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Sensory study in restaurant interior design

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Sensory study in restaurant interior design

by

Xue Yu

A thesis submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of
MASTER OF ARTS

Major: Art and Design (Interior Design)

Program of Study Committee:
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Iowa State University
Ames, Iowa
2009

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ABSTRACT

According to five senses, sight, smell, taste, hearing, and haptic, sight receives the most attention in restaurant interior design; however, the other senses are significant as well. Since taste is impossible to deliver through interior design, this thesis focuses on the other four senses, which are sight, smell, hearing and haptic, in regard to restaurant sensory design.

To impart sensory design strong theory background, in literature review part, physiological and psychological theory about sight, smell, hearing, and haptic are studied. These senses do not act separately, but work as a unit to deliver humans a comprehensive perception of a space.

The main purpose of this thesis is to create a restaurant sensory design framework, which is applicable for designers to design a restaurant. Moreover, the framework is an effective reference for restaurant owners as well.

A case study is followed to illustrate how to use the framework while designing a restaurant. King Buffet, a Chinese restaurant in Ames, Iowa is chosen as the subject of case study. The final redesign shows distinct advances compared to the original design, which reveals importance of sensory design.
CHAPTER 1. INTRODUCTION

Problem Statement

Customers go to restaurants not only enjoy food, but also for communication, business negotiation, and other social activities. Therefore, restaurants provide the integrated functions of dining room, living room, meeting room, and even courtyard and playground. Thus not only sight, other senses like smell, hearing, and haptic also need be well considered.

In interior design practice, sight generally plays a dominant role. Designers always pay attention to color, materials, formation, illumination, and so on, however, other senses, such as odor, hearing, haptic, are barely considered. Without non-visual sensory design, interior space would be uncomfortable. Although sight is the most important sense while human perceiving the world, other sense systems are also significant. Non-visual sensation can strengthen visual perception, and deliver a distinct identity to an interior space.

Moreover, interior designers should consider following questions: What causes a restaurant to be loved by customers apart from delicious food? How does a restaurant engender a strong impression for customer? How is a restaurant remembered by customer? This thesis tries to answer these questions based on sensory study. Sensory design achieves an impressive and memorable space which enhances customer sensory perceptions, attracts them come in, stimulate their consumption, and induces them return.

Purpose of Study

The purpose of this study is as follows:

First, based on sensory study, propose a framework. Through sensory study of sight, smell, hearing, and haptic, find approaches which are applicable in restaurant interior design,
and transfer them into a framework. The framework would be an effective reference for designers and restaurant owners.

Second, through case study, illustrate the importance of sensory design and feasibility of the framework. To test the application, the framework is applied to redesign a Chinese restaurant. Through a comparison between original design photos and redesign renderings, design advances are demonstrated, which displays the significance of sensory design and feasible application of the framework.

**Organization of Document**

This thesis has five chapters. In Chapter 1, problems with regard to restaurant interior design practice are addressed, as well as study purpose and document organization. In Chapter 2, literature about sight, smell, hearing, and haptic are studied. Theories and studies which are applicable in restaurant design are discussed. In Chapter 3, the restaurant market is analyzed. Based on sensory study and market analysis, sensory design approaches are proposed in illustration tables, and all design approaches compose the sensory design framework. In Chapter 4, an existing restaurant is redesigned according to the framework. Redesign is demonstrated through computer drawings and renderings, which exhibit distinct advantages comparing to the existing design. In Chapter 5, conclusions and implications of the study are delivered.
CHAPTER 2. LITERATURE REVIEW

This chapter focuses on literature concerning sensory study and interior design practice. Academic research relating to sight, smell, hearing, and haptic is studied. For each sense, theories that have potential application in restaurant design are discussed.

Overview

Humans build experience from previous activities. Experience is a complex pattern of feeling and thought. “Human feeling is not a succession of discrete sensations; rather memory and anticipation are able to wield sensory impacts into a shifting stream of experience so that we may speak of a life of feeling as we do of a life of thought. In fact, they lie near the two ends of an experiential continuum, and both are ways of knowing” (Tuan, 1977). The human sensory system not only engenders feeling, but is important tool to know the world.

“Experience is a cover-all term for the various modes through which a person knows and constructs a reality. These modes range from the more direct and passive senses of smell, taste, and touch, to active visual perception and the indirect mode of symbolization” (Tuan, 1977). Customers have dining and social activities in restaurants, a procedure in which all senses work together and then engender certain feelings and perceptions to compose a certain experience.

Sight

Sight receives the most attention in interior design practice compared to other senses. Designers always consider physical visual stimulation, which is just one role of visual design. Sight not only affects humans physically and psychologically, but has strong association with
other senses. There are three sections in sight study: ornament and scale, sunlight, and Kaplan and Kaplan’s preference theory. Because this thesis focuses on restaurant sensory design, color, formation and other sight elements concerning modeling and styling are not included.

