertisement to construct a within or between modality study design. The factorial design of Unnava and colleagues involved the visual or auditory presentation of the advertisement paired with visual versus auditory imagery contained within the advertisement.

One post-analysis limitation that warrants further discussion is the issue of resources required for performing dual cognitive tasks. Hypotheses were based on a theory of resource competition when participants were asked to simultaneously form imagery and perceptually evaluate objects. Resource competition requires that the dual tasks overlap sufficiently in their need for processing resources. For study 1, it is difficult to know without just noticeable difference (JND) pretests whether the stimuli presented contained sufficient overlapping features to lead to the interference effects addressed in the theoretical sections of this paper in chapters 2 and 3. For study 2, the methodology did not allow for testing the overlap in resources required for simultaneous evaluation of the product while also recalling imagery instructions from the advertisement. One avenue for addressing this question would be analysis of the neurological processing activation under conditions where participants were haptic evaluating or imaging the stimuli used here using fMRI or other nueroimaging techniques.

Another limitation of the dissertation is in the way the studies attempt to isolate effects of haptic versus visual imagery without accounting for the remaining sensory modalities. Just as perception is a multimodal experience, imagery could operate as a complete mental recreation of an experience, involving the visual, haptic, olfactory, auditory, and taste. Future research should focus more on all modality aspects of imagery rather than on one imagery modality.

Further, participants were instructed to perform either haptic or visual imagery, although it can’t be known for certain that they performed the imagery as instructed. Analyses showing differences in effects of high versus low imagery ability in the two modalities allows for some speculation that participants were at least attempting to follow instructions, but additional research might be necessary to investigate the effect of instructions on participant imagery performance. Related to this issue is the likelihood that individuals might possess preferences for types of imagery used. As was discussed in the section on future research, more information is needed to assess whether participants may have preferred to use visual versus haptic imagery, regardless of instruction.

There are a few additional methodological issues to consider when evaluating the findings of this dissertation. The first is the nature of the stimuli used in study 1. Having shapely objects familiar to participants that could have been easily named by participants (i.e., sphere versus cube) could allow for spreading activation. This more elaborate processing could affect the reaction time for individuals or groups who were activating extended mental networks activated by specific terms being used to cognitively describe the objects. Textures were not as easily distinguished through verbal labels and this could have confounded the results, accounting for the superior ability to process and image the shapes as opposed to the textures. Klatzky, Lederman, and Metzger (1985) found that participants were both fast and accurate in identifying objects haptically that were familiar and easy to name. The authors purposely excluded objects that were not easily named, as previous research had revealed that verbal labels allow for better object recognition in general. Establishing labels for describing textures or using shapes that are not easily verbally labeled could help to avoid this potential confound in future studies.

Another stimulus related concern is the complexity of the stimuli. There has been some debate concerning whether 3D versus 2D objects are appropriate for haptic identification of objects. Lederman and Klatzky (1987) discuss their previous research in which participants spent several minutes exploring 2 dimensional displays without correctly identifying objects, while more recent work has used 3 dimensional objects with near perfect identification accuracy (Lederman and Klatzky 1997). Given that shapes used here were 3 dimensional and textures lend themselves less to 3 dimensional presentation (although efforts were made here to make textures as 3 dimensional as possible), this mismatch of dimensionality could confound results.

An additional methodological concern that deserves further consideration is the nature of the data collection. A computer mouse labeled with written and Brailled letters indicating the buttons to push for “same” and “different” was used for study 1 respondents. Sighted persons effortlessly glanced at the letters when confused about which button to push, but blind participants who were confused tended to feel around for the Braille. This likely introduced more error variance to the reaction times of the blind participants. For that reason, I'd like to urge caution when comparing reaction times of the sighted and blind participants in study 1. The longer reaction times for the blind versus sighted could be due to differences in the effort required to find and press the response indictor button. One potential solution for future research is using voice recognition software to measure the exact point that the participant verbalizes their response. This method has been used by other researchers in the area of haptic processing (Klatzky, Lederman, and Metzger 1985). Another solution would be to spend additional time in practice, to ensure that participants were able and willing to respond in the intended manner.

If delayed responses for the blind are not due to difficulty in using the response mechanism used, there is a possibility that the blind participants may have been overprocessing the stimuli during product evaluation. There has been some speculation in the literature that unique populations may put forth more effort or provide more information than more typical populations of consumers (Carswell, Rinaldo, and Stephens 2005). There was some anecdotal evidence in this study that could lead to the assumption that blind consumers may have made unnecessary elaboration for the task at hand. For example, one blind participant verbalized to the researcher that the two spheres were indeed different because one had a dimple, while the other did not. Upon further inspection, one sphere did have an extremely small dimple that seemingly went unnoticed by the sighted participants.

Reactance Theory (Brehm 1966) states that when people perceive that they have been treated unfairly, they will become extremely motivated to overvalue the task that could right the perceived wrong. The work of Baker (2006) revealed that blind consumers feel ignored by marketers. Perhaps the participants in this study were reacting by overvaluing the comparison task, leading to increase elaboration and increased time for processing.

CONCLUSION

This dissertation laid out several goals to be met. First, it set out to investigate the existence of a haptic memory store. Results of the two studies could not conclusively reject the proposition that a haptic memory store exists. In study 2 there were selected significant differences in the number and type of imagery recall statements from the ad depending on the properties of the products being evaluated. This and future research focused on haptic imagery as a mnemonic will allow marketers to understand not only how consumers use imagery but also to know in which situations imagery should be encouraged or discouraged.

A second goal of the dissertation involved shared resources of perceptual and imagery processing. Not having used neuroimaging techniques, it is difficult to determine where the processing for the information performed in the task occurred in the cortices. As a behaviorally based dissertation, further evidence is needed in terms of assessing the overlap and how processing is structured for haptic or visual imagery. The current results do not rule out the viability this theory and do provide fertile ground for future research.

A third goal was to examine the behavioral consequences of evaluating structural versus substance properties. Data revealed that evaluating textures took consistently more time than evaluating shapes in all circumstances with all participants. Marketing products that contain primarily substance properties like bedsheets, carpeting, or fabric may require a new approach, particularly in marketing online.

In conclusion, many of the goals laid out at the onset were met or partially met. As with most dissertations, however, these studies and their analyses created more questions than answers. Visual imagery research has provided a rich area of research and application to the field of marketing as well as marketing managers. In investigating the use of other imagery modalities managers are provided with an opportunity to expand their message to a more elaborate and sophisticated form of communication with the consumer.

Appendix A

Pretest Trial Assessment

SS# _______ Trial # ______

1. **The imagery that occurred was clear.**

1 2 3 4 5 6 7

Strongly Agree Strongly Disagree

2. **The imagery that occurred was detailed.**

1 2 3 4 5 6 7

Strongly Agree Strongly Disagree

3. **The imagery that occurred was fuzzy.**

1 2 3 4 5 6 7

Strongly Agree Strongly Disagree

4. **The imagery that occurred was vague.**

1 2 3 4 5 6 7

Strongly Agree Strongly Disagree

5. **I imagined the feel of the object.**

1 2 3 4 5 6 7

Strongly Agree Strongly Disagree

Please answer the following questions about the touch properties of the object that you evaluated:

