The Impact of New technology and Sitting Posture on Seating Design

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THE IMPACT OF NEW TECHNOLOGY AND SITTING POSTURE ON FURNITURE DESIGN

By

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Date
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Abstract

This thesis focused on a chair which was designed to accommodate various postures assumed by people using smartphone and tablet technology. The overall seating design was the result of ergonomic research and anthropometric studies. This chair would be used in hotel lobbies.

(Key words: postures, sitting, smartphone, seating design)
CHAPTER 1

Introduction

Tablets and smartphones, are key players in the fast-growing world of mobile computers and are becoming increasingly popular in the market. Ericsson forecasts “smartphone subscriptions worldwide will be 1.1 billion by the end of 2012 growing to 3.3 billion in 2018, with 257 million smartphones and 126 million tablets in the US alone.” (“Ericsson Mobility Report”, 2013). Smartphones, in place of feature phones, have taken over the cellular phone market. With the increasing use of mobile advanced computing technology, people can do almost everything that they can do on their computers no matter where they go. As a result of this growth in new technology, it affects the way people sit. A global posture study conducted by office furniture maker Steelcase across eleven countries, observing two thousand people in a wide range of environments, has shown that “the use of new technology affects people’s new body position” (Hasse, 2013).

The smartphones and tablets are widely used in public spaces today. Although a great deal of research has been conducted by scholars on sitting postures and its connection to modern seating design, but few have incorporated the study on smartphones and tablets. How today’s technology will impact people’s posture has not yet been adequately determined by scholars and researchers. Thus, conducting this research has become a necessity.
Purpose of the Study

To achieve the goal, I will use observation as a tool to view people’s shifting posture patterns in hotel environments. The findings will be analyzed ergonomically to seek what features a hotel arm chair should have. Through my design process, different design concepts will be explored to better support sitting posture while using mobile technology.

The evolution of my hotel arm chair throughout the complete design process is documented in this thesis, including conceptual and design development phases, scale models, prototyping and completed construction.

As a result of this research, a new armchair facilitating tablets and smartphones use will be created largely for use in hotel environments. Hotel guests are using this mobile technology to reach out for social connection and infinite information. This research is essential because the seating design for hotel lobbies today does not factor in the use of smartphones and tablets. The seating chair design needs improvements to accommodate sitting postures while using smartphones and tablets.

Assumption

In my literature review, certain reasons were documented that effect furniture design. This included people’s daily posture, ergonomics and users’ habits. By conducting this research and designing the project, the following questions will be addressed: Will the new chair design support the sitting posture caused by smartphones
and tablets? And how will the posture change? Investigations will be helpful to determine factors that change the furniture design. Some researchers and scholars have conducted research and experiments that impact chair design. This thesis will not address the issues of chair construction techniques.

**Research Components**

Chapter 2 presents a literature review which covers the historical background of modern chair design and addresses the issues of changing posture in hotel lobby spaces. The study includes each of our body parts and its support while having the freedom of mobility. Further, the study contains the recent research on ergonomics in seating design which leads to the answers on how chair design will be able to address the issue of changing posture when people are using tablets and smartphone technology. Chapter 3 will indicate my unobtrusive observation on seating postures and the application of shifting table will be analyzed. In order to define a set of requirements and for ergonomic chair design, four previous cases in chair design will be studied in ergonomic and anthropometric background. Chapter 5 will specify the application of the findings to design.
CHAPTER 2

Literature Review

Historic Perspective

The history of seating design can be traced back to 3000 BC (Pynt & Higgs, 2010, p. 15). Ancient Egyptian furniture embodied both functionality and artistry. The seating was a symbol that represented the fortune and social status in the past. Compared to Ancient Egyptians, Ancient Chinese furniture was not the symbol of the social status until the Tang Dynasty. Besides the status and functionality, chairs also represent the rites and customs in ancient times.

Chair design is changing throughout history. Accordingly, standpoints on different aspects of the driving forces which lead to chair design are varying from time to time. Studies conducted by researchers on human’s posture contribute to chair design. In Cranz ’s book *The Chair: Rethinking Culture. Body, and Design* quoted in his article “The Alexander Technique in the world of design: posture and the common chair”. It is stated, “it is evident to understand that the evolution of furniture, its constructive details and concepts by means of study of postures and man’s aspirations in compliance with values, cultural standards, customs and the analysis of social and economic standards.” (Cranz, Part I: the chair as health hazard, 2000).

Throughout the history of modern architecture, furniture has served the most concise representation of an architect’s principles. In contemporary society, sitting is a big part of people’s lives, and it remains an invaluable daily necessity. The influence of
poor seating design can lead to many problems, such as dysfunction, pain and disability (Pynt & Higgs, 2010).

Ergonomics research has become extremely important in understanding the interactions between humans and other elements of a system like chairs. This assists people in comprehending the human scale and how a chair can support the human body. This helps designers comprehend the users’ body dimensions and sitting behavior in order to design their furniture on a more comfortable scale. Different seating designs bring about different user experiences.

**Human Body Parts in Relation to Seating Design**

Different parts of the human body are playing different roles in terms of seating design. Each part of the body has its favorite positions. From a functional perspective, the purpose of chair design is to accommodate each body part and offer the freedom of mobility.

**Headrest**

The head of the human body is one of the factors that designers should always take into consideration when they design the chair. When people are seated, the head is perfectly comfortable once it is balanced on top of a naturally curved, upright spinal column. In *Rethinking Seating*, Opsvik states, “…if we have chosen to adopt a posture where upper body is leaning strongly one way or another, it is not so natural or easy to
balance our head.” (Opsvik, 2009, p. 54) It is very difficult to use a device to support their heads while people are moving their upper bodies forward when seated. Besides the backrest and seating pad, the headrest will be another support to the body.

Whether the seating has headrest or not is largely dependent on the purpose of the chair. In a school classroom environment, the chairs are designed for students to sit and do the school work. Because school wants students to think and concentrate on the class, the head does not need support. In hotel lobby environments, for example, chair users are normally laid-back and feel relaxed. Therefore, either a headrest or a high back seating would be preferred for the hotel guests.

**Backrest**

Historically, high-back chairs were used in ancient times to indicate power and status. Today, high-back rest in office spaces are not efficient ways to support posture changes. Opsvik points out two major reasons for this: first, when sitting sideways in the chair, it is impossible to put your shoulders and arms anywhere. Second, we cannot get support for our neck and lower back at the same time (Opsvik, 2009). The only way to support for one’s neck is to move forward when sitting in a traditional high back chair. The Aeron ergonomic chair (See Figure 1) accommodates both the sitter and the environment. It adapts naturally and virtually to every part of our body. Searingen found that the addition of a backrest inclined 15 degree from vertical will reduce body weight on the sitting area by 4.4 percent. (Zacharkow, 1988, p. 259)
Having said that, high back chairs give users a sense of security and privacy in public spaces today. If people are not working, they tend to move only slightly and sit statically. People often protect their personal spaces in public areas by choosing high-back chairs.

The seating comfort is largely dependent on the seating cushion materials, as well as on ergonomic and anthropometric considerations. Therefore, a back cushion, such as a softer foam cushion, is essential to improve the comfort and pressure distribution of the backrest (Zacharkow, 1988). Having a high back seat and back cushion will not only protect personal space but also offer the seating comfort in public spaces.

