3D SURFACE TEXTURE AND ITS EFFECT ON BRAND IDENTITY: A STUDY IN THE MILITARY CONTEXT

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ABSTRACT

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This thesis focuses on relations between surface texture and brand identity in the field of Industrial Design, embracing texture as both a technical/functional characteristic and a source of brand perception. The work examines these relations within the military products sector, through a case study of a product design for the Turkish product manufacturer Aselsan. An empirical approach is taken, involving the evaluation of visual and physical surface texture designs by participants. The study was carried out in two stages. The first study focused on visual experience, and the second study focused on both visual and tactile experience. Overall, the aim is to investigate how various aspects of surface texture may be manipulated to communicate brand identity effectively. During the research process, surface texture features including the form of the surface textures, variations in the settlements on the surface, size differences, and settlement densities were examined. The results show that the manipulated surface texture features have an effect on brand perception. As a result of the evaluation specific to the brand identity of the relevant company, the following texture features come to the fore: high density positioning and their presentation as protrusions. Additionally, the research seeks to provide a new method and examples of 3D surface texture evaluation and data suitable for

designers and engineers within or outside the military products sector to assist their decisions on 3D texture definition to help communicate a defined brand image.

Keywords: Surface Texture, Brand Identity, Materials Experience, Product Perception

ÖZ

3B YÜZEY DOKUSU VE MARKA KİMLİĞİNE ETKİSİ: ASKERİ BAĞLAMDA BİR ÇALIŞMA

Çankaya, Erdem
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Bu tez, Endüstriyel Tasarım alanında dokuyu hem teknik/fonksiyonel bir özellik hem de bir marka algısı kaynağı olarak benimseyerek, yüzey dokusu ve marka kimliği arasındaki ilişkileri odağına almaktadır. Çalışma, Aselsan için bir ürün tasarımı vaka çalışması üzerinden askeri ürünler sektöründeki bu ilişkileri incelemektedir. Ampirik yaklaşım benimsenerek, yüzey dokusu tasarımlarının katılımcılar tarafından görsel ve fiziksel olarak değerlendirilmiştir. Çalışma iki aşamada gerçekleştirilmiştir. İlk çalışmada görsel deneyimine odaklanıp, ikinci çalışmada hem görsel hem dokunsal deneyime odaklanılmıştır. Genel olarak amaç, marka kimliğini etkili bir şekilde iletmek için yüzey dokularının sahip olduğu çeşitli özelliklerinin nasıl manipüle edilebileceğini araştırmaktır. Araştırma sürecinde yüzey dokularının formu, yerleşim varyasyonları, sahip oldukları boyut farklılıkları ve yerleşim yoğunlukları gibi özellikler incelenmiştir. Sonuçlar, manipüle edilen yüzey dokusu özelliklerinin marka algısını etkilemede etkili olduğunu göstermektedir. İlgili firmanın marka kimliğine özel değerlendirme sonucunda, yüksek yoğunlukta konumlandırılma ve yüzey üzerinde çıkıntılar olarak yerleşimi öne çıkmaktadır. Ek olarak, araştırma, tanımlanmış marka imajının iletişimine yardımcı olma amacıyla askeri ürünler sektörü içindeki veya sektör dışındaki tasarımcılar ve mühendisler için 3B doku

kullanımına ilişkin kararlarına yardımcı olmayı, yeni bir 3B yüzey dokusu verisi yöntemi ve örnekleri sağlamayı amaçlamaktadır.

Anahtar Kelimeler: Yüzey Dokusu, Marka Kimliği, Malzeme Deneyimi, Ürün Algısı

To my family…

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And thanks to the one who embraces me kindly whenever I feel stressed.

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CHAPTER 1

INTRODUCTION

Surface improvements play an important role in product design. Basically, surface textures are mostly evaluated from a usability perspective. Especially in handheld devices, 3-dimensional surface textures are used in scenarios such as a better grip and the use of control equipment. In addition to the functionality of these textures, there is also the issue of how they are perceived by the user. In other words, textures also should be evaluated from hedonic perspectives in addition to their functional use. Relatively few systematic studies in this area have been made, especially when factoring in an additional and novel requirement for texture to help communicate a brand image. Therefore, this study combines the generation and evaluation of 3-dimensional surface textures on a hand-held device, in terms of functionality, hedonics and brand image.

1.1 Background and Motivation of the Study

Surface textures, which are among surface improvement options, are a phenomenon that should be examined in the interaction of the user with the product from the point of view of industrial design. The use of 3D surface textures, both functional (e.g. preventing slippage, referencing important areas of the product) and hedonic (e.g. pleasing the user visually and tactually) affects the brand image (i.e. the image that someone has in their mind concerning brand perception). The surface textures used for functional purposes in products in the marketplace inevitably also satisfy the user on a hedonic level. For this reason, designers should not focus only on functionality but also on the hedonic aspect of surface textures in their design processes.

Surface textures are usually evaluated from a usability perspective or from a simple point of view of providing pleasant visual effects that may add interest to a plain product surface. Especially in handheld devices, 3D surface textures are used in scenarios requiring better grip and ease of use of control equipment.

Through effective use of surface textures, designed products can be differentiated from their competitors on the market, whilst there is an opportunity to use surface texture as a means to communicate brand values. Especially when the military product sector is considered, the products in this sector are very similar in external appearance due to the technical standards that must be applied, the production technology used because of low volumes of production, and the resistance to environmental conditions. 3D surface textures offer a unique opportunity to differentiate devices in such a sector and introduce a level of product identity that is not currently seen.

Surface textures are perceived by the user, both tactually and visually. For this reason, design research into surface texture must take into account the full experience across visual and tactual senses and should not focus solely on one or the other. This is especially the case when functional requirements relating to sufficient grip must be satisfied, as well as a unique visual identity that reflects a brand. In the process of designing the design elements, a strategic connection can be established from corporate identity to product design by using the brand identity and the manifestation of brand values, which are the main values of corporate identity (Zengin, 2010). Tactile and visual experience can be used in harmony to reflect brand values and create a brand image in electro-optic military devices. In order to differentiate from the products in the market and create a brand image, Aselsan, the manufacturer of electro-optical devices for use in the military sector, has approved the investigation of this opportunity. Through this thesis, the researcher, who works at Aselsan as an industrial designer, aims to investigate the subject taking a practical, experimental approach.

1.2 Aim and Objectives of the Study

The aim of the research was to examine 3D surface textures visually and tactually and investigate their effect on brand image. The literature review in Chapter 2 showed that while the interaction of surface textures with the human senses has been studied in depth, there is a gap in its application and effect on brand image. Therefore, in this research, a number of studies and experiments have been carried out to explore the situation.

When technology products are examined in today's conditions, it is seen that most of the products in the market are very close to each other in terms of price and technically meeting the user's needs (Ashby & Johnson, 2013). In line with this approach, also for electro-optical devices in the military product sector, it is seen that they have very similar external forms due to technical standards they must have, their resistance to harsh environmental conditions and production technologies used due to low quantities. Differentiation from the products in the market, creating a product identity and achieving brand recognition with the use of manipulated 3D surface textures remain as an interesting area in this sector. As a result of these, the selected product segmentation is handheld electro-optical military devices. Furthermore, these devices were especially suited to the study because of their handheld specifications, leading to an opportunity to examine tactile experience and visual experience at the same time. The objectives for this study can be summarised as follows:

- To analyse the functional and hedonic aspects of surface textures
- To explore how surface texture can be manipulated for its impact on brand identity
- To assist designers in their decisions regarding the use of 3D textures
- To provide a new method to generate 3D surface texture options alongside their systematic evaluation

In order to achieve these objectives, the research progressed through three steps:

I. Surface textures in the market were examined and grouped,
II. Brand values of the company (Aselsan) were examined,
III. A controlled experiment was carried out on textures suited to communicating the brand values.

1.3 Research Questions

The thesis attempts to find answers to the following questions.

- How do 3D surface treatments applied to materials in handheld military products affect the brand image?
- Which combination of texture elements best communicates the Aselsan brand image?
- How do users evaluate various types of surface textures?

1.4 Structure of Thesis

The thesis is composed of five chapters as listed below.

Chapter 1, *Introduction*, draws attention to the background of the research. The main focus of the study, research aim, objectives are outlined and research questions are presented.

Chapter 2, *Literature Review*, provides a review of the literature covering the topics of materials experience, the concept of 3D surface textures, sensory properties of 3D surface textures, and brand identity.

Chapter 3, *Experimental Approach and Methodology*, explains the brand identity analysis methodology carried out specifically for the company and defines the variables by which 32 3D surface textures are designed.

Chapter 4, *A Case Study on 3D Surface Texture and Brand Identity,* contains details of to generate 3D surface texture options alongside their systematic evaluation. It includes the experimental set-up, results and analysis.

Chapter 5, *Discussion and Conclusion*, presents the findings and their implications are discussed, whilst the research questions are revisited. Limitations of the study are given, and recommendations for further studies are made.

CHAPTER 2

LITERATURE REVIEW

In order to have a broad perspective, relevant literature was analysed for the period of 1994-2021 through METU and Aselsan Inc. Libraries and different electronic databases such as Science Direct, EbscoHost, Elsevier, ACM Digital Library, and major journals about defence by using broad variety of keywords such as material, material experience, surface texture, surface improvement, brand identity, usability, subjective measurement, usability in military products, perceived quality, apparent usability, human engineering, handheld military products, human factors in military, military requirements.

2.1 Materials Experience

We gain experience with every object around us. An interaction must take place in order for these experiences to occur. Parallel to this, our interaction with a material takes place through products. As a result of this interaction we produce meaning in a product and material (Karana et al., 2014). It is understood that this is a perceptual state within the meaning that the user creates for their products and materials. Material perception is about how we perceive different materials. Detection of material properties can include all our senses (Lindberg et al., 2013). When this sensation is examined, it is argued that the user's experience with the product material consists of three experimental components: aesthetic (sensorial) experience, experience of meaning and emotional experience (Karana et al., 2015). For the sake of clarity, we can give the following examples. Features such as shiny and smoothness can be shown as an aesthetic experience. Experience of meaning is

related to how a material is perceived. For example, some materials are modern, elegant, cozy, etc. For the emotional experience example, various materials cause users to feel amazed, surprised, bored, etc. (Karana et al., 2015). As Krippendorf (1989) states, the meaning derived by users and the meaning the designer objectifies may not be compatible with each other. In other words, the meaning that the designer hopes to be perceived may differ from the meaning the user interacts with and produces. For this purpose, evaluations should be made in the context of material-product combinations, which is an important design input.

Values created by user can be broken down into specific attributes. These attributes also contribute to product's usefulness, usability, desirability (Cagan & Vogel, 2002). As can be seen here, it is possible to observe several variables subjectively. While the technical properties of the material do not change from person to person, hedonic perception may differ. As Ingold (2011) has mentioned, the properties of materials are objective and measurable. On the other hand, qualities of materials are subjective. The properties of materials are in our hands while the qualities are in our heads. At the same time, the meaning of each material can be changed according to the product used. Also, it can differ for different user groups of different cultures, in different contexts and different times (Karana & Hekkert, 2010). But despite all this variability, the material experience can be designed based on some universal patterns (Karana et al., 2014). Surface textures are of great importance in this experience where users interact with materials (Şener & Pedgley, 2021).

2.2 Concept of 3D Surface Textures

From a materials experience perspective, surface properties play an important role in the user's interaction with a product. Surface properties help us to recognize, identify and experience the object. The tactual experiences that we experience quite widely in our daily life are formed partially by the texture properties of the material.

The term surface texture can be defined as a set of geometric features that the object has on its surface. When the surface properties are examined, two types of surface textures are noticed. The first of these is the surface properties of the material due to its nature. These textures originated from material properties defined as roughness, waviness and shape. Secondly, there are designed geometric features that are manipulated by the designer, created in 3 dimensions on the surface and having different height values. Common feature of manipulated and naturally occurring surface textures consists of a series of crests and troughs with characteristic shapes and intervals (Blunt & Jiang, 2003). These concepts are illustrated in Figure 2.1. Human fingerprints are composed of ridges about 0.1 mm high and 0.3-0.5 mm wide (Soanboon et al., 2016). When the surface pitches are smaller than these features of the fingerprint, it cannot be felt by people and a slippery feeling occurs. But when these pitches are larger than fingerprints, the fingerprint enters the gaps and the surface feels rough (Kawasegi et al., 2013).

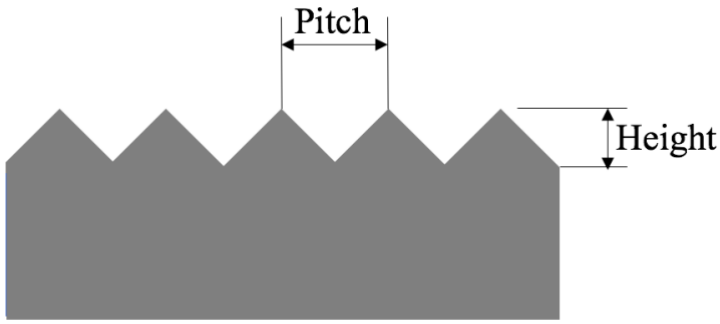

Figure 2.1 Pitch and height

In addition to the difference in height, the scales of the textures on the surface are also very important for identification. Şener & Pedgley (2021) collected surface textures under two main headings as macro-texture and micro-texture. In its general definition, micro-texture can be defined as the surface textures obtained as a result of surface finishing or roughness processes on a small scale or originating from the

material itself. Macro-texture can be defined as a designed form feature belonging to the surface on a large scale. Macro-texture elements are more distinguishable from the main body compared to micro-texture elements. While the macro-texture elements are more able to be distinguished by the sense of vision, micro-texture elements can be noticed more by touch. The elastomer material on the toothbrush in Figure 2.2 is intended to help the user hold it. The surface textures of the material itself are included here as micro-texture, while the designed texture added to the area where the finger will correspond is used as macro-texture.

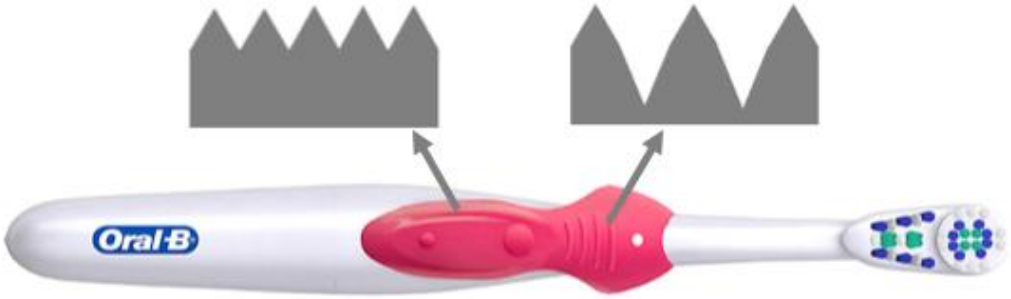

Figure 2.2 Toothbrush (Braun Inc., n.d.)

Bhushan et al. (1997) gathered ninety-eight adjectives (e.g. blotchy, dotted, holey, marbled, smooth, waffle) to describe surface textures. As can be seen here, surface textures are used as design inputs in a wide variety of definition processes.

Users behave in two basic situations when purchasing and experiencing a product. The first of these is emotional or hedonic satisfaction, the other is functional or utilitarian reasons (Batra & Ahtola, 1991). When examined from the perspective of tactual properties, textures, which are derived from material property or created by manipulation, are one of the features that improve the products in terms of both functional and hedonic properties. Lederman and Klatzky (1987) states that, one of the goals of the tactile experience is to guide user about properties such as texture, hardness, temperature, and weight, and another is to pioneer hedonic experiences. Designers need to make decisions based on the product performance thanks to the use of different materials and material textures. For example, material selection and

surface texture design to prevent the fingers from slipping in handheld devices. In addition to this example, the usage of textures not only improves the functionality of the products, it can also direct user about how to hold the product and give clues about important areas the product has. In Figure 2.3, there are examples where surface textures are directly related to use. Mizuhara, Hatano and Washio (2013) examined this situation in touchpads and stated that if the roughness of the plastic surface used in the touchpads is less than it should be and sufficient contact area is not provided, the usability of touchpad decreases.

Figure 2.3 Left image: Handheld barcode reader (Cognex Inc., 2021), right image: Trackpad (Apple Inc., 2021)

As mentioned before, users do not consider only the functional features of the product as important in their interaction with the product. Kakar (2017) argued that people prefer utilitarian traits to hedonic traits because they are more prone to making rational decisions. However, when today's conditions are examined, most of the products in the market are technically sufficient, the technical differences are quite small and the prices of the products that show close performance are quite close to each other (Ashby & Johnson, 2013). The camera example presented in Figure 2.4 can be presented as an example for this situation. Most cameras on the market are technically adequate and offer fairly close performance.

Figure 2.4 Sony Compact Camera (Sony Inc., 2020)

Hedonic experiences play an important role in the purchase decision-making stages of users due to the functional maturity of most of the products in the market. In order to explain hedonic and utilitarian definitions better, Chitturi et al. (2008) gave an example on concept of mobile phone;

> "…In the context of cell phones, for example, the phone's battery life and sound volume are utilitarian benefits, whereas aesthetic appeal from its shape and colour are hedonic benefits."

For this reason, when hedonic benefit is examined in 3-dimensional surface textures in handheld devices, the user questions how the product looks, how it is held, how it is used and how it feels. It is clear that functional use is the primary purpose of using surface textures in a control element or any part that comes into contact with the hand. However, when considered as a whole, it is seen that it affects the user both functionally and hedonically. As Norman (2013) points out, a successful design generally consists of the combination of perfect functionality with pleasure arising from appearance and interaction. To sum up, hedonic benefits are related with pleasure that users get by experiencing with product.

It can be said that physical products are left behind as a result of the increase in the dominance of digital products today. However, although the experience of touch is

not very important in these applications offered on a bright and flat screen, it still has a great importance in physical products (Şener & Pedgley, 2021). In the stage of perceiving the 3-dimensional world, effective information can be reached through touch, which is one of the five sensory organs.

In addition to all these positive features, surface textures also contain various negative aspects. The most prominent of these is that textured surfaces are more susceptible to contamination and are difficult to clean (Figure 2.5). At the same time, in addition to contamination under harsh conditions of use, it is a common problem that the surface textures break off from the surface they are on.

Figure 2.5 Dirty control knob because of texture

2.3 Sensory Properties of 3D Surface Textures

Zuo (2010) defined the term sensory property as;

> "Sensory properties, in this context, are defined as the properties that can be perceived by humans via sensory organs and can evoke physiological and psychological responses. These properties include colour, texture, sound, smell and taste."

Thanks to the texture and manipulated combinations used on the material, it creates a strong sensory impact on the user (Karana et al., 2014). When analysed through

3D surface textures, these features should not only satisfy the user functionally, but also the properties that appeal to the senses as hedonic should be enriched. By using these textures the user should be encouraged to hold the product and visually provide satisfaction to the user. The texture used on the material is defined as a designed phenomenon that supports the quality perception of a product. This includes the physical properties of the material itself or the result of surface coatings (Yanagisawa & Takatsuji, 2015). In Figure 2.6, the surface texture properties of the material in the left phone container, in other words micro texture, are used. In the image on the right, the surface texture was designed by the designer, in other words, it was used as a macro texture. Although the texture structures used here are different, the main functional purpose is to protect the phone and provide a better grip. However, thanks to the micro and macro surface textures used, different perceptions can be created by the user.

Figure 2.6 Phone covers (Apple Inc., 2020) (Spiegen Inc., n.d.)

People use their senses to discover all the phenomena in the outside world. For example, when a newspaper is read, the smell of ink, the texture of the paper, all the texts and visuals that are visible to the eye, the sound that occurs as you turn the pages, and the taste of a glass of tea drunk with it, a very complex sensing mechanism works even instantly. Most of the characteristic features of the product that are

perceived by the senses consist of the properties of the materials (Schifferstein & Wastiels, 2014). In this complex perception process, the importance of the materials used in the products can be clearly seen. In Schifferstein & Cleiren (2005) study of the sensory process of each sensation in detail, seeing and touching the most detailed information about a product was approximately equally successful, while obtaining information by ear was less successful, and the senses of smell and taste were the least successful. Since the senses of sight and touch are more dominant than the other senses, this study will focus on examining and comparing these two senses in a deeper way.

2.3.1 Vision and Touch

When we examine our environment, we notice many factors such as the objects around us, the shapes they have, what kind of materials they are made of, how to use them, and the surface textures they have, through our sense of vision. Schifferstein (2006) stated that visual sensation is a primary way of acquiring information and plays an important role in functional interaction. Vision is an intense source of information in a short time span. Since the visual experience in product-user interaction occurs before the touch experience, it is thought that the sense of touch attracts less attention compared to the sense of vision (Dargahi & Najarian, 2004). Seeing experience plays an important role in the first impression and the process of sensing in a short time. As a result of the prominence of the sense of vision, the visual features of the product attract more attention of product designers (Şener & Pedgley, 2021). However, Marlow and Jansson (2011) has argued that the sense of touch can be more effective than the sense of vision when it is touched for a significant period of time in interaction with a product. When this situation is examined, it can be said that the touch experience is sometimes ahead of the visual experience for the user, especially on handheld devices. As an example, in Figure 2.7, in game consoles control devices where long-term use takes place, intensive studies have been carried

out on this situation, and the best touch and visual experience has been given importance to the user.

Figure 2.7 PS5 controller (Sony Inc., 2020)

Along with the importance of the sense of vision, the sense of touch is also very important. If the touch experience is not suitable for the user, even the most visually appealing object will not be at the popular level it deserves (Sheldon & Arens, 1976). As it can be understood from here, in order to create satisfaction on the user side, it is not enough to address only the visual sense, but also to provide a tactile satisfaction. Using these two in harmony will provide a better user-product experience rather than just focusing on tactile or visual experience. From the perspective of 3D surface textures, with the help of form and pattern of the textures of the product, the user can experience a visual pleasure, while a tactile pleasure can be experienced in use. As can be understood from here, the surface texture allows it to be sensed both visually and tactually. However, when examining the sensation of texture individually, both visual and tactual senses have their own limitations. Thanks to the sense of vision, information about the form can be obtained in general, but this may change depending on environmental factors. For example, as the visual distance increases, the visual visibility of the mentioned textures will decrease and the engineering properties of the material become difficult to notice. Compared from this point of view, touch can explore local, minor features of the surface on the

product in a subtler way (Zuo, 2010). In this way, when user examines a product in his hand and starts to use it, sensing with touch is more honest and richer than the feeling gained by visual sense. This is especially important for micro textures, which arise from the material itself. It is very difficult to understand the properties of the relevant product or material without touching it. This will become understandable after the first contact with the product, as it may be difficult to understand that the respective material will aid in the grip by relying only on eyesight. Different material selections or designed surface textures are used to convey this situation to the user. In this way, before the tactile experience, relevant references are presented to the user visually.

As can be seen in Figure 2.8, controlled surface textures have been added to provide a holding reference and increase the grip feature. In addition, different material with a high coefficient of friction has been used, and the relevant reference and grip feature has been added.

Figure 2.8 Breville Immersion Blender (Breville Inc., n.d.)

The touch experience is of great importance even when the focus of vision is not on the product but on the job. In Figure 2.9, binocular can be given as example. The user focuses on the work he / she does with the sense of vision during use of the

product, so the interaction with the product is only tactile. In such cases, the user understands how to use the product or how to access the control elements, thanks to the tactile tips the product has. It can be operated by feeling one's way around the material surfaces.

Figure 2.9 Binocular (Nikon Inc., n.d.)

The producer of power tools brand Black&Decker has achieved a strong visual identity by combining the use of different materials, surface textures and colour in their product portfolio (Figure 2.10). These “high grip” components have created a very strong visual identity by visually differentiating from the main body and the use of colour. Thanks to the use of surface texture and design elements, a brand identity has been achieved that differs from its competitors in the market and can be distinguished by consumers.

Figure 2.10 Hand tool products (Black&Decker Inc., n.d.)

2.4 Brand Characteristics

The concept of personality can be defined as how a person constantly influences his / her own psychological structure and finally how he / she reacts to the environment. Corporations can also be included in these definitions, in line with the characteristics used to describe people (Krippendorf, 1989). As it can be understood from here, brand personality is a set of traits that people attribute to a product of a particular manufacturer as if it were a human. Consumers assign various personality qualities to all kinds of products, just like they assign to other people. These appointments may also change over time; therefore, both designers and marketing departments need to be careful about maintaining the brand personality they want to create in consumers (Gautvik, 2001). The branded characters of the companies appear as a result of the brand image as a whole. One of the most important elements of brand image is undoubtedly its manifestation in physical products. A company's product portfolio determines how the market and users perceive and interpret the brand, corporate image and characters of brand. These branded characters are not limited to product design. Brands' advertisements, packaging, brand positioning and other

marketing elements also play an important role in creating brand personality created by users (Gautvik,2001). But to put it in order, product portfolios, which have a high impact on the user and are PR elements of companies, are among the important elements of the brand image.

Users select products based on product features and brand characters and use all their senses to do so (Lindstorm,2005). As a result of all these sensory processes, people's choice of products and brands with personalities close to their own becomes meaningful. It is necessary to proceed by considering the effect of the design language that brands have in various product portfolios on creating these characters. Schmitt and Simonson (1997) state that product design can be used strategically with the help of brand identity to create a brand value. The process of designing a product in accordance with identity in order to create brand value includes complex structures. The integration of brand and product identity forms an important part of the strategic design and management system (Eok & Young, 2003). The product itself can be used directly as a communication tool in order to convey the meaning and promises of the brand to the consumer. For this, first of all, the brand should decide on the language that it wants to convey to the user and then transfer it to 3D products (Vossoughi, 1999).

As Ashby & Johnson (2013) states, the personality of the product is largely based on visual and tactile cues from the surfaces the product has. The order, proportion, shape, colour and texture are very important for the aforementioned surface properties. The harmony of the visual and tactile features of the product with the brand values gains great importance for the user to build character for the brand and the product. In the user's search for meaning, textures help the product gain identity and increase perceived value (Şener & Pedgley, 2021).

2.4.1 Brand Recognition via Product Design

As the number of companies in the market increases, their product range also increases. Many products are now technically mature. Products that have similar technological features and which do not differ from each other when evaluated technically are available in the market. As a result, distinctions in technical performance are slight, and the prices of products with nearly the same performance are almost the same (Ashby & Johnson, 2013). As the market for a product saturates, sales can be stimulated by differentiation. In such a market, differentiation is of great importance for companies. Thanks to the almost equal access of technology for most companies today, companies base their strategies on a different factor than technology to differentiate. The most sustainable method of differentiation from other companies in the market is to create a recognizable image of the brand. In other words, in product categories where technical differences between products are fairly close or even equal, firms shift their focus towards communicative product attributes that represent the symbolic domain of the product (Karjaalainen, 2003). Corporations have developed in the field of experiential design, since product development based on technology and performance was not sufficient. They grasped the importance of meeting their desires as well as their needs for consumers, and created processes of objects of desire (Gautvik, 2001).

Brand recognition generally appears as a definition that originates from the whole brand image of the company and has a very broad spread. This communication with the user group generally creates a portrait in their minds about the brand and this is defined as a brand image. In different words, brand image is based on a psychological portrait of the brand by a group of users. But the focus here is that product design leads to brand recognition. Since the product itself is an important media element in terms of communicating with the user, it creates brand recognition (Schmitt and Simonson, 1997). The design of a product is usually the subject of “visual brand recognition” (Karjalainen, 2003). The visual design of the product should directly convey the identity of the brand. One of the main goal of companies in competitive

markets is to create a unique perception. In other words, creating visual brand recognition with a product can be accomplished by creating rational connection within brand image values (Borja de Mozota, 2006). Design features are essential for creating meaning for consumers. Design features can be defined as form elements, detail treatments, materials, colours and textures (Chen & Owen, 1997). Continuous use of these auxiliary elements used in the design will increase the recognition of the brand, but if sufficient flexibility is not provided in the use of these elements, it may be considered as an unnecessary repetition and perceived negatively by customers (Pugliese & Cagan, 2002). In other words, these design features play an important role in visual recognition of brands. However, these elements must be applied strategically and consistently (Warell, 2001).

In order to create brand recognition, design can be used in two ways. The first of these is to create consumer interest by creating only visually attractive designs. The other is the method of creating strategic meaning (Page & Herr, 2002). In design semantics, brand recognition can be considered as a special application. The main concept here is how to construct brand-specific meanings and values with the help of design features. It is very important to recognize the functions that define the brand in terms of developing and maintaining brand identity. Creating product typologies with these functions is an important strategy. Product design semantics are directly related to the physical properties of branded products (Krippendorf, 1989). As mentioned earlier, certain characteristics attributed to people can also define brands. Examples of these physical definitions are size, form, texture, etc. such features can be given. The features described here serve as features that distinguish the product and the brand from its competitors (Karjalainen, 2003). Companies that want to differentiate from their competitors and create brand recognition should use semantic functions in their products. Thanks to these semantic functions, a figurative communication is created between the user and the product (Krippendorf, 1989).

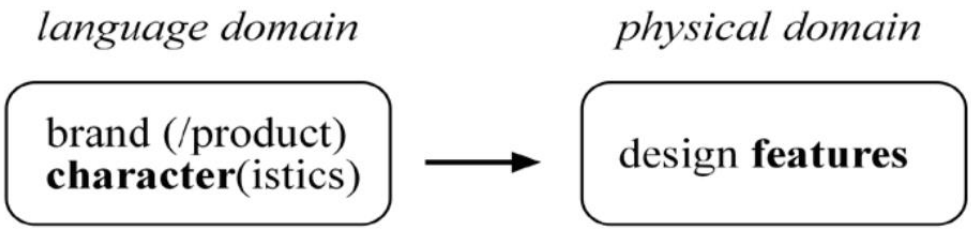

Figure 2.11 Semantic Transformation Process (Karjalainen,2007)

In other words, with the help of the semantic transformation process, the values and meanings of brand identity become concrete in the various physical design features of the product (Karjalainen, 2004). In order to create a brand identity, it is necessary to create design clues that correspond to the brand's values and product portfolio strategy. Thanks to these design clues, products function as communication tools that evoke brand identity by evoking the brand's values and meanings with the brand's strategically defined message. In the semantic transformation process, certain features are declared as main brand values as "adjective words" or “keywords” that are unique to that brand and define the product features. These descriptive words are used in the design of the product by transforming them into physical, visual features and elements (Zengin, 2010). Design features that refer to similar meanings appear to be universally accepted. Janlert and Stolterman (1997) reported in their research that warm colours and rounded forms can be considered approachable, friendly and domestic.

With the characteristic features of the product, a brand image is created, and as a result, brand recognition that is differentiated and separated from its competitors emerges with the help of the design of a product. The visual perception that the company wants to create in order to differentiate it from other companies in the market should create brand recognition with the help of product design.