6. **This item is:**

1 2 3 4 5 6 7

Easy to image Difficult to image

7. **When evaluating this object, the shape was the first thing I noticed.**

1 2 3 4 5 6 7

Strongly Agree Strongly Disagree

8. When evaluating this object, the texture was the first thing I noticed.

1 2 3 4 5 6 7

Strongly Agree Strongly Disagree

9. When I formed my image, shape was the salient factor.

1 2 3 4 5 6 7

Strongly Agree Strongly Disagree

10. When I formed my image, texture was the salient factor.

1 2 3 4 5 6 7

Strongly Agree Strongly Disagree

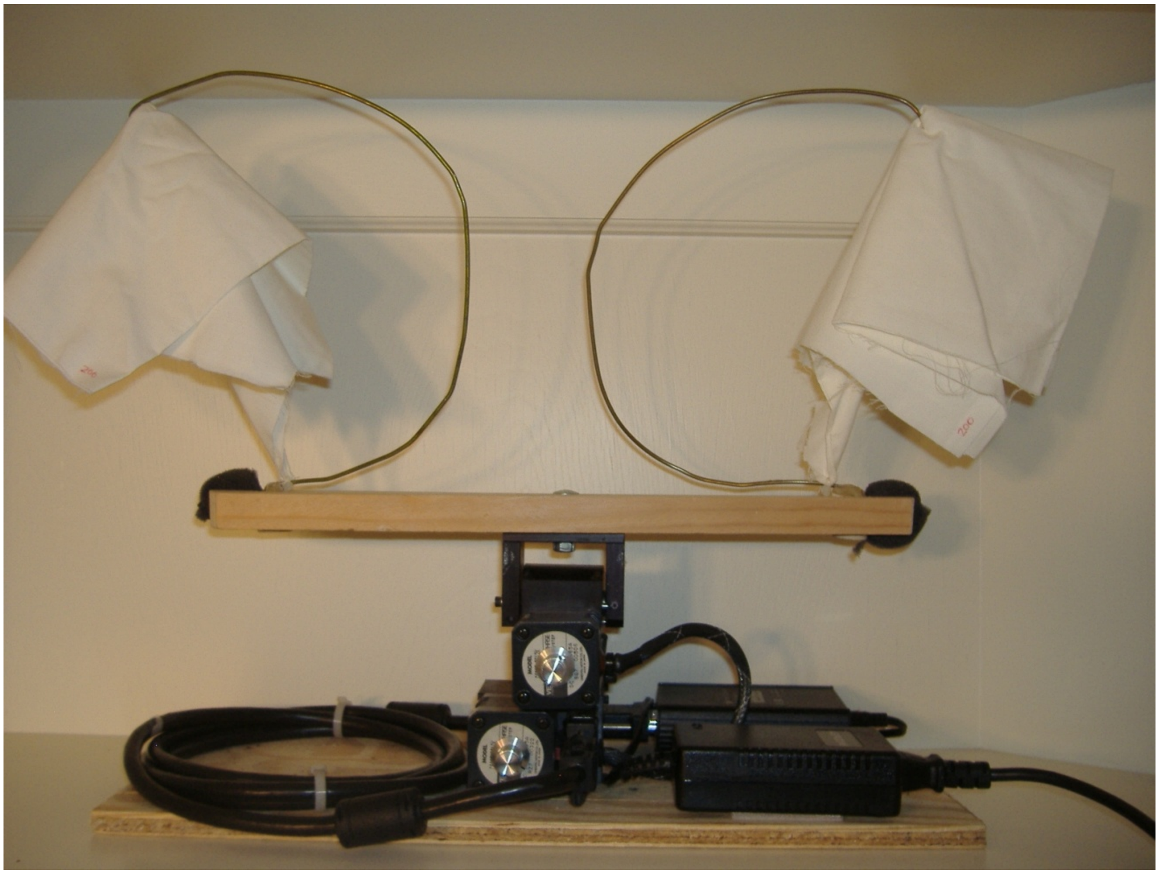
Appendix B

Stimuli

A. Study 1 shape stimuli: cube versus ball

B. Study 1 texture stimuli: 100 grade versus 180 grade sandpaper

C. Study 1 texture stimuli: 200 thread count versus 400 thread count sheets



D. Study 2 shaped grips

E. Study 2 textured grips

Appendix C

Auditory Advertisements

Grip Ad

Introducing an innovative product that will change the way you work, play, and compete! Replace factory hand grips on yard rakes, garden tools, tennis rackets, golf clubs, or anything else with Advanta™ multipurpose handle grips.

Made with patented plastic/foam infusion technology, Advanta™ replacement grips protect your equipment from wear from use, resist weather damage, and repel moisture from perspiration. In your mind, feel the sensation of high quality, durable material. You can really feel the difference.

Allow yourself to indulge in the fantasy of using our grips. The deep cushion creates a sensation that firmly molds to your fingers. Imagine the comfort of super-soft textured grips. That comfort continues on, even after hours of physical exertion. Forget about callouses or joint pain. These microtexture fibers create a non-slip surface that offers your hand a nice, firm hug, keeping your grip relaxed and cozy.

Dual wall grips with a durable inside liner offer an ergonomic design that decreases hand fatique. Our delicately designed contours literally hold your hand. In your mind, imagine how it would feel to slip your fingertips onto a grip shaped so naturally in your palm that your hand and the grip become one.

If you are an unusually large or small handed person, you probably have had trouble feeling comfortable with standard grips. Order yours in a custom size to fit your hand. A few simple measurements done at home will allow you to order your exact fit.

The exquisite shape provides comfort as well as form. Beautiful artisanship provides a shapely grip, resulting in both comfort and form. If you could imagine, the Advanta™ grip is a shapely work of art as well as a performance enhancer. Try to imagine how your hand will naturally mold into the Advanta™ grip.

Electronic Tape Measure

Presenting the tape measure that will simplify your projects. The Protrade™ electronic tape measure works for all types of jobs and is easy to use. It does the work for you. Just point and shoot and Protrade™ electronic tape precisely measures lengths up to 40 feet, making it suitable for large or small jobs. Just imagine, no more frustration searching through drawers for that rarely used tape measure specifically for longer distances. Protrade™ electronic tape measures are appropriate for every job. Protrade™ electronic tape measures use a beam of light instead of a physical tape, making them compact, precise, and portable. Imagine how easy it will be to hold and carry this light weight tool. It weighs so little, you might forget it's on your belt. No more trying to remember numbers in your head or stopping to write things down. Protrade™ electronic tape measures have a memory function with recall, and a calculator for adding and finding distances as well as calculating area and volume. Picture how these jobs usually go: fiddling with a tape, getting it to stay locked, finding pencils and paper, multiplying inches for area measures—what a hassle! With the push of a button, the Protrade™ electronic tape measure precisely records the information for you. Preparing for a job takes a large portion of the total job time, and Protrade™ electronic tape cuts this down to size so you can focus on the real work. Imagine, if you will, the experience of using our tape measures. The light weight tool, the simplicity of having no tape, and the effortless calculating. This tool should have a place in your toolbox.

Car Washing Glove

For those of you who are a little particular about your cars, the Specialized™ car washing glove is the most useful new product you'll see on the market this year. If you are a car owner who doesn't trust anything but quality products to touch your paint, this is the wash glove for you.

With the Specialized™ wash glove, no need to worry about carrying multiple wash towels. Specialized™ wash gloves have soft fiber on one side for washing, the other for drying. Ordinary car washing mitts may wash and dry your car, but they won't pamper the finish. Imagine that beautiful paint job looking like new after each and every wash. When you are caring for your car, you want to finish with a clean shine. Lint can artificially make your paint look dull. Specialized™ wash gloves are made of a patented microfiber that never leaves lint. Picture a perfect reflection in your chrome. Not a flaw in sight.

If you love your car, you want to focus on the car, not on the tools you use. Imagine how the light will dance off of your car as you run your hand across that shapely fender. You can feel the pride. These wash gloves come with adjustable straps to get just the right fit for you.

You bond with your car as you wash it and care for it. You may not actually hug your car, but you might imagine that you are going to after using this product. Allow Specialized™ wash gloves to help bring your relationship to a new level.

Spray Bottles

For your safety and convenience, Universal™ spray bottles make life easier for you, no matter what you do, from gardening, to cooking, to cleaning, or nursing. These multipurpose spray bottles are so useful and convenient that you'll be searching for reasons to fill them up!

With so many reports these days concerning chemical use, it's hard to know which products are safe for your family. Universal™ spray bottles are made of FDA approved, earth-friendly, non-toxic plastic that doesn't release chemicals, making it safe to use for plants or cooking. Just imagine yourself spraying vegetables with butter or spiced oil in the kitchen. You can almost smell the aroma in the steam rising up from the pan.

The trigger and grip of Universal™ spray bottles are ergonomically designed to better fit your hand. This makes Universal™ spray bottles easy for all ages. Imagine total comfort for your hands, even during big jobs requiring prolonged use. No more tired and painful joints.

Think about the possibilities that exist with Universal™ spray bottles. Picture yourself relaxed and confident that your child can manage the Universal™ sprayer without making a mess. Children can actively participate in daily activities like cooking and cleaning with Universal™ spray bottles.