**Armrests**

Elbows and forearms are the vulnerable areas of our bodies, some ergonomic office chairs have armrests that can be adjustable. This reduces the contact stress on elbows and minimize the injuries (Haworth, 2014). According to Pheasant, a minimum of 4 inches vertical armrest adjustment should be the North America standards (See Figure 2) (Pheasant, 1986).
Armrests offer very efficient ways to reduce muscle stress from the upper back, neck and shoulders. According to Pheasant, the seating armrests must support approximately 10.2% of our body weight, which can result in considerable exertion in muscles of these areas. (Pheasant, 1986, pp. 129-134)

When users are seated, their arms need both support and freedom. There are three main reasons for the purpose of having arm support, they are:

1. By supporting the arms and hands, armrests ease the load placed on the back.
2. Armrests provide more strength in the arms and ease the work that is to be done.
3. Arm supports reduce muscle strains.

When users are seated, they instinctively find places to rest their arms. If there is no place to rest their hands, they rest them on their laps. This natural instinct reduces work efficiency. Armrest offer more task. Significantly, a chair armrest is the natural place they find to have support. A forward inclination in upper armrest design or excessive concavity to upper backrest will result in too much stress in the posterior neck.
and upper back muscle. This will push the shoulders and upper trunk forward. (Zacharkow, 1988, p. 182).

Many people suffer from the body pain when they are seated. A gap between the back rest and armrest will allow the shoulders to have freedom of movement. Therefore, when the backrest is tilted, the neck can still rest at the same time. It also allows users to sit sideways and rest their arms.

**Hip**

One of the most important factors that influence the sitting posture is the mobility of the hips. When hip mobility is decreased, it will be impossible to achieve an upright sitting posture (Zacharkow, 1988, p. 64). According to Hertzberg, “A correct contoured surface, particularly one that is properly cushioned, will permit people to sit longer without discomfort than any flat seat. The contoured surface spreads the loads to the seating tissues and reduces the sitting pressure.” (Zacharkow, 1988, p. 102)

On one hand, insufficient seat depth leads to sitting fatigue. On the other hand, excessive forces the user to slide forward to avoid pressure on the back. In this position, it is not possible to obtain support from the backrest for the lumbar region of the back.

The general seating pad dimension is varying from 16 inches to 20 inches. According to Lueder in his book, *Hard Facts about Soft Machines*, he mentioned when there is a cushion, the seat 5–8 degrees from front to back slope will alleviate the discomfort. This also helps keep the occupant from sliding forward (Lueder & Noro, 1994).
Legs

The reason we sit on chairs is to allow our legs to move freely below our posteriors (Opsvik, 2009).

Easy chairs and sofas are typically lower than other forms of seating. We can place our feet at higher level to feel comfortable. When we rest our upper bodies in a reclined position, we prefer to have our feet raised. Conversely, when we are active, leaning our upper bodies over a table, we want our feet low (Opsvik, 2009).

The height of the chair directly leads to sitting comfort. The dimension of the chair height is decided by what activities we engage in and what types of environment we are in. Normal seat height is approximately 17.7 inches when used at a standard 28”-30” table. This will make individuals sit upright. If there is no table in front of them, they may feel the seat is too high to relax. Then, they will pull their legs under the seat (Zacharkow, 1988). Otherwise, when users lean back into a well-reclined position, their natural inclination is to stretch their legs in front of the chair.

Different height and varying body weight are key factors effecting suitable chair-size choice. On one hand, if the seating height is too low, there will be a lack of pressure distribution over the upper posterior thighs. Consequently, all the pressure will be accumulated in posterior to ischial tuberosities. On the other hand, providing the seat is too high for average individuals, they will move their posterior forward to avoid the pressure from their thigh. And they will end up in a slumped posture (Zacharkow, 1988).
Sitting Postures and Body Movements

Sitting is dynamic, as opposed to a static activity. (Zacharkow, 1988) According to Branton, the sitting body is “not merely an inert bag of bones, dumped for time in the seat, but a live organism in a dynamic state of continuous activity.” (Branton, The Comfort of Easy Chairs, 1966) People change postures for different activities. Cahir designs should allow the sitting postures we use.

As previously mentioned, sitting is one of the most diverse postures among human beings. Today, the sitting position is the most frequent body posture in industrialized countries. When we stay in public spaces, we sit and wait. When we work in the office, we sit in front of our desktops and work. In Grandjean & Hünting’s article, they stated sitting position is “characteristic of modern times” (Grandjean & Hünting, 1977, pp. 135-140).

Furniture designed for sitting allows people the opportunity to enjoy and experience a variety of postures while they are working or resting. Compared to standing and other body positions, when sitting, all the pressure of the body goes to the pad of the chair and surrounding areas. Well-designed sitting furniture and settings have been popular and has helped facilitate people’s daily lives.

Chair Loads

Chair load affects chair design. It impacts how the chair supports multiple people and their activities. When people are active, each part of the body is an individual
compartment. When the body parts all come together and are controlled by different joints, they create diverse dynamic or static postures. According to Paoliello stated in his *Chair Loads during Daily Activities*, he concludes “when a person sits, the body weight will be transferred to an area supported by the ischial tuberosities and their surrounding soft materials” (Paoliello, Vladimiro, & Carrasco, 2008). According to their experiment, seventy-five percent of the body weight is supported by four square inches of the sitting area. A heavy load is distributed to a small area. Sometimes this will lead to sitting fatigue and discomfort. Panero and Zelnik’s experiment on the chair loads will contribute to the data for furniture design.

Panero and Zelnik in 1979 observed people’s posture during a variety of daily activities. They created a list of tasks with different sorts of postures and tested the load distributions on chairs. Postures were put together into five test routines based on their similarities and each posture after tests and the load was analyzed. This experiment has been well indicated the data of load that should be supported in each of the chair components. (See Figure 3) This has shown the variation of the sitting forces distributed in different seating components. (Paoliello, Vladimiro, & Carrasco, 2008)

![Figure 3 Final load values during sitting activities of daily living at chair feet, backrest, armrest, and seat rails](image-url)
We know from the experiment that the seating pad should be the space that sustain most of the seating force. Then, it will be the seating legs, seating arms and seating back. This shows us how the volume of each seating components should be designed.

Chair dimensions crossed with ergonomic considerations impact sitting comfort. Every effort should be made to factor in the demands of task and workplace constraints. Seating design should contribute to and promote postural change. In this study the postures under consideration are those assumed by people using smartphones and tablets.
CHAPTER 3

Methodology and Procedures

This chapter presents the qualitative research data that was collected to identify postural shifting when using smartphones and tablets. In order to identify the design concept, five hotel lobbies were used to collect data. Statistics were recorded included posture length, whether the occupants used tablets or smartphones, seating types and assumption about the activities they were doing. Body movement was the focus of the research. These findings were factored into the chair that was designed after this research.