The distinctive forms and shapes used in the design of the product are the most solid foundation used to create a brand among different channels (Lindstorm, 2005). From a broad perspective, globally known companies are included not only with their sufficient technical qualities but also with their identifiable designs. Recognition of

product design means recognition of the brand. Therefore, it can be determined and interpreted that distinctive design is realized with the steadiness in design language. Companies can choose to create products with high aesthetics and eye-catching designs, providing a strong brand image for the company. In addition, it is not an easy strategy to link the product design language with brand identity. The only strategy can be interpreted as making design choices to decide to create good-looking designs to create brand recognition with a solid brand image (Page & Herr, 2002). When analysed for companies with a wide product range, this approach may lead companies to have a more divergent looking product portfolio, which may negatively affect the brand image.

2.4.2 Product Family

Designers deliberately use clear visual references as clear design features that will be directly perceived by target customers. These design features can be shapes, colours, materials and textures, surface finishes and similar physical elements. To achieve brand recognition, these design sub-elements must be used steadily and clearly on the product portfolio. However, these sub-design elements should be balanced between constant, developmental and innovative design approaches. Design features can be used both artificially and identity-based. BMW uses strong shapes and dynamic forms in its cars that clearly convey BMW's power and performance values, which equates to making BMW cars the "ultimate driving machines" as the brand slogan suggests. Design cues may be perceived as "artificial" if the link between design references and brand core values is missing. BMW's famous kidney-shaped grille is an example of an artificial design clue. Its appearance is not directly related to the values typical of BMW. But its continuous use over time has made a significant contribution to brand recognition. It should also be noted that this sub-design element received a lot of negative criticism after its continuous and exaggerated use. Figure 2.12 shows the steady use of the kidney grille types used by BMW.

Figure 2.12 BMW kidney shape grill
(https://cdn.motor1.com/images/mgl/0mW0n/s1/bmw-grille-lead.jpg)

More than one product is required to improve brand recognition. In order to create brand identity and support this recognition relationship with the user, companies must ensure visual consistency in their product portfolio (Karjalainen, 2007). To create a harmonious product portfolio, the "product family concept" is very important for brands (Warell, 2001). The distinctive design features are used strategically to create a product family on product portfolios with steady use. As a result, it becomes important to have design features specific to the products in the brand's portfolio. Thanks to design features that have a repetitive and distinctive feature, brands create a remarkable distinction. Brands and their products are included in the market, which are recognized among certain user groups and differ from other products. Differentiation of the product from other companies in the market is also considered as an activity that makes brands successful (Karjalainen, 2007).

Designers can have a positive effect on the brand's recognition and permanence in the brand, thanks to the approach to create meaning for the brand and the regular use of design features in the product portfolio. Design basically plays an important role in conveying important brand values to users (Creusen & Schoormans, 2005). To

briefly, with the help of strategic use of the design, a successful brand identity and visual differentiation can be achieved (Stompff, 2003). In Figure 2.13, SMEG gains brand recognition by using form elements effectively and strategically.

Figure 2.13 SMEG products (SMEG Inc., n.d.)

The sub-design elements used in the products can be examined under two main headings. These are "explicit" and "implicit" design references (Karjalainen, 2005; Crilly, 2005). Using explicit design references is simple method for designers, it is possible to increase brand recognition with a strategic repetition method. When using explicit design references, it is necessary to strike a balance between familiarity and innovation. On the other hand, implicit design references are not directly

distinguishable, but contain references that, when used, are meaningful to the user or consumer. When examined from this perspective, implicit references are based on the values of the brand. They are elements that convey the character of the brand and support brand recognition. It is especially difficult for brands with a wide product portfolio to use explicit design references. The most important reason for this is that these references are subject to highly category-specific and product-specific geometries and forms. It is very difficult for companies with a wide product portfolio to transfer these references from one category to another. However, when the implicit references are examined, they do not depend on a specific product category, but on a value judgment, so they can be easily transferred to other product portfolios. Brand design cues should be "value based" to contribute to solid and consistent recognition. (Karjalainen, 2007). Both implicit and explicit design references play a crucial role as value-based design cues evoke references that are closely linked to the core values of the brand. In other words, it is not only a fairly simple use of explicit design cues for brand recognition, but also the use of implicit references in product design is very important.

Using sub-design elements in the product portfolio is a challenging process for designers. It is very important to capture the visual similarity of the products with the other products in the portfolio during the product family creation process. To harmonize innovation with the past in a product under development is of great importance in terms of not using excessive similarities with boring design language. Design elements selected from a pool are not used to achieve good design (Yamamoto & Lambert, 1994). However, design guidelines can be used to facilitate the work of designers working under a corporate culture. In brief, design guidelines aim to inspire the visual design direction and guiding principles for design process. The guidelines also assist for a recognizable and product family look with other products in the brand portfolio.

2.4.3 Touch as a Brand Tool

Sener & Pedgley (2021) stated that texture brings character and interest to a product. As a result of the strategic selection and consistent use of various design features, brands achieve high brand recognition. Although surface textures are considered as a secondary element as a design feature, they are a design element that should be considered very important (Ashby & Johnson, 2013). Products with high brand recognition are produced as a result of the fusion of technology and emotional appeal. In order to reach a strong brand recognition, design elements should be used with a conscious meaning creation approach (Creusen & Schoormans, 2005). Surface textures are also used to create visual recognition and create a successful brand identity (Stompff, 2003). Figure 2.14, shows one of the important sectors where the experience of touch is presented as a brand value is the textile field. Thanks to the texture, which has a great effect on the perceived quality, it has an inseparable aspect in textile products as it provides physical contact (Şener & Pedgley, 2021).

Figure 2.14 Fabric texture (Vivense Inc., 2021)

It is recognized that surface textures also play an important role in increasing visual recognition in general. However, as mentioned before, it is important to use surface textures strategically, just like other design elements. In other words, the design

elements used for visual purposes should adopt the company's scope of competition and strategic intent (Ravasi & Lojacono, 2005). To illustrate, as a result of the irrepressible progress of smartphones, a new product has also entered our lives, phone protectors. Many companies have started to produce phone protectors using high quality materials such as flexible material or leather. In response to this situation at Apple, it started to produce not only the phone, but also phone cases that fit its brand image. In Figure 2.15, Apple designed and produced covers that encourage the user to touch, in line with the company's brand values and the form criteria it applies.

Figure 2.15 Apple phone case (Apple Inc., 2021)

Rippon (2004) stated that a company's success will increase if it has a tested finishing pallet that responds to market needs and has received feedback from potential customers. In opposition to this argument, Veryzer (2000) stated that, design brand guides that are expected to be implemented in new products for the company will narrow the perspective of designers. However, it is revealed that companies that aim to demonstrate a brand value and put forward a strategy for this purpose adopt design templates. The strategy trying to be put forward here is not only to desire the product

by the user, but to establish a direct connection with the brand (Gautvik,2001). For this reason, as mentioned in the visual phenomenon and brand relationship, design templates for brand guidance should provide continuity in accordance with the time, but it should also offer various flexibility to the designers. In Figure 2.16 a product family has been created by using features such as colour use and surface improvements.

Figure 2.16 Small home appliances (Arçelik Inc., n.d.)

In the study conducted by Schoormans et al. (2010), a surface texture element, ribs, are used for provide better grip and these ribs used as a brand characteristic creator. When examining the surface textures, it is possible to observe the effect of the communication with the user not only at the visual level but also on the brand recognition as a result of the tactile experience. When consumer behaviour is

examined, Peck (2011) stated that people do not tend to touch only for the purpose of exploring the material properties, but for other reasons too. The Figure 2.17 contains an explanation for classifying the tactile experience into four categories.

The categories "touch to purchase", "touch to obtain non-haptic information" and "touch to obtain haptic product information" are categories that focus mainly on a user's need. The main purpose is to seek information, retrieve clues from memory, and create product judgments. The hedonic touch category, on the other hand, suggests that some touches are made as an end in themselves, as it has been examined before.

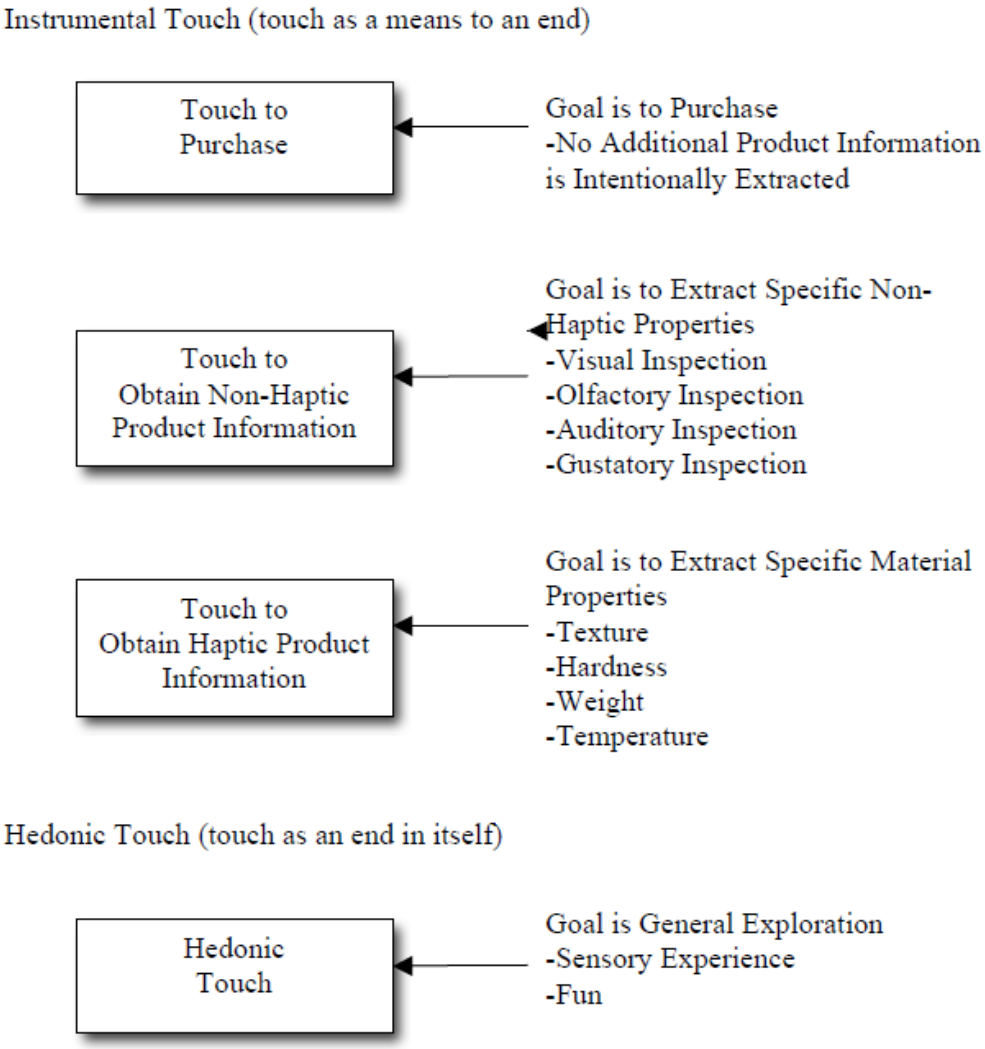

Figure 2.17 Touch experience (Peck, 2011)

In the first stage, a consumer can only touch a product to make a purchase. This type of touch experience, usually at the product packaging level, is at the level of repeat purchases. At this touch level, the tactile system deliberately does not contain purchase decision information about the product.

In the next stage, the consumer can touch the product in order to access additional information that cannot be optimally determined by the tactile perceptual system. The most common type of touch for which non-tactile information is requested is visual inspection (Peck, 2011). Continuing with the packaging example, the

consumer touches the product in order to read the visual elements or legal information on the packaging. In this tactile experience, the tactile system is used to assist other sensing systems.

In the final stage, the consumer may want to directly touch a product to obtain material properties such as texture, hardness, temperature and weight information, which is the product information that can be best collected by simply touching it. The consumer, who wants to explore certain material properties, uses the sense of touch (Peck, 2011). At the level of accessing such material properties, visual sensation helps the tactile experience by providing a quick glance (Klatzky et al., 1993).

Touch experience is an effective method to obtain information about texture, hardness, temperature and weight (Klatzky & Lederman, 1992). With the help of surface textures, some objects encourage touch more than other products. For this reason, consumers want to touch the products before purchasing them in order to access various product information that can only be obtained by touch (Peck, 2011). It is better for consumers to experience the product physically, by touching, rather than seeing the product only visually (McCabe & Nowlis, 2003). Grohmann, Spangenberg and Sprott (2007) also stated that tactile input has a positive effect on the evaluation of products in material properties such as softness and texture, especially in products produced using quality materials.

Often consumers want to touch products to ascertain specific product information that only touch can provide. As discussed, touch excels at obtaining texture, hardness, temperature and weight information (Klatzky & Lederman, 1992). Holbrook (1983), when using sweaters as stimuli for a study, noted the strong role played by tactile cues when participants were evaluating a product.

Grohmann et al. (2007) also examined product factors. They found that tactile input had a positive effect on the evaluation of products that varied in the material properties of softness and texture, especially for products high in quality. From the perspective of brand identity, Peck & Childers (2003) stated that tactile sensations

generated by the tactile experience can differentiate a brand from its competitors, and indeed, consumers often stated that they want to touch products before making a purchase decision.

As Ashby and Johnson (2013) points out, especially in electro-optic devices such as cameras, material selection is focused on metal, as it offers "engineering quality". When the military sector is examined, the vast majority of manufacturers develop their products on metal materials, usually aluminium, in order to comply with various standards. However, various uses of different materials are also identified, especially for weight reduction. At the same time, it is a common situation to combine different materials in order to differentiate from the products in the market. When we examine the civil sector, it is possible to see the use of various polymers, elastomer materials and even paper products in order to differentiate from the competitors in camera-type devices.

CHAPTER 3

EXPERIMENTAL APPROACH AND METHODOLOGY

Evaluating the visual and tactile design features of products is seen as a difficult process with personal tastes and understandings coming to the fore. As stated previously, visual and tactile features are directly related to the emotions and intuitions of users arising from processes experienced in the past. For this research, a methodology was defined that could help determine the relationship between brand values and surface textures.

3.1 Analysing Brand Characters

The first step in the empirical study for this research was to determine the brand values of Aselsan, the military sector company on which the research would be made. The company does not have a brand manual to provide a starting point for such an investigation, therefore the researcher initiated a special brand focused study. In order to determine brand values, the communication channel tools of the company were examined in detail. First of all, a research was carried out on the information presented on the company's website, and then the advertising campaigns were examined in detail. The company's posts on social media were examined and used in the data obtained from this source. Hsu et al. (2000) stated that, various descriptive words that are evaluated from a designer’s point of view (e.g., feminine, avant-garde, emotional) have different or no equivalents on the user's side. For this reason, it was decided to stick with the study of common words in the relevant communication channels and avoid design jargon. As a result of this research, the adjectives used in the communication channels of the brand were examined and the phrases that were repeated more than once were selected.

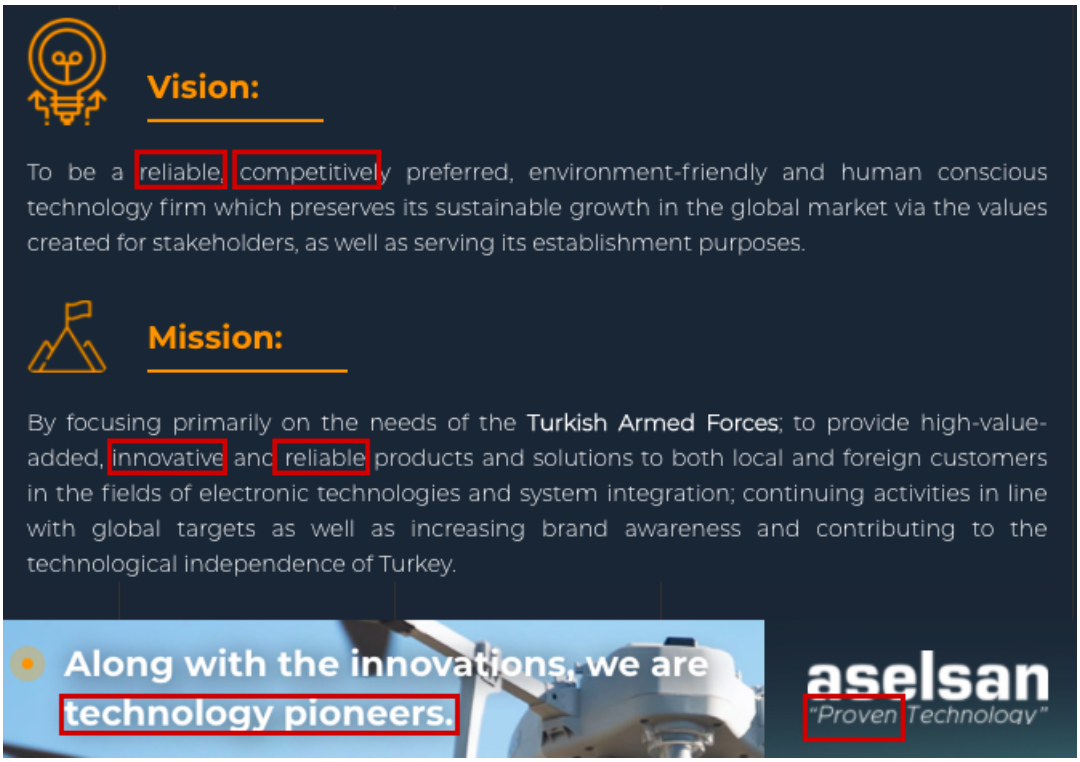

Figure 3.1 Photos from company website (www.aselsan.com.tr/en)

Figure 3.2 Aselsan Youtube page

Figure 3.3 Aselsan Twitter page

The adjectives that were commonly found as representing Aselsan brand values were: "rugged", “technological”, "multi-functional", "indefectible", "long-life", "innovative", "competitive", "reliable", "secure”, “proven". Since it is necessary to determine which adjectives reflect the brand more accurately in order to be used in the continuation of the study, an additional study was conducted. The aim here was to understand which adjectives reflect the brand more. For this purpose, a survey was conducted with 10 industrial designers working in different sectors within the company. This survey was conducted through Google Forms (Appendix G) and the questions submitted for evaluation were sent to each user in a mixed order (shuffle question order). The people participating in the study are industrial designers working in various sectors of the company. The total working period of the participants in the company varies between 3 and 16 years. The average value is 5.5 years.

3.2 Analysing Surface Textures

The study of Şener & Pedgley (2021) on more than 200 products showed that 3D surface texture design (texturization) can be achieved by considering features under three main categories: geometry, bipolar scaling, and arrangement.

The “geometry” category consists of the following features.

- Extruded polygons, e.g. square, triangle, dot etc.
- 3 dimensional volumes, e.g. prism, pyramid, dome etc.
- Longitudinal volumes, e.g. channel, ridge, notch etc.
- Irregular shapes, e.g. emblem, figure, wave, material imitation etc.

The “bipolar scaling” category consists of the following features.

- Single or multi size elements
- High or low density elements
- Sub or super surface textures
- Flat or curved surface elements

The “arrangement” category consists of the following features.

- Positioning texture elements on the surface, e.g. linear placement, radial placement
- Edge conditions of texture elements on the surface, e.g. abruptly finish or fade out to flat

Since research presented in this thesis aimed to create a set of rules for texturization, features that are difficult to adapt to this set of rules were eliminated and design elements were decided with five variables in total. In the relevant guide, it is aimed to reach various topography rules that are suitable and unsuitable to be applied for the use of designers and related engineers. Under the geometry variable, it was decided to eliminate the irregular elements and evaluate the 3-dimensional volumes under polygons. For the purpose of generalization, the square volume was chosen to evaluate the extruded polygons, and channel structure was chosen as the longitudinal element. Other than these, irregular shapes and other 3D volume elements were not

taken into consideration. For the bipolar scaling category, curved surface elements have not been examined and fixed or variable dimensions of the surface textures, their presentation as indentations (sub-surface) or protrusions (super-surface) on the surface, their high or low density placement were investigated. For the arrangement category, surface texture elements are placed on the surface in linear or radial arrangements. In this study, edge conditions of surface texture elements were not studied. Since each variable has two options, across a total of five variables, a grand total of 32 (2^5) surface textures having different combinations of features were designed and modelled using CAD software (Appendix E). A specification matrix was created based on the combinations of features under geometry, bipolar scaling and editing, and then creative solutions were produced for how the textures should look. In the process of deciding on the design of the textures, no direct semantic translation was carried out between Aselsan brand adjectives and the designed textures. The approach followed in this research was to create a wide variation in texture, assuming that a shortlist of 32 relevant samples would be identified as "better textures". Details of these textures are presented in Table 3.1. Since the related study took place under the conditions of the COVID-19 pandemic, it had to be divided into stages. In order to minimize pandemic risks, instead of the tactile and visual evaluation of all samples, which will be carried out for a long time with close contact in a closed environment, primarily digital visual evaluation was carried out. In this visual evaluation, which is called as study 1 was carried out with 20 participants. The total working period of the participants in study 1 varies between 4 and 19 years. The average value is 6.5 years.

Table 3.1 Generated texture samples properties

Option 1	Polygon	Single Size	Linear Placement	High	Sub Surface
Option 2	Polygon	Single Size	Linear Placement	High	Super Surface
Option 3	Polygon	Single Size	Linear Placement	Low	Sub Surface
Option 4	Polygon	Single Size	Linear Placement	Low	Super Surface
Option 5	Polygon	Single Size	Radial Placement	High	Sub Surface
Option 6	Polygon	Single Size	Radial Placement	High	Super Surface
Option 7	Polygon	Single Size	Radial Placement	Low	Sub Surface
Option 8	Polygon	Single Size	Radial Placement	Low	Super Surface
Option 9	Polygon	Multi Size	Linear Placement	High	Sub Surface
Option 10	Polygon	Multi Size	Linear Placement	High	Super Surface
Option 11	Polygon	Multi Size	Linear Placement	Low	Sub Surface
Option 12	Polygon	Multi Size	Linear Placement	Low	Super Surface
Option 13	Polygon	Multi Size	Radial Placement	High	Sub Surface
Option 14	Polygon	Multi Size	Radial Placement	High	Super Surface
Option 15	Polygon	Multi Size	Radial Placement	Low	Sub Surface
Option 16	Polygon	Multi Size	Radial Placement	Low	Super Surface
Option 17	Channel	Single Size	Linear Placement	High	Sub Surface
Option 18	Channel	Single Size	Linear Placement	High	Super Surface
Option 19	Channel	Single Size	Linear Placement	Low	Sub Surface
Option 20	Channel	Single Size	Linear Placement	Low	Super Surface
Option 21	Channel	Single Size	Radial Placement	High	Sub Surface
Option 22	Channel	Single Size	Radial Placement	High	Super Surface
Option 23	Channel	Single Size	Radial Placement	Low	Sub Surface
Option 24	Channel	Single Size	Radial Placement	Low	Super Surface
Option 25	Channel	Multi Size	Linear Placement	High	Sub Surface
Option 26	Channel	Multi Size	Linear Placement	High	Super Surface
Option 27	Channel	Multi Size	Linear Placement	Low	Sub Surface
Option 28	Channel	Multi Size	Linear Placement	Low	Super Surface
Option 29	Channel	Multi Size	Radial Placement	High	Sub Surface
Option 30	Channel	Multi Size	Radial Placement	High	Super Surface
Option 31	Channel	Multi Size	Radial Placement	Low	Sub Surface
Option 32	Channel	Multi Size	Radial Placement	Low	Super Surface

The set of 32 texture designs were used for the first round of evaluation (Study 1), involving visual-only evaluation. For study 2, which included tactile evaluation, a subset of 5 of the 32 designs was produced with the help of a 3D printer, using flexible TPU material. In Study 2, participants first rated each sample tactual-only. When the tactual evaluation was completed for 5 samples, both visual and tactile evaluation were performed. Study 2 was carried out with 10 participants, the participants in this study were selected to be different from the 20 participants who participated in the Study 1. Study 2 was planned not to exceed 20 minutes, since the study, which focused on the tactile experience after the visual evaluation, was carried out face-to-face and the participants did not want to make contact in a closed area for a long time during the pandemic conditions in which the study took place. In the pilot tests, it was noticed that the tactile evaluation and both the tactile and visual evaluation of a sample took an average of 4 minutes. For this reason, second study was carried out with 5 samples with the highest average score in the first study. The total working period of the participants in study 2 varies between 3 and 14 years. The average value is 4.5 years.

3.3 Data Collection

Osgood et al. (1957), developed the method named semantic differential method. It was considered for use in this present study as the main method for investigating the perception of design features of texturized samples by the users. This method is based on the participants' evaluation of their perceptions of the product on a bipolar adjective Likert scale. In the study by Khalaj and Pedgley (2019), in which they developed what they called the Semantic Discontinuity Detection (SDD) method, instead of bipolar adjectives a single-pole Likert semantic scale was used. In this research, Semantic Differential method was not preferred since it requires researcher to add the phrase "what the product is not" instead of focusing only on the phrase that is intended to be expressed. In other words, the least preferred bipolar phrases were not used. In SDD method 5-point Likert scale is used for the participant to

assess the intended perceptibility of the identified meanings, from ‘slightly descriptive’ to ‘totally descriptive’. In parallel with SDD, instead of bipolar adjectives, single pole Likert semantic scale was adopted in this research and a 5-point Likert scale was used as the data collection method. The evaluation is presented on an alternative scale that emphasizes the suitability of a stimulus (an adjective, a texture sample) to communicate brand values, ranging from very unsuitable to very suitable (1- Very unsuitable, 2 - Unsuitable, 3 – Neutral, 4 – Suitable, 5 - Very suitable).

CHAPTER 4

CASE STUDY ON 3D SURFACE TEXTURE AND BRAND IDENTITY

In this chapter, a series of studies will be explained to investigate 3-dimensional surface textures suitable for the brand identity of Aselsan. Determination of brand characteristics, determination and design of 3D surface texture types, and later studies of 3D surface texture-brand identity relationship were conducted as controlled experiments. The research was carried out in two stages. In the first study, 3D surface textures were evaluated visually. In the study 2a, the surface textures were evaluated without visual evaluation, focusing on the tactile experience. In the study 2b, it was evaluated both tactually and visually. Since the interaction of the tactile experience of the participants with the brand identity was requested, the tactile experiment was also carried out in addition to the visual experiment. Each study is presented in detail under the following titles.

4.1 Determination of Brand Characteristics

As mentioned before, since Aselsan did not have any document about product design and brand identity, the brand characteristics had to be determined. In the first study, research was carried out on the communication channels used by the brand in order to determine the word phrases that reflect the brand identity. In the study that was conducted with 10 industrial designers working in different sectors within the company, the participants were asked to evaluate the level of reflecting the Aselsan brand identity between 1 and 5 in the aforementioned word phrases. Google Forms, an online survey application, was used in the study. In the Table 4.1 the phrases are ranked from the highest to the lowest according to their average (mean) grades.

Table 4.1 Rank order of adjectives describing Aselsan brand identity

Rugged	4,44
Reliable	4,25
Secure	4,22
Long-Life	4,11
Technological	3,89
Proven	3,78
Indefectible	3,56
Competitive	3,33
Multi-Functional	3
Innovative	2,89

4.2 Investigation of Surface Texture Effect on Brand Identity

Experiments were carried out in two stages. Since the effect of surface textures on both visual identity and touch experience on brand image was wanted to be investigated, firstly, 32 textures were studied online with 20 participants, using the Skype application. The full set of 32 texture designs are contained in Appendix E. 16 samples were shown to each participant so that the duration of the study did not exceed 30 minutes. By showing 16 samples to each participant using the random distribution method with the help of an algorithm (see Appendix F) run in Matlab (MathWorks Inc., nd) each texture sample was seen by 10 participants. Table 4.2 shows the sample numbers evaluated by each participant for the first study. Following, Table 4.3 shows the sample numbers evaluated by each participant for the second study.

Table 4.2 Study 1 participant - sample number pairing

PT.1	27	29	5	30	21	4	9	18	31	6	32	16	26	14	2	28
PT.2	22	25	24	13	23	11	15	19	8	17	12	7	20	10	3	1
PT.3	11	6	26	10	17	20	9	21	23	24	15	3	8	30	5	27
PT.4	18	32	4	31	1	25	28	13	14	19	12	2	29	16	7	22
PT.5	6	12	21	25	3	30	16	14	15	10	17	27	26	13	18	31
PT.6	29	20	19	7	8	28	32	4	9	23	11	1	24	22	2	5
PT.7	24	4	21	16	25	23	29	11	7	1	17	20	28	26	19	6
PT.8	8	32	2	22	3	27	5	15	14	13	10	12	31	30	9	18
PT.9	31	14	32	10	23	22	18	6	5	2	29	7	12	15	28	21
PT.10	13	16	4	19	8	9	20	27	24	30	1	11	3	17	25	26
PT.11	16	2	6	24	5	11	20	7	8	30	9	25	10	3	19	22
PT.12	18	14	21	31	23	4	15	12	27	28	17	32	13	1	29	26
PT.13	25	13	7	26	31	11	22	15	27	6	28	32	17	29	19	5
PT.14	14	24	18	3	4	16	2	30	23	1	20	8	21	12	10	9
PT.15	7	19	21	14	31	3	4	5	6	20	2	30	24	28	32	26
PT.16	17	13	1	10	11	15	27	18	12	22	29	23	25	8	16	9
PT.17	26	16	25	13	9	2	22	14	15	20	11	23	5	3	1	21
PT.18	24	17	4	6	7	29	18	30	32	28	12	10	27	31	8	19
PT.19	15	9	25	8	3	22	23	21	14	13	27	11	26	28	17	31
PT.20	2	12	32	20	5	1	6	24	19	30	18	29	7	4	10	16

Table 4.3 Study 2 participant - sample number pairing

PT.1	6	10	13	21	30
PT.2	6	10	13	21	30
PT.3	30	6	10	13	21
PT.4	30	6	10	13	21
PT.5	21	30	6	10	13
PT.6	21	30	6	10	13
PT.7	30	21	30	6	10
PT.8	30	21	30	6	10
PT.9	10	30	21	30	6
PT.10	10	30	21	30	6

Participants rated each texture sample between 1 and 5 (1- not suitable at all, 2- not suitable, 3- neutral, 4- suitable, 5- absolutely suitable) according to the word phrases shown in Table 4.1 reflecting the brand identity identified in the previous study. In study 1, 10-second animation and three photo-realistic images (renderings) were taken for each sample at a fixed angle, using the same material and fixed light source. In the interviews conducted over Skype, the 10-second animation video was shown first, and then three rendered visuals were presented on the screen and the participants were asked to make an evaluation. Participants were not presented with a time limit during evaluation and were asked to notify them when they had completed each assessment. Relevant adjectives were presented to the participants in both Turkish and English. The studies were planned to not exceed 30 minutes in

order not to let the participants get bored and lose their interest throughout the study. In Figure 4.1, sample number 1 and sample number 32 are shown in render images taken with fixed angle and fixed light source and the same "neutral" material.