With a wide-mouthed sprayer that never clogs, thicker liquids are as easy as water. No more soaking in hot water to unclog those sprayers. You'll never buy another product in a factory spray bottle. Just picture how easy it will be to clean those scraped knees and elbows by misting them with medicine. Your children's faces will be all the reward you need.

Pen

Introducing the new Azura™ line of pens that will revolutionize the way you write. These pens are so much fun to use; we have to include free refills with every purchase. Imagine a pen that you love so much that you resist using your word processor!

Take a moment to allow yourself to experience Azura™ pens in your mind. The roller ball technology glides across the paper like a blade on ice. Your markings have never been so elegant, your handwriting never so beautiful.

Azura™ pens use twist action to activate the tip. The patented gear technology allows activation to slide smoothly. Imagine holding and turning a barrel that glides like a hot knife through butter. You'll never buy an inferior writing tool again.

The ergonomic shape of the barrel makes it comfortable in your hand. Mentally experience a pen of medium weight that doesn't tire out your hand. You'll be able to write all of your cards in one sitting. You'll no longer dread the task of holiday cards or thank you notes.

What would the most beautiful pen in the world look like? These pens are custom made. Azura™ pens are accented with your choice of chrome or gold. Barrel colors come in solid or marbled ceramic, we have a beautiful palette of colors to choose from. Visualize what you would consider the most beautiful pen, and that is what your Azura™ pen will look like.

Appendix D

The Betts' QMI Vividness of Imagery Scale

(Richardson 1983)

An image aroused by an item on this scale may be:

1 Perfectly clear and as vivid as the actual experience
2 Very clear and comparable in vividness to the actual experience
3 Moderately clear and vivid
4 Not clear or vivid, but recognizable
5 Vague and dim
6 So vague and dim as to be hardly discernable
7 No image present at all, you only 'knowing' that you are thinking of the object

Thinking of 'feeling' or touching each of the following, considering carefully the image which comes to your mind's touch, and classify the images suggested by each of the following questions as indicated by the degrees of clearness and vividness specified on the Rating Scale.

Item:

1. Sand
2. Linen
3. Fur
4. The prick of a pin
5. The warmth of a tepid bath

Appendix E

25 HIQ Items

Instructions: In your mind, please try to imagine sensations from the following descriptions. Try to imagine, to the best of your ability, the physical sensations on your hands or skin that you associate with each description. After imagining the sensation as clearly and in as much detail as you can, rate each image by the degree of clarity and vividness, according to the following scale.

A skin sensation imagined from an item on this scale may be:
1 No sensation present at all, just an awareness that you are trying to imagine the sensation
2 Vague and dim
3 Not clear or vivid, but a recognizable sensation
4 Moderately clear and vivid
5 Perfectly clear and as vivid as the actual experience

Item:

1. Holding a laptop computer (W)
2. Holding a snowball (Temp)
3. Pressing the palm of your hand against a concrete floor (H)
4. Sifting through beach sand with your fingers (Tex)
5. Holding your hand above boiling water (Temp)
6. Running your finger across the blade of a sharp knife (P)*
7. Collecting a handful of ice from the freezer (Temp)
8. Holding a melting popsicle in your palm (Temp)
9. Rubbing a Sponge across your palm (Tex)
10. Petting a dog's fur (Tex)
11. Grasping a balloon in your hand (W)
12. Running your fingers across a candle’s flame (Temp)
13. Squeezing a foam ball (H)
14. Pushing your hand against a marble wall (H)
15. Lifting a book (W)
16. Rubbing a razorblade across your hand (P)*
17. Sticking the end of your finger with a needle (P)*
18. Carrying a piece of paper in your hand (W)
19. Brushing your hand against a cactus (P)*
20. Hitting your thumb with a hammer (P)*
21. Gripping a cell phone in your palm (W)
22. Running your hand across a wooden fence post (Tex)
23. Pressing your fingers against the screen mesh in an open window (H)
24. Rubbing a rose petal between your fingers (Tex)
25. Squeezing a bicycle tire to check the air pressure (H)

*Pain items were not included in the final analysis.

Appendix F

The Vividness of Visual Imagery Questionnaire-2

Original 16 items from (Marks 1972); Additional 16 items from Marks 1995.

This questionnaire contains several sections. In each section, you will be given a description of a scene followed by four questions related to the scenario given. After reading each question, please close your eyes to construct a mental image of the described scene. Once your image has been formed, open your eyes to rate the mental image you constructed. You will do this for each mental image requested.

A visual image aroused by an item on this scale may be:

1 No image at all, you only know that you are thinking of the object
2 Vague and dim
3 Moderately clear and vivid
4 Clear and reasonably vivid
5 Perfectly clear and as vivid as normal vision

For items 1-4, think of some relative or friend whom you frequently see (but who is not with you at present) and consider carefully the picture that comes before your mind's eye.

Item:

1. The exact contour of face, head, shoulders, and body.
2. Characteristic poses of head, attitudes of body, etc.
3. The precise carriage, length of step, etc., in walking.
4. The different colors worn in some familiar clothes.

For items 5-8, think of the rising sun. Consider carefully the picture that comes before your mind's eye.

Item:

5. The sun is rising above the horizon into a hazy sky.
6. The sky clears and surrounds the sun with blueness.
7. Clouds. A storm blows up, with flashes of lightning.

8. A rainbow appears.

For items 9-12, think of the front of a shop which you often go to. Consider the picture that comes before your mind's eye.

Item:

9. The overall appearance of the shop from the opposite side of the road.
10. A window display including colors, shapes and details of individual items for sale.
11. You are near the entrance. The color, shape, and details of the door.
12. You enter the shop and go to the counter. The counter assistant serves you. Money changes hands.

For items 13-16, think of a country scene which involves trees, mountains and a lake. Consider the picture that comes before your mind's eye.

13. The contours of the landscape.
14. The color and shape of the trees.
15. The color and shape of the lake.
16. A strong wind blows on the trees and on the lake causing waves.

For items 17-20, think of being driven in a fast moving automobile by a relative or friend along a major highway. Consider the picture that comes into your mind's eye.

17. You observe the heavy traffic travelling at maximum speed around your car. The overall appearance of vehicles, their colors, sizes, and shapes.
18. Your car accelerates to overtake the traffic directly in front of you. You see an urgent expression on the face of the driver and the people in other vehicles as you pass.
19. A large truck is flashing its headlights directly behind. Your car quickly moves over to let the truck pass. The driver signals with a friendly wave.

20. You see a broken-down vehicle beside the road. Its lights are flashing. The driver is looking concerned and she is using a mobile phone.

Instructions:
For items 21-24, think of a beach by the ocean on a warm summer's day. Consider the picture that comes before your mind's eye.

21. The overall appearance and color of the water, surf, and sky.

22. Bathers are swimming and splashing about in the water. Some are playing with a brightly colored beach ball.

23. An ocean liner crosses the horizon. It leaves a trail of smoke in the blue sky.

24. A beautiful air balloon appears with four people aboard. The balloon drifts past you, almost directly overhead. The passengers wave and smile. You wave and smile back at them.

Instructions:
For items 25-28, think of a railway/train station. Consider the picture that comes before your mind's eye.

25. The overall appearance of the station viewed from in front of the main entrance.

26. The overall appearance of the station viewed from in front of the main entrance.

27. You approach the ticket office, go to a vacant counter and purchase your ticket.

28. You walk to the platform and observe other passengers and the railway lines. A train arrives. You climb aboard.

Instructions:
Finally, think of a garden with lawns, bushes, flowers, and shrubs. Consider the picture that comes before your mind's eye.

29. The overall appearance and design of the garden.

30. The color and shape of the bushes and shrubs.

31. The color and appearance of the flowers.

32. Some birds fly down onto the lawn and start pecking for food.

Appendix G

Style of Processing Questionnaire

INSTRUCTIONS: The aim of this exercise is to determine the style or manner you use when carrying out different mental tasks. Your answers to the questions should reflect the manner in which you typically engage in each of the tasks mentioned. There are no right or wrong answers, we only ask that you provide honest and accurate answers. Please answer each question by circling one response indicating how much you agree or disagree with each statement. For example, if you are provided with the statement, "I seldom read books," and this was your typical behavior, even though you might read say one book a year, you would circle the "Strongly Agree" response.