Based on the literature review, sitting posture, ergonomic data, and sitting behavior affect seating design. I used this shifting posture data to analyze and explore the patterns that people are using when they are using the tablets and smartphone technology. By conducting unobtrusive observations, two questions will be asked: First, what are the aspects in furniture design that do not support the series of sitting postures? Second, what are the body movement tendencies when people are seated? In the observation, different body movements were recorded in detail. Typical hotel lobby furniture was documented to see what features need to be modified to accommodate tablets and smartphone technology.
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*Note.* This sketches was assure sitting postures while using smartphones/tablets. The sketches above is not in chronological order.
Observation Tables:

Table 2

*Recording of the human subjects posture in Ritz Carlton, Atlanta, GA*

Date: September 18<sup>th</sup>, 2013 & September 19<sup>th</sup>, 2013

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<th>Time</th>
<th>Whether Use tablet/smartphone</th>
<th>Assumption on what they are doing</th>
<th>Furniture type</th>
<th>Others record</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Female</td>
<td>17</td>
<td>3 min</td>
<td>8:03 pm</td>
<td>Smartphone</td>
<td>Texting/Chatting online/Kill the time</td>
<td>Chair</td>
<td>The Chair arm supports her elbow. The chair has enough depth to cross her feet on it.</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
<td>3 min</td>
<td></td>
<td>8:06 pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
<td>2 min</td>
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<td>8:09 pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>18</td>
<td></td>
<td>6 min</td>
<td></td>
<td>8:11 pm</td>
<td></td>
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</tr>
<tr>
<td>20</td>
<td></td>
<td>1 min</td>
<td></td>
<td>8:17 PM</td>
<td></td>
<td></td>
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<tr>
<td>17</td>
<td></td>
<td>5 sec</td>
<td></td>
<td>8:18 pm</td>
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<td>8:18 pm</td>
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<td></td>
</tr>
<tr>
<td>2</td>
<td>Female</td>
<td>4</td>
<td>5 min</td>
<td>8:35 pm</td>
<td>Smartphone</td>
<td>Texting/Chatting online/Kill the time</td>
<td>Seating Stool</td>
<td>She crosses her legs to put her cellphone.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>40 sec</td>
<td></td>
<td>8:40 pm</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Female</td>
<td>6</td>
<td>1 min</td>
<td>9:18 pm</td>
<td>Smartphone</td>
<td>Kill the time, wait her group members</td>
<td>Lounge sofa</td>
<td>She slightly lean on her left to the sofa pillow.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Male</td>
<td>21</td>
<td>5 min</td>
<td>4:53 pm</td>
<td>Smartphone</td>
<td>Kill the time, wait for someone</td>
<td>Lounge sofa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td>2 min</td>
<td></td>
<td>4:58 pm</td>
<td></td>
<td>Kill the time, wait for someone</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Male</td>
<td>5</td>
<td>1 min</td>
<td>8:08 pm</td>
<td>Smartphone</td>
<td>Looking something on the phone</td>
<td>Bar Stool</td>
<td>Sitting in the Bar talking and playing the cellphone</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td></td>
<td>1 min</td>
<td>8:09 pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td></td>
<td>3 min</td>
<td>8:10 pm</td>
<td>No</td>
<td></td>
<td>Talking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
<td>30 sec</td>
<td>8:13 pm</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td></td>
<td>30 sec</td>
<td>8:13 pm</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
<td>8 min</td>
<td>8:14 pm</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td></td>
<td>2 min</td>
<td>8:22 pm</td>
<td>Smartphone</td>
<td>Playing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Female</td>
<td>13</td>
<td>40 sec</td>
<td>8:34 pm</td>
<td>Smartphone</td>
<td>Talking on the phone</td>
<td>Sofa</td>
<td>Chair</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>1 min</td>
<td>8:35 pm</td>
<td></td>
<td>Texting/playing cellphone</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td>3 min</td>
<td>8:36 pm</td>
<td></td>
<td>Texting/playing cellphone</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Male</td>
<td>16</td>
<td>2 min</td>
<td>8:56 pm</td>
<td>Smartphone</td>
<td>Texting/playing cellphone</td>
<td>Sofa</td>
<td>Chair</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>1 min</td>
<td>8:58 pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>5 min</td>
<td>8:59 pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Table 2 Continued. The number above is in chronological order.
### Table 3

*Recording of the human subjects posture in Ritz Carlton, Atlanta, GA*

*Date: September 20th, 2013*

<table>
<thead>
<tr>
<th>Sample number</th>
<th>Gender</th>
<th>Posture illustration</th>
<th>Posture duration</th>
<th>Time</th>
<th>Whether Use tablets/smartphone</th>
<th>Assumption on what they are doing</th>
<th>Furniture type</th>
<th>Others record</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Female</td>
<td>14</td>
<td>1 min</td>
<td>6:36 PM</td>
<td>Smartphone</td>
<td>Texting/Chatting online/Kill the time</td>
<td>Chair</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>13</td>
<td>3 min</td>
<td>6:37 PM</td>
<td></td>
<td>Calling on the phone</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25</td>
<td>6 min</td>
<td>6:40 PM</td>
<td></td>
<td>Texting/Chatting online/Kill the time</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>15</td>
<td>5 min</td>
<td>6:46 PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>14</td>
<td>5 min</td>
<td>6:51 PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Female</td>
<td>9</td>
<td>30 sec</td>
<td>6:54 PM</td>
<td>Smartphone</td>
<td>Texting/Chatting online/Kill the time</td>
<td>Seating stool</td>
<td>She crosses her legs to put her cellphone.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>26</td>
<td>4 sec</td>
<td>6:54 PM</td>
<td>No</td>
<td>Drinking</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>14</td>
<td>3 min</td>
<td>6:55 PM</td>
<td>Smartphone</td>
<td>Texting/Chatting online/Kill the time</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>26</td>
<td>3 sec</td>
<td>6:58 PM</td>
<td>No</td>
<td>Drinking</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6:58 pm stood up and left</td>
</tr>
<tr>
<td>3</td>
<td>Male</td>
<td>16</td>
<td>1 min</td>
<td>7:05 pm</td>
<td>Smartphone</td>
<td>Kill the time, wait her group members</td>
<td>Lounge sofa</td>
<td>She slightly lean on her left to the sofa pillow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14</td>
<td>40 sec</td>
<td>7:06 pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>13</td>
<td>5 sec</td>
<td>7:06 pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Female</td>
<td>28</td>
<td>1 min</td>
<td>7:15 pm</td>
<td>Smartphone</td>
<td>Texting</td>
<td>Lounge chair</td>
<td>She is texting, taking at the same time. Occasionally drinking</td>
</tr>
<tr>
<td></td>
<td></td>
<td>26</td>
<td>6 sec</td>
<td>7:16 pm</td>
<td>No</td>
<td>Drinking</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>9</td>
<td>30 sec</td>
<td>7:16 pm</td>
<td>Smartphone</td>
<td>Chatting</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>1 min</td>
<td>7:17 pm</td>
<td>Texting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>35 sec</td>
<td>7:18 pm</td>
<td>Texting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>2 min</td>
<td>7:19 pm</td>
<td>No</td>
<td>Chatting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>3 min</td>
<td>7:21 pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Female</td>
<td>30</td>
<td>4 min</td>
<td>7:28 pm</td>
<td>Tablets</td>
<td>Looking something on the tablets</td>
<td>Lounge chair</td>
<td>Sitting in the Bar talking and playing the cellphone</td>
</tr>
<tr>
<td>26</td>
<td>5 sec</td>
<td>8:09 pm</td>
<td>Smartphone</td>
<td>Looking cellphone</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>3 min</td>
<td>8:10 pm</td>
<td>Tablets</td>
<td>Looking something on the tablets</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8:13 pm Start to eat</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Male</td>
<td>1</td>
<td>4 min</td>
<td>8:38 pm</td>
<td>Smartphone</td>
<td>Talking on the phone</td>
<td>Sofa</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>5 sec</td>
<td>8:42 pm</td>
<td>Texting/playing cellphone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standing and walking away for 1 min, came back and sat in the same seating</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>2 min</td>
<td>8:43 pm</td>
<td>Smartphone</td>
<td>Waiting someone</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Male</td>
<td>31</td>
<td>2 min</td>
<td>8:55 pm</td>
<td>Smartphone</td>
<td>Texting/playing cellphone</td>
<td>Sofa Chair</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>1 min</td>
<td>8:57 pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>3 min</td>
<td>8:58 pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 sec talking to someone, looking up</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>3 min</td>
<td>9:52 pm</td>
<td>Smartphone</td>
<td>Texting/playing cellphone</td>
<td>Sofa Chair</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Table 3 Continued. The number above is in chronological order.