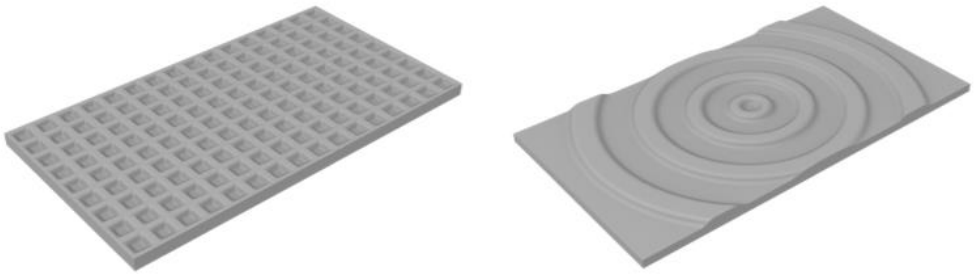

Figure 4.1 Sample No:1 and No:32

Participants were selected among engineers and industrial designers working in different engineering branches within the company. PANAS scale methodology was applied to measure the participants' pre- and post-study moods. In the study, it is expected that there will be no remarkable change in the participant’s mood. With the help of the PANAS scale, an objective measurement of people's “positive affect (PA)” and “negative affect (NA)” can be made (Clark & Watson, 1991). Participants were asked to answer their previous and post study moods on the PANAS scale. For evaluation purposes, "interested", "distressed", "excited", "strong", "guilty", "scared", "hostile", "enthusiastic", "proud", "irritable", "alert", "ashamed", "inspired", "nervous" moods were asked to evaluate on a scale of 1-5 (Riopel, 2021). In Figure 4.2 the average (mean) data of pre-study evaluation, and in Figure 4.3 the average (mean) data of post-study evaluation are presented.

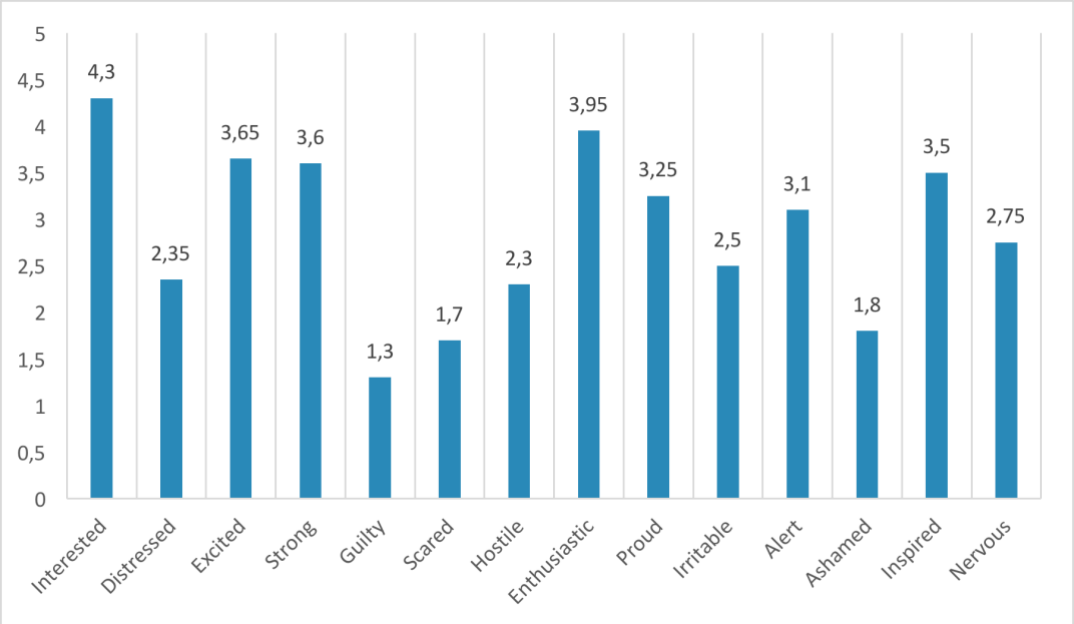

Figure 4.2 PANAS pre-study results Study 1

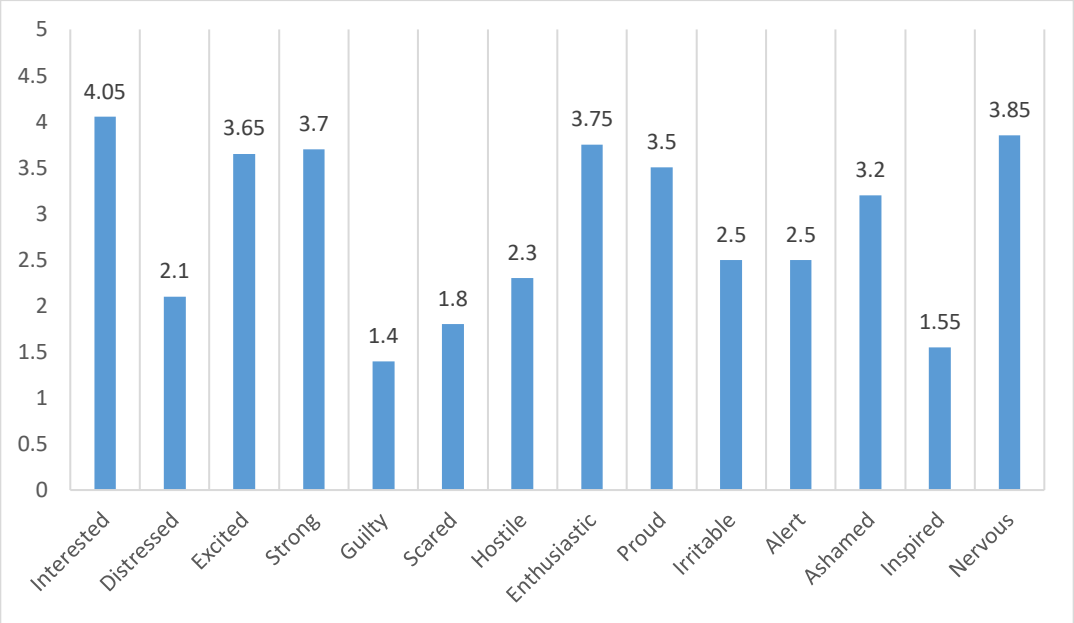

Figure 4.3 PANAS post-study results study 1

From the Study 1 (visual only) PANAS post-study and pre-study data, four positive affect measures increased, one (“excited”) has not changed and two of positive affect measures (“interested” and “enthusiastic”) decreased, whilst three negative measures decreased, two of them (“hostile” and “irritable”) has not changed and two negative

measures (“guilty” and “scared”) increased. A paired t-test (α=0.05) was performed on the PANAS data to evaluate for significant differences. To perform paired t-test, t-Test calculator from GraphPad was utilized (GraphPad Software, Inc., 2021). For positive affect, comparison of the pre-study data (M=3.62, SD=0.41) and post-study data (M=3.67, SD=0.27) shows a not statistically significant difference, t(7) =0.60, p=.57. Similarly, for negative affect, comparison of the pre-study data (M=2.10, SD=0.51) and post-study data (M=2.00, SD=0.43) shows a not statistically significant difference in negative affect, t (7) =1.32, p=.23.

Positive Affect	Pre-Study	Post-Study	Negative Affect	Pre-Study	Post-Study
Mean	3.62	3.67	Mean	2.10	2.00
SD	0.40	0.27	SD	0.51	0.43
t	0.60		t	1.32	
P	.57		P	.23	
Result	not statistically significant		Result	not statistically significant	

Figure 4.4 Summary of paired t-test of PANAS study 1

Later, five samples with the highest score from the study 1 were produced. A two-step evaluation was made for these five samples. The number of samples was limited to 5 so that the study would not exceed 20 minutes under pandemic conditions. Participants were first asked to evaluate the tactile experience without seeing the examples, and to evaluate them with the same phrases (this will be referred to as touch-only). Afterwards, the participants were asked to make an additional evaluation by both seeing and touching (this will be referred to as visual+touch). For study 2, five samples were attached to the dummy product. Participants experienced both touch-only and visual+touch evaluation of textures through the dummy product. Figure 4.5 shows the concept of a dummy product with a texture sample.

Figure 4.5 Dummy product with texture sample

After the tactile evaluation of the 5 samples, the participants were asked to select the sample that best suits each phrase under a fixed light source, both visually and tactually. Thanks to the setup, the participants were able to see the produced samples under a constant light source. Figure 4.6 shows the touch only and visual+touch evaluation conditions. Figure 4.7 shows the fixed light source, mini studio conditions.

Figure 4.6 Touch only and Visual+Touch testing setup

Figure 4.7 Fixed lighting conditions for visual evaluation

As similar to the visual-only evaluation of 32 samples study, participants for evaluation of the 5 shortlisted physical samples were selected among engineers and industrial designers working in different engineering branches within the company. As was done in the previous study, participants were asked to evaluate their mood on the PANAS scale before and after the study. In Figure 4.8 the average (mean) data of pre-study evaluation, in Figure 4.9 post-study evaluation are presented.

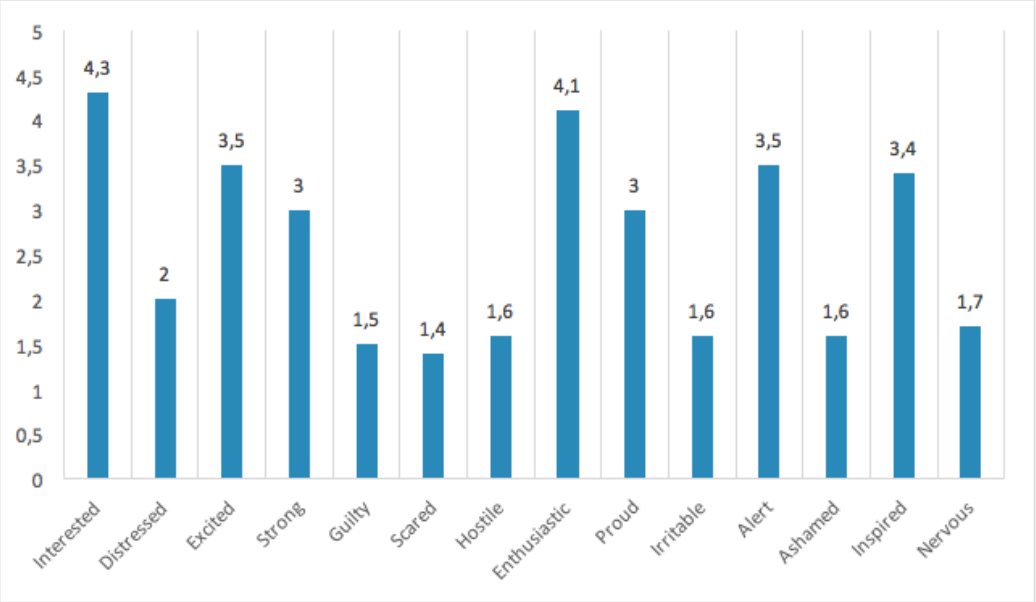

Figure 4.8 PANAS pre-study results study 2

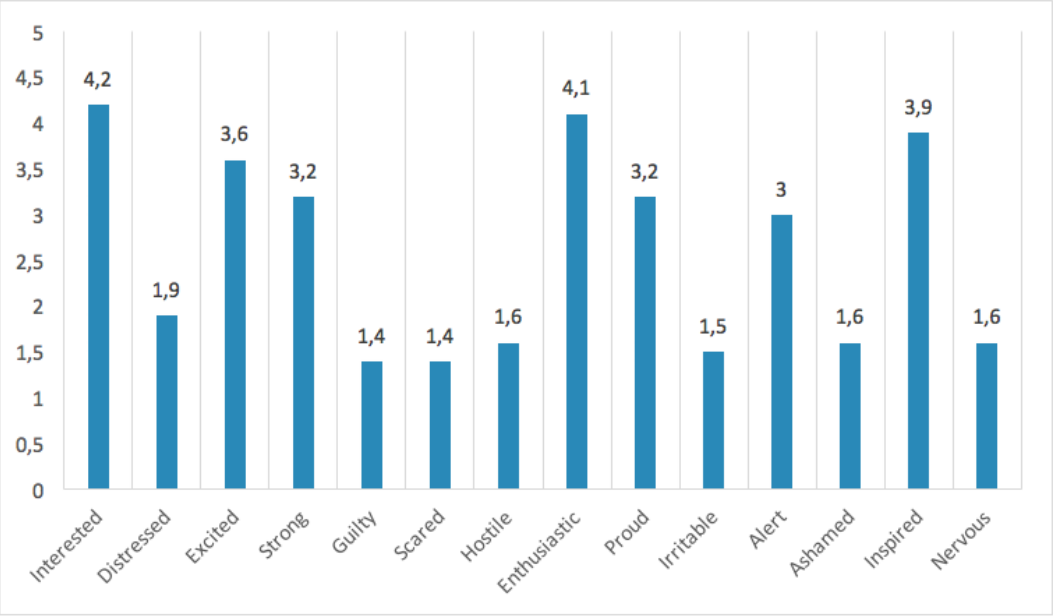

Figure 4.9 PANAS post-study results study 2

From the Study 2 (touch-only and visual+touch) PANAS post-study and pre-study data, three positive affect measures increased, one (“enthusiastic”) has not changed and three of positive affect measures (“interested”, “proud” and “alert”) decreased, whilst four negative measures decreased, three of them (“hostile”, “alert” and

"scared") has not changed. A paired t-test (α=0.05) was performed on the PANAS data to evaluate for significant differences. To perform paired t-test, t-Test calculator from GraphPad was utilized (GraphPad Software, Inc., 2021). For positive affect, comparison of the pre-study data (M=3.61, SD=0.44) and post-study data (M=3.60, SD=0.48) shows a not statistically significant difference, t (7)=0.11, p=.91. For negative affect, comparison of the pre-study data (M=1.63, SD=0.19) and post-study data (M=1.51, SD=0.17) shows statistically significant difference in negative affect, t(7)=2.83, p=.03. It has also been interpreted as the decrease in the negative moods of the participants for face-to-face work under pandemic conditions when the study is over.

Positive Affect	Pre-Study	Post-Study	Negative Affect	Pre-Study	Post-Study
Mean	3.61	3.60	Mean	1.63	1.57
SD	0.44	0.48	SD	0.19	0.17
t	0.11		t	2.83	
P	.91		P	0.03	
Result	not statistically significant		Result	statistically significant	

Figure 4.10 Summary of paired t-test of PANAS study 1

4.2.1 Results of Study 1 (Visual-Only)

Since it was desired to measure the level of perception created by the surface textures of the participants in the determined adjectives in the study, firstly, quantitative data linked to the Likert scale was transferred to the spreadsheet. Afterwards, the arithmetic means and standard deviations of the data for the words reflecting the brand were calculated. The threshold value was determined to perform the evaluation for each word phrase. The threshold value calculation was obtained by adding the standard deviation value to the mean value.

Proven

In the evaluation of 32 samples for the adjective "proven", the average score is 3.228 on a 1-5 Likert scale. The standard deviation is 0.348. Six samples scored higher than the threshold value (3.576) for adjective “proven”. When these 6 are examined, the following observations are made.

- Arrangement: 4 (67%) linear, 2 (33%) radial
- Size: 3 (50%) multi-size, 3 (50%) single-size.
- Positioning: 1 (17%) sub-surface, 5 (83%) super-surface.
- Form: 3 (50%) channel, 3 (50%) polygon
- Density: 5 (83%) high, 1 (17%) low

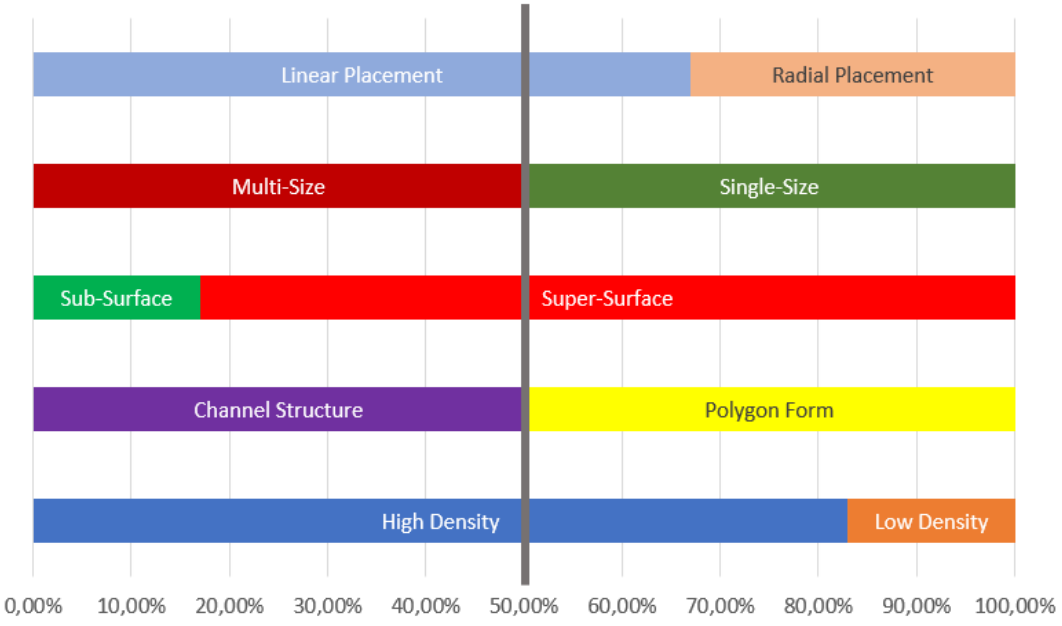

Figure 4.11 "Proven" perception

Linear placement, super surface and high-density layout stand out for the characteristic “proven”.

Technological

In the evaluation of 32 samples for the adjective "technological", the average score is 3.178 on a 1-5 Likert scale. The standard deviation is 0.517. Six samples scored higher than the threshold value (3.695) for adjective “technological”. When these 6 are examined, the following observations are made.

- Arrangement: 2 (33%) linear, 4 (67%) radial
- Size: 4 (67%) multi-size, 2 (33%) single-size.
- Positioning: 3 (50%) sub-surface, 3 (50%) super-surface.
- Form: 2 (33%) channel, 4 (67%) polygon
- Density: 6 (100%) high, 0 (0%) low

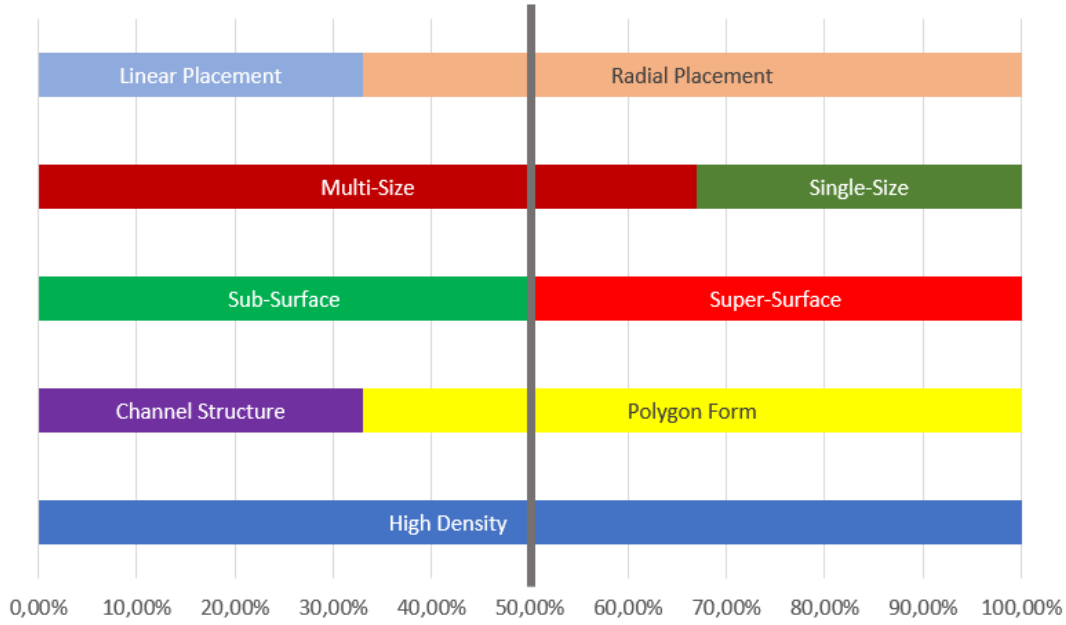

Figure 4.12 “Technological” perception

Radial placement, multi-size, polygon form and high-density layout stand out for the characteristic “technological”.

Rugged

In the evaluation of 32 samples for the adjective "rugged", the average score is 3.369 on a 1-5 Likert scale. The standard deviation is 0.427. Four samples scored higher than the threshold value (3.796) for adjective “rugged”. When these 4 are examined, the following observations are made.

- Arrangement: 3 (75%) linear, 1 (25%) radial
- Size: 2 (50%) multi-size, 2 (50%) single-size.
- Positioning: 1 (25%) sub-surface, 3 (75%) super-surface.
- Form: 2 (50%) channel, 2 (50%) polygon
- Density: 3 (75%) high, 1 (25%) low

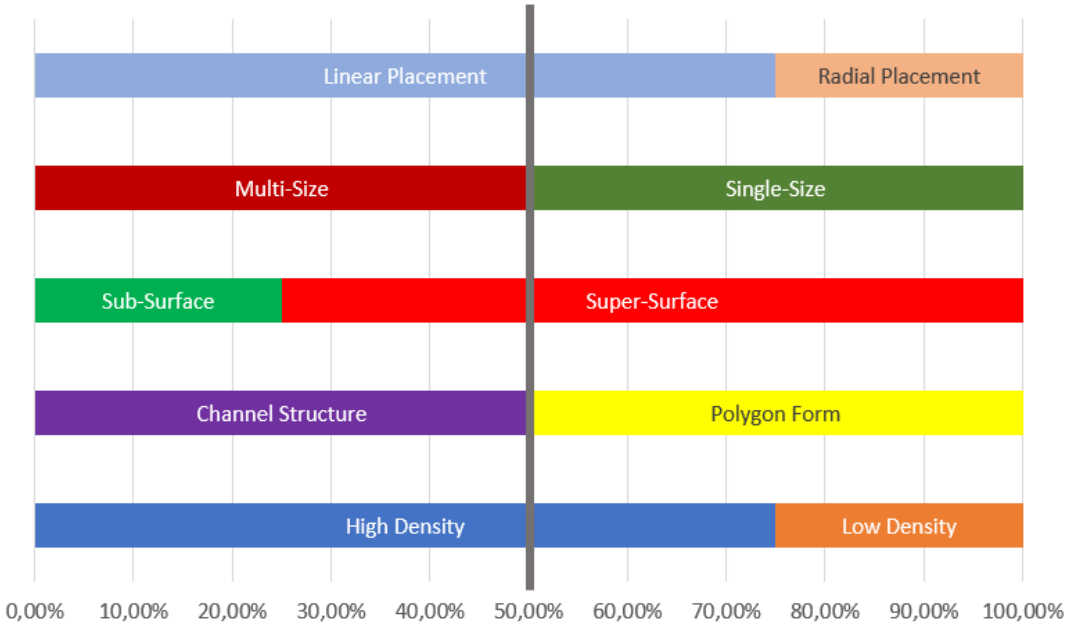

Figure 4.13 "Rugged" perception

Linear placement, super surface and high-density layout stand out for the characteristic “rugged”.

Multi-Functional

The average score in the evaluation of 32 samples for the adjective "multi-functional" is 3.225 on a 1-5 Likert scale. The standard deviation is 0.411. Five samples scored higher than the threshold value (3.636) for adjective “multi-functional”. When these 5 are examined, the following observations are made.

- Arrangement: 3 (60%) linear, 2 (40%) radial
- Size 5 (100%) multi-size, 0 (0%) single-size.
- Positioning: 2 (40%) sub-surface, 3 (60%) super-surface.
- Form: 1 (20%) channel, 4 (80%) polygon
- Density: 4 (80%) high, 1 (20%) low

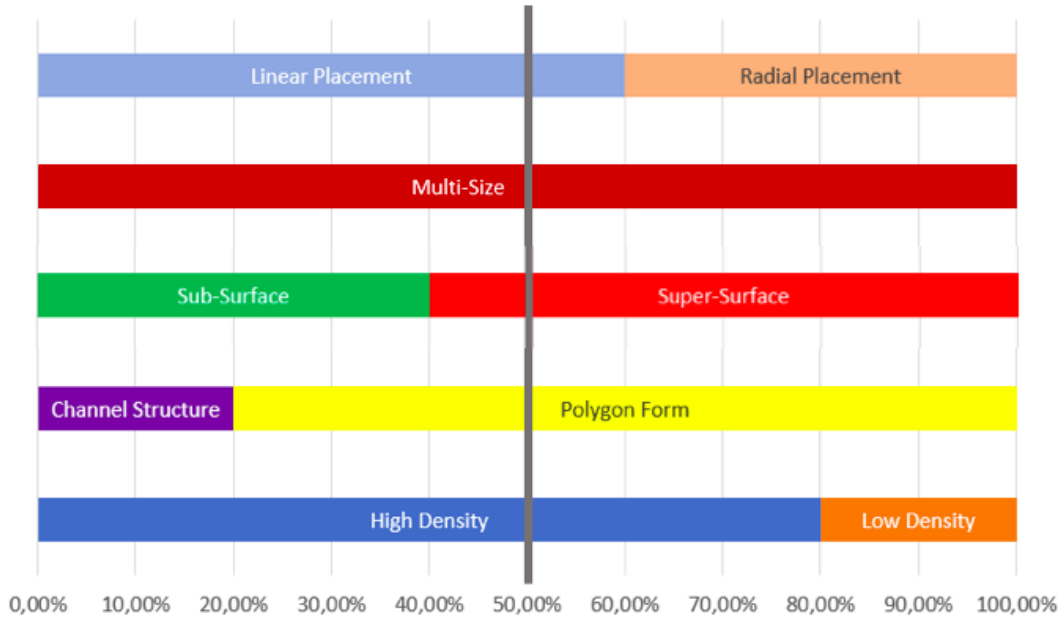

Figure 4.14 “Multi-Functional” perception

Linear placement, multi size, sub surface, polygon form and high-density layout stand out for the characteristic “multi-functional”.

Indefectible

In the evaluation of 32 samples for the adjective "indefectible", the average score is 3.034 on a 1-5 Likert scale. The standard deviation is 0.391. Five samples scored higher than the threshold value (3.425) for adjective “indefectible”. When these 5 are examined, the following observations are made.

When the samples with a score above the average are examined;

- Arrangement: 4 (80%) linear, 1 (20%) radial
- Size 1 (20%) multi-size, 4 (80%) single-size.
- Positioning: 2 (40%) sub-surface, 3 (60%) super-surface.
- Form: 3 (60%) channel, 2 (40%) polygon
- Density: 4 (80%) high, 1 (20%) low

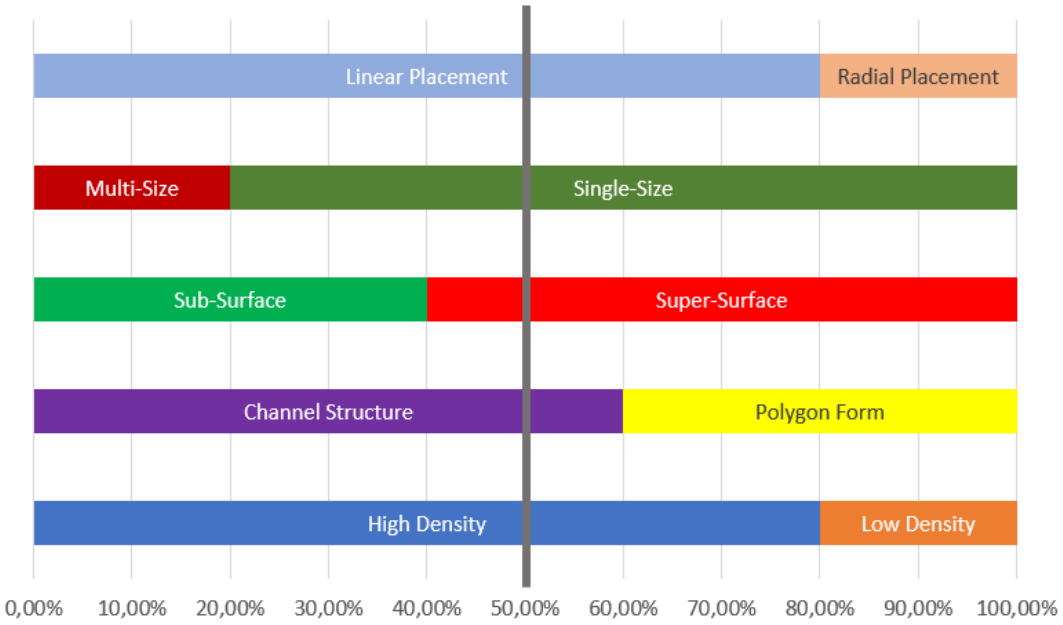

Figure 4.15 "Indefectible" perception

Linear placement, single size, super surface, channel form and high-density layout stand out for the characteristic “indefectible”.

Long Life

The average score in the evaluation of 32 samples for the adjective "long-life" is 3.344 on a 1-5 Likert scale. The standard deviation is 0.388. Five samples scored higher than the threshold value (3.732) for adjective “long-life”. When these 5 are examined, the following observations are made.

- Arrangement: 3 (60%) linear, 2 (40%) radial
- Size 3 (60%) multi-size, 2 (40%) single-size.
- Positioning: 1 (20%) sub-surface, 4 (80%) super-surface.
- Form: 6 (100%) channel, 0 (0%) polygon
- Density: 3 (60%) high, 2 (40%) low

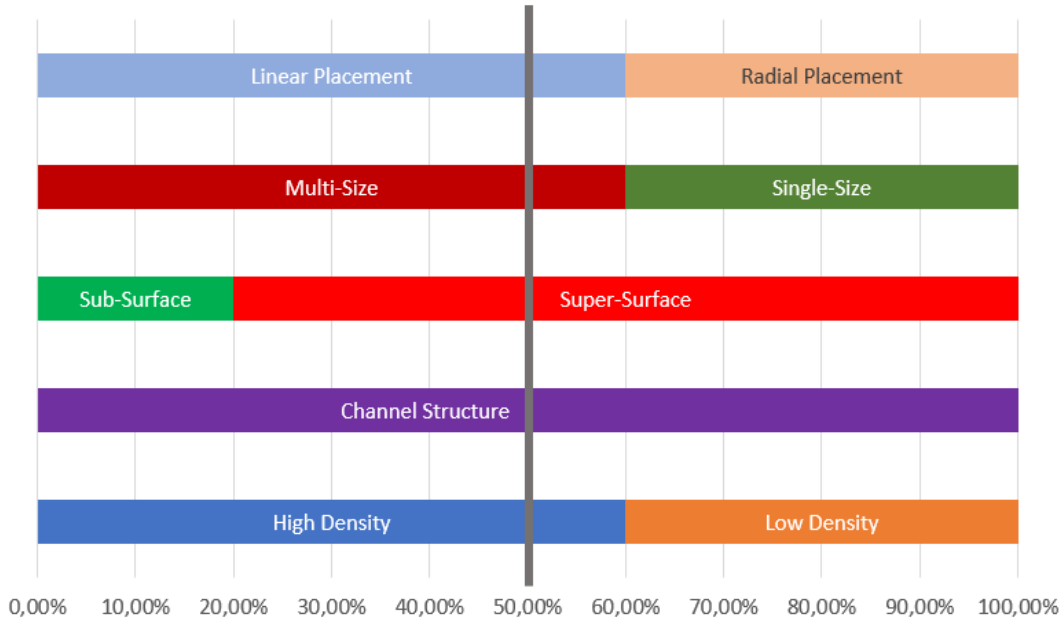

Figure 4.16 "Long-Life" perception

Linear placement, multi size, super surface, channel form and high-density layout stand out for the characteristic “long-life”.