1. I enjoy doing work that requires the use of words.

1	2	3	4	5
Strongly Disagree				Strongly Agree

2. I like to picture future events or situations in my mind.

1	2	3	4	5
Strongly Disagree				Strongly Agree

3. I can never seem to find the right word when I need it.

1	2	3	4	5
Strongly Disagree				Strongly Agree

4. I do a lot of reading.

1	2	3	4	5
Strongly Disagree				Strongly Agree

5. There are some special times in my life that I like to relive by mentally picturing just how everything looked.

1	2	3	4	5
Strongly Disagree				Strongly Agree

6. I think I often use words the wrong way.

1	2	3	4	5
Strongly Disagree				Strongly Agree

7. Before I perform an activity, I often close my eyes and picture doing it.

1	2	3	4	5
Strongly Disagree				Strongly Agree

8. I enjoy learning new words.

1 2 3 4 5
Strongly Disagree Strongly Agree

9. When listening to someone describing their experiences, I try to mentally picture what was happening.

1 2 3 4 5
Strongly Disagree Strongly Agree

10. When I think of someone I know, I often “picture” in my mind what they look like.

1 2 3 4 5
Strongly Disagree Strongly Agree

11. I find it helps to think in terms of mental pictures when doing many things.

1 2 3 4 5
Strongly Disagree Strongly Agree

12. I prefer to read about how to do something before I try it myself.

1 2 3 4 5
Strongly Disagree Strongly Agree

13. I often think of synonyms for words.

1 2 3 4 5
Strongly Disagree Strongly Agree

14. When I have forgotten something, I frequently try to form a mental picture to remember it.

1 2 3 4 5
Strongly Disagree Strongly Agree

15. I have difficulty learning new words.

1 2 3 4 5
Strongly Disagree Strongly Agree

16. I enjoy using mental pictures to help me solve problems.

1 2 3 4 5
Strongly Disagree Strongly Agree

17. I prefer activities that don’t require a lot of reading.

1 2 3 4 5
Strongly Disagree Strongly Agree

18. I spend very little time trying to increase my vocabulary.

1 2 3 4 5
Strongly Disagree Strongly Agree

19. I seldom picture past events in my mind.

1 2 3 4 5
Strongly Disagree Strongly Agree

20. My thinking often consists of mental pictures or “images.”

1 2 3 4 5
Strongly Disagree Strongly Agree

Appendix H

Trial Assessment Questionnaire (TAQ)

1. How confident were you in your comparison of the two objects?

   1 2 3 4 5 6 7
   Not At All Confident … Extremely Confident

2. How sure were you in your comparison of the two objects?

   1 2 3 4 5 6 7
   Not At All Sure … Extremely Sure

3. How frustrated were you when comparing the two objects?

   1 2 3 4 5 6 7
   Not At All Frustrated … Extremely Frustrated

4. How clear was the image that you were asked to form during the task?

   1 2 3 4 5 6 7
   Not At All Clear … Extremely Clear

5. How vivid was your image?

   1 2 3 4 5 6 7
   Not At All Vivid … Extremely Vivid

6. Were you able to keep the image of the first object in your mind while you evaluated the second object?

   1 2 3 4 5 6 7
   Not At All Able … Extremely Able

7. How successful would you say you were with keeping the image of the first object in your mind while you evaluated the second object?

   1 2 3 4 5 6 7
   Not At All Successful … Extremely Successful

Appendix I
General Participant Questionnaire

1. Please indicate by circling, whether you are:

   MALE　　　　　　　　FEMALE

2. Please indicate your age: __________

3. Please indicate by circling, whether you are:

   RIGHT HANDED　　　　　　　　LEFT HANDED

4. Please indicate by circling one of the following whether you have:

   a. Normal vision

   b. Corrected vision (wear corrective glasses or contacts)

   c. Visually impaired

5. If you indicated above that you have normal or corrected vision, then do not answer the remainder of this questionnaire. If you indicated that you do have visual impairment, please answer the following questions.

   a. At what age did you become blind? (If your blindness was gradual, please indicate the age at which you lost all functional sight.) ___________

   b. Please tell us what medical condition or other circumstance led to your becoming blind (please use the back of this sheet if additional space is necessary). ____

Appendix J

Advertisement Assessment Questionnaire (AAQ)

Instructions: Please answer the following questions about the advertisement or product that you were asked to evaluate. Please do the best you can to answer each question as honestly as possible.

1. What is your overall feeling regarding the advertisement that you heard?

   1 2 3 4 5 6 7
   Very Unfavorable Very Favorable

   1 2 3 4 5 6 7
   Very Bad Very Good

   1 2 3 4 5 6 7
   Very Negative Very Positive

2. How frustrated were you when trying to remember and recall the information from the advertisement?

   1 2 3 4 5 6 7
   Not At All Frustrated Extremely Frustrated

3. How confident were you in your recollection of the advertisement?

   1 2 3 4 5 6 7
   Not At All Confident Extremely Confident

   1 2 3 4 5 6 7
   Not At All Sure Extremely Sure

4. If you formed an image while listening to the advertisement, how clear was the image?

   1 2 3 4 5 6 7
   Not At All Clear Extremely Clear

5. If you formed an image while listening to the advertisement, how vivid was your image?

   1 2 3 4 5 6 7
   Not At All Vivid Extremely Vivid

6. Overall, you'd rate the advertisement as:

1 2 3 4 5 6 7
Ineffective Effective
1 2 3 4 5 6 7
Not enjoyable Enjoyable
1 2 3 4 5 6 7
Unhelpful Helpful
1 2 3 4 5 6 7
Not thrilling Thrilling
1 2 3 4 5 6 7
Not functional Functional
1 2 3 4 5 6 7
Not delightful Delightful
1 2 3 4 5 6 7
Unnecessary Necessary
1 2 3 4 5 6 7
Dull Exciting
1 2 3 4 5 6 7
Impractical Practical
1 2 3 4 5 6 7
Not fun Fun

7. How likely would you be to purchase this product?

1 2 3 4 5 6 7
Not At All Likely Extremely Likely

8. Overall, you'd rate this product as:

1 2 3 4 5 6 7
Bad Good

1 2 3 4 5 6 7
Undesirable Desirable

1 2 3 4 5 6 7
Unfavorable Favorable

1 2 3 4 5 6 7
Worthless Worthwhile

1 2 3 4 5 6 7
Useless Useful

Please mark how strongly you agree or disagree with the following statements:

9. The advertisement brought pictures or images to my mind that helped clarify what was being said in the advertisement.

1 2 3 4 5 6 7
Do Not Agree Strongly Agree

10. I found myself thinking of images or pictures as I listened to the advertisement.

1 2 3 4 5 6 7
Do Not Agree Strongly Agree

11. The advertisement caused me to imagine how the product would feel in my hands.

1 2 3 4 5 6 7
Do Not Agree Strongly Agree

12. While listening to the advertisement, I found myself imagining that I was holding the product.

1 2 3 4 5 6 7
Do Not Agree Strongly Agree

The following questions are rated on a 7 point scale of "strongly disagree/strongly agree." Please answer these questions as they relate to the advertisement you were asked to evaluate.

1. The imagery that occurred was clear.

1 2 3 4 5 6 7
Strongly Disagree Strongly Agree

2. The imagery that occurred was detailed.

1 2 3 4 5 6 7
Strongly Disagree Strongly Agree

3. The imagery that occurred was weak.

1 2 3 4 5 6 7
Strongly Disagree Strongly Agree

4. The imagery that occurred was fuzzy.

   1 2 3 4 5 6 7
   Strongly Disagree Strongly Agree

5. The imagery that occurred was vague.

   1 2 3 4 5 6 7
   Strongly Disagree Strongly Agree

6. The imagery that occurred was vivid.

   1 2 3 4 5 6 7
   Strongly Disagree Strongly Agree

7. The imagery that occurred was sharp.

   1 2 3 4 5 6 7
   Strongly Disagree Strongly Agree

8. The imagery that occurred was well-defined.

   1 2 3 4 5 6 7
   Strongly Disagree Strongly Agree

9. I really only experienced one image.

   1 2 3 4 5 6 7
   Strongly Disagree Strongly Agree

10. I imagined a number of things.

    1 2 3 4 5 6 7
    Strongly Disagree Strongly Agree

11. Many images came to my mind.

    1 2 3 4 5 6 7
    Strongly Disagree Strongly Agree

12. I fantasized about the product in the ad.

    1 2 3 4 5 6 7
    Strongly Disagree Strongly Agree

13. I imagined what it would be like to use the product advertised.

1 2 3 4 5 6 7
Strongly Disagree Strongly Agree

14. I imagined the feel of the product.

1 2 3 4 5 6 7
Strongly Disagree Strongly Agree

In the space provided below, please write your opinion of what this study has been about today. Use the back of this sheet if additional space is needed. Alternative for visually impaired participants: Please tell the researcher.