The two tables above are two samples of five tables which illustrate 35 different human subjects who have been observed in five different hotel lobby environments.

Posture illustration, time duration and furniture type have been recorded as a table text.
form. The purpose of this form is to get the common features of people’s body movement when they are using tablets and smartphones in hotel public spaces.

In this table after observation, I found out that the maximum duration of a series of postures did not exceed 30 minutes. The longest duration time of a single posture was about 6 minutes. Also, these tables above help us to continue our research about human continuous postures in more visualized way in the following procedure.

**Visualized Human Posture Shifting in Hotel Lobbies**

The table below shows the continuous shifting postures people assure while using smartphones/tablets. Each human subject was originally recorded in text form and converted in a series of visualized posture sketches that I summarized in Table 1. The hotel seating furniture was photographed to be analyzed after Table 4.

Table 4

<table>
<thead>
<tr>
<th>Sketches</th>
<th>Furniture Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject 1:</td>
<td>![Image]</td>
</tr>
<tr>
<td>Subject 2:</td>
<td>![Image]</td>
</tr>
</tbody>
</table>

*Note.* Table 4 Continued. The horizontal posture sketches above is in chronological order.
Note. Table 4 Continued. The horizontal posture sketches above is in chronological order.
Observation Analysis and Findings

After conducting the observation, I identified several phenomenon in the observation: First, people preferred sitting alone rather than sitting together. If the individual stayed alone, he chose to sit in a single lounge chair rather than long sofa. If there are no other choices, they will sit on a sofa. Even then they chose to sit on two ends of the sofa. Individuals are inclined to protect their personal space and privacy. Second, when using smartphones and tablets; people are more inclined to shift their body position left, center and right. In the hotel public spaces under observation, lounge chairs and sofas appeared to support the sitting postures comfortably, but not while people used tablets and smartphones. There is no support for elbows while people are moving their devices. Moreover, people tend to lean to the left and to the right occasionally. Lounge
chairs in these hotel lobbies did not provide effective support for the posture shifting sideways, just shifting from front to back.

Based on the Visualized Continuing Posture Shifting Table shown in table 7, I generated the people’s posture shifting variation diagram (See Figure 4). Based on the diagram, we can see the spine shifting tendency is from left to center to right, and vice versa. To support posture shifting while using smartphones and tablets, the chair should be designed to support to the left and to the right shifting more than front to back shifting.

![Figure 4 Posture Spine Shifting Variation Diagram](image)

According to the observation time and table, I generate the total time on each sitting posture bar diagram (see Figure 5). This diagram has shown when they use smartphones and tablets, the total time duration for human subjects to spend on each posture. In the diagram, people are using posture 14, 15 and 21 the most. A flat tablet surface on the chair can be an addition to the seating arm in structure.
Based on the diagram and the table, these subjects’ postures have much in common. They shifted from the left to the right, from the front to the back when they were using their tablets and smartphones. Most often the people being observed were waiting for someone, inquiring at the front desk, or had their smartphones and tablets to spend free time in the lobby. None of the subjects sat more than 30 minutes. This indicates that in the hotel lobby, people are sitting and lingering for short periods of time.

Not all of the seating types in the hotel lobby supported the occupants’ posture (e.g. typing, watching videos) adequately. The seating had no ability to support angled sitting postures or shifting sideways. In the observation, most people put their tablets on their laps to type and watch videos. There is no such support on the chair armrest to accommodate the smartphones and tablets, such as when people are resting their elbows or in the situation that people are tired of holding tablet and would like to put the tablet somewhere to watch the videos. What if people want to watch their tablets from a distance and slouch back? These problems and designing issues needs to be addressed during the design process.
Seating products by the most preeminent designers in ergonomic seating has set thoughtful examples of ergonomic chairs. Good seating design should be stable, promote dynamic posture support, and allow natural motion between positions.

Case Study

Overview

Throughout the 20s century, designers and architects created lounge and dining seating mainly focused on aesthetic dimensions and economic consideration. With the emergence of the field of the ergonomics in the 1950s, designers began to tackle the physical need of the sitter (Pynt & Higgs, 2010, pp. 264-265). Modern seating design which emphasized ergonomic and anthropometric aspects has been popularized as never before. It was not until the 1970s that ergonomics were taken into consideration in chair design. Four ergonomic chairs were analyzed: the Eames Lounge Chair, Ergonomic Chair Pod, Gravity Balans Rocking Chair and coconut Chair was discussed to figure out how those ergonomic and anthropometric data apply to chair design. Design concept will be analyzed in this chapter.

For functional seating, consideration must be given to posture health. Le Corbusier, a Swiss-French pioneer of modern architect in 20th century, insightfully believed that a functional chair should serve psychological and physiological needs (Pynt & Higgs, 2010, p. 287). These chairs, in certain ways, fulfilled the psychological demands and included aesthetic dimension. Further, these chair designers had thoughts not only the
aesthetic dimension, but also the ergonomic dimensions and appropriate materials which contribute to the overall comfort of their furniture design.

Case 1

<table>
<thead>
<tr>
<th>Seating Name</th>
<th>Coconut Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designer</td>
<td>George Nelson</td>
</tr>
<tr>
<td>Year</td>
<td>1955</td>
</tr>
<tr>
<td>Dimension:</td>
<td>Height 33” x Width: 40” x Depth: 34”</td>
</tr>
<tr>
<td>Materials and Specs</td>
<td>Polished aluminum, steel, foam rubber, artificial leather</td>
</tr>
</tbody>
</table>

The Coconut Chair was designed by George Nelson in 1955. The designer deliberately delivered an easy-going type of seating. He introduced the idea of the chair with a look of a partial coconut. It is consist of a piece of bent steel with foam padding.