**Ornament and Scale**

Ornament is not redundant decoration; it shows status and displays wealth. For example, there are many ornaments in a palace, and no ornaments in slum. Accordingly, scale is not always decided by function, but also marks status. For instance, a grand entrance of a palace does not supply a function, but exhibits high social and political status. “A grand entry suggests grandeur waits on its other side” (Malnar & Vodvarka, 2004, p.154). Therefore, in interior design, more details and large scale are applied in areas used by owners and guests, and less details and a smaller scale are applied in service areas.

Furthermore, intricate details are used to prolong visitor’s stay. According to Clark’s study, people remember simple figures more easily than complex ones (Lawless, 1978). People are fascinated by ornament details, because those details cannot be remembered for a long time. It is thus ever new and interesting, and people are willing to devote their information-seeking attention to it (Malnar & Vodvarka, 2004, p.172). Therefore, people linger longer time in a space where there are more details than in one with fewer details. This approach can be used by designers to control rate of movement. For example, in the interior of Paris Opera, Charles Garnier used this approach to design the main stairs. In 1871, Garnier published *Le theatre*, in which he addressed his design approach about details. He considered the activities of entering the building, circulating, socializing, and arriving in the auditorium as a sequence, experienced both psychologically and physically. Thus the plan reflects circulation into two activities, processional and functional. More elaborate details exist in
 commodious spaces. “Only when Garnier wants movement to be quick dose he eliminates ornament entirely” (Zanten).

Far from concealing deficiency or redundancies, ornament delivers vital function. It precisely identifies a space, including its social and cultural function, and transmits that identity to the audience (Malnar & Vodvarka, 2004, p.174).

**Sunlight**

In addition to visual function, sunlight affects people psychologically and influences health. Natural sunlight not only supplies illumination, but benefits humans psychologically and physically. According to a study by Mass, Jayson, and Kleiber, where lighting approximates the spectral quality of natural sunlight, there is less perceptual fatigue and improved acuity. (Maas, Jayson, and Kleiber, 1974, p.524-26). Fritz Hollwich studied the effect of high-intensity artificial light which induced stressful reaction and increased metabolic activity, however humans adapt to high levels of intense outdoor sunlight without difficulty (Hollwich, 1979, p.90 ). Therefore, in terms of interior design practice, designers may adopt sunlight if possible to avoid using high-intensity artificial light.

Lack of sunlight slows down work efficiency and induces illness. In a study conducted by Kuller and Lindsten, schoolchildren were placed in a classroom without sunlight to observe the role of sunlight on stress hormones, classroom performance, body growth, and sick leave. They found that “work in classroom without daylight may upset the basic hormone pattern, and this in turn may influence the children’s ability to concentrate or cooperate, and also eventually have an impact on annual body growth and sick leave”( Kuller and Lindsten, 1992, p.316). Therefore, interior designers may pay attention to apply sunlight to space where people stay long time, such as classrooms, offices, hospitals, and so on, to avoid problems induced by the absence of sunlight.
Kaplan and Kaplan’s Preference Theory

According to Kaplan and Kaplan’s preference theory, there are two basic informational needs: understanding and exploration. “The combination of these two domains results in four distinct patterns: complexity, coherence, legibility and mystery. Complexity refers to the preference people have for patterns that are neither high nor low in information; in a scene, the intricacy of the elements. Coherence refers to the sense of order and the degree to which one’s attention is directed. Legibility is a notion which basically refers to our ability to form a clear mental image of a space and later recall it. Mystery is perhaps the most intriguing factor, as it describes not what is there but the degree to which it is suggested that more information is available if we pursue it” (Malnar and Vodvarka, 2004, p.99).

Kaplan’s study focuses mainly on landscape design and urban planning. Suzanne C. Scott studies how complexity and mystery relate to people’s perception in interior spaces and how complexity and mystery affect preference (Scott, 1993). Humans prefer complexity over simplicity. “Rapoport and Kantor suggest that humans prefer complexity and ambiguity in their everyday environments, and Porteous suggests although human seek to optimize input, they prefer overload to deprivation”. (Malnar and Vodvarka, 2004, p.100). Mystery is defined as the degree to which people are attracted to pursue more information by proceeding further into the scene (Gimblett, Itami and Fitzgibbon, 1985, p.89). There was a high degree of agreement among observers, but of greater interest is the character of the five attributes agreed on. “These were screening, the degree to which the larger view is obstructed; distance of view, the distance from the observer to the nearest elements; spatial definition, the degree to which the elements enclose the viewers; physical accessibility, the apparent means of moving through the scene; and radiant forest, the sunlit area we see beyond the darkened foreground” (Malnar and Vodvarka, 2004, p.99). If the elements are too far way to achieve, the mystery rate is low; as the accessibility increases, so does the mystery rating. In order to have high mystery, everything need not be seen at first glance.
In Scott’s study, she lets three groups of subjects value 80 variable sides, which are interior photos with different level of complexity and mystery. Scott confirms that complexity and mystery strongly associates with preference. She describes the relationship among complexity, mystery, and preference by calculating Pearson’s product-moment correlation coefficients, using mean complexity, mystery, and preference scores for each of the 80 interior scenes. “A high positive correlation was found between complexity and preference and a moderately high positive correlation was observed between mystery and preference. Correlation of mean complexity and mystery scores also yielded a positive relationship” (Scott, 1993).