Appendix K

Communication-Evoked Imagery Scale

Please rate the items on the following scale:

1. The imagery that occurred was clear.

Strongly Disagree							Strongly Agree
	1	2	3	4	5	6	7

2. The imagery that occurred was detailed.

Strongly Disagree							Strongly Agree
	1	2	3	4	5	6	7

3. The imagery that occurred was weak.

Strongly Disagree							Strongly Agree
	1	2	3	4	5	6	7

4. The imagery that occurred was fuzzy.

Strongly Disagree							Strongly Agree
	1	2	3	4	5	6	7

5. The imagery that occurred was vague.

Strongly Disagree							Strongly Agree
	1	2	3	4	5	6	7

6. The imagery that occurred was vivid.

Strongly Disagree							Strongly Agree
	1	2	3	4	5	6	7

7. The imagery that occurred was sharp.

Strongly Disagree							Strongly Agree
	1	2	3	4	5	6	7

8. The imagery that occurred was well-defined.

Strongly Disagree							Strongly Agree
	1	2	3	4	5	6	7

9. I really only experienced one image.

1 2 3 4 5 6 7
Strongly Disagree Strongly Agree

10. I imagined a number of things.

1 2 3 4 5 6 7
Strongly Disagree Strongly Agree

11. Many images came to my mind.

1 2 3 4 5 6 7
Strongly Disagree Strongly Agree

12. I fantasized about the product in the ad.

1 2 3 4 5 6 7
Strongly Disagree Strongly Agree

13. I imagined what it would be like to use the product advertised.

1 2 3 4 5 6 7
Strongly Disagree Strongly Agree

14. I imagined the feel of the product.

1 2 3 4 5 6 7
Strongly Disagree Strongly Agree

Appendix L

Coding Instructions for Transcribed Recall of Advertisements

Dear Coder:
Thank you for agreeing to help with data coding. Each participant was asked to recall as much information as possible from the same advertisement. The advertisement was for a multipurpose handle grip. The task that I am requesting from you is to code the recall of the advertisement for each participant. Please code each statement using the instructions below.

1. Listen to and read the advertisement so that you are familiar with it. The advertisement has been imbedded with phrases that have “no imagery,” “texture imagery,” or “shape imagery.” You will be asked to partition phrases in each participant recall and label each. I have provided a list of key words and phrases to help you decide how to categorize each partitioned idea.

2. As you read each recall statement, please underline and label text that you consider a unique, ad-related idea. By unique, I mean that each phrase can only be counted once. When a person reviews and repeats something they’ve already stated, you should only count the idea once. By ad-related, I mean that you should not count phrases such as “I don’t remember” or “I have a bad memory” because these are not related to the ad. You will label texture imagery statements “T”, shape imagery “S”, no imagery statements “N”, additional statements “A”, and comparison of the stimulus and ad “C”. A better description of each category is given below.

3. Key words to use:

    a. Texture Imagery (related to texture):

        Material
        Sensation
        Durable
        Relaxed and cozy
        Cushion
        Soft
        Non slip
        No pain
        No calluses/blisters
        Hugs your hand

    b. Shape Imagery (related to shape):

        Molds to your hand
        Hand and grip become one
        Shape
        Holds your hand
        Work of art
        Contoured
        Ergonomic
        Merge into
        Fit to your hand
        Artisan
        Performance enhancer

    c. Non-Imagery (statements from the ad that don’t involve texture or shape imagery):

High quality
Measured/custom made/size
Dual wall grips/construction
Function/purpose
Advanta brand
Water proof/repellant

d. These key words may be used frequently and should be coded according to context. When faced with these phrases or words, you should code as texture if they fall within the texture oriented content of the ad and as shape if they fall within the shape content of the ad. If no context is discernable, please code them as non-imagery statements.

Comfort
Fatigue
Feel/feeling

4. Additional advertisement-related statements are those given during recall that do not include texture imagery, shape imagery, or no imagery statements. Typically these will be statements that are related to the ad but couldn't be mapped onto the advertisement. For example, the participant may state something that is not actually in the ad. These statements would not include, however, statements such as, "I don't know" or "My memory is bad."

5. While each participant recalled the advertisement, they were asked to touch a handle grip. If they commented on the grip they were touching or compared the ad with the grip they were touching, the each unique statement will be labeled "C".

6. Next, count the number of texture imagery statements, shape imagery statements, non-imagery statements, additional statements, and comparison statements separately and record the number for each in the space provided below the recollection.

   PLEASE NOTE: Participant recall was transcribed from a video tape. Do not use my punctuation as delimiters to partition statements. There could be more than one statement within one sentence, as I have it transcribed. For example, a person may recall shape imagery and texture imagery within the same sentence.

The Multipurpose Handle Grip Advertisement:

Introducing an innovative product that will change the way you work, play, and compete! Replace factory hand grips on yard rakes, garden tools, tennis rackets, golf clubs, or anything else with Advanta™ multipurpose handle grips. [MOST OF THIS PARAGRAPH WOULD FALL INTO NO IMAGERY]

Made with patented plastic/foam infusion technology, Advanta™ replacement grips protect your equipment from wear from use, resist weather damage, and repel moisture from perspiration. [NO IMAGERY STATEMENTS] In your mind, feel the sensation of high quality, durable material. You can really feel the difference. [TEXTURE IMAGERY STATEMENTS]

Allow yourself to indulge in the fantasy of using our grips. The deep cushion creates a sensation that firmly molds to your fingers. Imagine the comfort of super-soft textured grips. That comfort continues on, even after hours of physical exertion. Forget about callouses or joint pain. These microtexture fibers create a non-slip surface that offers your hand a nice, firm hug, keeping your grip relaxed and cozy. [MOST OF THIS PARAGRAPH WOULD FALL INTO TEXTURE IMAGERY]

Dual wall grips with a durable inside liner offer an ergonomic design that decreases hand fatique. Our delicately designed contours literally hold your hand. In your mind, imagine how it would feel to slip your fingertips onto a grip shaped so naturally in your palm that your hand and the grip become one. [MOST OF THIS PARAGRAPH WOULD FALL INTO SHAPE IMAGERY]

If you are an unusually large or small handed person, you probably have had trouble feeling comfortable with standard grips. Order yours in a custom size to fit your hand. A few simple measurements done at home will allow you to order your exact fit. [MOST OF THIS PARAGRAPH WOULD FALL INTO NO IMAGERY]

The exquisite shape provides comfort as well as form. Beautiful artisanship provides a shapely grip, resulting in both comfort and form. If you could imagine, the Advanta™ grip is a shapely work of art as well as a performance enhancer. Try to imagine how your hand will naturally mold into the Advanta™ grip. [MOST OF THIS PARAGRAPH WOULD FALL INTO SHAPE IMAGERY]

BIBLIOGRAPHY

Ahsen, Akhter (2003), "Image and maze: Learning through imagery functions," Journal of Mental Imagery, 27 (3), 3-62.

Aleman, André, Laura van Lee, Mariska H. M. Mantione, Ilse G. Verkoijen, and Edward H. F. de Haan (2001), "Visual imagery without visual experience: Evidence from congenitally totally blind people," Neuroreport: For Rapid Communication of Neuroscience Research, 12 (11), 2601-04.

Amedi, Amir, Lotfi B. Merabet, Felix Bermpohl, and Alvaro Pascual-Leone (2005), "The Occipital Cortex in the Blind: Lessons About Plasticity and Vision," Current Directions in Psychological Science, 14 (6), 306-11.

Amorim, Michel-Ange, Jack M. Loomis, and Sergio S. Fukusima (1998), "Reproduction of Object Shape is More Accurate Without the Continued Availability of Visual Information," Perception, 27, 69-86.