Innovative

The average score in the evaluation of 32 samples for the adjective "innovative" is 3.041 on a 1-5 Likert scale. The standard deviation is 0.636. Five samples scored higher than the threshold value (3.677) for adjective “innovative”. When these 5 are examined, the following observations are made.

When the samples with a score above the average are examined;

- Arrangement: 2 (40%) linear, 3 (60%) radial
- Size: 4 (80%) multi-size, 1 (20%) single-size.
- Positioning: 3 (60%) sub-surface, 2 (40%) super-surface.
- Form: 1 (20%) channel, 4 (80%) polygon
- Density: 3 (60%) high, 2 (40%) low

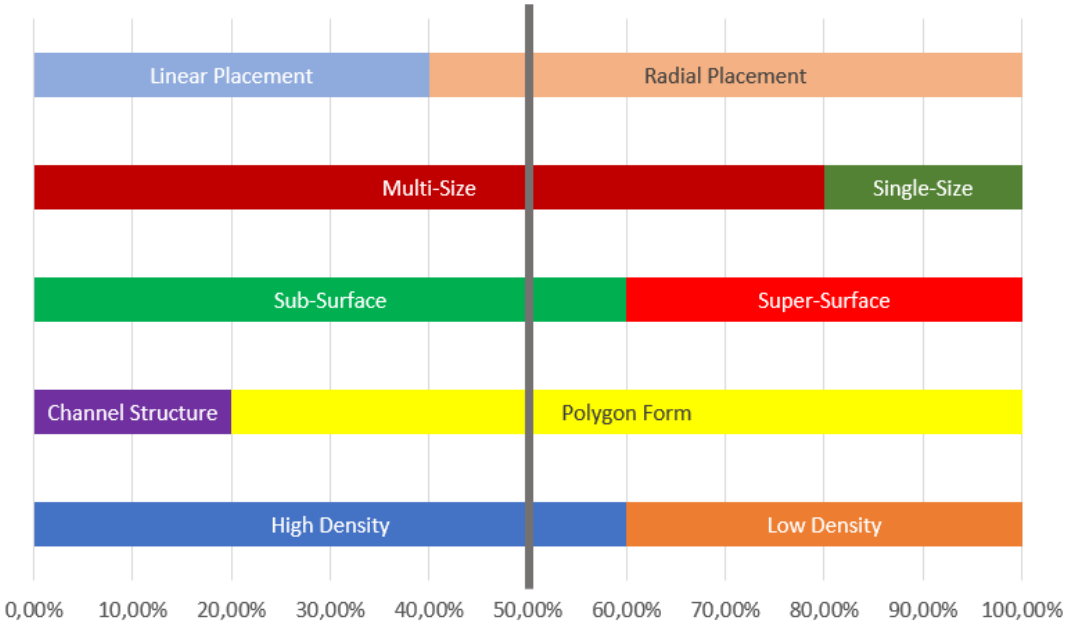

Figure 4.17 "Innovative" perception

Radial placement, multi size, sub surface, polygon form and high-density layout stand out for the characteristic “innovative”.

Competitive

In the evaluation of 32 samples for the adjective "competitive", the average score is 3.094 on a 1-5 Likert scale. The standard deviation is 0.419. Five samples scored higher than the threshold value (3.513) for adjective “competitive”. When these 5 are examined, the following observations are made.

When the samples with a score above the average are examined;

- Arrangement: 0 (0%) linear, 5 (100%) radial
- Size: 3 (60%) multi-size, 2 (40%) single-size.
- Positioning: 3 (60%) sub-surface, 2 (40%) super-surface.
- Form: 3 (60%) channel, 2 (40%) polygon
- Density: 4 (80%) high, 1 (20%) low

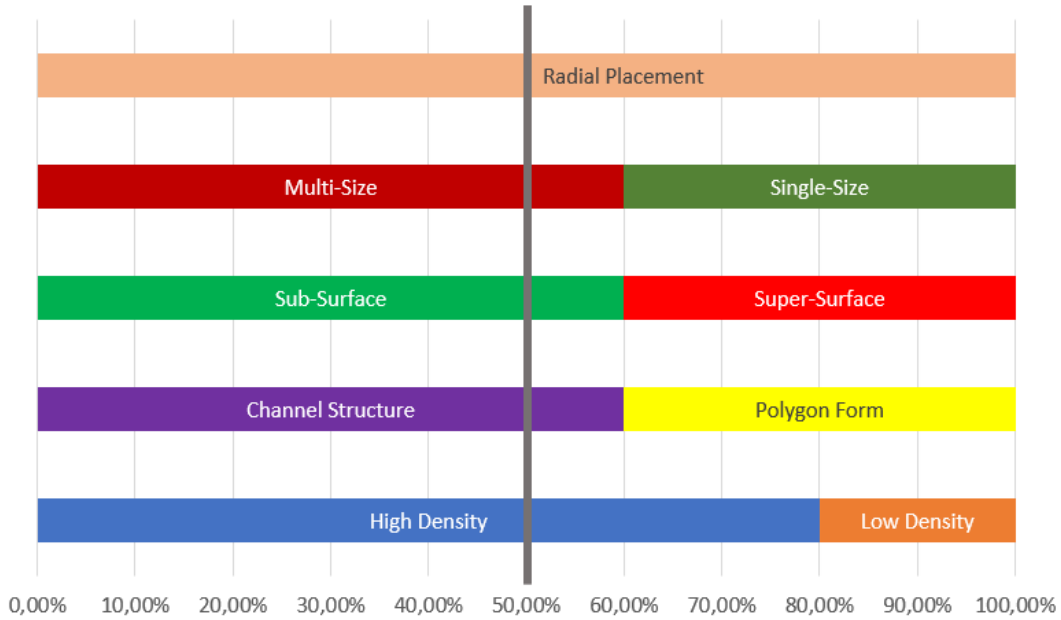

Figure 4.18 “Competitive” perception

Radial placement, multi size, sub surface, channel form and high-density layout stand out for the characteristic “competitive”.

Reliable

In the evaluation of 32 samples for the adjective "reliable", the average score is 3.281 on a 1-5 Likert scale. The standard deviation is 0.340. Four samples scored higher than the threshold value (3.621) for adjective “reliable”. When these 4 are examined, the following observations are made.

When the samples with a score above the average are examined;

- Arrangement: 3 (75%) linear, 1 (25%) radial
- Size 3 (75%) multi-size, 1 (25%) single-size.
- Positioning: 0 (0%) sub-surface, 4 (100%) super-surface.
- Form: 3 (75%) channel, 1 (25%) polygon
- Density: 3 (75%) high, 1 (25%) low

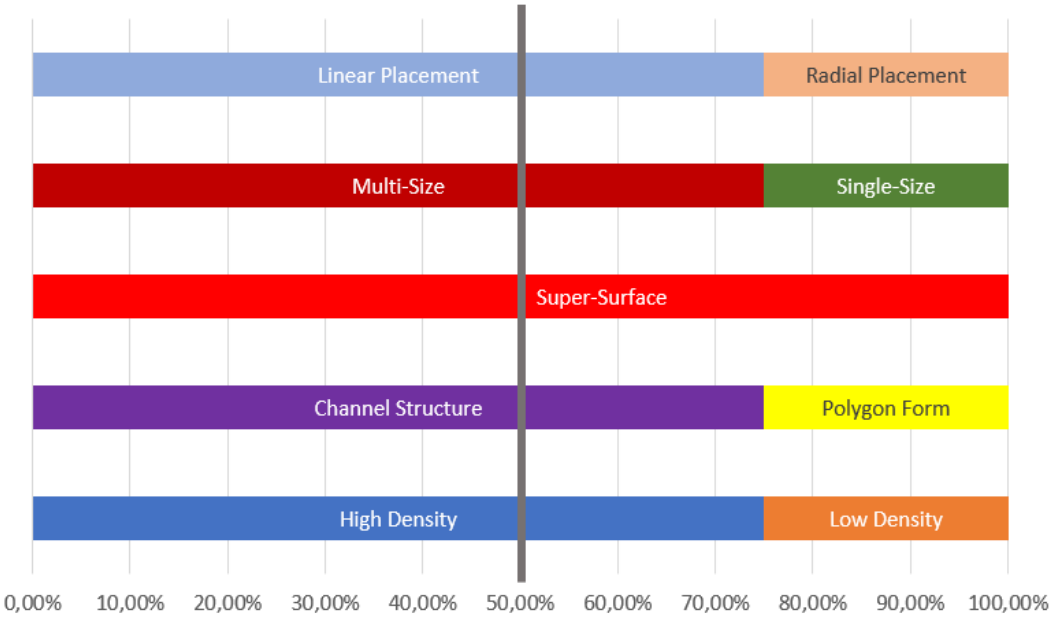

Figure 4.19 “Reliable” perception

Linear placement, multi size, super surface, channel form and high-density layout stand out for the characteristic “reliable”.

Secure

The average score in the evaluation of 32 samples for the adjective "secure" is 3.053 on a 1-5 Likert scale. The standard deviation is 0.303. Six samples scored higher than the threshold value (3.356) for adjective “secure”. When these 6 are examined, the following observations are made.

- Arrangement: 5 (83%) linear, 1 (17%) radial
- Size: 4 (67%) multi-size, 2 (33%) single-size.
- Positioning: 1 (17%) sub-surface, 5 (83%) super-surface.
- Form: 4 (67%) channel, 2 (33%) polygon
- Density: 4 (67%) high, 2 (33%) low

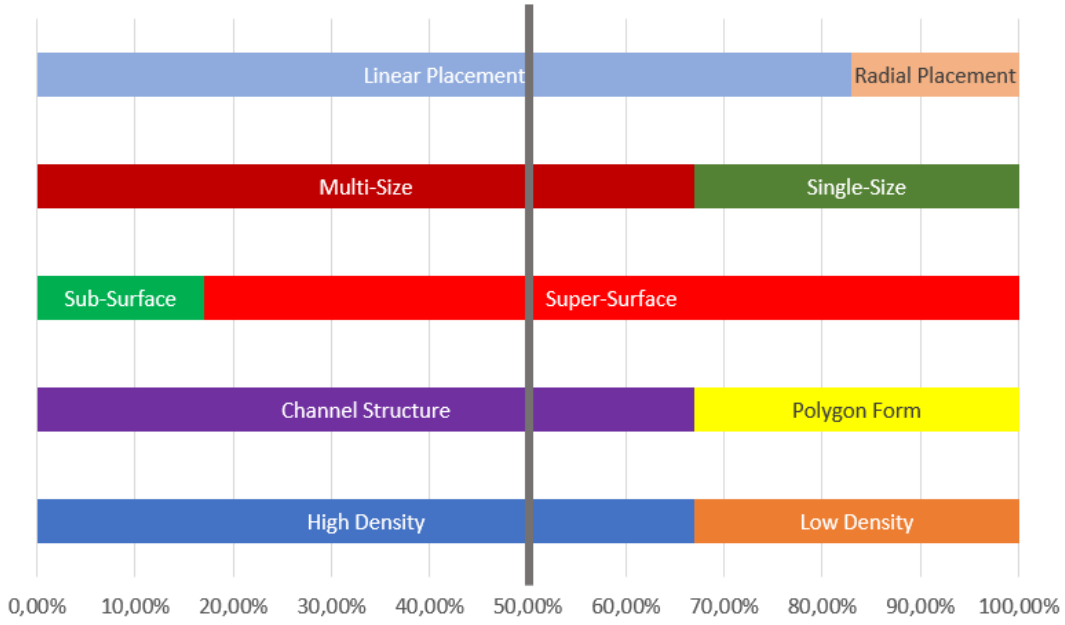

Figure 4.20 “Secure” perception

Linear placement, multi size, super surface, channel form and high-density layout stand out for the characteristic “secure”.

Average Scores

Across the evaluation of 32 samples for all adjectives, the average score per sample is 3,185 on a 1-5 Likert scale. The standard deviation is 0.239. Three samples scored higher than the threshold value (3.424). Table 4.4 detailed data of the samples scored higher than the threshold value.

Table 4.4 Average scores of digital visual evaluation

		Geometry	Arrangement	Bipolar Scaling		
	Mean Score	Form	Placement	Size	Density	Sub/Super
Option 30	3,73	Channel	Radial	Multi Size	High	Super Surface
Option 10	3,64	Polygon	Linear	Multi Size	High	Super Surface
Option 6	3,49	Polygon	Radial	Single Size	High	Super Surface

When the samples with a score above the average are examined;

- Arrangement: 1 (33%) linear, 2 (67%) radial
- Size: 2 (67%) multi-size, 1 (33%) single-size.
- Positioning: 0 (0%) sub-surface, 3 (100%) super-surface.
- Form: 1 (33%) channel, 2 (67%) polygon
- Density: 3 (100%) high, 0 (0%) low

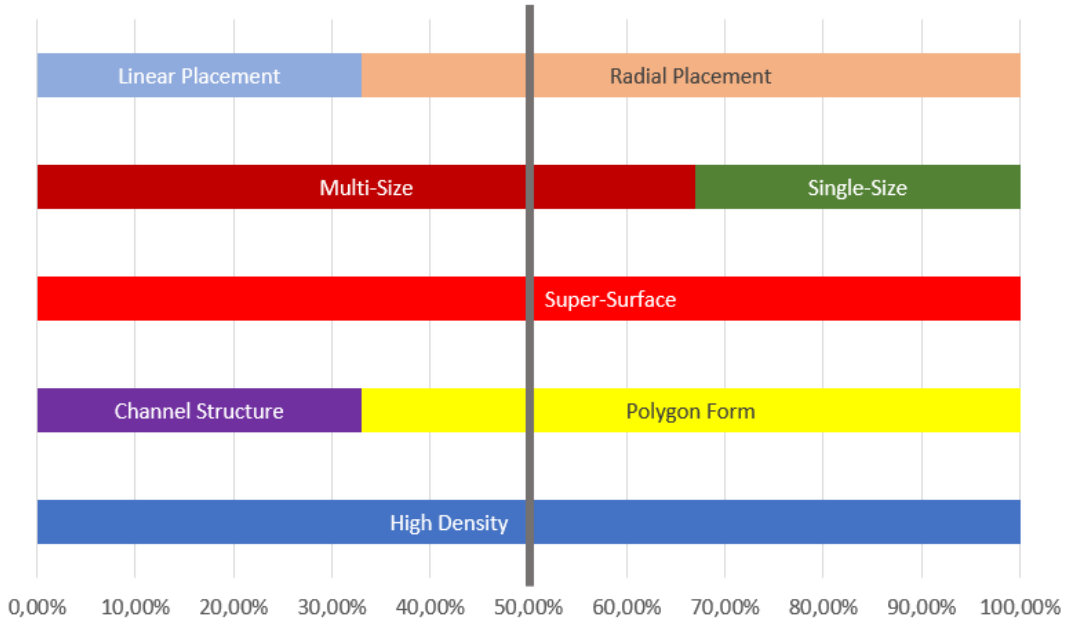

Figure 4.21 Average scores

Radial placement, multi size, super surface, polygon form and high-density layout stand out for the average scores.

4.2.2 Results of Study 2 (Touch-Only, then Visual+Touch)

For the next step of the research, study 2, the textures receiving the five highest average scores across all adjectives were produced for touch-only and visual +touch evaluation of the textures. Since the data for this study were collected in two steps using physical samples (touch-only, followed by visual+touch), the evaluations presented here are made separately. Comparisons were made afterwards. The following section describes the characteristics of the chosen 5 textures, taken from amongst the full set of textures designed for study 1.

The first is “option 6” (Table 4.5 and Figure 4.22), having a polygon form, single-size positioned, radially located, high density and super surface feature.

Table 4.5 Option 6 Properties

Option 6	Channel	Multi-Size	**Radial Placement**	**High Density**	**Super Surface**
	Polygon	**Single-Size**	Linear Placement	Low Density	Sub Surface

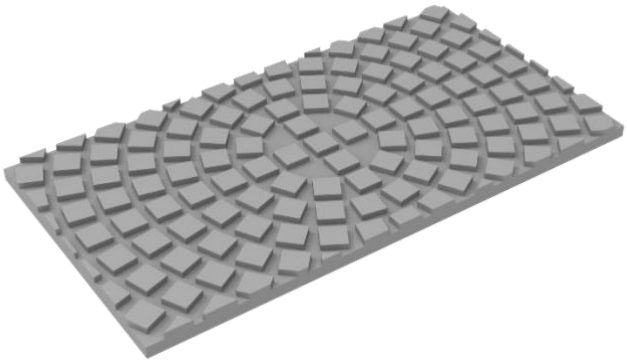

Figure 4.22 Option 6

The second is “option 10” (Table 4.6 and Figure 4.23), having a polygon form, variably size positioned, linearly arranged, high density and super surface feature.

Table 4.6 Option 10 Properties

Option 10	Channel	**Multi-Size**	Radial Placement	**High Density**	**Super Surface**
	Polygon	Single-Size	**Linear Placement**	Low Density	Sub Surface

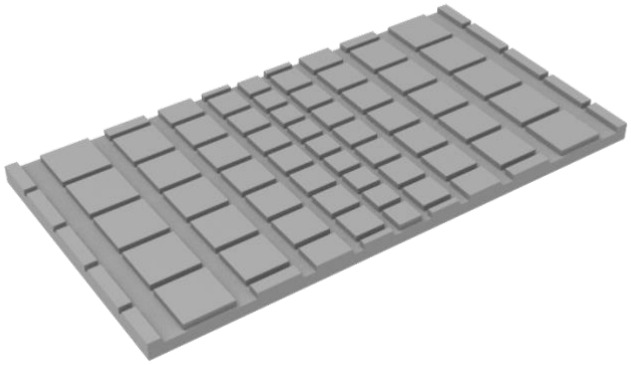

Figure 4.23 Option 10

The third is “option 13” (Table 4.7 and Figure 4.24), having a polygon form, variably size positioned, radially located, high density and sub surface.

Table 4.7 Option 13 Properties

Option 13	Channel	**Multi-Size**	**Radial Placement**	**High Density**	Super Surface
	Polygon	Single-Size	Linear Placement	Low Density	**Sub Surface**

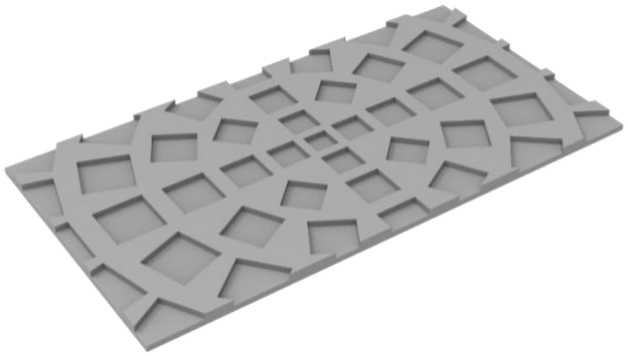

Figure 4.24 Option 13

The fourth is “option 21” (Table 4.9 and Figure 4.25), having a channel form, fixedly size positioned, radially located, high density and sub surface feature.

Table 4.8 Option 21 Properties

Option 21	**Channel**	Multi-Size	**Radial Placement**	**High Density**	Super Surface
	Polygon	**Single-Size**	Linear Placement	Low Density	**Sub Surface**

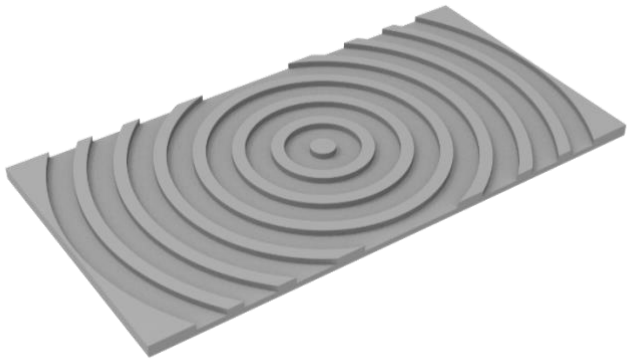

Figure 4.25 Option 21

The fifth is “option 30” (Table 4.9 and Figure 4.26), having a channel-shaped, variably size positioned, radially located, high-density and super-surface features.

Table 4.9 Option 30 Properties

Option 30	**Channel**	**Multi-Size**	**Radial Placement**	**High Density**	**Super Surface**
	Polygon	Single-Size	Linear Placement	Low Density	Sub Surface

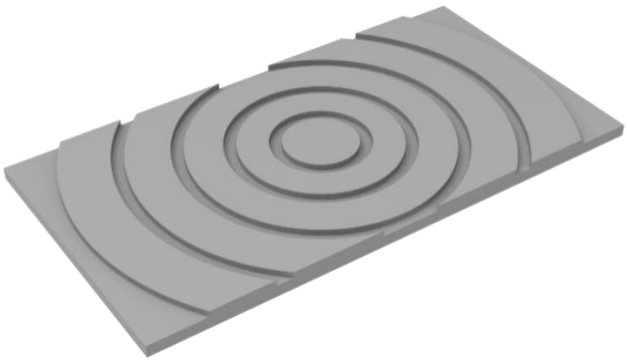

Figure 4.26 Option 30

4.2.2.1 Evaluation of Tactual (Touch-Only) Experience

Figure 4.27, Figure 4.28, Figure 4.29, Figure 4.30, Figure 4.31 and Figure 4.32 show the scores each of the 5 samples received when evaluated according to brand values.