The designer offers beautiful and refreshing geometric variation to many modern atmospheres. The user can lay her body in the chair and feel relaxed. This chair can be widely used in hospitality and residential spaces. Such as in hotel lobby environments, the form of chair design breaks away from set conventional and gives the lobby a unique look. In the 1960s, industrial designers created the ergonomic chair as the Coconut Chair.

From the middle picture in figure 6, we can see the chair seat perfectly accommodates the female from the back to the thigh. It brings about an unwinding sitting environment. This seating furniture has implied the ergonomic thinking from the product
designer in 60s. It has demonstrated the aim of the seating design was to support the human body in the most proper posture for different scenarios.

![Figure 6 the Coconut Chair by George Nelson]

**Case 2**

<table>
<thead>
<tr>
<th>Seating Name</th>
<th>Eames Lounge Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designer</td>
<td>Charles Eames</td>
</tr>
<tr>
<td>Year</td>
<td>1956</td>
</tr>
<tr>
<td>Dimension</td>
<td>H:32&quot;  W:32.75&quot;  D:32.75&quot;</td>
</tr>
<tr>
<td>Materials and Specs</td>
<td>Seven-ply walnut, santos palisander, ebony-stained ash or white ash veneer; molded plywood frame; Edelman® All-Grain, leather upholstery; urethane foam padding; die-cast aluminum braces; stainless steel glides.</td>
</tr>
</tbody>
</table>
As for the icon of seating design in the 20th century, Eames aimed to create in the design “the warm, receptive look of a well-used first baseman's mitt (Eidelberg, Hine, & Kirkham, 2006).” The chair has three major components: the headrest, the backrest and the seat. (See Figure 7) Unlike most of modern furniture which only emphasized the
function and look, Eames lounge chair is not only an elegant design but also one built for comfort.

The Eames engaged several experiments on the furniture construction materials. According to Eidelberg mentioned in his book, *The Eames Lounge Chair: An Icon for Modern Design*, they used “heavy rubber washers glued to the backrest of the chair and screwed it to lumbar support. The washers allow the backrest to slightly bend. Seating cushions are sewn with a zipper around the outer edge that connects them to a stiff plastic backing” (Eidelberg, Hine, & Kirkham, 2006). The chair seat height is low and fixed at an angle. (Eidelberg, Hine, & Kirkham, 2006) The upholstered armrests give the user a space to place their hands and arms.

When I see Eames lounge chair, I can feel the sense of someone had a laid-back posture sitting in it in their living room. Figure 9 (from A to D) illustrates the body movement of the user when they are going to sit, and vice versa. From figure D, it is apparent that the user is sitting with their lumbar tilted. It shows us the infinite relaxing design elements in this lounge chair. The whole sitting process is front to back body movement. The seat is permanently tilted at a 15-degree angle to take the weight off the user’s lower spine (Eidelberg, Hine, & Kirkham, 2006). According to the literature review, all the muscle stresses are appropriately distributed to the upholstery at the chair back. The upholstery sitting back and seating pad help to relieve the sitting fatigue.
Case 3

<table>
<thead>
<tr>
<th>Seating Name</th>
<th>Gravity Balans Rocking Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designer</td>
<td>Peter Opsvik</td>
</tr>
<tr>
<td>Year</td>
<td>1999</td>
</tr>
<tr>
<td>Dimension</td>
<td>53.1”D, 28.7”W, 48”H. Seat height: 17.3”</td>
</tr>
<tr>
<td>Materials and Specs</td>
<td>Oak and beech woods and Polyurethane foam cushion</td>
</tr>
</tbody>
</table>

Figure 11 Gravity Balans Rocking Chair

Figure 12 Active and Static Posture

The increasing interests of ergonomic investigation into sitting posture has mainly concentrated on the corporate environments so far. Peter Opsvik, a Norwegian industrial designer, has expanded his design concept from office seating to recreational seating. He created Gravity Balans rocking chair in 1999. The chair has a very insecure look, nevertheless, it is very practical and safe seating design (see Figure 11). Depending on how users sit and how much the
chair reclines, people can use this rocking chair to work, read or nap. This chair has demonstrated that sitting can respond to both static and active position.

The most intriguing feature of this chair is its fully reclined position. (See Figure 12) Perhaps users will need some time to conquer the fear of falling because this position does seem to defy gravity. (Holm, 2014) This position efficiently depicts a napping or other relaxing activities scenarios in residential environments. But there is much security and strong support in their back and legs.

The other position is the most formal position in the office environment. People use this position to have a formal conversation. In this position, people sit upright. Generally, their core spines tend to parallel to the seating back (Holm, 2014).

Another sitting position not simply permits enough comfort, but also lets user to be functional while seated. It would be ideal for those are in informal occasions, such as reading and socializing (Holm, 2014).

As for the material of this rocking chair, Oak and beech woods provides the main structural support of the chair. Polyurethane foam cushion covered in headrest, backrest seat pad has eased the sitting muscle tension and relieve the sitting fatigue.
Case 4

<table>
<thead>
<tr>
<th>Seating Name</th>
<th>Ergonomic Chair Pod</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designer</td>
<td>Benjamin Hubert</td>
</tr>
<tr>
<td>Year:</td>
<td>2011</td>
</tr>
<tr>
<td>Dimension</td>
<td>H: 51.2” W: 37.4” D: 31.5”</td>
</tr>
<tr>
<td>Materials and</td>
<td></td>
</tr>
<tr>
<td>Specs</td>
<td>• Recycled pet felt Steam</td>
</tr>
<tr>
<td></td>
<td>• Bent ash timber</td>
</tr>
<tr>
<td></td>
<td>• Recycled foam cushions with kvadrat upholstery</td>
</tr>
</tbody>
</table>

Figure 13 Ergonomic Chair Pod by Benjamin Hubert

Figure 14 Sitting Posture in Ergonomic Chair Pod and Chair Components
Designed by London product designer Benjamin Hubert, the ergonomic Chair Pod (See Figure 13) with a pressed-felt shell look focused on people’s privacy and individuality. The “Pod”, a large privacy chair, was designed for breakout areas in corporate, hospitality or residential settings. The design goal is to create acoustical privacy in large shared spaces. By using a thin sheet of molded recycled PET-coated felt and wood base, the chair itself is not only comfortable but also functional for users (Hubert, 2014).

In the modern era, individuals are more inclined to protect their personal bubble and privacy in public spaces. This chair has fulfilled the users’ physical and psychological needs. The ergonomic aspects of the chair allow the user to work comfortably while feeling relaxed and separated from their busy life. The chair back is 51.2 inches tall which is taller than most of the chair in the market today. It brings about “a room-in room” experience since the users’ head is hiding in the chair shell. One of the special features of this chair design is the curved back, which assists in blocking acoustic and visual distraction from the surroundings (Hubert, 2014).

Figure 14 has shown some possible sitting postures in the chair Pod. Essentially, when users are seated, their bodies were adjacent to the foam cushions and upholstery. Thus, the muscle stress will be properly distributed. This chair also accommodates the use of laptops which can be seen in those public places like hotel lobbies, office breakout areas, etc. When people use laptop devices, their spine tends to slightly move forward from the chair back. This chair has successfully address the sitting posture in modern era. (See Figure 14)
Case Study Analysis

These four chairs, which span the last five decades, have greatly addressed the sitting posture issues in different settings. From the relaxed to formal posture, these iconic chairs have greatly influenced the modern chair design and impacted our perspectives on seating design. These four chairs have tackled the sitting posture problems successfully. They have provided the furniture that can accommodate either relaxing or formal sitting movements.