Argo, Jennifer J., Darren W. Dahl, and Andrea C. Morales (2006), "Consumer Contamination: How Consumers React to Products Touched by Others," Journal of Marketing, 70 (April), 81-94.

Arterberry, M. E., C. Craver-Lemley, and A. Reeves (2003), "Visual imagery is not always like visual perception," Behavioral and Brain Sciences, 25 (2), 183-+.

Atwood, April (1989), "Extending Imagery Research to Sounds: Is a Sound Also Worth a Thousand Words?," Advances in Consumer Research, 16, 587-94.

Babin, L. A. and A. C. Burns (1997), "Effects of Print Ad Pictures and Copy Containing Instructions to Imagine on Mental Imagery that Mediates Attitudes.," Journal of Advertising, 26 (3), 33-44.

---- (1998), "A Modified Scale for the Measurement of Communication-Evoked Mental Imagery," Psychology & Marketing, 15 (3), 261-78.

Bagnara, Sebastiano, Francesca Simion, Maria E. Tagliabue, and Carlo Umilta (1988), "Comparison Processes on Visual Mental Images," Memory & Cognition, 16 (2), 138-46.

Bailes, Sally M. and Robert M. Lambert (1986), "Cognitive aspects of haptic form recognition by blind and sighted subjects," British Journal of Psychology, 77 (4), 451-58.

Baker, Stacey Menzel (2006), "Consumer normalcy: Understanding the value of shopping through narratives of consumers with visual impairments," Journal of Retailing, 82 (1), 37-50.

Bertolo, Helder (2005), "Visual Imagery Without Visual Perception?," Psicologica, 26, 173-88.

Betts, G.H. (1909), The Distribution and Functions of Mental Imagery. New York: Columbia University Teacher's College.

Blanco, Florentino and David Travieso (2003), "Haptic exploration and mental estimation of distances on a fictitious island: From mind's eye to mind's hand," Journal of Visual Impairment and Blindness, 97 (5), 298-300.

Blankenburg, Felix, Christian C. Ruff, Ralf Deichmann, Geraint Rees, and Jon Driver (2006), "The Cutaneous Rabbit Illusion Affects Human Primary Sensory Cortex Somatotopically," PLoS Biology, 4 (3), e69.

Bone, P. F. and P. S. Ellen (1992), "The Generation and Consequences of Communication Evoked Imagery," Journal of Consumer Research, 19 (1), 93-103.

Brehm, J. (1966), A theory of psychological reactance. New York: Academic Press.

Burns, Alvin C., Abhijit Biswas, and Laurie A. Babin (1993), "The Operation of Visual Imagery as a Mediator of Advertising Effects.," Journal of Advertising, 22 (2), 71-85.

Cacioppo, J. T. and R. E. Petty (1982). "The need for cognition." Journal of Personality and Social Psychology 42(1): 116-131.

Carli, G., F. I. Cavallaro, and E. L. Santarcangelo (2007), "Hypnotizability and Imagery Modality Preference: Do Highs and Lows Live in The Same World?" Contemporary Hypnosis, 24 (2), 64-75.

Carpenter, Patricia A. and Peter Eisenberg (1978), "Mental rotation and the frame of reference in blind and sighted individuals," Perception and Psychophysics, 23 (2), 117-24.

Carswell, C. Melody (2002), "Sensory and Perception: Cognitive Psychology Proseminar." Lexington, KY.

Carswell, Melody, Shannon Rinaldo, and Eric Stephens (2005), "Representative Sampling of Users? To The Contrary.," Ergonomics in Design, 13 (1), 25.

Childers, Terry L. and Michael J. Houston (1984), "Conditions for a Picture-Superiority Effect on Consumer Memory," Journal of Consumer Research, 11 (2), 643-54.

---- (1983), "Imagery Paradigms for Consumer Research: Alternative Perspectives from Cognitive Psychology," Advances in Consumer Research, 10 (1), 59-64.

Childers, Terry L., Michael J. Houston, and Susan E. Heckler (1985), "Measurement of Individual Differences in Visual Versus Verbal Information Processing," Journal of Consumer Research, 12 (2), 125-34.

Childers, T. L. and J. Jass (2002). All Dressed Up With Something to Say: Effects of Typeface Semantic Associations on Brand Perceptions and Consumer Memory. Journal of Consumer Psychology, Lawrence Erlbaum Associates. 12**:** 93-106.

Cocude, M., E. Mellet, and M. Denis (1999), "Visual and Mental Exploration of Visuo-Spatial Configurations: Behavioral and Neuroimaging Approaches," Psychological Research, 62, 93-106.

Craig, E. M. (1973), "Role of Mental Imagery in Free Recall of Deaf, Blind, and Normal Subjects," Journal of Experimental Psychology, 4, 22-24.

Craver-Lemley, C., M. E. Arterberry, and A. Reeves (1997), "Effects of imagery on vernier acuity under conditions of induced depth," Journal of Experimental Psychology-Human Perception and Performance, 23 (1), 3-13.

---- (1999). ""Illusory" illusory conjunctions: The conjoining of features of visual and imagined stimuli." Journal of Experimental Psychology-Human Perception and Performance 25(4): 1036-1049.

Craver-Lemley, C. and A. Reeves (1992), "How Visual-Imagery Interferes with Vision," Psychological Review, 99 (4), 633-49.

---- (1987), "Visual-Imagery Selectively Reduces Vernier Acuity," Perception, 16 (5), 599-614.

Crowne, D. P. and D. Marlowe (1960). "A new scale of social desirability independent of psychopathology." Journal of Consulting Psychology 24(4): 349-354.

D'Angiulli, A. (2002), "Mental image generation and the contrast sensitivity function," Cognition, 85 (1), B11-B19.

Davidson, Philip W. (1976), "Haptic perception and blindness: An overview," Journal of Pediatric Psychology, 1 (3), 21-25.

Davidson, Philip W., Judith K. Barnes, and Gina Mullen (1974), "Differential effects of task memory demand on haptic matching of shape by blind and sighted humans," Neuropsychologia, 12 (3), 395-97.

Dingfelder, Sadie F. (2007), "Phantom pain and the brain: An actual touch, or an imaginary one? It's all the same to (some parts of) your brain," Monitor on Psychology, 38 (1), 22-23.

Evans, Paul M. and James C. Craig (1992), "Response competition: A major source of interference in a tactile identification task," Perception & Psychophysics, 51 (2), 199-206.

Farah, M. and A. F. Smith (1983), "Perceptual Interference and Facilitation with Auditory Imagery.," Perception & Psychophysics, 33, 475-78.

Farah, M. (1985). "Psychophysical evidence for a shared representational medium for mental images and percepts." Journal of Experimental Psychology: General 114: 91-103.

Finke, R. A. (1980). "Levels of Equivalence in Imagery and Perception." Psychological Review 87: 113-132.

---- (1989), Principles of Mental Imagery. Cambridge, MA: MIT Press.

---- (1985), "Theories Relating Mental Imagery to Perception," Psychological Bulletin, 98, 236-59.

Finke, R. A. and H. S. Kurtzman (1981), "Area and Contrast Effects Upon Perceptual and Imaginal Acuity," Journal of Experimental Psychology: Human Perception and Performance, 7, 825-32.

Ganis, G., W. L. Thompson, and S. M. Kosslyn (2004), "Brain areas underlying visual mental imagery and visual perception: an fMRI study," Cognitive Brain Research, 20 (2), 226-41.

Gerardin, Emmanuel, Angela Sirigu, Stephane Lehericy, Jean-Baptiste Poline, Bertrand Gaymard, Claude Marsault, Yves Agid, and Denis Le Bihan (2000), "Partially Overlapping Neural Networks for Real and Imagined Hand Movements," Cereb. Cortex, 10 (11), 1093-104.

Gibson, James J. (1962), "Observations on Active Touch," Psychological Review, 69 (6), 477-91.

Gilbert, Avery N., Melissa Crouch, and Sarah E. Kemp (1998), "Olfactory and visual mental imagery," Journal of Mental Imagery, 22 (3), 137-46.