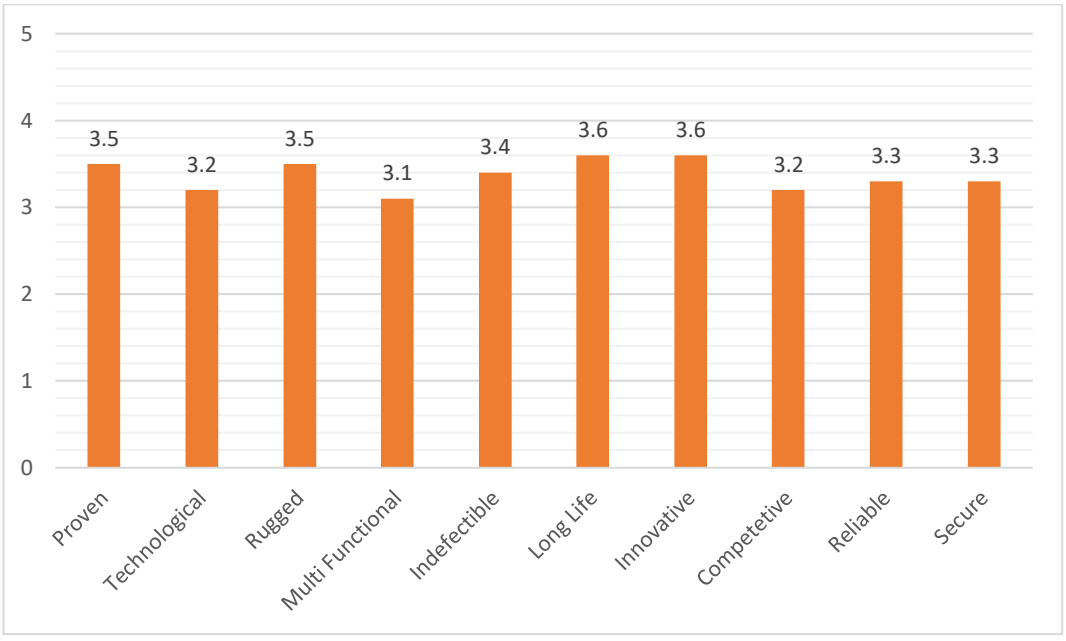

Figure 4.27 Option 6 (Poly, Single, Radial, Super, High) - tactual evaluation

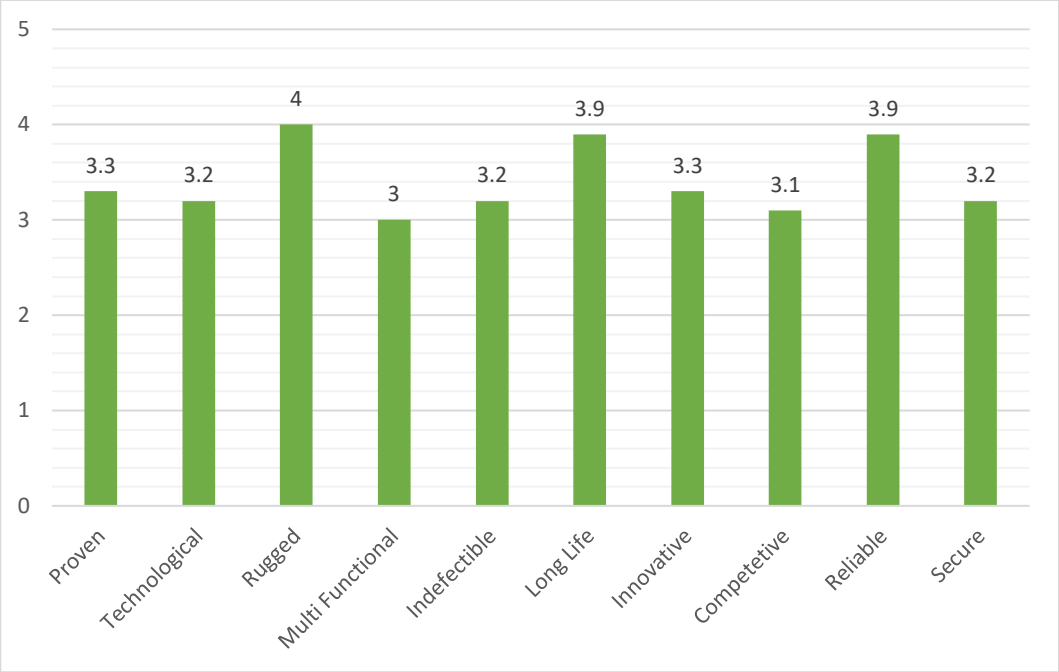

Figure 4.28 Option 10 (Poly, Multi, Linear, High, Super) - tactual evaluation

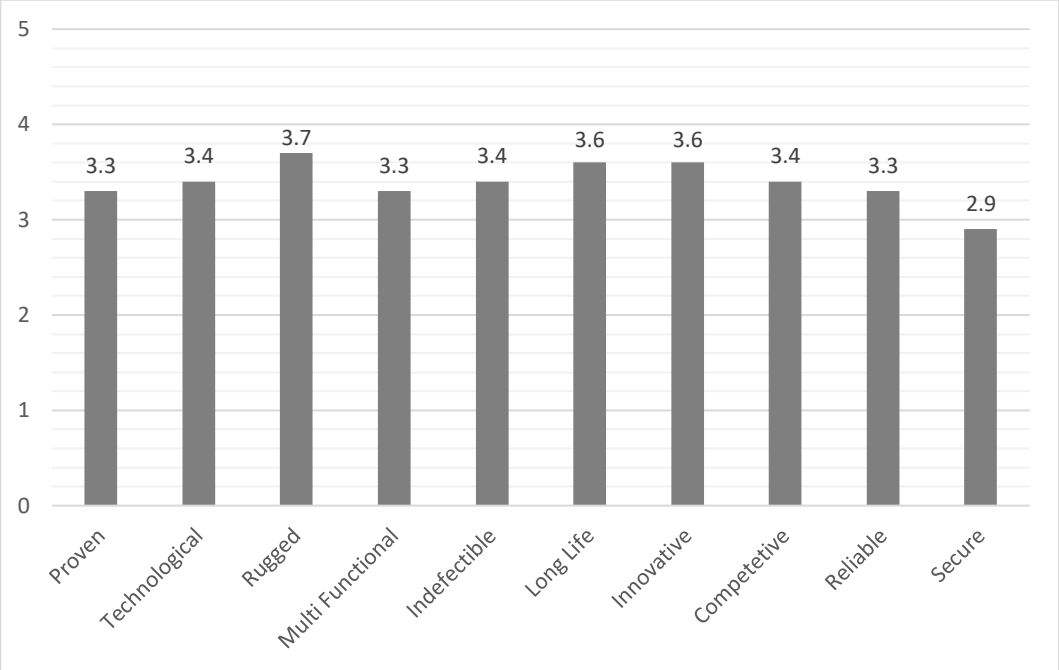

Figure 4.29 Option 13 (Poly, Multi, Radial, High, Sub) - tactual evaluation

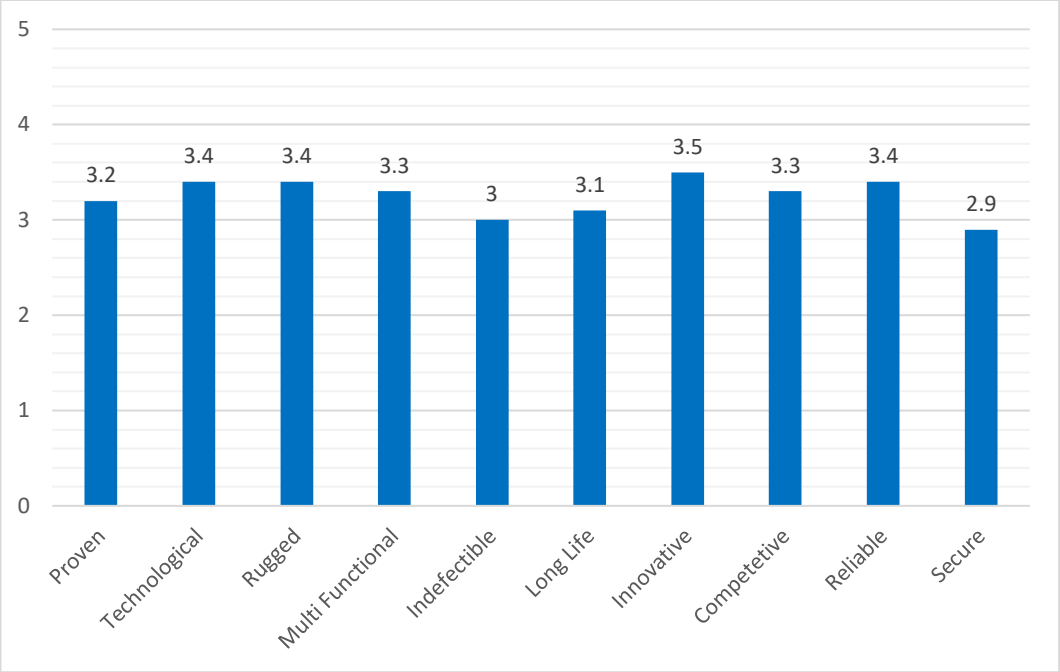

Figure 4.30 Option 21 (Channel, Single, Radial, High, Sub) - tactual evaluation

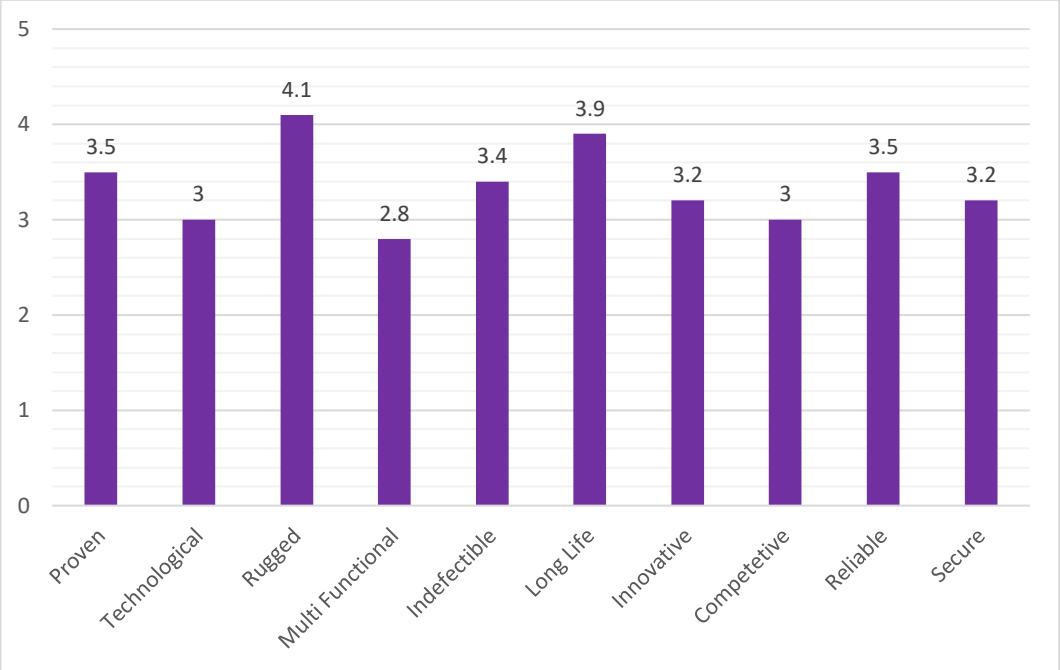

Figure 4.31 Option 30 (Channel, Multi, Radial, High, Super) - tactual evaluation

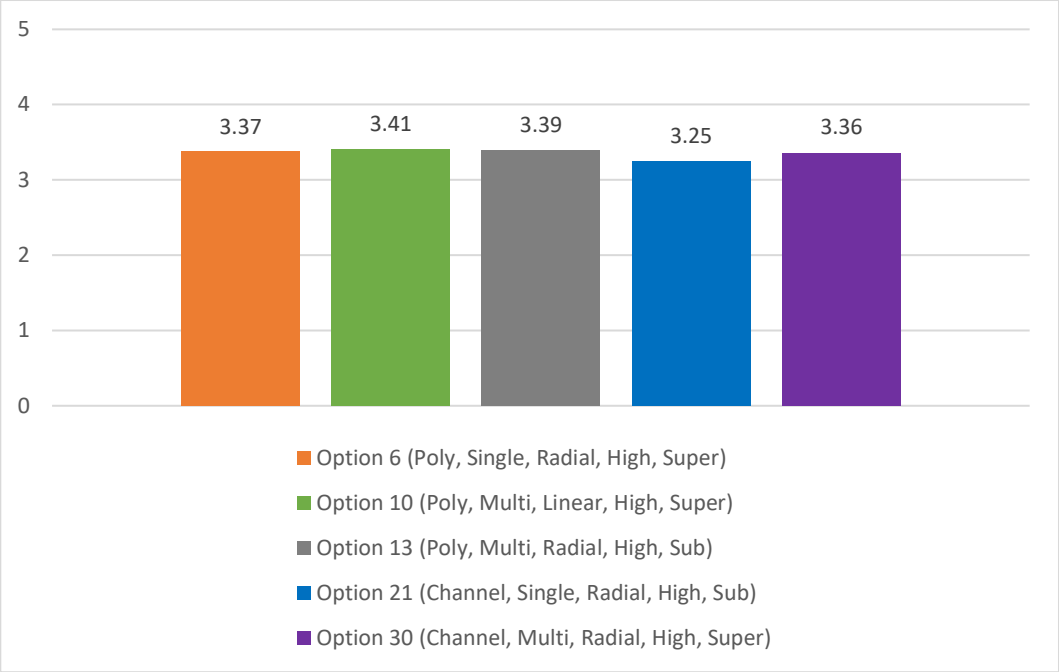

Figure 4.32 Average scores by tactual evaluation

Among the 5 evaluated samples, 4 of them have radial layout and 1 of them have linear layout, so they were not evaluated because sufficient data could not be presented within the scope of this feature. In addition, since all of the 5 most popular samples were those with high density settlements, no evaluation was made for this feature either. Evaluation was only based on the use of variable size or constant size of surface textures, the form of surface textures, sub-surface and super-surface characteristics of the layout. In all three of these features, the feature that stands out was evaluated when two of the highest scoring surface textures shared a common feature. When there was no common feature between the sample with the highest two scores, it was considered that a distinctive feature did not stand out.

Proven

Average score is 3.36 for "Proven" domain. Standard deviation is 0.134. From the data, it can be said that the surface textures with the super surface feature are more

successful than the sub surface in creating the perception of "proven" as a result of the touch experience.

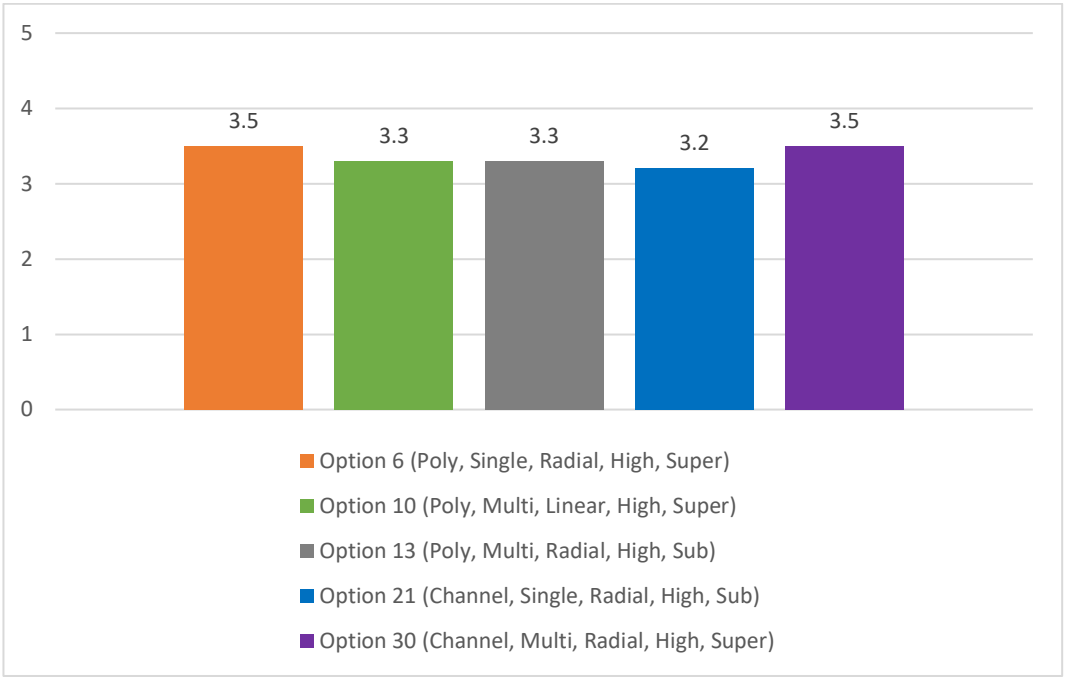

Figure 4.33 “Proven” scores by tactual experience

Technological

Average score is 3.24 for "Technological" domain. Standard deviation is 0.167. The surface textures with the sub surface feature are more successful than the super surface in creating the perception of "technological" as a result of the touch experience.

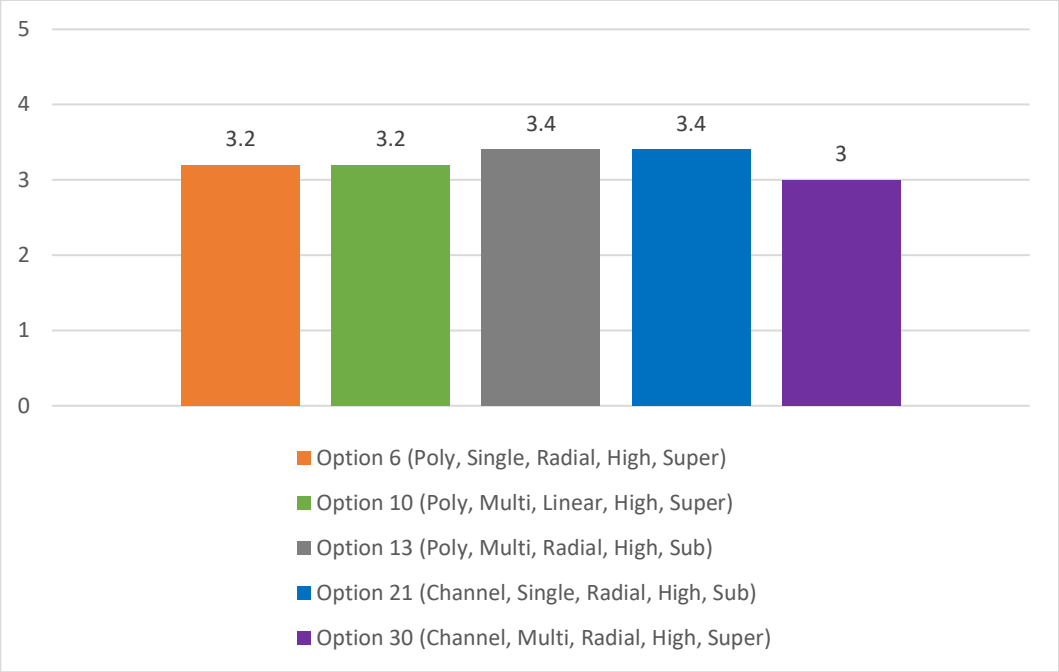

Figure 4.34 “Technological” scores by tactual experience

Rugged

Average score is 3.74 for "Rugged" domain. Standard deviation is 0.305. 3D surface textures with the variable size placement feature are more successful than the fixed size placement in creating the perception of "rugged" as a result of the touch experience. In addition, the surface textures with the super surface feature are more successful than the sub surface in creating the perception of "rugged" as a result of the touch experience.

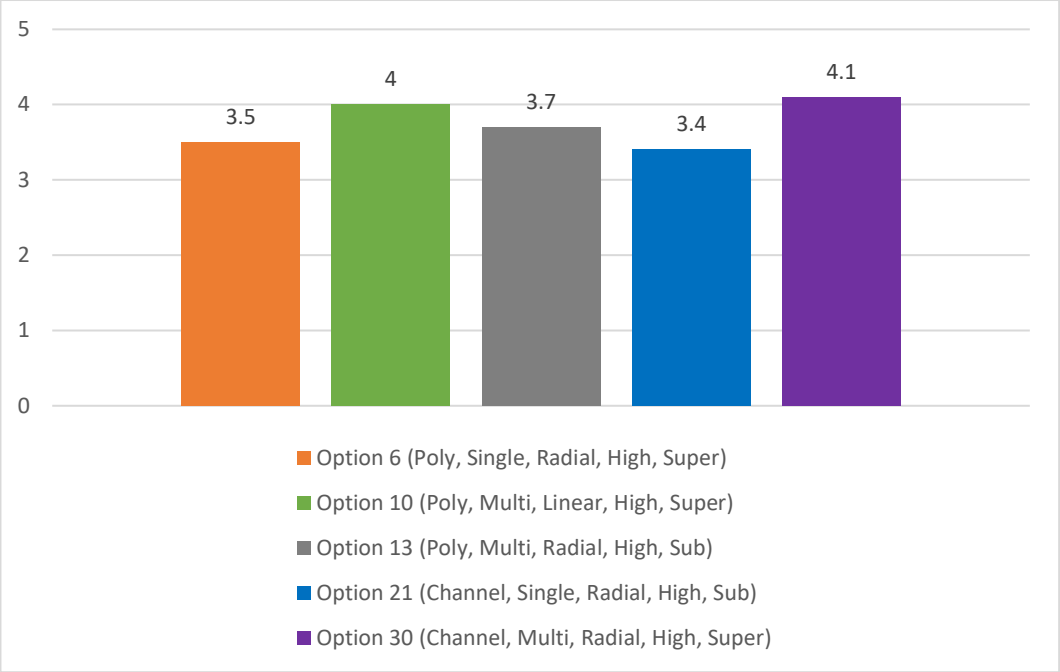

Figure 4.35 “Rugged” scores by tactual experience

Multi-Functional

Average score is 3.1 for "Multi-Functional" domain. The standard deviation is 0.212. 3D surface textures with the sub surface feature are more successful than the super surface in creating the perception of "multi-functional" as a result of the touch experience.

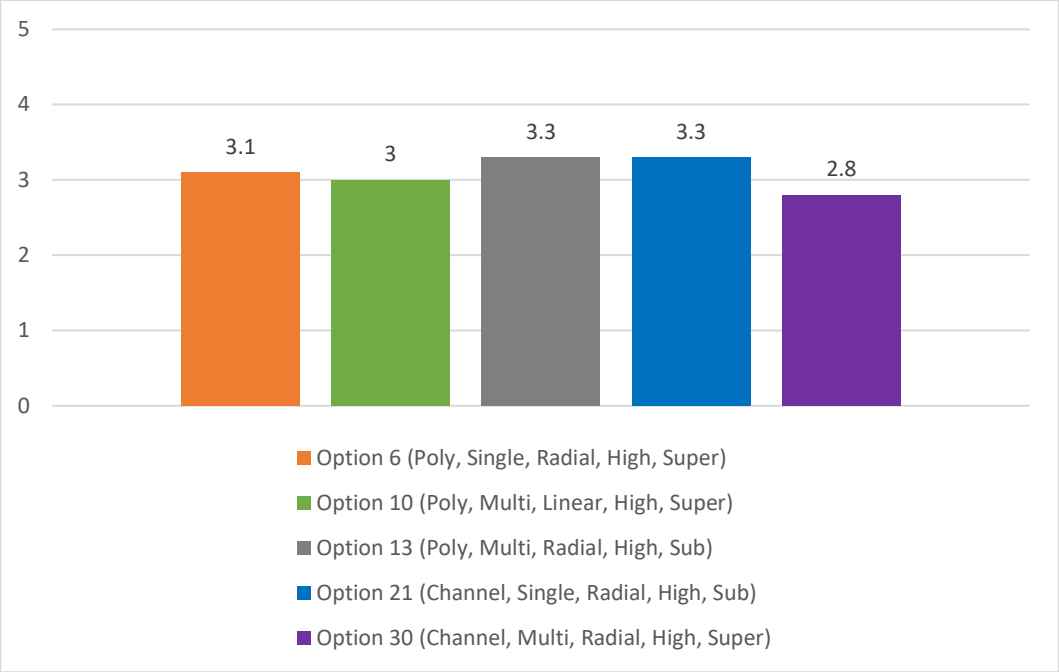

Figure 4.36 “Multi-Functional” scores by tactual experience

Indefectible

Average score is 3.28 for "Indefectible" domain. The standard deviation is 0.179. 3D surface textures with the polygon shaped are more successful than the channel-structure types in creating the perception of "indefectible" as a result of the touch experience.

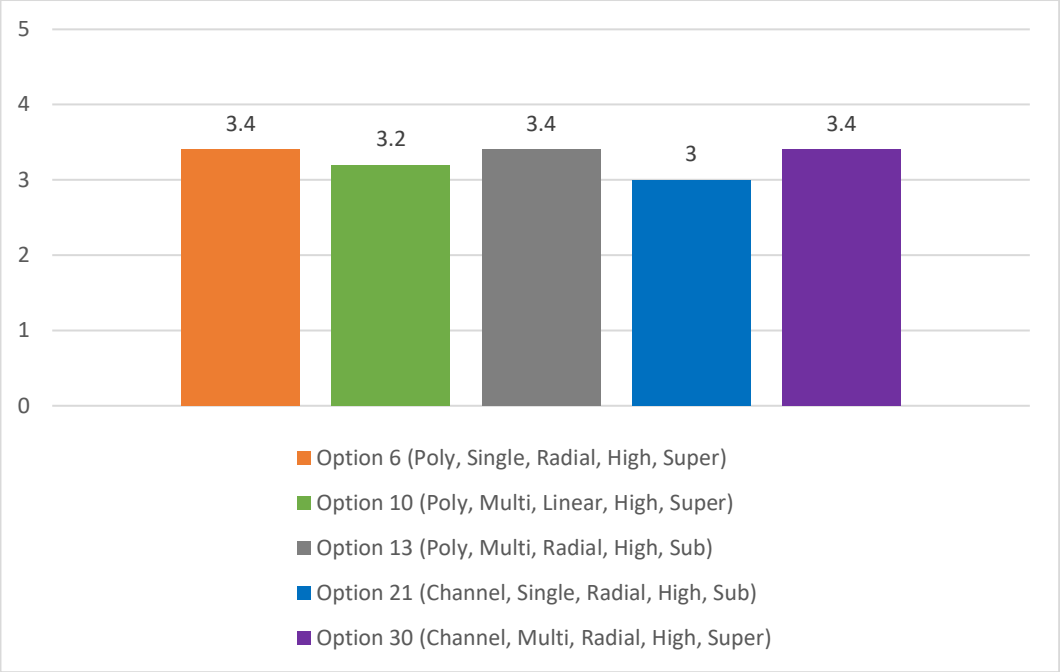

Figure 4.37 “Indefectible” scores by tactual experience

Long-Life

Average score is 3.5 for "Long-Life" domain. The standard deviation is 0.43. 3D surface textures with the super surface feature are more successful than the sub surface in creating the perception of "long-life" as a result of the touch experience. In addition, 3D surface textures with the variable size placement feature are more successful than the fixed size placement in creating the perception of "long-life".

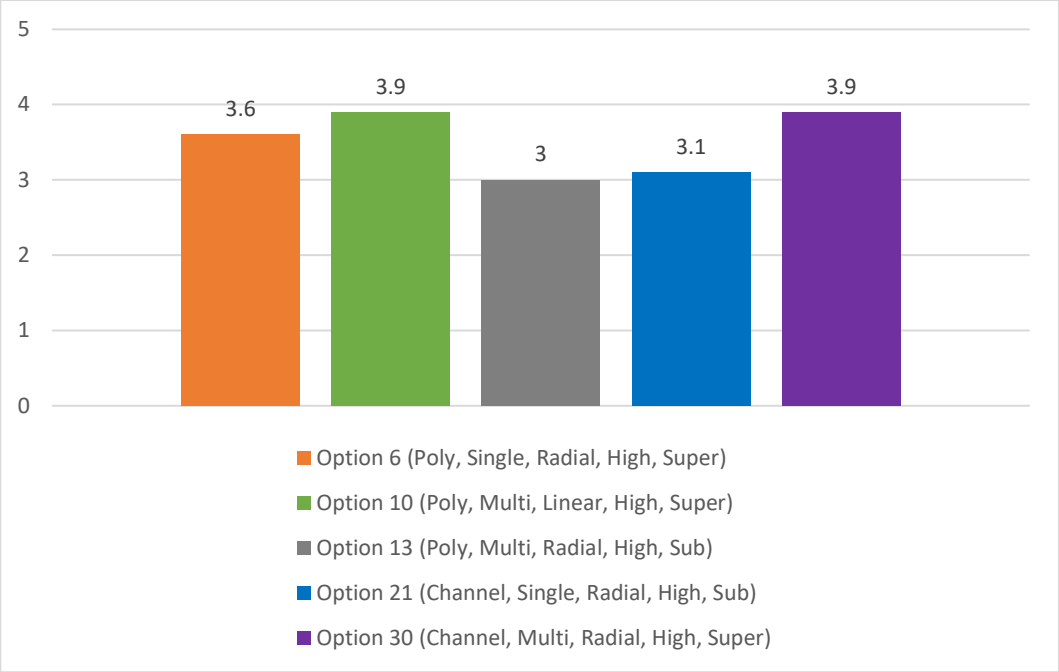

Figure 4.38 “Long-Life” scores by tactual experience

Innovative

Average score is 3.44 for "Innovative" domain. The standard deviation is 0.182. 3D surface textures with the polygon form are more successful than the channel-structure types in creating the perception of "innovative" as a result of the touch experience.

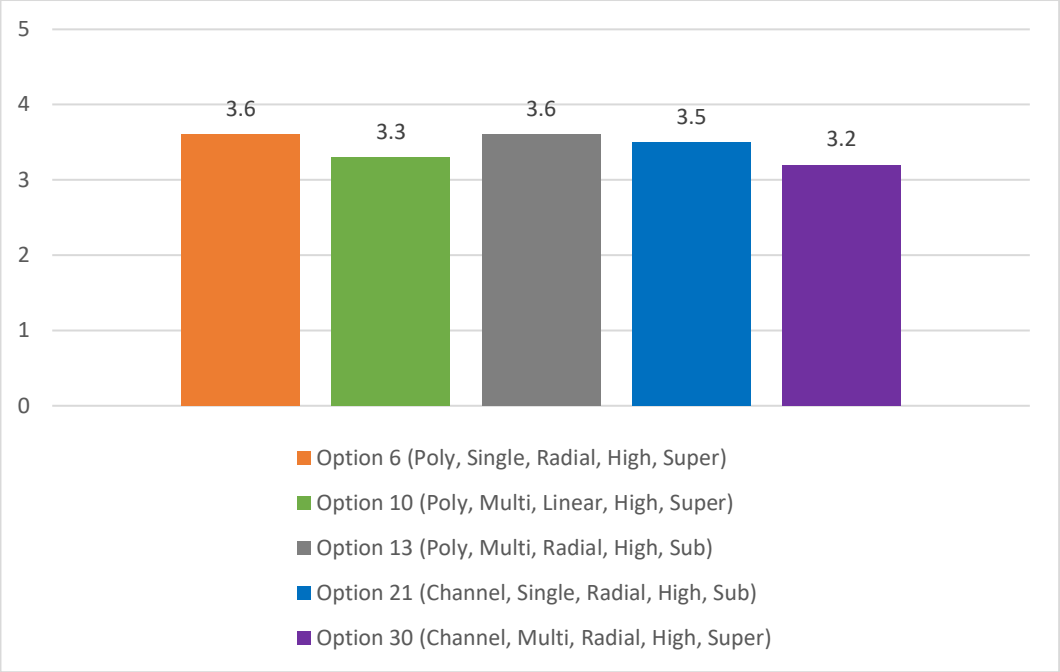

Figure 4.39 “Innovative” scores by tactual experience

Competitive

Average score is 3.2 for "Competitive" domain. The standard deviation is 0.158. 3D surface textures with the sub surface feature are more successful than the super surface in creating the perception of "competitive" as a result of the touch experience.

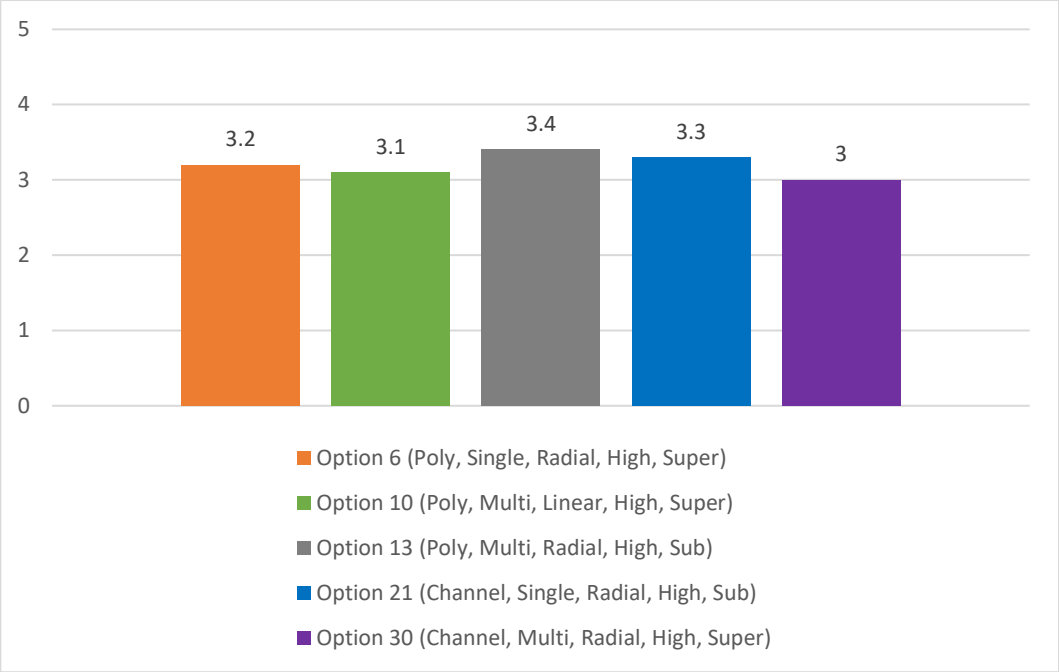

Figure 4.40 “Competitive” scores by tactual experience

Reliable

Average score is 3.48 for "Reliable" domain. The standard deviation is 0.249. 3D surface textures with the super surface feature are more successful than the sub surface in creating the perception of "reliable" as a result of the touch experience. In addition, 3D surface textures with the variable size placement feature are more successful than the fixed size placement in creating the perception of "reliable".

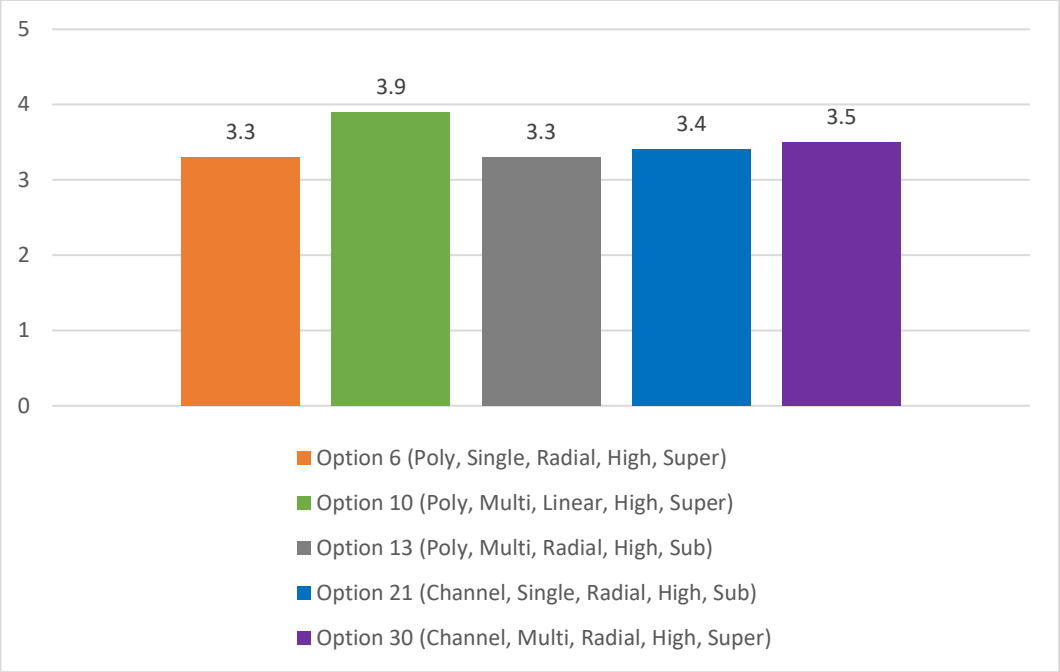

Figure 4.41 “Reliable” scores by tactual experience

Secure

Average score is 3.1 for "Secure" domain. The standard deviation is 0.187. From the data, it can be said that the surface textures with the super surface feature are more successful than the sub surface in creating the perception of "secure" as a result of the touch experience. In addition, 3D surface textures with the polygon form are more successful than the channel-structure types in creating the perception of "secure".

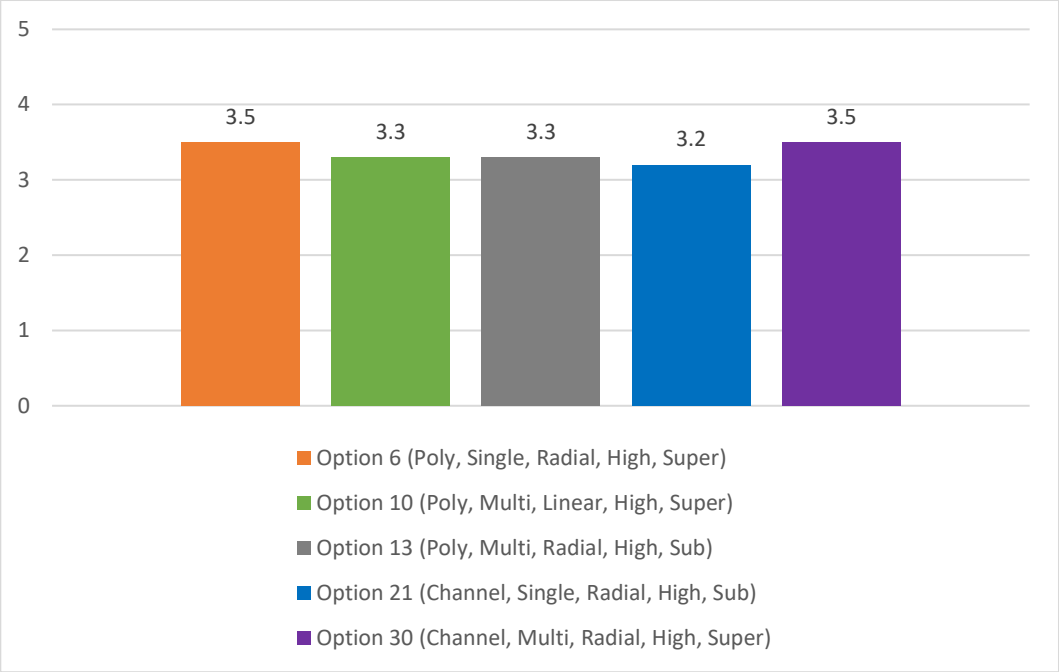

Figure 4.42 “Secure” scores by tactual experience

4.2.2.2 Evaluation of Combined Visual and Tactual Experience (Visual+Touch)

The graphs below show the scores each of the 5 samples received when evaluated according to brand values.