These four chairs have addressed the sitting issues from different aspects both functionally and comfortably. First, Coconut Chair is accommodating the users’ relaxing and slouched sitting posture. When users are in this chair, they will be in the position between laying down and sitting upright. Second, in the aspect of construction, the use of leather and upholstery gives Eames Lounge Chair the softness to relieve the muscle stress when you are laying down and trying to relax. The 15° angled back is one of the design indications that this chair is used for leisure spaces. Third, Gravity Balans Rocking Chair is the most diverse chair design among those four samples. It gives the users both formal and informal, leisure and straight sitting postures. The streamline structural design gives the chair an active appearance. Fourth, the most significant feature of Ergonomic Chair Pod is the seating material. The foam cushion and upholstery curvy back provides the user a secure environment. From the head to the back to the hip, the body parts are adjacent to those soft materials. Much body pain can be easily avoided.

Further, in our society today smartphones and tablets are powerful, convenient and multi-purpose devices. Using iPads or iPhones in whatever occasions has become an
evident phenomenon. When people use iPads or iPhones, their body movements can be different from the original way they sit. They tend to shift their body left and right. In lobby environments, perhaps they would not lay their body down. These chairs I have analyzed have not shown enough spaces for the users to move their body from left to right.
CHAPTER 4

Design

In this chapter, I continued my chair design process by explaining the research procedures made towards my design goal in terms of the application to problems solving and development of my design. According to the observation analysis, I found posture shifting tendency while using tablets and smartphones. Analysis of case studies and comprehensive observation statistics revealed that the left and right angled is the body shifting variation when they use tablets and smartphones. These seating dimension data literally determined how I designed my lounge chair. Compared to general work environments, hotel lobbies are generally laid-back and relaxed areas. For a chair design side view, the back needs to be tilted between 95-105 degrees in order to support people’s slouched sitting posture when they use tablets and smartphones. Chair armrest need to be added to the chair in order to support smartphone or tablet use and also give the arm the freedom to rest and stretch.

Based on this analysis, I came up with four concept schemes to explore the seating design possibilities. To record my thinking process, I made models to expand my design concept into different directions. Each of these paper models varies from each other. For the brainstorming process, making models helps me to think about the design in three-dimensional ways (See Figure 15).

According to the literature review, case study and observation analysis, schematic design will be continued by choosing one final model that will hit the design
goal. Ergonomic and anthropometric data will be applied to the dimensions and angle to this seating furniture.

Figure 15 Chair Models (1'=1")

**Models and Concept Schemes**

Initially, to excavate different possibilities of this project, I prepared 30 various models that convey different design concepts which were the results of my research (See Figure 15). These models imply varying forms and design aesthetics. After the analysis of these models, four concept schemes were chosen from thirty models which would apply to my research process; I also developed the four models into thirty-eight models (See Figure 15 - Figure 19). These models have revealed my design concept into four different directions.

The first series of models can accommodate two people. (See Figure 16) It embraces a very organic shape seat allowing people to move around. It shows the
flexibility of the seating. The seating back and seating pad are upholstered; this will provide comfort while using smartphone and tablet technology.

![Image of chair model scheme 1](image1.png)

**Figure 16 Chair Model Scheme 1**

However, this concept scheme does not work for tablets use. It is not efficient when two people are sitting at the same chair and use tablets simultaneously, because there is no sufficient support and space for the arms.

The second series of models (See Figure 17) focused on the use of serial planes. Throughout the models, by changing the shapes of each piece attached together and copying the body shape while sitting, the design format and direction have created a sort of pattern.

![Image of chair model scheme 2](image2.png)

**Figure 17 Chair Model Scheme 2**
I did not choose to develop this design scheme notwithstanding that models have shown different curvy seating back and seat outlines to accommodate sitting. “Owning to the reason the chair has certain unsafe qualities when it is placed in high-end lobby environments.”

The third series of models (See Figure 18) implies the concept of insect wings. It looks like an insect is about to open the wings and start to fly. This concept defines the idea of wings’ symmetry and balance. The wings have a concept of protection and extension. They also have the look of flora petals. They resemble the look of petals when blooming. This concept enables the body movements from left to right, and vice versa. Further, the armrest is offering the space to place tablets and move the arms.

The fourth series of models mimics the shape of seashells (See Figure 19). It is well acknowledged that seashell is the symbol of marine lives. The outer layer of the shell is protective to the inner body. The seashell curving shape outline resembles the
look of the seating posture. When people are seated, they would like to have to have a sense of security and protection. Meanwhile, in hotel lobby environments, they tend to have a laid-back posture since they don’t need to have high concentration on something. People’s laid back postures tend to fit in the seashell shape. Seashells tend to accommodate people’s sitting posture when mimicking the sitting body figure outline. This brings people seating comfort while they are using tablets and smartphones.

Even though the models have shown what users can do their body movements without any barriers in this chair, they did not present the frequency of use of those mobile devices. There is no structural support for the tablet use. These chairs do not demonstrate the possibilities of the use of tablets incorporated with the main chair structure.

According to the analysis of the model making process, design concept 3 reflected my research of my analysis. Based on the research conducted in previous chapters, it is possible to develop my chair which accommodates the body movements.
The third series of models can support tablets using. Therefore, it was chosen to develop my design process.

**Design Concept**

Insects are integral parts in our wide range of natural resources. The dragonfly remains as one of the most reminiscent pieces in my childhood memories. With such a special shape and texture, dragonfly wings are defining the concept of flexibility and toughness. When I saw a static dragonfly try to extend and vibrate its wings in the botanical garden, it brought me a sense of resilience. When it is closed, its thorax is under the protection from shielding wings. The resilience and pliability of the wings has maintained most of its body weight. When individuals are seated and feel weary, the seating back remains as a protective support for their body. The concept of my chair back design mimics the shape of the dragonfly wings.

In some public places, the privacy of the individual remains overly exposed. When users are sitting in the chair, they are desperately demanding privacy for their personal bubble spaces. Yet the chair seating pad provides the support for the torso pressure meanwhile the chair back contributes to a sense of shielding. My inspiration of the chair back design originated from the shape of the dragonfly wings (See Figure 20). The shadow of the dragonfly wings defines the contour of the chair back. The upholstery fabric design pattern was inspired by the insect wings pattern. The overall back shape gives the chair a very bold or elegant look. The shape resembles the shape of the dragonfly when it is going to extend the wings and is about to fly. (See Figure 21)
The seat back shape itself has a very identical and elegant contour. The shape of the wings gives the chair a symmetrical look. The shape and form of the chair seen from the back and front is what makes the design special.

This chair will accommodate the user in all the various activities in the hotel lobby comprising the time they stay in lounge: from playing tablets and relaxing to talking on the phone to interacting with others; from turning or reaching to bending or stretching.
This seating furniture will be stable in one location since it will be in the hotel lounge. This arm chair will not just fit the body dimension, but also support all the posture shifting either using tablets or not. It will be simple, natural, easy and enjoyable to use.