Giraud, A., C. Price, J. Graham, E. Truy, and R. Frackowiak (2001), "Cross-Plasticity Underpins Language Recovery after Cochlear Implantation," Neuron, 30 (3), 657-64.

Grohmann, Bianca, Eric R. Spangenberg, and David E. Sprott (2007), "The Influence of Tactile Input on the Evaluation of Retail Product Offerings," Journal of Retailing, 83 (2), 237-245.

Halpern, Andrea R. and Robert J. Zatorre (1999), "When That Tune Runs Through Your Head: A PET Investigation of Auditory Imagery for Familiar Melodies," Cereb. Cortex, 9 (7), 697-704.

Herdman, Chris M. and Alinda Friedman (1985), "Multiple Resources in Divided Attention: A Cross-Modal Test of the Independence of Hemispheric Resources.," Journal of Experimental Psychology: Human Perception and Performance, 11 (1), 40-49.

Herman, James F., Therese G. Herman, and Steven P. Chatman (1983), "Constructing cognitive maps from partial information: A demonstration study with congenitally blind subjects," Journal of Visual Impairment and Blindness, 77 (5), 195-98.

Hollins, Mark (1986), "Haptic mental rotation: More consistent in blind subjects?," Journal of Visual Impairment and Blindness, 80 (9), 950-52.

---- (1985), "Styles of mental imagery in blind adults," Neuropsychologia, 23 (4), 561-66.

Isaac, A., D. Marks, and E. Russell (1986), "An Instrument for Assessing Imagery of Movement: The Vividness of Movement Imagery Questionnaire (VMIQ)." Journal of Mental Imagery, 10, 23-30.

Kaski, D. (2002), "Revision: Is visual perception a requisite for visual imagery?," Perception, 31 (6), 717-31.

Keller, Punam Anand and Lauren G. Block (1997), "Vividness Effects: A Resource-Matching Perspective," Journal of Consumer Research, 24 (3), 295-304.

Keppel, Geoffrey and Thomas D. Wickens (2004), Design and Analysis: A Researcher's Handbook (4th ed.). Upper Saddle River: Pearson Prentice Hall.

Kisielius, Jolita and Brian Sternthal (1984), "Detecting and Explaining Vividness Effects in Attitudinal Judgments," Journal of Marketing Research, 21 (February), 54-64.

Klatzky, Roberta L. and Susan J. Lederman (2001), "Modality Specificity in Cognition," in The Nature of Remembering: Essays in Honor of Robert G. Crowder, Henry L. Roediger III and James S. Nairne and Aimee M. Surprenant, Eds. Washington, D.C.: American Psychological Association.

Klatzky, Roberta L., Susan J. Lederman, and Dana E. Matula (1991), "Imagined Haptic Exploration in Judgments of Object Properties," Journal of Experimental Psychology: Learning, Memory, and Cognition, 17 (2), 314-22.

Klatzky, Roberta L., Susan J. Lederman, and V. Metzger (1985), "Identifying Objects by Touch: An "Expert System."" Perception & Psychophysics, 37, 299-302.

Kosslyn, S. M. (1975), "Information Representation in Visual Images.," Cognitive Psychology, 7, 341-70.

Kosslyn, S. M., Giorgio Ganis, and William L. Thompson (2001), "Neural Foundations of Imagery," Nature Reviews, 2, 635-42.

Kosslyn, Stephen Michael, A. Pascual-Leone, O. Felician, S. Camposano, J. P. Keenan, W. L. Thompson, G. Ganis, K. E. Sukel, and N. M. Alpert (1999), "The Role of Area 17 in Visual Imagery: Convergent Evidence from PET and rTMS," Science, 2, 167-70.

Kosslyn, Stephen Michael, W. L. Thompson, I. J. Kim, and N. M. Alpert (1995), "Topographical Representations of Mental Images in Primary Visual Cortex," Nature, 378, 496-98.

Krech, D., M. Rosenzweig, and E. Bennett (1963), "Effects of complex environment and blindness on rat brain," Archives of Neurology, 8, 403-12.

Lederman, Susan J. (1985), "Tactual Roughness Perception in Human: A Psychophysical Assessment of the Role of Vibration.," in Hand Function and the Neocortex, A. W. Goodwin and Smith Darian, I., Eds. New York: Springer-Verlag.

Lederman, Susan J. and Roberta L. Klatzky (1993), "Extracting object properties through haptic exploration," Acta Psychologica, 84 (1), 29-40.

----- (1997), "Relative Availability of Surface and Object Properties During Early Haptic Processing," Journal of Experimental Psychology: Human Perception and Performance, 23 (6), 1680-1707.

---- (1998), "The Hand as a Perceptual System," in The Psychobiology of the Hand, Kevin J. Connolly, Ed. Cambridge: Cambridge University Press.

---- (1987), "Hand Movements: A Window Into Haptic Object Recognition," Cognitive Psychology, 19, 342-68.

---- (1990), "Haptic Classification of Common Objects: Knowledge Driven Exploration.," Cognitive Psychology, 22, 421-59.

---- (1992), "Stages of Manual Exploration in Haptic Object Identification.," Perception & Psychophysics, 52 (6), 661-70.

Lederman, Susan J., Roberta L. Klatzky, and Paul O. Barber (1985), "Spatial and movement-based heuristics for encoding pattern information through touch," Journal of Experimental Psychology: General, 114 (1), 33-49.

Lederman, Susan J., Craig D. Summers, and Roberta L. Klatzky (1996), "Cognitive Salience of Haptic Object Properties: Role of Modality-Encoding Bias.," Perception, 25, 983-98.

Lee, Louise and David Kiley (2005), "Love Those Boomers; Their New Attitudes and Lifestyles are a Marketer's Dream," in Business Week.

Marks, David F. (1972), "Individual Differences in the Vividness of Visual Imagery and Their Effect on Function," in The Function and Nature of Imagery, P. W. Sheehan, Ed. New York: Academic Press.

---- (1973), "Visual Imagery Differences in the Recall of Pictures," British Journal of Psychology, 64, 17-24.

---- (1995). "New Directions for Mental Imagery Research." Journal of Mental Imagery 19(3-4): 153-167.

McCabe, Deborah Brown and Stephen M. Nowlis (2003), "The Effect of Examining Actual Products or Product Descriptions on Consumer Preference," Journal of Consumer Psychology, 13 (4), 431-39.

Mellet, E., L. Petit, B. Mazoyer, M. Denis, and N. Tzourio (1998), "Reopening the Mental Imagery Debate: Lessons From Functional Anatomy," NeuroImage, 8, 129-39.

Mellet, E., N. Tzourio-Mazoyer, S. Bricogne, B. Mazoyer, S. M. Kosslyn, and M. Denis (2000), "Functional Anatomy of High-Resolution Visual Mental Imagery," Journal of Cognitive Neuroscience, 12 (1), 98-109.

Mellet, E., N. Tzourio, F. Crivello, M. Joliot, M. Denis, and B. Mazoyer (1996), "Functional Anatomy of Spatial Mental Imagery Generated From Verbal Instruction," The Journal of Neuroscience, 16, 6504-12.

Merabet, Lotfi B., Gregor Thut, Brian Murray, Jessica Andrews, Steven Hsiao, and Alvaro Pascual-Leone (2004), "Feeling by Sight or Seeing by Touch," Neuron, 42, 173-79.

Millar, Susanna (1975), "Spatial Memory by Blind and Sighted Children," British Journal of Psychology, 11.

Miller, Darryl W. and Lawrence J. Marks (1997), "The Effects of Imagery-Evoking Radio Advertising Strategies on Affective Responses.," Psychology & Marketing, 14 (4), 337-60.

Nelson, Randall J. (1985), "Sensorimotor Cortex Responses to Vibrotactile Stimuli During Initiation and Execution of Hand Movement," in Hand Function and the Neocortex, A. W. Goodwin and Smith Darian, I., Eds. New York: Springer-Verlag.

Nunnally, J. C. and I. H. Bernstein (1994). Psychometric Theory. New York, McGraw-Hill.

Okada, H. and K. Matsuoka (1992), "Effects of Auditory Imagery on the Detection of a Pure Tone in White Noise: Experimental Evidence of the Auditory Perky Effect.," Perceptual & Motor Skills, 74 (2), 443-48.

Paivio, A. (1986). Mental Representations. New York, Oxford University Press.