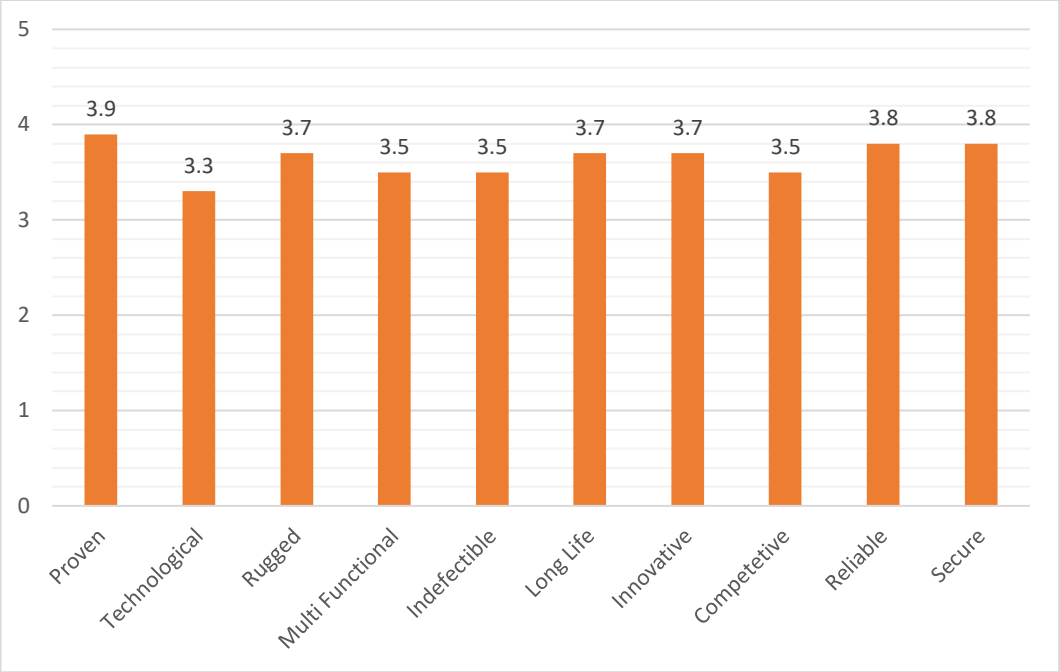

Figure 4.43 Option 6 (Poly, Single, Radial, High, Super) – Visual+Touch evaluation scores

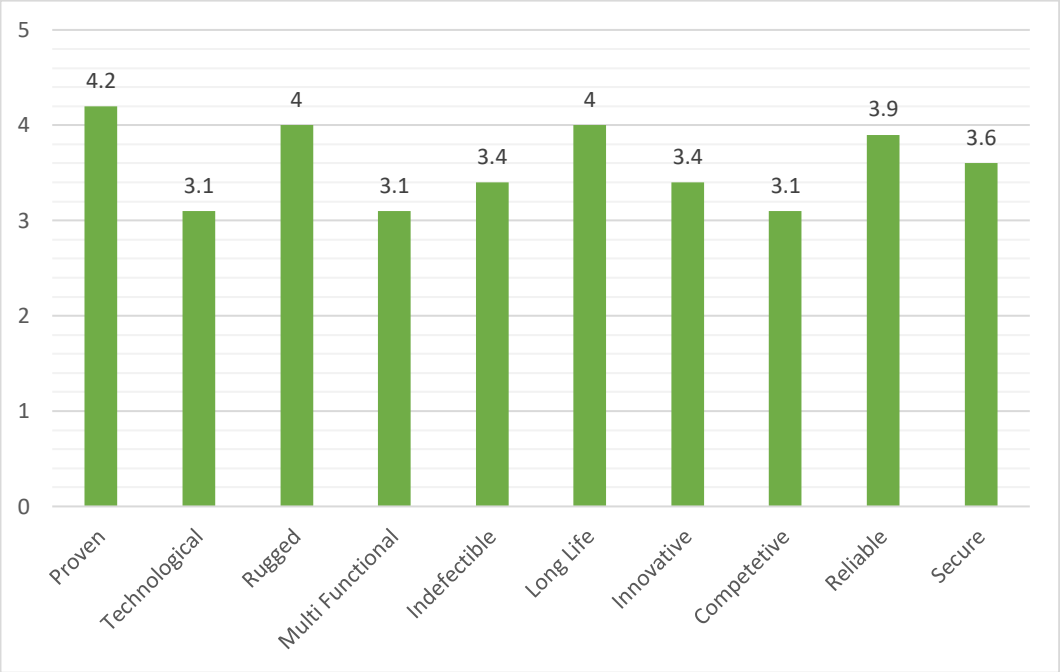

Figure 4.44 Option 10 (Poly, Multi, Linear, High, Super) – Visual+Touch evaluation scores

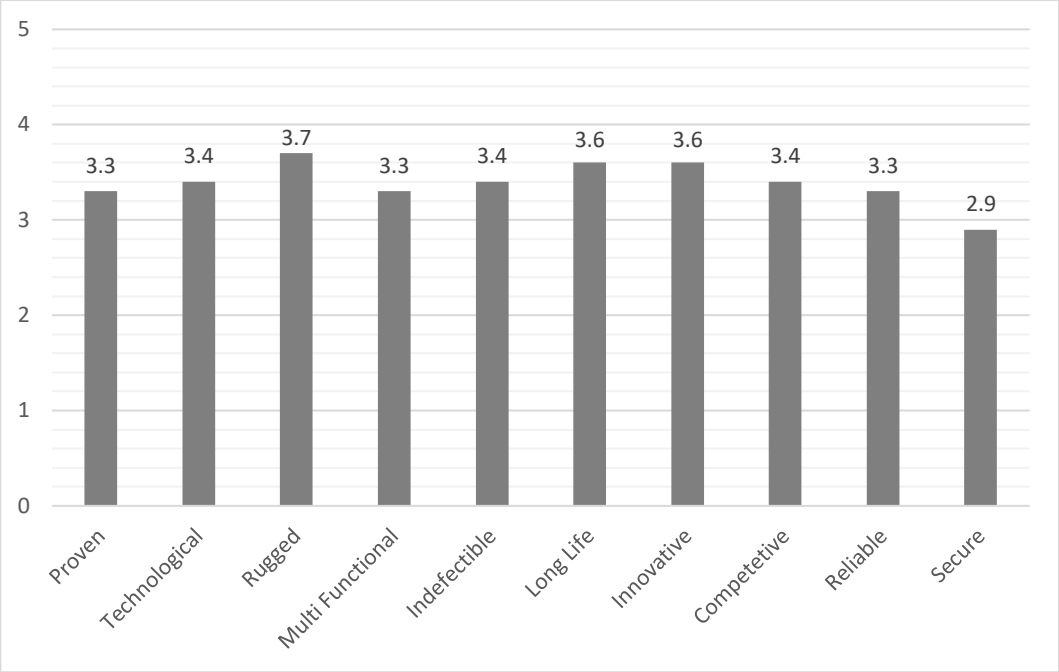

Figure 4.45 Option 13 (Poly, Multi, Radial, High, Sub) – Visual+Touch evaluation scores

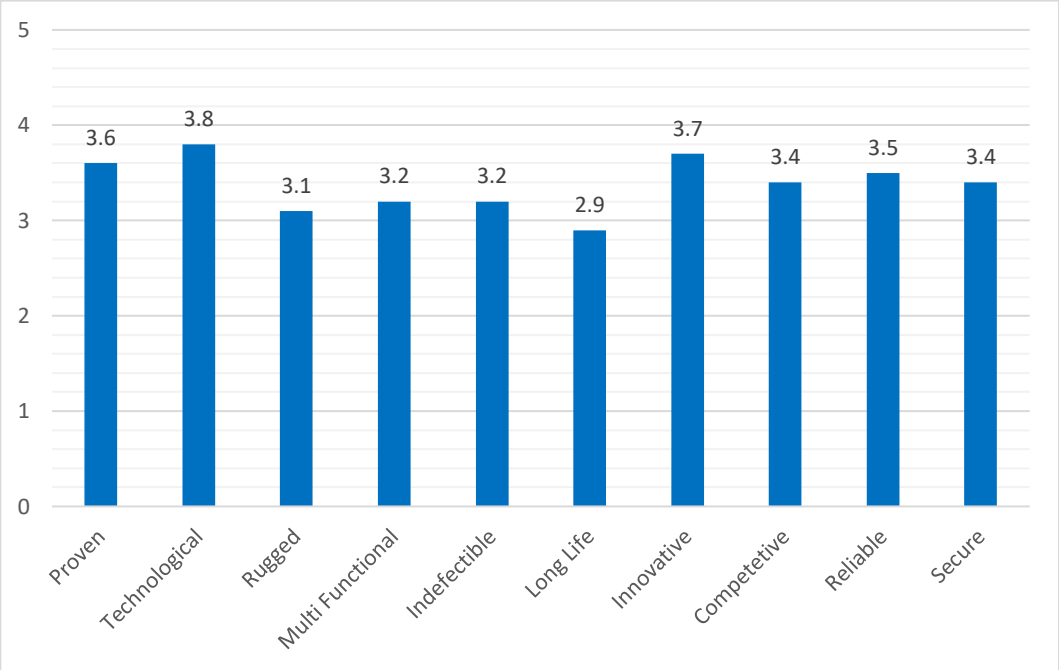

Figure 4.46 Option 21 (Channel, Single, Radial, High, Sub) – Visual+Touch evaluation scores

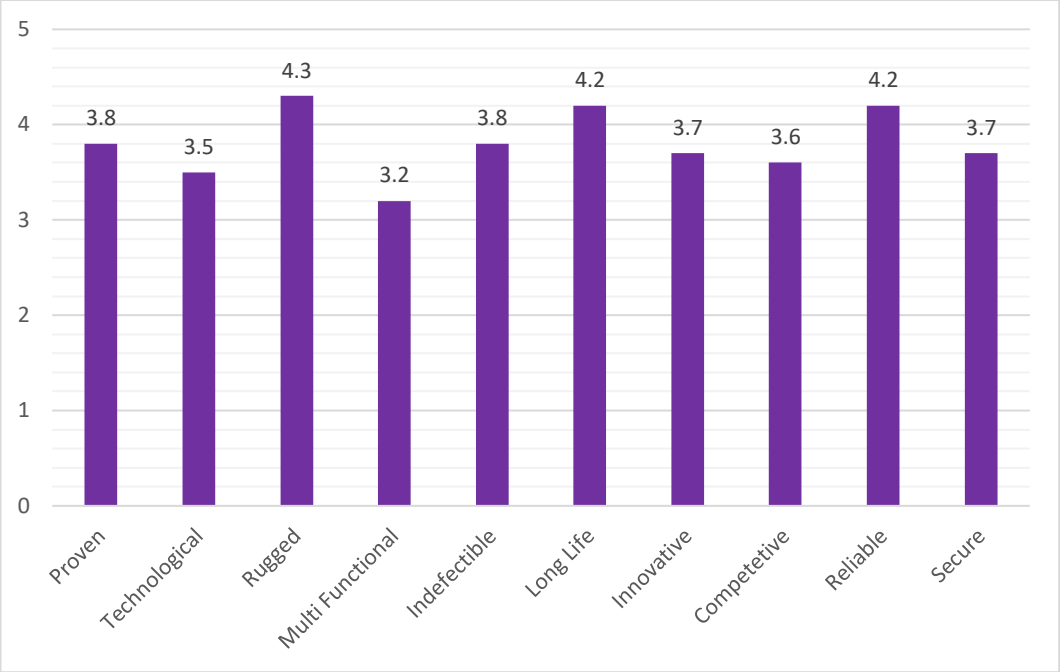

Figure 4.47 Option 30 – (Channel, Multi, Radial, High, Super) Visual+Touch evaluation scores

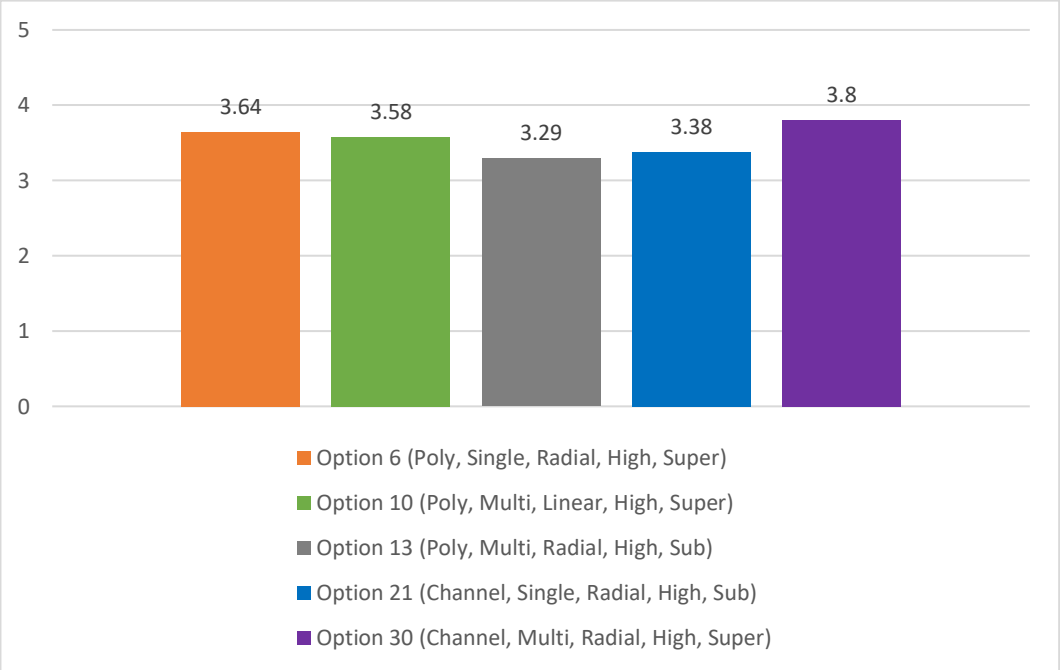

Figure 4.48 Visual+Touch evaluation average scores

Identical to the study focusing on touch-only experience, each brand image will be evaluated in detail as a result of visual+touch experience and the inferences will be shared. Afterwards, the evaluation will be made on the average score consisting of the points obtained from each adjective. Again, as in the previous touch-only study, radial or linear positioning and density characteristics were not studied. Evaluation was only based on the use of variable size or constant size of surface textures, the form of surface textures, sub-surface and super-surface characteristics of the layout. Just as in the previous study, in all three of these features, the feature that stands out was evaluated when two of the highest scoring surface textures shared a common feature. When there was no common feature between the sample with the highest two scores, it was considered that a distinctive feature did not stand out.

Proven

Average score is 3.74 for “Proven” domain. The standard deviation is 0.371. From the data, it can be said that the surface textures with the super surface feature are more successful than the sub surface in creating the perception of "proven" as a result of the touch and visual experience. In addition, 3D surface textures with the polygon form are more successful than the channel-structure types in this brand value.

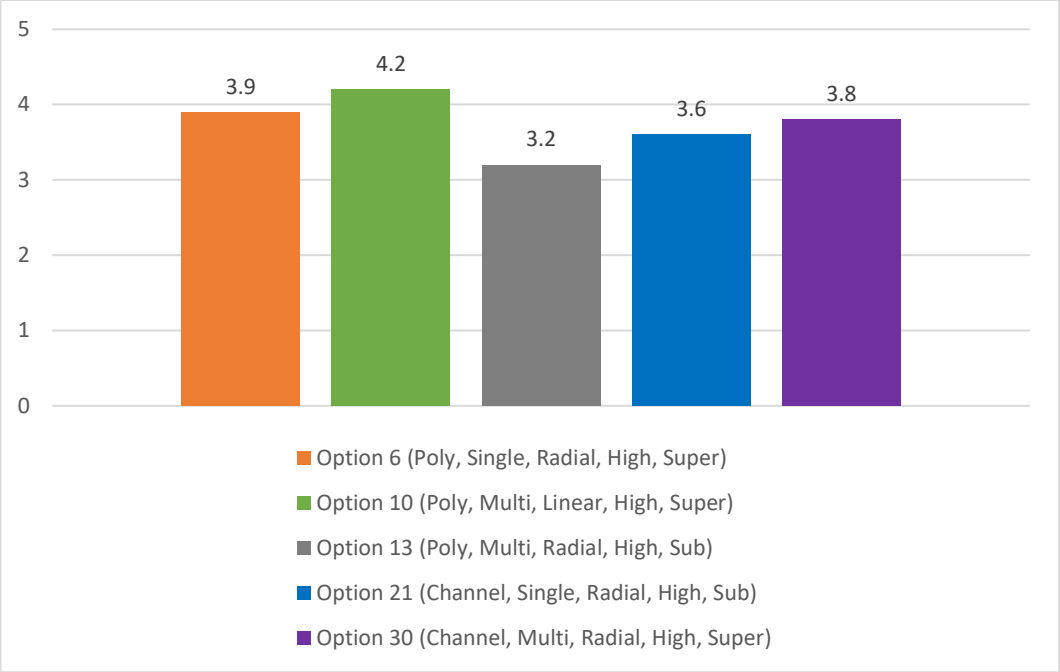

Figure 4.49 “Proven” scores by Visual+Touch evaluation

Technological

Average score is 3.52 for "Technological" domain. The standard deviation is 0.335. The surface textures with the sub surface feature are more successful than the super surface in creating the perception of "technological" as a result of the touch and visual experience.

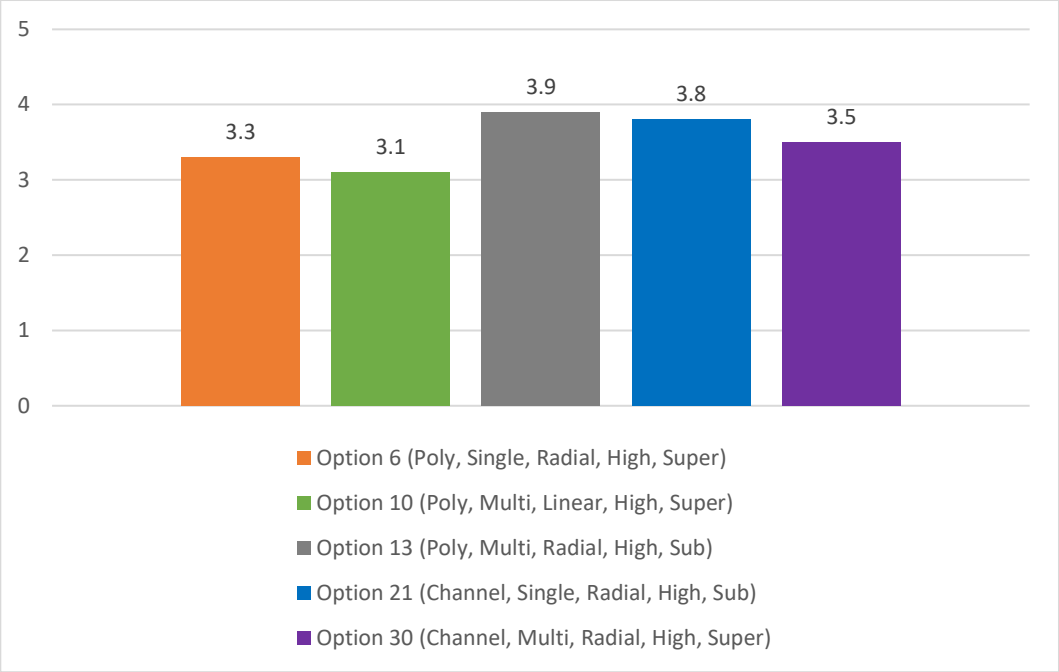

Figure 4.50 “Technological” scores by Visual+Touch evaluation

Rugged

Average score is 3.72 for “Rugged” domain. The standard deviation is 0.46. 3D surface textures with the variable size placement feature are more successful than the fixed size placement in creating the perception of "rugged" as a result of the touch and visual experience. In addition, the surface textures with the super surface feature are more successful than the sub surface in creating the perception of this brand value.

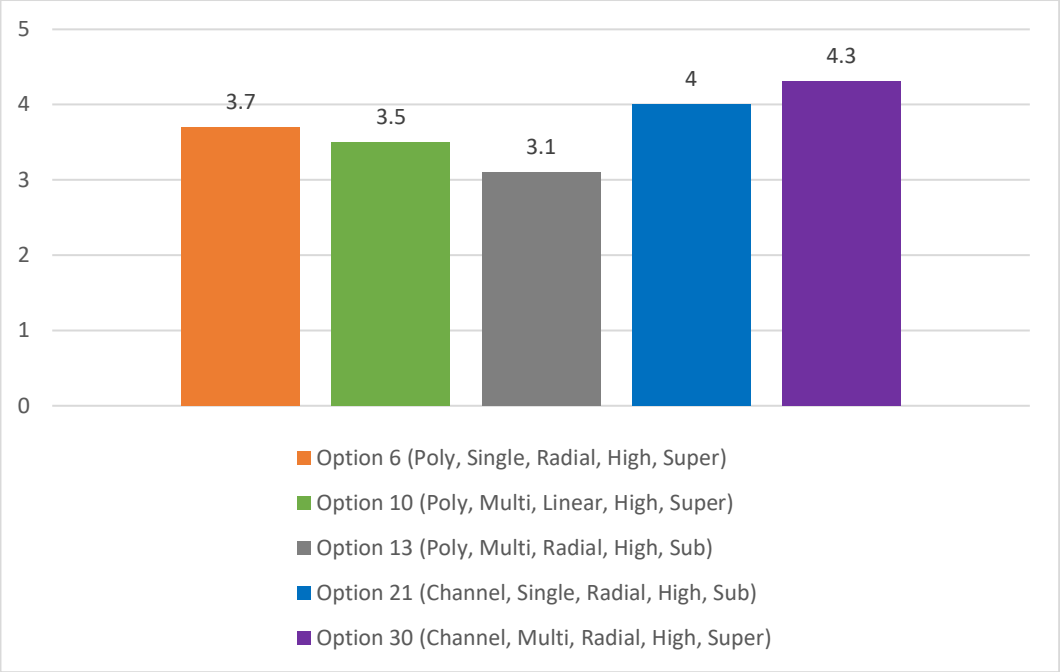

Figure 4.51 “Rugged” scores by Visual+Touch evaluation

Multi-Functional

Average score is 3.24 for "Multi-Functional" domain. The standard deviation is 0.152. In the tactile and visual experience, there is no surface texture feature that clearly distinguishes this brand value.

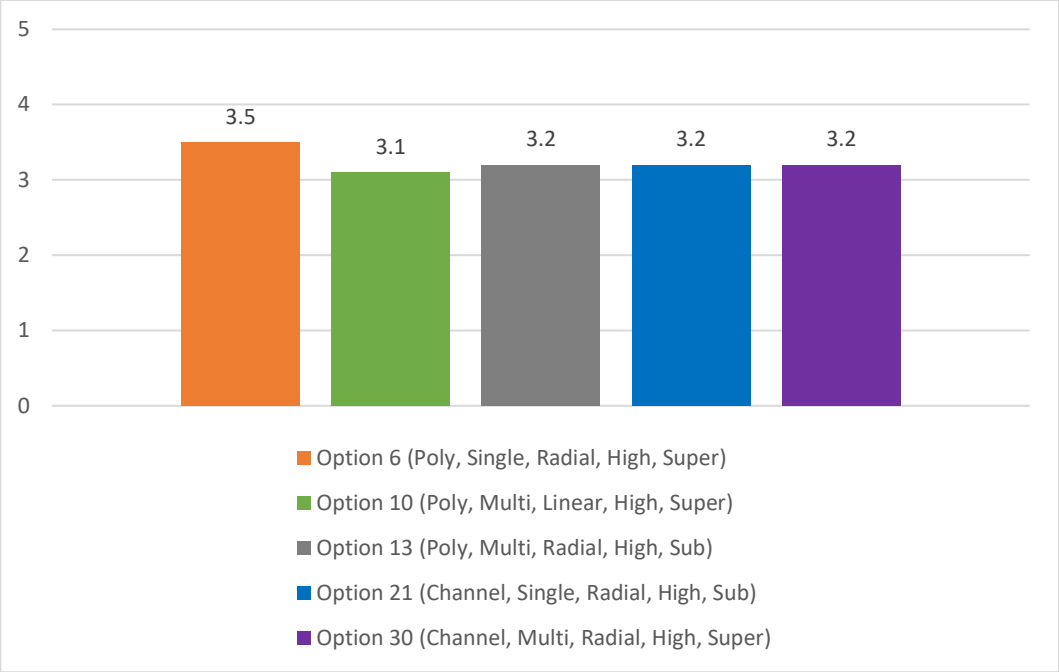

Figure 4.52 “Multi-Functional” scores by Visual+Touch evaluation

Indefectible

Average score is 3.38 for "Indefectible" domain. The standard deviation is 0.303. 3D surface textures with the super surface feature are more successful than the sub surface in creating the perception of this brand value.

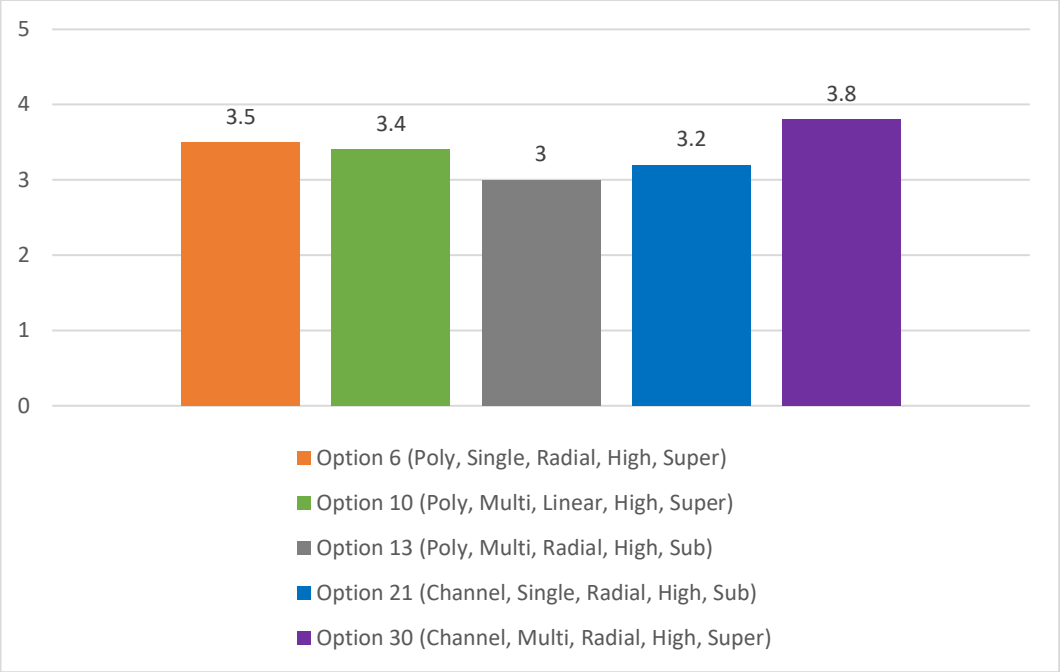

Figure 4.53 “Indefectible” scores by Visual+Touch evaluation

Long-Life

Average score is 3.54 for "Long-Life" domain. The standard deviation is 0.611. 3D surface textures with the super surface feature are more successful than the sub surface in creating the perception of "long-life" as a result of the tactile and visual experience.

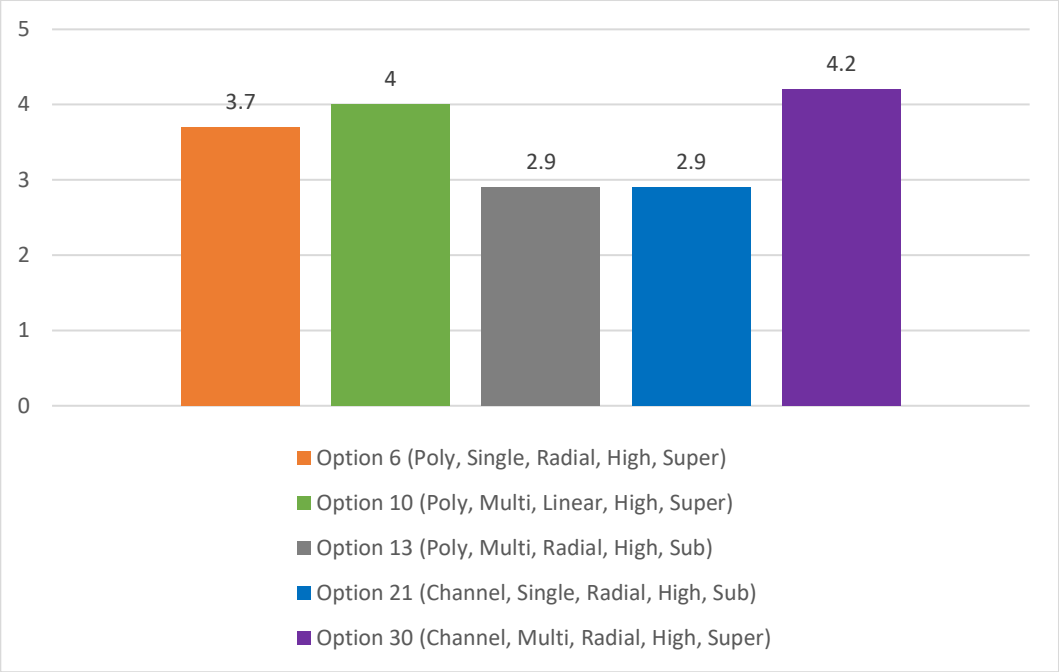

Figure 4.54 “Long-Life” scores by Visual+Touch evaluation

Innovative

Average score is 3.66 for "innovative" domain. The standard deviation is 0.152. In the tactile and visual experience, there is no surface texture feature that clearly distinguishes this brand value.

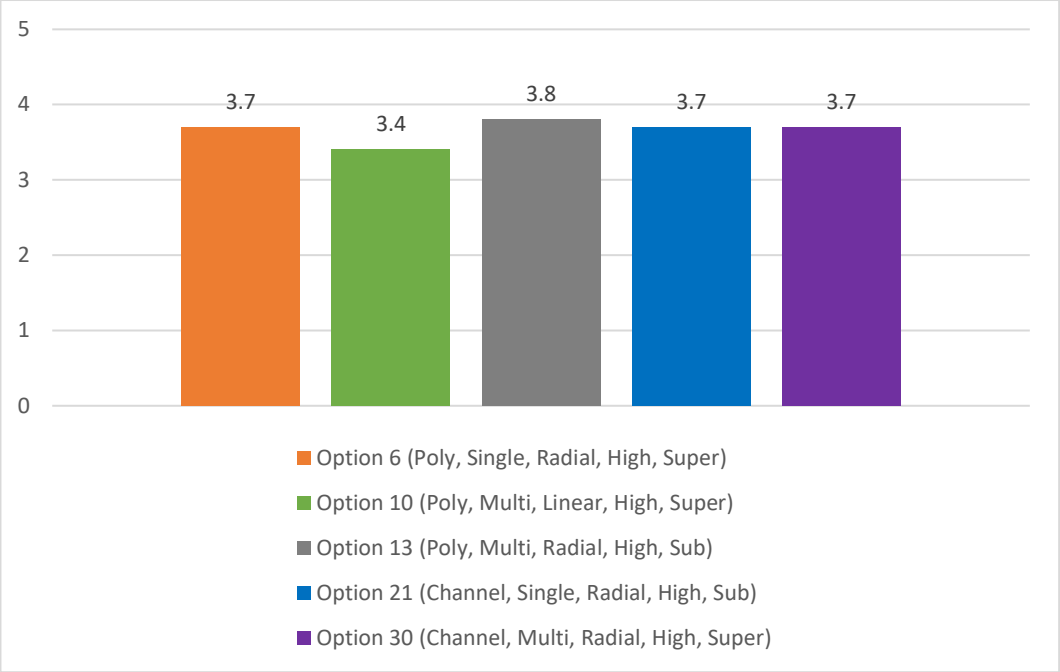

Figure 4.55 “Innovative” scores by Visual+Touch evaluation

Competitive

Average score for 5 samples is 3.38 for "Competitive" domain. Standard deviation is 0.192. 3D surface textures with the super surface feature are more successful than the sub surface in creating the perception of "competitive" as a result of touch and visual experience.