The chair main structural material can be crafted from birch board. (See Figure 22) The use of the material accentuates the concept from our natural environment. It gives the chair a geometric, elegant and refined outlook.

Figure 22 Chair rendering with fabric pattern

For the next step, different sitting postures and body movements have been explored, envisioning how the chair would accommodate the people with different body
movements. (See Figure 24) As previous research mentioned, the back pad and seating pad have alleviated the sitter’s sitting pressure. The user’s privacy is separated by the high back. Further, according to literature review, seat back is crucial for the sitting comfort as well. According to chair back ergonomics mentioned previously, for the seating back, I angled the back 10° angled for a casual chair. These angled wood structural piece, seat pad, back pad are combined, thus allowing the seat to conform to the sitter’s movement by providing an optimum level of support.

Figure 24 Different postures with iPad in Chair

**Chair Ergonomic Dimensions**

This arm chair will support user from watching the video position through the support of armrest to laid-back resting body position. According to literature review, the seat height is designed to 16.5 inches and it is tilted 10° angle towards the back. The seating height fulfills the seating height ergonomic dimension from 16.1 inches to 17.7 inches. There will be a 1 ½ inches seating foam cushion on the surface of the seat. It was
wrapped with the muslin. Based on the research previously, the seating foam pad will relieve the sitting fatigue and pressure will be distributed by those surrounding tissues.

The armrest shape seemed to be a symmetrical trapezoid. I curved the front and back line due to the frequency of body movements when users are seated. People tend to sit in the center line at first and shift their body left to right. As a result of my design, center line of the seating would be longer than the two symmetrical hypotenuse. This also allows the users to sit with angled positions or to stretch their legs when they feel tired.

From the side view of the chair design, there is an evident gap between the arm and back part. (See Figure 25) This gap allows the elbows to move easily and allow the chair to “breath”. In the seating back design, I chose to have two angled tall planes to give individuals enough privacy. The long side of the back is 34 inches and it is in the center part of the chair. The length gives users enough depth to fit their legs.
This chair will accommodate forward, reclined, angled and tilted postures while maintaining the lumbar pressure. This was reinforced by the seating pad which was attached with the seating back. When users are using mobile technology, they could move their body easily without seating barriers.

The Arm Chair in Hotel Lobby Environments

Mobile technology has impacted body movements in our daily lives. The influence of this on furniture design will increase in the foreseeable future. Lounge chairs encourage people to have a slouched postures, such as sitting with legs extended, unsupportive modular seating, beanbags, etc. (Pynt & Higgs, 2010, p. 271).

According to Baker, “compared to other occupancies such as retails, museums or restaurants, hotel consumers spend much longer time in hotels. The longer one stays in the facility, the greater the chance the physical setting will help to impact the general service satisfaction. (Baker, Grewal, & Parasuraman, 1994)” Hotel lobby accommodates as a main circulation space which leads guests to different occupancies of the hotel (Rutes, 2012). In order to illustrate the surrounding lobby settings, the pictures below (See Figure 26-32) have indicated the arm chair location and proportion within the hotel lobby environment. The first series of pictures (See Figure 26-28) have shown the chair could be used in boutique hotel lobby environment. The second series of figures (See Figure 29-32) have demonstrated this arm chair can be displayed in grand convention hotel lobby settings.
Because of its size the chair appears to be a throne. Not only does it provide the space for the body movements, but it also separates the users from circulating crowds in different hotel lobby environments.

The abstract botanic pattern textile for seating pad not only gives the chair a glamorous feature but also delivers the perception of insect texture in nature. The abstract pattern of the fabric gives the chair a luxurious look and harmonizes with the birch pattern which appears to be the chair structure. The application of the arm chair should be placed in contemporary hotel atmospheres.

This arm chair design demonstrates the new digital lifestyle we are living, which is using mobile technology to reach social connection and access infinite information. To respond to the fast growing use of mobile technology, furniture needs to allow the posture shifting. When people are seated and use tablets or smartphones, the chair can accommodate their body movements without any barriers.
Figure 27 Modern Boutique Hotel Lobby Night Scene with Arm Chair rendering view 1

Figure 28 Modern Boutique Hotel Lobby Night Scene with Arm Chair rendering view 1
Figure 29 Modern Grand Hotel Lobby with Arm Chair rendering view 1

Figure 30 Modern Grand Hotel Lobby with Arm Chair rendering view 2
Figure 31 Modern Grand Hotel Lobby with Arm Chair rendering view 3

Figure 32 Modern Grand Hotel Lobby with Arm Chair rendering view 4
CHAPTER 5

Conclusion

Modern lifestyles that directly promote the use of mobile technology, presents a challenge in furniture design to accommodate its use. The proliferation and popularity of mobile technology appears to be an inevitable consequence of modern living.

Research in anthropometrics and ergonomics play significant roles for us to understand how our body will work functionally. Anthropometric data determines how to design furniture to the right scale. Advanced ergonomic chair design supports changing postures. This thesis therefore mainly stressed the factors that impact seating design: body parts and chair design, from ergonomic considerations to users’ activity habits, and to chair load aspects. The qualitative research and experiments have been conducted to test people’s shifting postures tendency and the factors that support that tendency. This thesis has demonstrated the wide use of smartphones, and tablets have changed the way people sit and shift their body positions. Sitting postures are the driving forces for the seating design.

Qualitative research has been done to justify the changes that have happened in this mobile technology-oriented society. In this thesis, the hotel arm chairs are well supporting people’s changing posture when they are using mobile technology devices. The chair’s arm has offered user’s arm and tablets a platform in support. The chair back angle accommodates people’s shifting body position either to the left or to the right. The high back is contributing to the user’s personal privacy and separates himself from the crowds in public settings. In addition to the ergonomic design, the upholstery seating pad
and back pad were attached with the foam cushion and wrapped with dragonfly wing pattern muslin. The back upholstery pad is one inch thick and the seating pad is 1.5 inches in thickness. By adding these to the chair birch structure, the user’s body sitting pressure will be distributed and the sitting discomfort will be alleviated. Literally, this armchair will support the body movements for the individuals in hotel lobby environments.

**Future Research**

The future research presents the need for future possible study on human ergonomics in relation to furniture design. In this study, the ergonomics data was largely used in the dimension of the chair’s design.

First, research for furniture materials can be conducted more in depth. The use of furniture material can change comfort level when people are using tablets and smartphones. For instance, further research can touch new ground on how to address the material of the arm pad when people are using tablet technology.

Second, body measurement for different human subject samples can be conducted to determine the precise variation on the seating dimension. A large number of people’s body dimensions can be measured and tested in order to obtain the premium furniture size. The demographic body dimension data can come from different genders, ages, races, heights, weights and so on.

Third, through the construction of the arm chair piece, there are many limitations on the CNC Router in cutting the birch pieces and construction the pieces together. Thus, this final piece has been modified multiple times due to construction technology in this
project. I will have to assume that there will be more efficient 3-D Router to cut the material and shape it into more ergonomic seating design.