Peck, Joann and Terry L. Childers (2003a), "Individual Differences in Haptic Information Processing: The "Need for Touch" Scale," Journal of Consumer Research, 30 (December), 13.

---- (2005), "Self-Report and Behavioral Measures in Product Evaluation and Haptic Information: Is What I Say How I Feel?," Advances in Consumer Research, 32, 1/8.

---- (2003b), "To Have and To Hold: The Influence of Haptic Information on Product Judgments," Journal of Marketing, 14.

Peck, Joann and Jennifer Wiggins (2006), "It Just Feels Good: Customers' Affective Response to Touch and Its Influence on Persuasion," Journal of Marketing, 70 (4), 56-69.

Peng, G.C., J. F. Baker, and B. W. Peterson (1994), "Dynamics of directional plasticity in the human vertical vestibulo-ocular reflex.," Journal of Vestibular Research, 4 (6), 453-60.

Perky, C.W. (1910). "An Experimental Study of Imagination." American Journal of Psychology 21: 422-452.

Petrova, Petia K. and R.B. Cialdini (In press), "Evoking Imagination as a Strategy of Influence," in Handbook of Consumer Psychology, Curtis P. Haugtvedt and Frank Kardes and Paul Herr, Eds.

Petrova, Petia K. and Robert B. Cialdini (2005), "Fluency of Consumption Imagery and the Backfire Effects of Imagery Appeals," Journal of Consumer Research, 32 (3), 442.

Pietrini, Pietro, Maura L. Furey, Emiliano Ricciardi, M. Ida Gobbini, W. H. Carolyn Wu, Leonardo Cohen, Mario Guazzelli, and James V. Haxby (2004), "Beyond sensory images: Object-based representation in the human ventral pathway," Neuroscience, 101 (15), 5658-63.

Project, The Boston Retinal Implant (2006). Boston, VA.

Rebotier, T. P., D. J. Kirsh, et al. (2003). "Image-dependent interaction of imagery and vision." American Journal of Psychology 116(3): 343-366.

Reed, Catherine L., Shy Shoham, and Eric Halgren (2004), "Neural Substrates of Tactile Object Recognition: An fMRI Study.," Human Brain Mapping, 21, 236-46.

Reeves, A. (1981), "Visual Imagery Reduces Sensitivity to Hue-Varying, But Not to Luminance-Varying, Visual Stimuli.," Perception & Psychophysics, 29, 247-50.

Reeves, Adam (1980), "Visual Imagery in Backward Masking," Psychonomic Society, 28 (2), 118-24.

Révész, G. (1950), Psychology and art of the blind. London: Green Longmans.

Richardson, A. (1969). Mental Imagery. London, Routledge and Kegan Paul.

Richardson, Alan (1983), "Imagery: Definition and Types," in Imagery: Current Theory, Research, and Application, Anees A. Sheikh, Ed. New York: John Wiley & Sons.

Röder, Brigitte, Frank Rösler, and Erwin Hennighausen (1997), "Different cortical activation patterns in blind and sighted humans during encoding and transformation of haptic images," Psychophysiology, 16.

Roland, P. E.; Gulyas, B. (1995), "Visual Memory, Visual Imagery, and Visual Recognition of Large Field Patterns by Human Brain: Functional Anatomy by Positron Emission Tomography," Cerebral Cortex, 1, 79-93.

Rueckl, J. G., K. R. Cave, and S. M. Kosslyn (1989), "Why are "What" and "Where" Processed by Separate Cortical Visual Systems? A Computational Investigation," Journal of Cognitive Neuroscience, 1, 171-86.

Sadato, Norihiro, Tomohisa Okada, Manabu Honda, and Yoshiharu Yonekura (2002), "Critical Period for Cross-Modal Plasticity in Blind Humans: A Functional MRI Study.," NeuroImage, 16, 398-400.

Sadato, Norihiro, Alvaro Pascual-Leone, Jordan Grafmani, Vicente Ibanez, Marie-Pierre Deiber, George Dold, and Mark Hallett (1996), "Activation of the Primary Visual Cortex by Braille Reading in Blind Subjects," Nature, 380, 526-28.

Sathian, K. and A. Zangaladze (2002). Feeling with the mind's eye: contribution of visual cortex to tactile perception. Behavioural Brain Research. 135: 127.

Segal, S. J. and V. Fusella (1970), "Influence of Imaged Pictures and Sounds on Detection of Visual and Auditory Signals," Journal of Experimental Psychology, 83, 458-64.

Sekuler and Blake (2002), "Touch," in Perception. 4th ed. Boston: McGraw Hill.

Servos, P., Susan J. Lederman, D. Wilson, and J. Gati (2001), "fMRI Derived Cortical Maps for Haptic Shape, Texture, and Hardness," Cognitive Brain Research, 12, 307-13.

Sheehan, P. W. (1967), "A Shortened Form of Betts' Questionnaire Upon Mental Imagery.," Journal of Clinical Psychology, 23 (3), 386-89.

Sheik, A. A. (1983). Imagery-- Current Theory, Research, and Application. New York, Wiley.

Shrout, P. E. and J. L. Fleiss (1979). "Intraclass Correlations: Uses in Assessing Rater Reliability." Psychological Bulletin 2: 420-428.

Tanner, Lindsey (2004), "Millions of Americans at risk for vision loss or blindness, numbers expected to surge," in Associated Press. Chicago.

Thinus-Blanc, C. and F. Gaunet (1997), "Representations of Space in Blind Persons: Vision as a Spatial Sense?," Psychological Bulletin, 121 (1), 20-42.

Thompson, Richard F. (1993), The Brain (2nd ed.). New York: W. H. Freeman and Company.

Tootell, Roger B., Martin S. Silverman, Eugene Switkes, and Russell L. deValois (1982), "Deoxyglucose analysis of retinotopic organization in primate striate cortex," Science, 218 (4575), 902-04.

Uhl, F., T. Kretschmer, G. Lindinger, and G. Goldenberg (1994), "Tactile mental imagery in sighted persons and in patients suffering from peripheral blindness early in life," Electroencephalography & Clinical Neurophysiology, 91 (4), 249-55.

Unnava, H. Rao, Sanjeev Agarwal, and Curtis P. Haugtvedt (1996), "Interactive Effects of Presentation Modality and Message-Generated Imagery on Recall of Advertising Information," Journal of Consumer Research, 23, 81-88.

Unnava, H. Rao and Robert E. Burnkrant (1991), "An Imagery-Processing View of the Role of Pictures in Print Advertisements," Journal of Marketing Research, 28, 226-31.

Viswanathan, Madhubalan and Terry L. Childers (2003), "An enquiry into the process of categorization of pictures and words," Perceptual and Motor Skills, 96 (1), 267-87.

Voss, Kevin E., Eric R. Spangenberg, Bianca Grohmann (2003). Measuring the Hedonic and Utilitarian Dimensions of Consumer Attitude. Journal of Marketing Research (JMR), American Marketing Association. 40: 310-320.

Wikipedia (2006), "Perception," Wikipedia.

Yoo, Seung-Schik, Daniel K. Freeman, James J. McCarthy, III, and Ferenc A. Jolesz (2003), "Neural substrates of tactile imagery: A functional MRI study," Neuroreport: For Rapid Communication of Neuroscience Research, 14 (4), 581-85.

Yoo, Seung-Schik, Chang Lee, and Byung Gil Choi (2001), "Human brain mapping of auditory imagery: event-related functional MRI study," NeuroReport, 12 (14), 3045-49.

Zhang, Minming, Valerie D. Weisser, Randall Stilla, S. C. Prather, and K. Sathian (2004), "Multisensory cortical processing of object shape and its relation to mental imagery," Cognitive, Affective and Behavioral Neuroscience, 4 (2), 251-59.

Zimler, Jerome and Janice M. Keenan (1983), "Imagery in the congenitally blind: How visual are visual images?," Journal of Experimental Psychology: Learning, Memory, and Cognition, 9 (2), 269-82.

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Rinaldo, Shannon (2003). "The Effects of Ethical Concerns on Physicians' Attitudes Toward the Promotion Strategies of the Pharmaceutical Industry," Proceedings of the American Marketing Association Summer Educator's Conference, Chicago, IL.

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