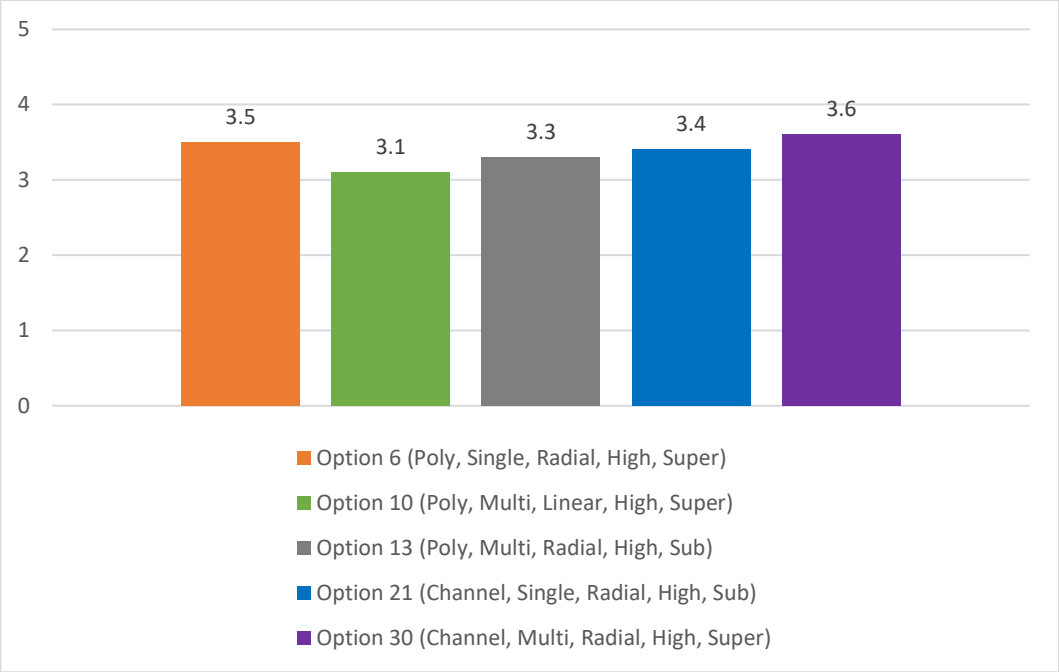

Figure 4.56 “Competitive” scores by Visual+Touch evaluation

Reliable

Average score is 3.68 for "Reliable" domain. Standard deviation is 0.455. 3D surface textures with super surface feature are more successful than the sub surface in creating the perception of "reliable" as a result of the tactile and visual experience. In addition, 3D surface textures with the variable size placement feature are more successful than the fixed size placement in creating the perception of "reliable".

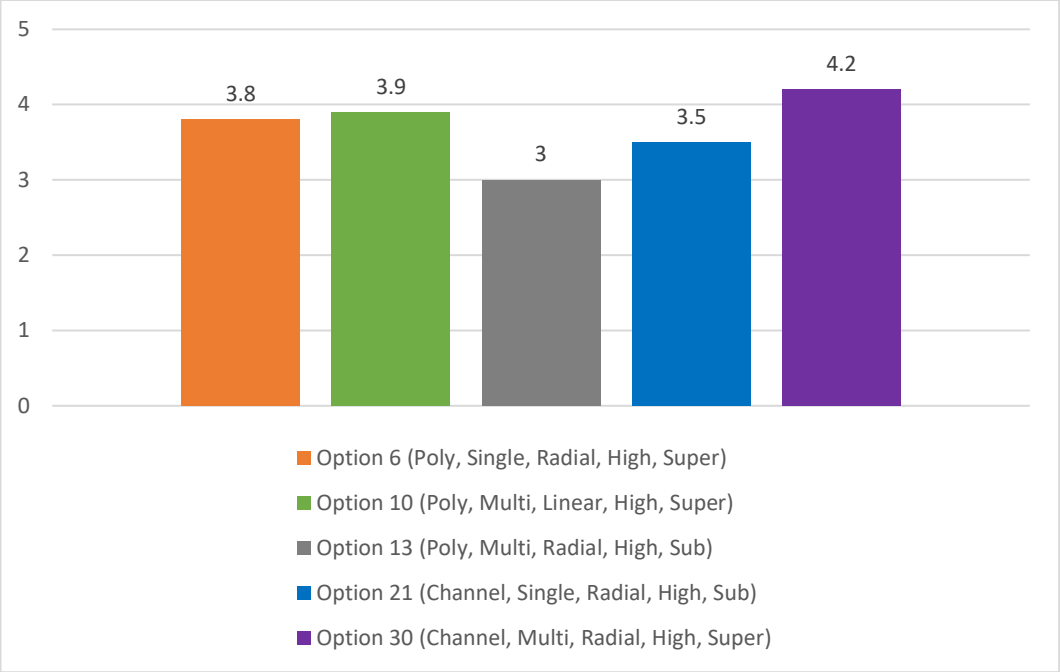

Figure 4.57 “Reliable” scores by Visual+Touch evaluation

Secure

Average score is 3.52 for "Secure" domain. The standard deviation is 0.277. From the data, it can be said that surface textures with the super surface feature are more successful than the sub surface in creating perception of "secure" as a result of the tactile and visual experience.

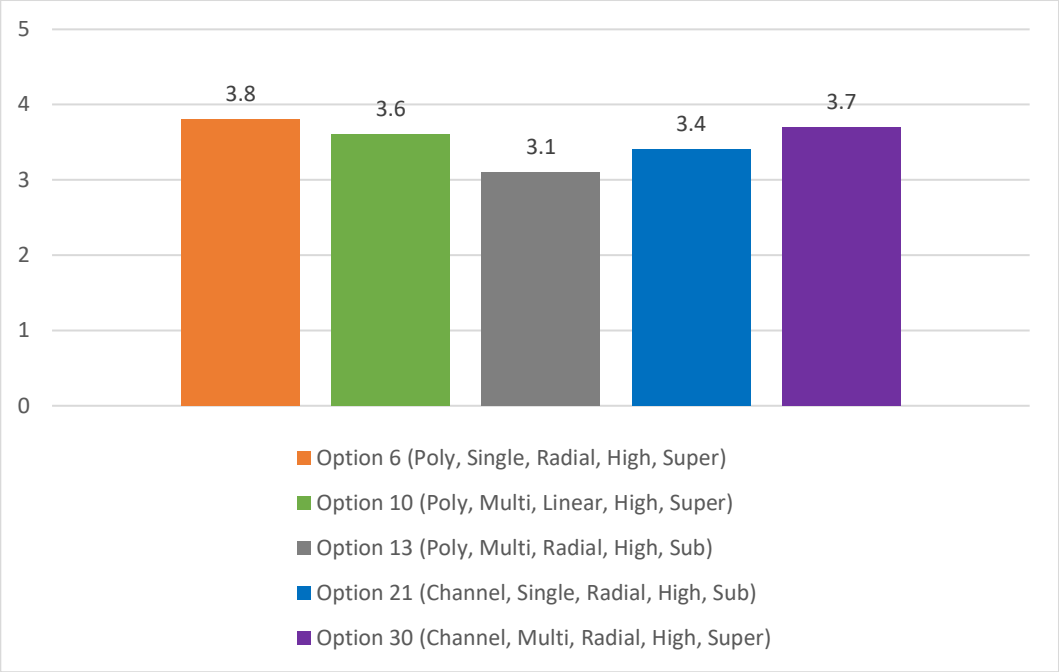

Figure 4.58 “Secure” scores by Visual+Touch evaluation

4.3 Analysis of the Data

In this section, the conclusions drawn from each study will be explained in detail. For this purpose, first of all, the evaluation of brand analysis, the visual experience in the digital environment, the tactile experience in the physical environment, and the results of combined visual and tactile experience will be analysed. Afterwards, only visual experience, only tactile experience and combined visual and tactile experience results will be compared.

4.3.1 Analysis of Brand Values

ANOVA analysis was performed with the help of SPSS program in order to make statistical comparisons between the samples. The results of one way analysis of variances for this purpose show that, since p-value<α, the difference between the averages of some groups is big enough to be statistically significant (α=0.05, p-value=0.00029). The test statistic F equals 4.007, is not in the 95% critical value

accepted range. The observed effect size f is 0.67, that indicates that the magnitude of the difference between the averages is large. In the post-hoc Tukey HSD / Tukey Kramer analysis performed later showed that the means of the following pairs are significantly different: “Rugged” - “Multi-Functional”, “Rugged” - “Innovative”, “Innovative” – “Reliable”, “Innovative” – “Secure”. Figure 4.59 shows the average scores for brand values. The three adjectives that most reflect the brand, stemming from the results of this study, are “rugged”, “reliable” and “secure”. The ones that reflect the brand at the lowest level due to the results of this study are “innovative” and “multi-functional”.

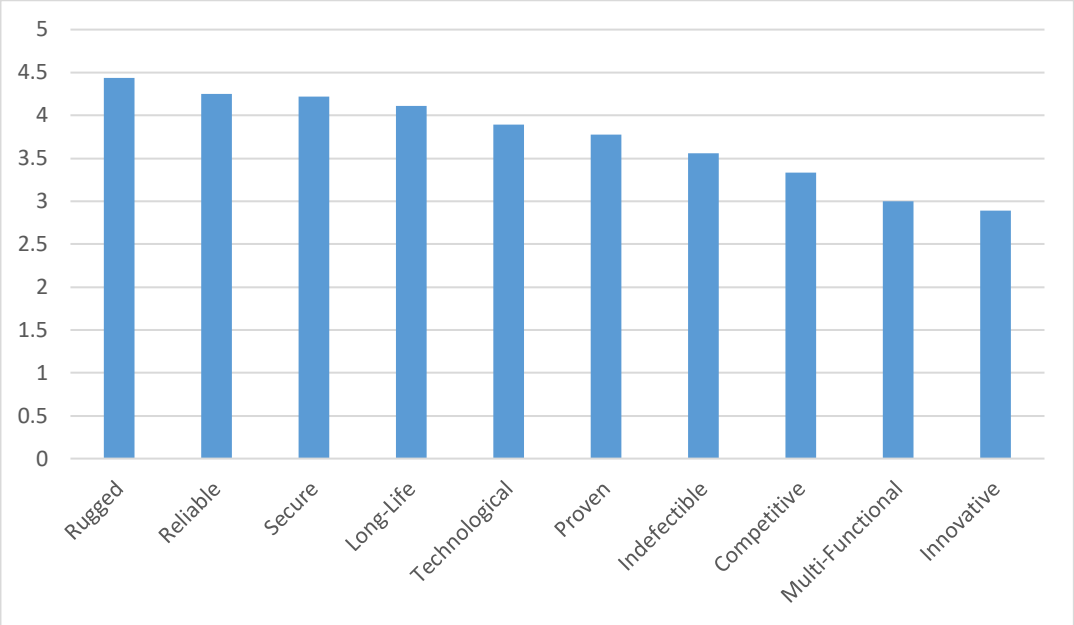

Figure 4.59 Average scores for brand values

4.3.2 Analysis of Study 1 (Visual-Only)

ANOVA analysis was performed with the help of SPSS program in order to make statistical comparisons between the samples. The results of one way analysis of variances for this purpose show that, since p-value<α, the difference between the averages of some groups is big enough to be statistically significant (α=0.05, p-value=1.42x10-9). The test statistic F equals 3.753, is not in the 95% critical value

accepted range. The observed effect size f is 0.64, that indicates that the magnitude of the difference between the averages is large. In the post-hoc Tukey HSD / Tukey Kramer analysis performed later showed that the means of the total of 25 pairs are significantly different. Table 4.10 shows the statistically different pairs and Figure 4.60 shows the average scores of study 1(visual only). As a result of the examination made here, Option 30 with channel form, multi size, radial placement, high density, super surface features (statistical difference with 9 different samples) and Option 10 with polygonal form, multi size, linear placement, high density super surface features (statistical difference with 5 different samples) stand out with their high scores. Option 7, which has polygonal form, single size, radial placement, low density, sub surface features, stands out with its low score (statistical difference with 12 different samples).

Table 4.10 Tukey HSD Analysis for study 1

Option	1	4	6	7	8	9	10	13	14	15	18	19	20	21	23	24	25	29	30	31	32
1																			x		
4							x												x		
6				x	x																
7			x			x	x	x	x		x			x	x	x	x		x	x	
8			x				x												x		
9				x																	
10		x		x	x								x								x
13				x																	
14				x																	
15																			x		
18				x																	
19																			x		
20							x												x		
21				x																	
23				x																	
24				x																	
25				x																	
29																			x		
30	x	x		x	x					x		x	x					x			x
31				x																	
32							x												x		

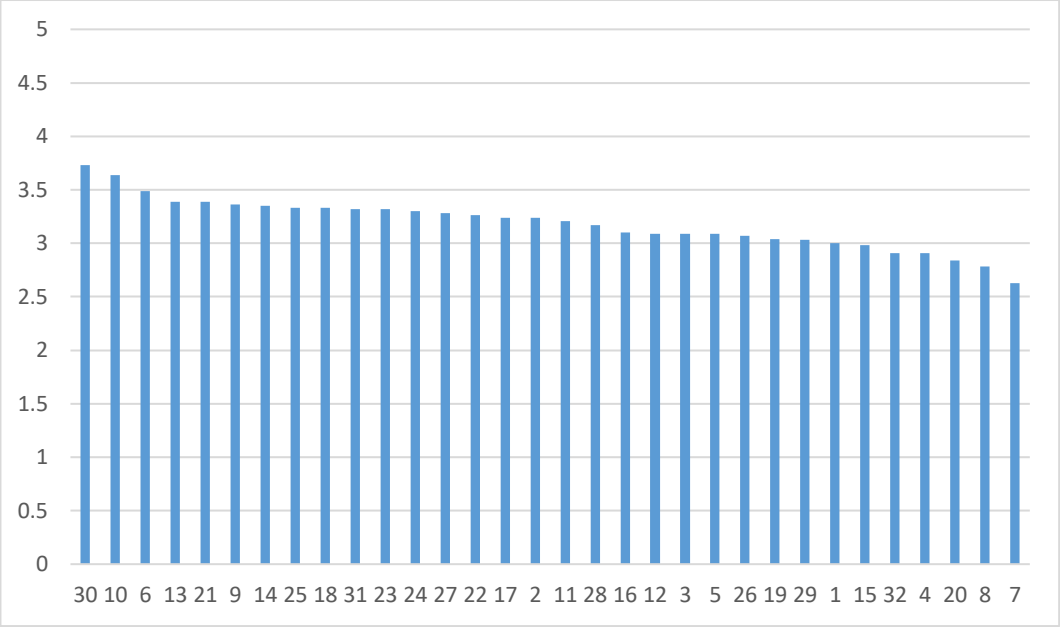

Figure 4.60 Average scores of study 1

4.3.3 Analysis of Study 2

For the touch-only evaluation, ANOVA analysis was performed with the help of SPSS program in order to make statistical comparisons between the samples for tactual evaluation. The results of one way analysis of variances for this purpose show that, since p-value>α, the difference between the averages of all groups is not big enough to be statistically significant. (α=0.05, p-value=0.77). The test statistic F equals 0.456, is in the 95% critical value accepted range. The observed effect size f is 0.20, that indicates that the magnitude of the difference between the averages is medium. In the post-hoc Tukey HSD / Tukey Kramer analysis performed later showed that there is no significant difference between the means of any pair. When tactile experience is evaluated alone, it is seen that there is no statistically significant difference between the five samples measured. However, when the relevant analysis is applied to visual + tactile experience evaluation, since p-value<α, the difference between the averages of some groups is big enough to be statistically significant (α=0.05, p-value=0.016). The test statistic F equals 3.411, is not in the 95% critical

value accepted range. The observed effect size f is 0.55, that indicates that the magnitude of the difference between the averages is large. In the post-hoc Tukey HSD / Tukey Kramer analysis performed later showed that the means of the following pairs are significantly different: Option30 – Option 13 and Option 30 – Option 21. The difference between Option 30, which has the highest score as a result of the combined visual and tactile experience, with the channel, multi-size, radial placement, high density, super surface features, and Option 13 with the polygonal form, multi-size, radial placement, high density, sub-surface features and Option 21 with the channel form, single-size, radial placement, high density, sub-surface features stands out. As a result of this analysis, it is revealed that the use of super surface textures instead of sub surface elements is more appropriate for this brand specific values.

4.3.4 Comparison of Study 1 and Study 2 Results

In this section, a comparison of scoring based on digital visual evaluation (study 1), touch-only experience (study 2a) and scoring based on both touch and visual experience (study 2b) will be made in detail within the scope of the first and second studies. Figure 4.61 shows the mean score comparison of study 1, study 2a and study 2b. In the examinations made on average scores, it was observed that while the score of 4 samples increased in tactile and visual experience (Sample No: 6, 10, 21, 30), only 1 sample (Sample No: 13) had a decrease. It was observed that while the participants scored lower in the assessment focusing only on the tactile experience, they scored higher in both visual and tactile experiences. Figure 4.62, Figure 4.63, Figure 4.64, Figure 4.65 and Figure 4.66 shows the score received by each brand value in brand analysis part and the visual (digital), touch-only, combined visual and touch experience scores for Option 6, Option 10, Option 13, Option 21 and Option 30, respectively.

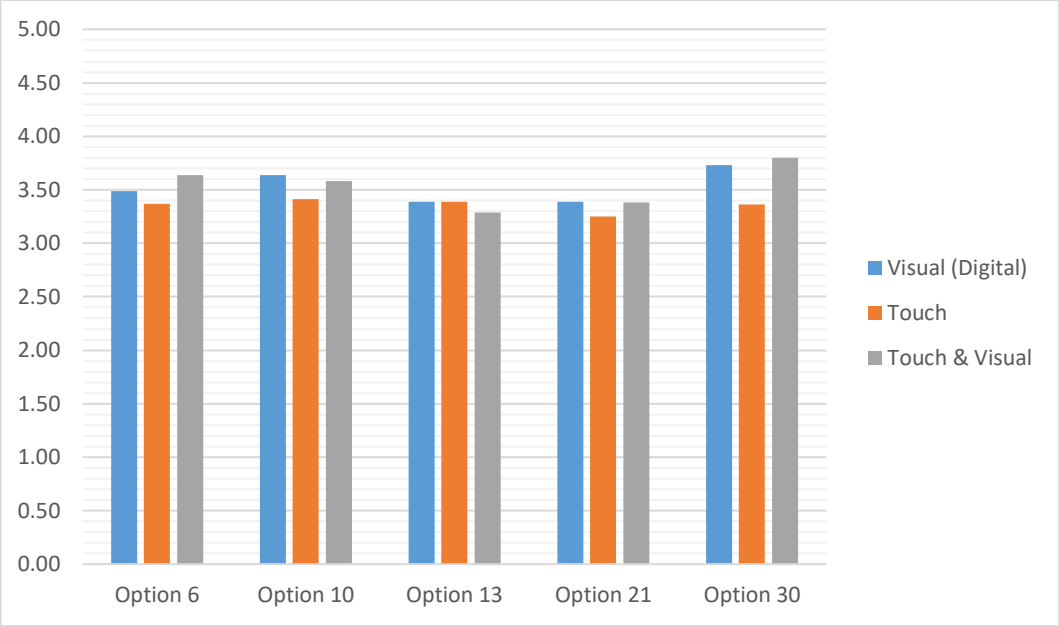

Figure 4.61 Average scores comparison of Study 1 and Study 2

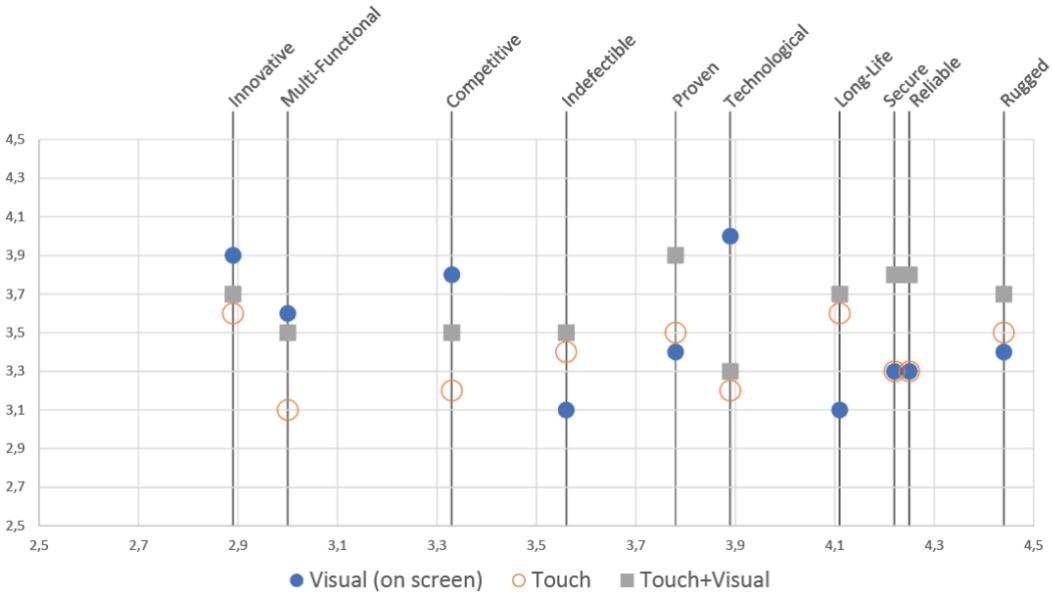

Figure 4.62 Option 6 (Poly, Single, Radial, High, Super) scores comparison

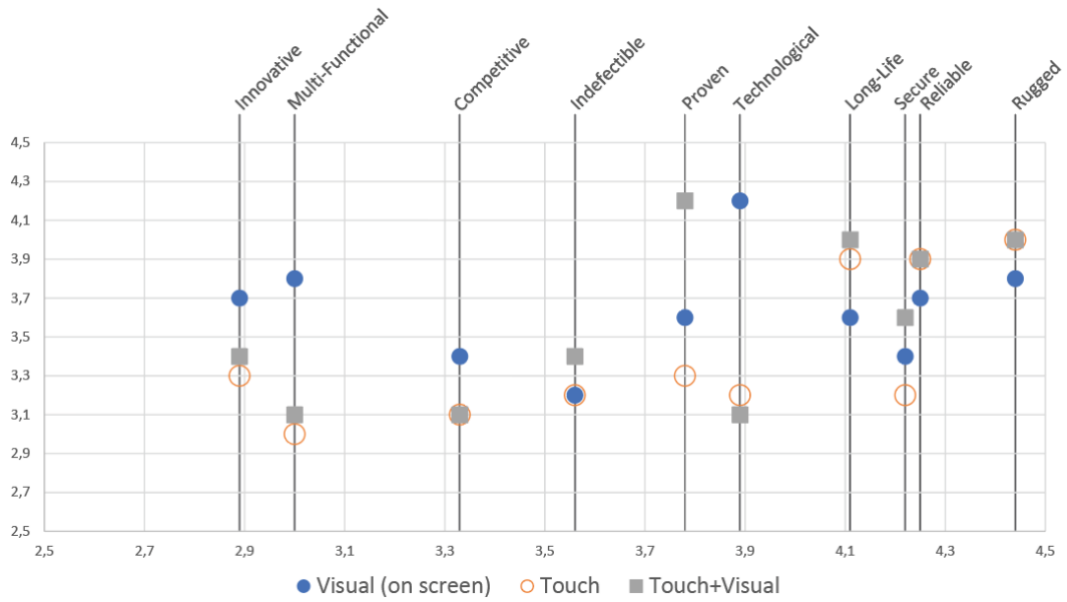

Figure 4.63 Option 10 (Poly, Multi, Linear, High, Super) scores comparison

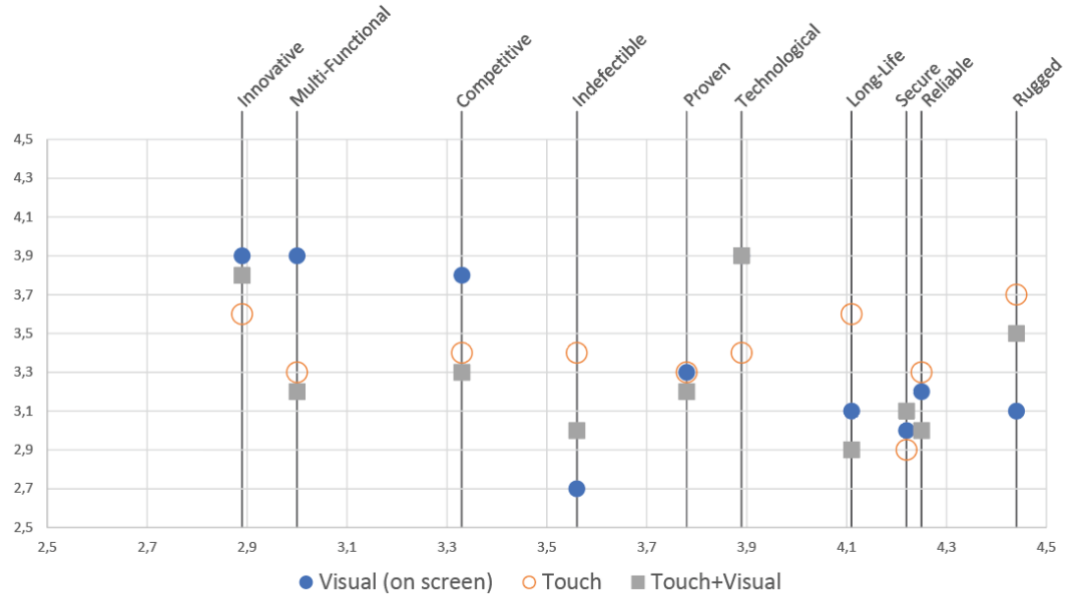

Figure 4.64 Option 13 (Poly, Multi, Radial, High, Sub) scores comparison

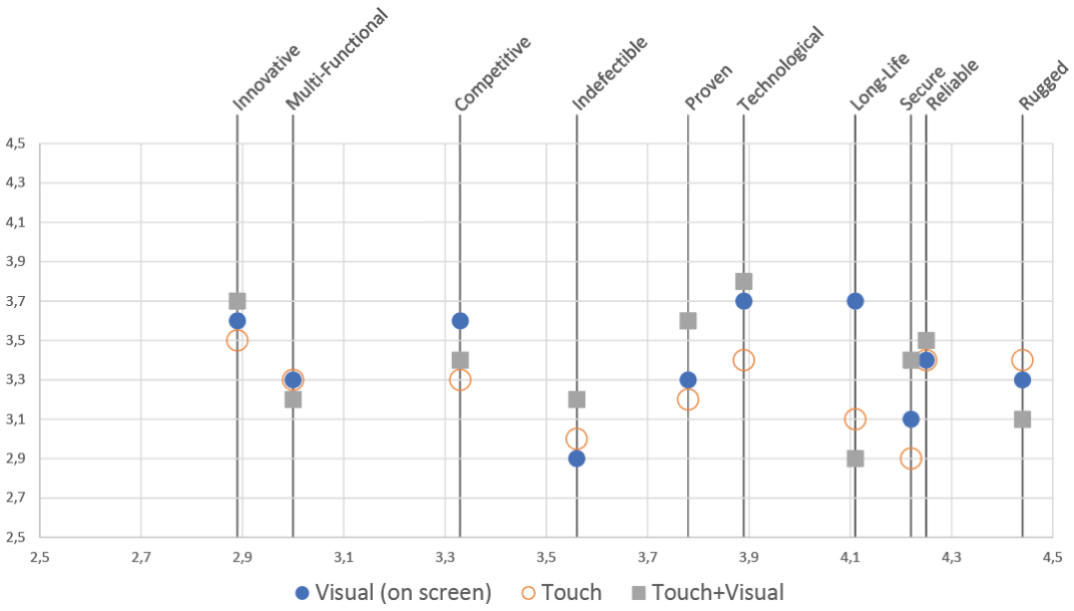

Figure 4.65 Option 21(Channel, Single, Radial, High, Sub) scores comparison

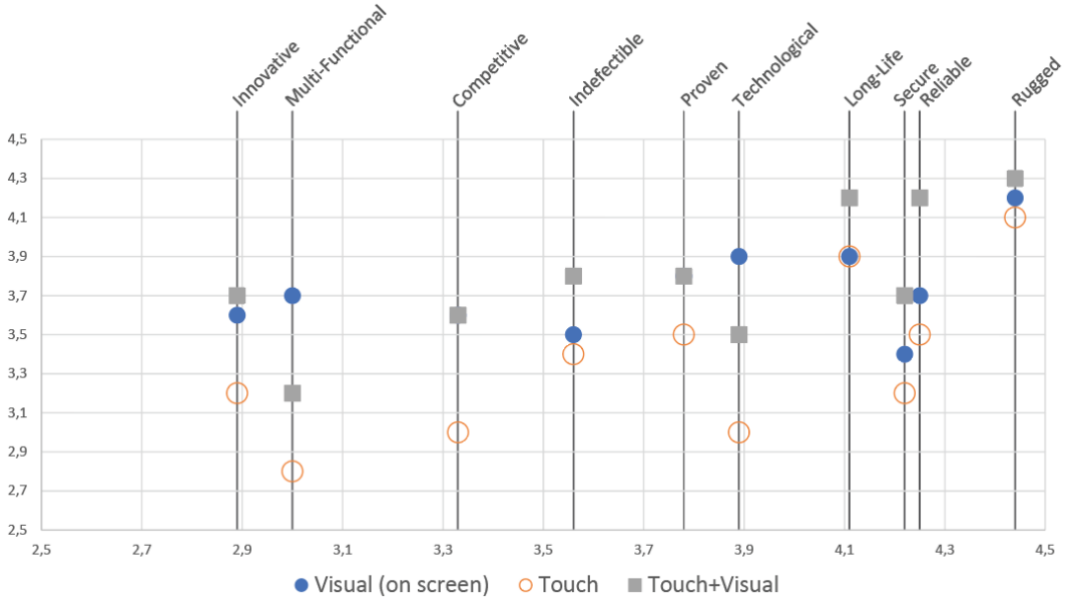

Figure 4.66 Option 30 (Channel, Multi, Radial, High, Super) scores comparison

Participants reported that they were often unable to distinguish clearly during the study focused on the tactile experience. Scores given in the study focusing on the touch experience were generally lower than the scores given in other studies. Paired t-tests (α=0.05) were performed on the visual (on screen), touch-only and combined visual and touch data to evaluate for significant differences. When the visual assessment performed in the digital environment and combined tactile and visual assessment performed physically are compared, there is no statistical difference in the five samples. When the tactile experience is compared with the visual experience performed in the digital environment, there is no statistical difference for the 6th, 10th and 13th options. However, there is not quite statistically significant difference for option 21(Channel, Single, Radial, High, Sub) and very significant difference for option 30 (Channel, Multi, Radial, High, Super). When this comparison is made with touch-only experience and combined tactile and visual experience, there is no statistical difference for the 13th and 21th options. However, there is not quite statistically significant difference for option 10 (Poly, Multi, Linear, High, Super), extremely significant difference for option 6 (Poly, Single, Radial, High, Super) and option 30 (Channel, Multi, Radial, High, Super).