Overall, these questions and limitations I have mentioned above can be resolved to obtain the data and conduct the design research in future study.
References


Garber, M. (2013, 2 25). *9 New Ways to Sit in the Office, Thanks to Smartphones and Tablets*. Retrieved from The Atlantic:


Appendix A

MFA Show

This thesis project was displayed in Master of Fine Arts Degree Candidates Exhibition from April 12, 2014 - May 04, 2014. The show features 16 MFA candidates from Lamar Dodd School of Art. The installation of the exhibition features hotel arm chair, a concept poster (Size: 36”x140”) and an iPad standing in the chair arm displaying video of my chair design process and the chair’s outlook in different hotel lobby environments. The chair was on 4’x4’ Pedestal and standing in front of the poster. Visitors can walk around the chair and watch the iPad video.

Figure 33 Concept for Exhibition Installation
Figure 34 Hotel Arm Chair Prototype View 1
Figure 35 Hotel Arm Chair Prototype Back View

Figure 36 Hotel Arm Chair Prototype Front View

Figure 37 MFA Exhibition Gallery in Georgia Museum of Art
Appendix B

Design Materials and Construction

Figure 22 to Figure 24 have shown the original arm chair look in three dimension view. They were rendered by 3Ds Max in order to have a sense of proportion and dimension of the whole chair design. Figure 21 have shown the basic wood material for structure construction. I am using for the birch for furniture construction since it is one of the most ideal it is ideal for creating high-quality furniture (Green, 2014). Hardwoods such as birch are also less susceptible to scratches and dents. Among all high-quality domestic hardwoods, birch is one of the most economical.

According to Green, Birch is also a good wood for creating furniture because of its machining properties. It yields a smooth finish when planed and sanded. It responds well to cuts and drills, and it holds screws and nails well (Green, 2014). The chair construction materials (birch and upholstery) and the processes used to produce the chair will be environmentally intelligent and do no harm to either users or the lobby environment.
Figure 38 Birch Texture for Chair Construction

Figure 39 Birch Texture for Chair Construction

Figure 40 Chair preliminary 3-D model rendering
The next step, I have developed my drawings into the AutoCAD file into three identical MDF Boards (see Figure 42). The MDF boards are ½” in thickness. Each slots and notches need to be precise for the construction.

Figure 42 Chair pieces Autodesk CAD drawing for CNC
To make every detail attached together with no gaps, I tested each piece and make the models into AutoCAD wireframe to test each notches and slots in the drawing. The models in 3D has shown the arm chair from different angles (See Figure 44- Figure 47)

Figure 43 Arm Chair Structural Model in Autodesk CAD

Figure 44 Arm Chair Final Structural Model in Autodesk CAD Wireframe View 1
Figure 45 Arm Chair Final Structural Model in Autodesk CAD Wireframe View 2

Figure 46 Arm Chair Final Structural Model in Autodesk CAD Wireframe View 3

Figure 47 Arm Chair Structural Model in Autodesk CAD Wireframe View 4
For the chair structure, the center back of the chair was connected by the horizontal lines. There are two symmetrical vertical plates at back of the chair. It has many slots for the horizontal wood sticks. These horizontal wood sticks were stabilized into two vertical plates at the center back of the chair. This gives this arm chair a sense of architectural aesthetics in a regular order form.

The symmetrical angled back were two pieces of birch. They give the occupants enough privacy and space to move their body parts and shifting the postures. Each shape of the wood pieces are coordinated with the wood grain to attach together.

In order to test the angles and dimensions for construction, The arm chair mock-up was cutted to test the ergonomic dimensions and seating angles (See figure 31). The MDF Boards are ½ inch in thickness. The final chair turns out the prototype chair is larger than the final one. (See Figure 48)

Figure 48 Chair Mock-Up in MDF
Appendix C

CONSENT FORM

The Impact of New technology and Sitting Posture on Seating Design

You are invited to be in a research study of The Impact of New technology and Sitting Posture on Seating Design. You were selected to agree the research process. We ask that you read this form and ask any questions you may have before agreeing to be in this study.

This study is conducted by: Quan Yuan

Department of Interior Design,
Lamar Dodd School of Art
The University of Georgia

Background Information

The purpose of this study is: To investigate how smartphone and tablets technology will impact people’s sitting posture within hotel lobby environment.

Procedures:

If you agree to be in this study, the researcher will do the following things:
1. You will agree to allow and support the unobtrusive observation process for this research project. The researcher will remain invisible during the observation. There will not be interruption during the observation and recording process.

2. Posture shifting will be recorded by hand drawings. And seating furniture will be photographed for research record.

The observation will last about 60-90 minutes and be recorded to be transcribed.

Confidentially:

The records of this study will be kept private. In any sort of report we might publish, we will not include any information that will make it possible to identify a subject. Research records, including the photographs, will be surely and only researchers will have access to the records. They will all be destroyed after the project completion.

Voluntary Nature of the Study:

Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with the University of Georgia. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.
Contacts and Questions:

The researchers conducting this study are: Quan Yuan. You may ask any questions you have now. If you have questions later, you are encouraged to contact him at 255 Preserve Dr, Apt 1021, Athens, GA, 30606, Phone 706-910-5080, Email: mickey17@uga.edu. Or contact the advisor Thom Houser Email Address: thouser@uga.edu

You will be given a copy of this information to keep for your records.

Statement of Consent:

I have read the above information. I have asked questions and have received answers. I consent to support in this study.

Signature__________________________________________Date:________________________

Signature of Investigator: ___________________________ Date:________________________
Appendix D

Consent Cover Letter

September 10, 2013

Dear Hotel Manager:

I am a graduate student under the direction of Prof. Thom Houser in the Department of Interior Design at Lamar Dodd School of Art at The University of Georgia. I invite you to let me do the observation in the hotel lobby in a research study entitled “The Impact of Technology and Social Behavior on Furniture Design” The purpose of this study is to demonstrate the impact of smartphones and tablets in hotel public spaces as a driving force of furniture design.

My research will involve the observation of the people’s posture and behavior in hotel public spaces, I would draw and record the gesture and visual information on the sketchbook. Photographs or videos may or may not be taken. And the research should only take about usually 1-1.5 hours your involvement in the study is voluntary, and you may choose not to participate or to stop at any time without penalty or loss of benefits to which you are otherwise entitled. If you decide to stop or withdraw from the study, the information/data collected from or about you up to the point of your withdrawal will be kept as part of the study and may continue to be analyzed.
The consumers in the hotel during this research would be anonymous. The results of the research study may be published, but your name or any identifying information will not be used. In fact, the published results will be presented in summary form only.

The findings from this project may provide information on the library at the University of Georgia. There are no known risks or discomforts associated with this research.

If you have any questions about this research project, please feel free to call me at (706)-910-5080 or send an e-mail to mickey17@uga.edu. Questions or concerns about your rights as a research participant should be directed to The Chairperson, University of Georgia Institutional Review Board, 629 Boyd GSRC, Athens, Georgia 30602; telephone (706) 542-3199; email address irb@uga.edu.

By completing and returning this questionnaire in the envelope provided, you are agreeing me to participate in the above described research project.

Thank you for your consideration! Please keep this letter for your records.

Sincerely,

Quan Yuan