Option 6	Visual Only	Touch+Visual	Touch Only	Touch +Visual	Visual Only	Touch Only
Mean	3.49	3.64	3.37	3.64	3.49	3.37
SD	0.32	0.18	0.18	0.18	0.32	0.18
t	1.07		5.01		0.91	
P	.31		.0007		.38	
Result	not statistically significant		extremely statistically significant		not statistically significant	

Figure 4.67 Summary of paired t-tests of Option 6 (Poly, Single, Radial, High, Super)

Option 10	Visual Only	Touch+Visual	Touch Only	Touch +Visual	Visual Only	Touch Only
Mean	3.64	3.58	3.41	3.58	3.64	3.41
SD	0.28	0.42	0.37	0.42	0.28	0.37
t	0.36		1.85		1.69	
P	.73		.09		.12	
Result	not statistically significant		not quite statistically significant		not statistically significant	

Figure 4.68 Summary of paired t-tests of Option 10 (Poly, Multi, Linear, High, Super)

Option 13	Visual Only	Touch+Visual	Touch Only	Touch +Visual	Visual Only	Touch Only
Mean	3.39	3.29	3.39	3.29	3.39	3.39
SD	0.45	0.34	0.22	0.34	0.45	0.22
t	0.95		0.93		0	
P	.37		.38		1	
Result	not statistically significant		not statistically significant		not statistically significant	

Figure 4.69 Summary of paired t-tests of Option 13 (Poly, Multi, Radial, High, Sub)

Option 21	Visual Only	Touch+Visual	Touch Only	Touch +Visual	Visual Only	Touch Only
Mean	3.39	3.38	3.25	3.38	3.39	3.25
SD	0.26	0.28	0.20	0.28	0.26	0.20
t	0.09		1.54		2.04	
P	.93		.15		.072	
Result	not statistically significant		not statistically significant		not quite statistically significant	

Figure 4.70 Summary of paired t-tests of Option 21 (Channel, Single, Radial, High, Sub)

Option 30	Visual Only	Touch+Visual	Touch Only	Touch +Visual	Visual Only	Touch Only
Mean	3.73	3.8	3.36	3.8	3.73	3.36
SD	0.23	0.35	0.41	0.35	0.23	0.41
t	0.70		9.24		3.58	
P	.50		<0.0001		.006	
Result	not statistically significant		extremely statistically significant		very statistically significant	

Figure 4.71 Summary of paired t-tests of Option 30 (Channel, Multi, Radial, High, Super)

CHAPTER 5

DISCUSSION AND CONCLUSIONS

This thesis aimed to design and evaluate 3D surface textures and determine their effect on brand image. At the beginning of the study, three research questions were posed. The first question about the brand image and texture relationship. The second question about the surface texture placement, and the third question about user's perception on different placements of textures. The following sections revisit the research questions, discuss the implications of the research, and suggest possible areas for further research.

5.1 Revisiting the Research Questions

The new knowledge obtained during the research process, which was carried out to answer the research questions that cannot be answered only with the findings of the literature review, is presented below.

5.1.1 How do 3D Surface Treatments Applied to Materials in Handheld Military Products Affect the Brand Image?

Personality traits used to describe a person are also used to describe brands. The factors that determine these personality traits should be carefully determined by the marketing and design departments (Krippendorf, 1989). Moreover, as Ashby & Johnson (2013) stated, the products of brands, which are one of the most important communication tools, also have personality, and these personalities are formed due to features such as the product's proportion, form, colour and surface textures. As seen in the literature, surface textures play an important role as an effective communication tool in the process of creating and perceiving the brand image.

Surface textures have an important place in influencing the brand image, not only as a visual communication tool, but also because they respond to both touch and visual experience.

In addition, as Şener & Pedgley (2021) stated, surface textures are very effective in the product's identity during the users' search for meaning. Surface textures play an active role in the identity creation processes of the product, as users interact with both touch and visual interaction. In this search for meaning by users, various features of surface textures and surface product placement algorithms are of great importance.

It has also been observed as a result of the two-stage studies carried out that, thanks to the 3D surface textures, brand values of different characteristics can be conveyed to the user. With the help of manipulated surface textures, the user can be communicated both visually and tactilely, and various perceptions reflecting brand values can be accessed. As a result of the evaluation specific to the brand identity of military product manufacturer Aselsan, the following texture features come to the fore when analysed in a holistic approach: high density positioning and placement of textures as protrusions on the surface (super surface). In this study, no statistical difference was observed in the form differences of surface textures, their use in different or fixed sizes, and their radial or linear placement on the surface.

5.1.2 How do Users Evaluate Various Types of Surface Textures?

The types of surface textures were evaluated according to the forms they have. As Şener & Pedgley (2021) stated, surface textures can be evaluated under four main headings as geometry, extruded polygons, 3 dimensional volumes, longitudinal volumes and irregular shapes. In this study, the main focus has been on two elements. The first of these are surface textures in polygonal structure and the second is surface textures in channel structure. During the research process, forms in polygonal structure were evaluated only as a square. Here, polygons such as triangle, pentagon,

and hexagon were not investigated one by one, but the square form was preferred in order to represent the polygon form.

In the study carried out, it has been shown that while different form structures have a positive effect on various brand images, they have a negative effect on some. According to results of the first study, which aims to evaluate surface textures only visually, textures with channel form are perceived as closer to "indefectible", "long-life", “competitive” and "reliable". Textures with polygonal form perceived as closer to "technological", “multi-functional” "innovative" and "secure". In visual only evaluation, when all brand images were evaluated on average, it was seen that the surface textures with the polygon-shaped form were perceived closer to brand values than those with the channel-shaped form, but there is no obvious statistical difference when the holistic view is taken. In the study, which focuses only on tactile experience and combined tactile and visual experience, no statistical difference is observed when a holistic analysis is performed on the form.

5.1.3 Which Combination of Texture Elements Best Communicates the Aselsan Brand Image?

When the layout algorithms of the surface textures are examined, it is evaluated that the forms are presented as fixed or variable, linear or radial layout, positioning at high or low density, and realized as protrusions or indentations on the surface.

Regarding the result of the study focused only on visual evaluation of texture for the Aselsan brand; when the surface textures are of fixed size perceived as closer to "indefectible" whereas when they are variable, "technological", "multi-functional", “long-life”, "innovative", "competitive", “reliable” and “secure” values come to the fore. When surface textures are placed linearly perceived as closer to "proven", "rugged", "multi-functional", "indefectible", "long-life", “reliable” and "secure", whereas when they are placed radially "technological", "innovative" and "competitive" values stand out. When surface textures are placed as protrusions on

the surface perceived as closer to “proven”, “rugged”, “multi-functional”, “indefectible”, “long-life”, “reliable” and secure whereas when placed as indentations from the surface, “innovative” and "competitive" values come to the fore. When the settlement densities of the surface textures are evaluated, high density elements are perceived as closer for all brand keywords. In this study, when all brand keywords were evaluated on average, it was seen that the surface textures with the radial placement, multi-size elements, protrusions on the surface and high density settlement were perceived closer to brand values but there is no obvious statistical difference when the holistic view is taken for different or fixed size elements and radial or linear placement of textures. Statistically distinctive features in this context are the use as protrusions on the surface (super surface) and the placement of high-density textures.

In the study 2, two variables were not evaluated because all of the five samples evaluated had high-density placement and four of them were radially placed (only one has linearly placement). Although no statistical difference was observed in the study focusing only on the tactile experience, the use as protrusions on the surface stands out in the perception of brand values in the study focusing on combined tactile and visual experience.

5.2 Further Research and Recommendations

After these evaluation studies, a new texturization guidance manual for surface textures can be prepared for Aselsan's new generation product designs by using most suitable topography data for the brand obtained as a result of this research.

Figure 5.1 shows the stages of "brand to branded texture" carried out in this research step by step. A preliminary study was carried out at the stage of reaching the brand identity keywords, which is the first stage of the research. If the brand has a previously created documentation for this purpose, it should be consulted. At the same time, direct semantic translation was not performed during the design of the

surface textures. The intended approach is to design surface textures in a wide framework and to reach the most suitable topography among them for brand values. In this study, it is assumed that all surface textures designed and researched meet the valid usability criteria (providing sufficient grip). However, when evaluating the surface textures, it would be appropriate to investigate this functionality, especially in hand-held products. In addition, in order to reduce the standard error level in future studies, it is recommended to study with more participants and to draw conclusions with a larger number of samples during the tactile evaluation in order to make the differences more obvious.

When the data obtained as a result of this research were examined holistically, no statistical difference was observed between the surface texture properties of the form criterion. However, high-density texture placement and the placement of textures as protrusions on the surface come to the fore. There is no obvious difference in the radial or linear placement on the surface and the presentation of the textures in fixed or variable sizes. In order to better observe the differences here, new studies can be carried out by increasing the number of participants. As a result of this research, when evaluated specifically for the company, the use of textures as protrusions instead of indentations on the surface and the choice of high-density texture placement instead of low-density placement can be preferred in harmony with the keywords that reflect the brand identity.

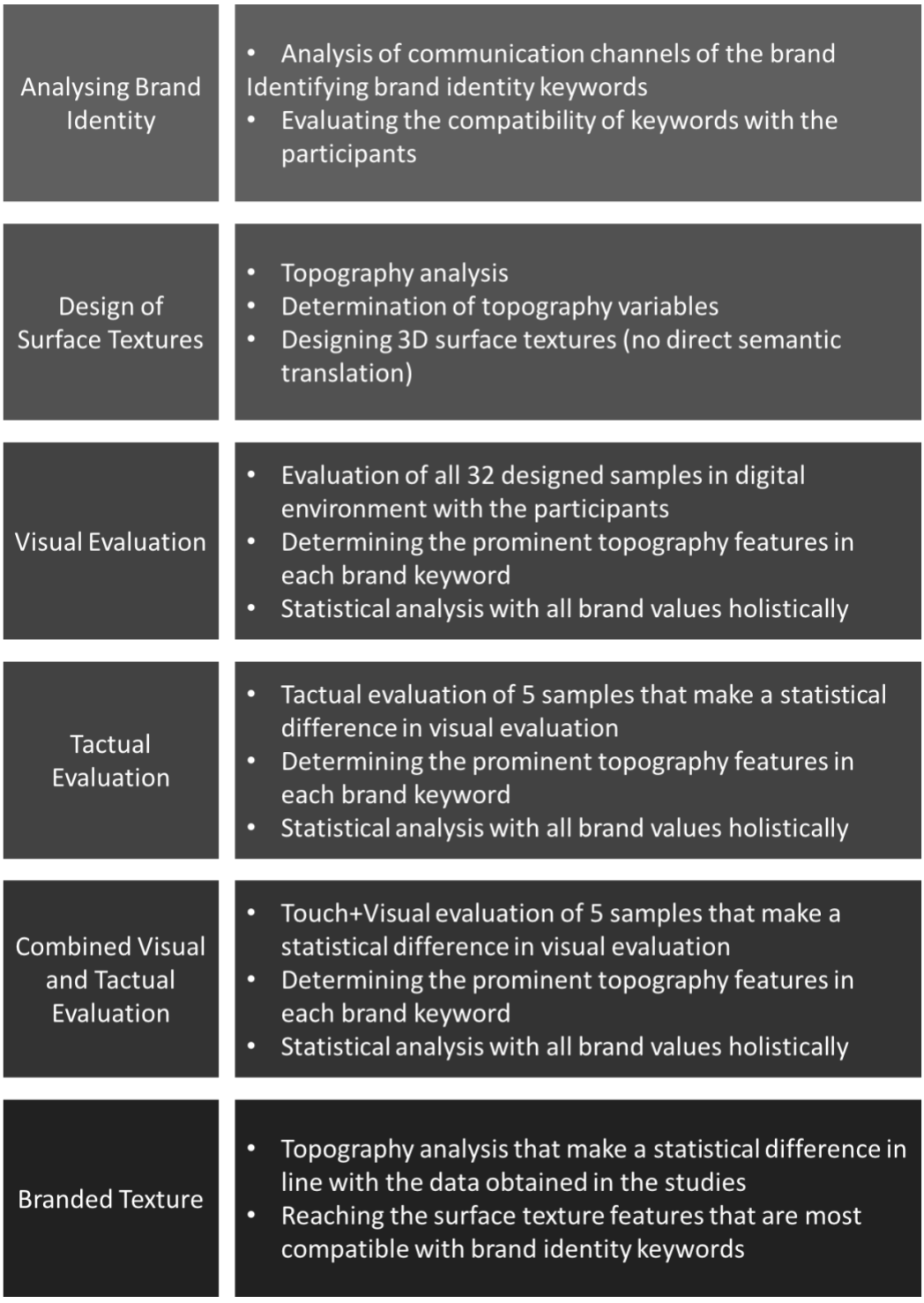

Figure 5.1 Brand to branded texture process

5.3 Limitations of the Study

Examination of the company's communication channels may not be the best solution at the stage of finding the keywords for brand identity. Alternatively, interviews could be conducted with senior staff responsible for brand identity. In addition, in the research carried out during the evaluation of the suitability of the keywords to the brand, small number of participants were involved (n=10). Consensus was not achieved in the translation of the phrases obtained in this study, and the translation was made directly using an English-Turkish dictionary. In order to avoid confusion, all the phrases in the studies are presented in both Turkish and English.

As a result of designing the surface textures, the grip effectiveness of the textures was assumed to be acceptable; there was no measurement of grip effectiveness made. In a repetitive study, the functional properties of the surface textures can be questioned along with the compliance with the brand identity.

The most important limiting factor is that the study was conducted during the COVID-19 pandemic period. For this reason, the study is divided into various sections, and tactile experience is examined in the secondary plan. For this purpose, the research was carried out with 20 participants in the online visual evaluation process. In the second study, evaluation was made with 10 participants. Small numbers of participants involved in each evaluation ($n<30$), so less confidence that statistical differences are meaningful. In addition, in the relevant studies, the reliability of participants' Likert scoring with regard to inconsistent or unusual scoring patterns, either individually or relative to other participants, was not checked.

Since the second study was conducted face-to-face and the participants did not want to have contact in a closed area for a long time, the study was planned to not exceed 20 minutes. If the pandemic conditions had not occurred, it was planned to evaluate all 32 samples both tactually and visually with 30 participants. In this way, arrangement and bipolar scaling-density features, which are two surface texture features that need to be eliminated, could also be evaluated. Considering the health

of the participants and the researcher in the pandemic conditions, the study was first carried out in the online environment. In the second study, the participants were reluctant to participate in the study because it was conducted face-to-face and in a closed environment. In addition, combined tactile and visual evaluation of all samples will provide more holistic results.

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APPENDICES

A. POSITIVE AND NEGATIVE AFFECT SCALE (PANAS)

Positive and Negative Affect Scale Presented to the Participants

P:

This scale consist of a number of words that describe different feelings and emotions. Read each item and mark the area you find appropriate. Indicate to what you extent you feel this way right now.

Interested				
Very unsuitable	Suitable	Neutral	Suitable	Very suitable
Distressed				
Very unsuitable	Suitable	Neutral	Suitable	Very suitable
Excited				
Very unsuitable	Suitable	Neutral	Suitable	Very suitable
Strong				
Very unsuitable	Suitable	Neutral	Suitable	Very suitable
Guilty				
Very unsuitable	Suitable	Neutral	Suitable	Very suitable
Scared				
Very unsuitable	Suitable	Neutral	Suitable	Very suitable
Hostile				
Very unsuitable	Suitable	Neutral	Suitable	Very suitable
Enthusiastic				
Very unsuitable	Suitable	Neutral	Suitable	Very suitable
Proud				
Very unsuitable	Suitable	Neutral	Suitable	Very suitable
Irritable				
Very unsuitable	Suitable	Neutral	Suitable	Very suitable
Alert				
Very unsuitable	Suitable	Neutral	Suitable	Very suitable
Ashamed				
Very unsuitable	Suitable	Neutral	Suitable	Very suitable
Inspired				
Very unsuitable	Suitable	Neutral	Suitable	Very suitable
Nervous				
Very unsuitable	Suitable	Neutral	Suitable	Very suitable

B. POSITIVE AND NEGATIVE AFFECT SCALE (Turkish)

Positive and Negative Affect Scale Presented to the Participants

P:

Bu ölçek farklı his ve duyguları içeren bir takım kelimeler içermektedir. Her maddeyi okuyun ve aşağıdaki ölçekteki uygun bulduğunuz altına bir işaretleme gerçekleştirin. Şu anda ne kadar bu şekilde hissettiğinizi belirtin.

İlgili (Interested)				
Hiç uygun değil	Uygun Değil	Nötr	Uygun	Kesinlikle Uygun
Sıkıntılı (Distressed)				
Hiç uygun değil	Uygun Değil	Nötr	Uygun	Kesinlikle Uygun
Heyecanlı (Excited)				
Hiç uygun değil	Uygun Değil	Nötr	Uygun	Kesinlikle Uygun
Güçlü (Strong)				
Hiç uygun değil	Uygun Değil	Nötr	Uygun	Kesinlikle Uygun
Suçlu (Guilty)				
Hiç uygun değil	Uygun Değil	Nötr	Uygun	Kesinlikle Uygun
Korkmuş (Scared)				
Hiç uygun değil	Uygun Değil	Nötr	Uygun	Kesinlikle Uygun
Karşıt (Hostile)				
Hiç uygun değil	Uygun Değil	Nötr	Uygun	Kesinlikle Uygun
Hevesli (Enthusiastic)				
Hiç uygun değil	Uygun Değil	Nötr	Uygun	Kesinlikle Uygun
Gururlu (Proud)				
Hiç uygun değil	Uygun Değil	Nötr	Uygun	Kesinlikle Uygun
Sinirli (Irritable)				
Hiç uygun değil	Uygun Değil	Nötr	Uygun	Kesinlikle Uygun
Atik (Alert)				
Hiç uygun değil	Uygun Değil	Nötr	Uygun	Kesinlikle Uygun
Mahçup (Ashamed)				
Hiç uygun değil	Uygun Değil	Nötr	Uygun	Kesinlikle Uygun
İlhamlı (Inspired)				
Hiç uygun değil	Uygun Değil	Nötr	Uygun	Kesinlikle Uygun
Gergin (Nervous)				
Hiç uygun değil	Uygun Değil	Nötr	Uygun	Kesinlikle Uygun

C. ANALYSIS OF SURFACE TEXTURES

Sample NO: P:

This scale consist of a number of words that describe Aselsan brand identity. Read each item and mark the area you find suitable for the perception it evokes for the relevant surface texture in the scale blow.

Proven				
Very unsuitable	Suitable	Neutral	Suitable	Very suitable
Technological				
Very unsuitable	Suitable	Neutral	Suitable	Very suitable
Rugged				
Very unsuitable	Suitable	Neutral	Suitable	Very suitable
Multi-Functional				
Very unsuitable	Suitable	Neutral	Suitable	Very suitable
Indefectible				
Very unsuitable	Suitable	Neutral	Suitable	Very suitable
Long-Life				
Very unsuitable	Suitable	Neutral	Suitable	Very suitable
Innovative				
Very unsuitable	Suitable	Neutral	Suitable	Very suitable
Competitive				
Very unsuitable	Suitable	Neutral	Suitable	Very suitable
Reliable				
Very unsuitable	Suitable	Neutral	Suitable	Very suitable
Secure				
Very unsuitable	Suitable	Neutral	Suitable	Very suitable

D. ANALYSIS OF SURFACE TEXTURES (Turkish)

Örnek Nu: K:

Bu ölçek Aselsan marka imajını yansıtan bir takım kelimeler içermektedir. Her maddeyi okuyun ve aşağıdaki ölçekte ilgili yüzey dokusu için sizde uyandırdığı algıya uygun bulduğunuz alanın altına bir işaretleme gerçekleştirin.

Güven Veren (Proven)				
Hiç uygun değil	Uygun Değil	Nötr	Uygun	Kesinlikle Uygun
Teknolojik (Technological)				
Hiç uygun değil	Uygun Değil	Nötr	Uygun	Kesinlikle Uygun
Dayanıklı (Rugged)				
Hiç uygun değil	Uygun Değil	Nötr	Uygun	Kesinlikle Uygun
Çok Fonksiyonlu (Multi-Functional)				
Hiç uygun değil	Uygun Değil	Nötr	Uygun	Kesinlikle Uygun
Sorunsuz (Indefectible)				
Hiç uygun değil	Uygun Değil	Nötr	Uygun	Kesinlikle Uygun
Uzun Ömürlü (Long-Life)				
Hiç uygun değil	Uygun Değil	Nötr	Uygun	Kesinlikle Uygun
Yaratıcı (Innovative)				
Hiç uygun değil	Uygun Değil	Nötr	Uygun	Kesinlikle Uygun
Rekabetçi (Competitive)				
Hiç uygun değil	Uygun Değil	Nötr	Uygun	Kesinlikle Uygun
Güvenilir (Reliable)				
Hiç uygun değil	Uygun Değil	Nötr	Uygun	Kesinlikle Uygun
Kuşkusuz (Secure)				
Hiç uygun değil	Uygun Değil	Nötr	Uygun	Kesinlikle Uygun

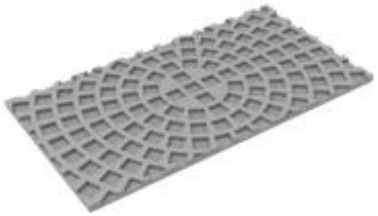
E. 3D SURFACE TEXTURE SAMPLES

Sample 1

Sample 2

Sample 3

Sample 4



Sample 5

Sample 6

Sample 7

Sample 8

3D Surface Textures Continued

Sample 9

Sample 10

Sample 11

Sample 12

Sample 13

Sample 14

Sample 15

Sample 16

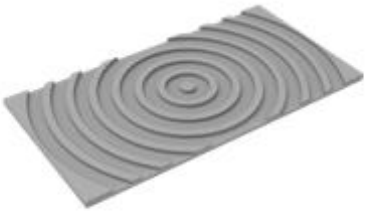
3D Surface Textures Continued

Sample 17

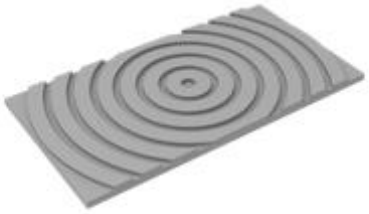
Sample 18

Sample 19

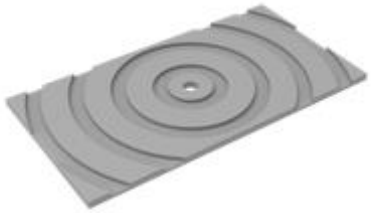
Sample 20



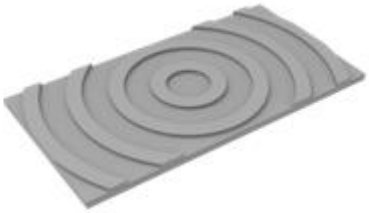
Sample 21



Sample 22



Sample 23



Sample 24

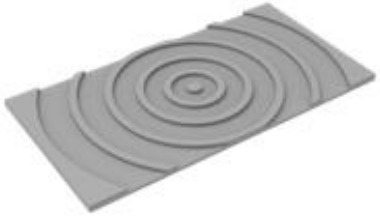
3D Surface Textures Continued

Sample 25

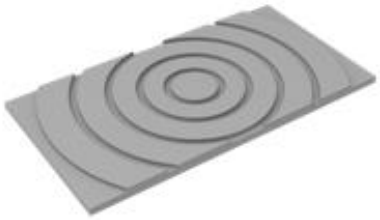
Sample 26

Sample 27

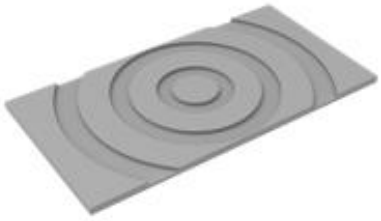
Sample 28



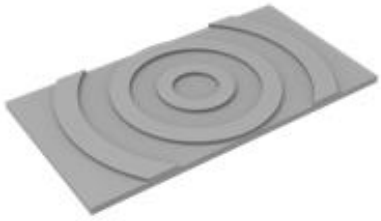
Sample 29



Sample 30



Sample 31

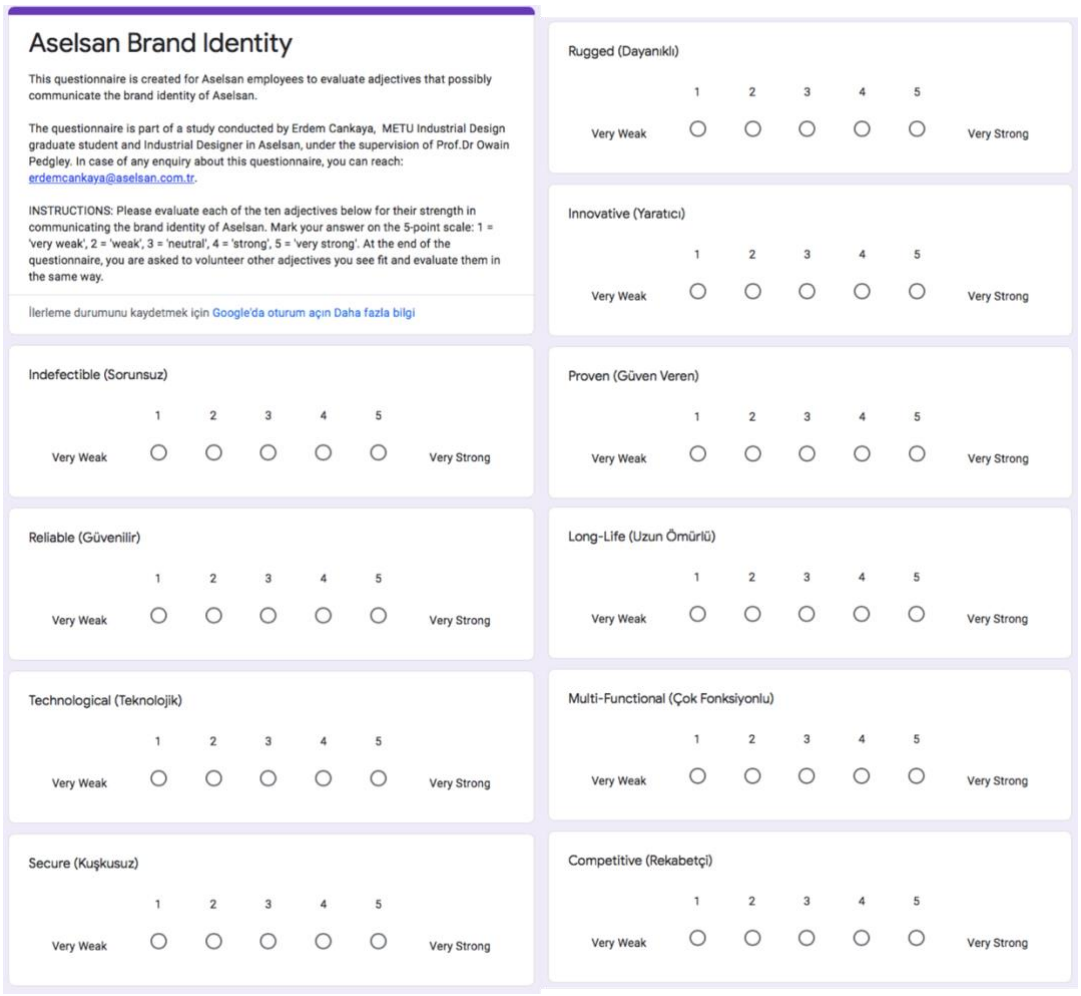


Sample 32

F. RANDOM DISTRIBUTION ALGORITHM

```
clc
clear all
close all

sampleSize = 32;
personCount = 20;
samplePerperson = 16;
sampleLimit = samplePerPerson*personCount/sampleSize;

sampleArray = zeros(2,sampleSize);
personArray = zeros(personCount,samplePerPerson);

for i=1:sampleSize
sampleArray(1,i) = i;
end

for k=1:personCount
    j = 1;
while(j<samplePerPerson+1)
    check = 1;
    randomNumber = randi (sampleSize);

    while(check)
        if (sampleArray(2,randomNumber)<sampleLimit && sampleArray(2,randomNumber) == min(sampleArray(2,:)))
        else
            randomNumber = randi (sampleSize)
        end
end
end
```

G. BRAND KEYWORD ANALYSIS



Aselsan Brand Identity

This questionnaire is created for Aselsan employees to evaluate adjectives that possibly communicate the brand identity of Aselsan.

The questionnaire is part of a study conducted by Erdem Cankaya, METU Industrial Design graduate student and Industrial Designer in Aselsan, under the supervision of Prof.Dr Owain Pedgley. In case of any enquiry about this questionnaire, you can reach: erdemcankaya@aselsan.com.tr.

INSTRUCTIONS: Please evaluate each of the ten adjectives below for their strength in communicating the brand identity of Aselsan. Mark your answer on the 5-point scale: 1 = 'very weak', 2 = 'weak', 3 = 'neutral', 4 = 'strong', 5 = 'very strong'. At the end of the questionnaire, you are asked to volunteer other adjectives you see fit and evaluate them in the same way.

İlerleme durumunu kaydetmek için Google'da oturum açın Daha fazla bilgi

Indefectible (Sorunsuz)

	1	2	3	4	5	
Very Weak	○	○	○	○	○	Very Strong

Reliable (Güvenilir)

	1	2	3	4	5	
Very Weak	○	○	○	○	○	Very Strong

Technological (Teknolojik)

	1	2	3	4	5	
Very Weak	○	○	○	○	○	Very Strong

Secure (Kuşkusuz)

	1	2	3	4	5	
Very Weak	○	○	○	○	○	Very Strong

Rugged (Dayanıklı)

	1	2	3	4	5	
Very Weak	○	○	○	○	○	Very Strong

Innovative (Yaratıcı)

	1	2	3	4	5	
Very Weak	○	○	○	○	○	Very Strong

Proven (Güven Veren)

	1	2	3	4	5	
Very Weak	○	○	○	○	○	Very Strong

Long-Life (Uzun Ömürlü)

	1	2	3	4	5	
Very Weak	○	○	○	○	○	Very Strong

Multi-Functional (Çok Fonksiyonlu)

	1	2	3	4	5	
Very Weak	○	○	○	○	○	Very Strong

Competitive (Rekabetçi)

	1	2	3	4	5	
Very Weak	○	○	○	○	○	Very Strong