In scoring complexity, a low score relates to a smaller, well-defined, boxlike geometrically shaped space, while a high score relates to larger and irregularly shaped spaces, subdivided by varied architectural elements, furnishings, and plants. Simple geometrical spaces have horizontal orientation and a single direction of visual emphasis. Complex geometrical space has a vertical orientation and multiple directions of visual emphasis (Scott, 1993).

Scott claims in addition to the number and variety of elements present in a scene, there are two additional sources of complexity. The first one is the “composition or pattern of elements in the scene,” which is arrangement or layout; the other is the setting’s spatial geometry, which is its volumetric shape and internal articulation. “One involves assessments as two-dimensional array, and the other one involves comprehension and consideration of its three-dimensional spatial relationships” (Scott, 1993).

By analyzing the mystery rating with related scenes, Scott concluded the interior spaces that yielded a higher mystery rating: “(a) offered shorter distances of view to the first points of interest; (b) provided accessibility to the larger environment via paths, particularly ones that were shorter, wider, and turns out of view; (c) were neither small and enclosed nor large and wide open; (d) included architectural features, furnishings, or plants that
simultaneously permitted a degree of visual access to other spaces while prohibiting total understanding of the setting; (e) showed dramatic brightness contrast between the foreground and areas deeper in the scene”. (Scott, 1993)

Scott also observes how the relationship between immediate location and promised information affects different levels of mystery and preference. When immediate location is desirable and the promised information is similar, mystery and preference are high; when promised information is more attractive than immediate location, mystery and preference are enhanced; when immediate location is undesirable and the promised information is similar, mystery and preference are lower; when promised information is uncertain because of limited indication of what it might be, mystery and preference are low (Scott, 1993). Therefore, the attraction value of promised information is a significant element of mystery level. To achieve high mystery, it is necessary to avoid exposing every element at first glance, while providing promised information with high-level attraction.

**Smell**

In interior design practice, smell seldom receives attention. However, smell has a strong association with feeling and influences people’s activities. Odor is a key motivational factor in human behavior, playing a critical role in behavior patterns. Smell affects areas of the brain that deal with emotions, feelings, and motivation, which can lead to a specific behavioral response. In terms of restaurant design, smell plays a significant role.

Smell enhances taste perception. “Taste and smell usually function in concert and can be regarded as alternatives ways to experience similar phenomenon” (Malnar & Vodvarka, 2004, p.42). Therefore, smell sensory design is especially important to restaurant interior design.
Further, “Odors lend character to objects and places, making them distinctive, easier to identify and remember” (Tuan, 1977, p.11). Pleasant odor provides a space with a favorable identity. Moreover, “there is a possible relationship between territoriality and odor preference. For example, in a relevant test, the sleeping place and the other intimate rooms where one feels at home and secure was mentioned by subjects in connection with pleasant odor memories” (Malnar & Vodvarka, 2004).

Odor has some other attributes. Forrest Wilson has studied odor sensitivity, and indicates that sensitivity varies over the course of a day and the sense of smell rapidly fatigues, and odor sensitivity weakens with age (Wilson, 1984, p.191).

**Fragrance**

Fragrance is a kind of pleasant odor which has psychological functions in addition to bringing pleasure and relaxation. The functions are as follows:

2. Facilitate recall of pleasant memories.
3. Reduce reported preferences for resolving interpersonal conflicts through relatively ineffective means.” (Malnar & Vodvarka, 2004)

The first and third ones may have commercial implications; the second one may have an effect on human behavior generally.

Specific fragrances perform precise functions. For example, lemon and peppermint can reinforce alertness and energy; lavender and cedar can reduce tension. (Iwahashi, 1992, 212-14). This is why lavender fragrance is adopted in spas, and air fresheners mainly have a lemony smell. This theory has been put into use by interior designers as well. For example, several large companies introduce fragrance to heating and air condition systems to boost work efficiency and reduce stress.
Fragrance can also be a primary determinant of spatial judgment. For example, in a test to detect the function of fragrance, a room containing low levels of fragrance was considered by subjects as brighter, cleaner, and fresher, yet no subject noted the fragrance (Clifford, 1985, 115-17). Fragrance makes a space more favorable, which may be applied in interior design practice.

**Hearing**

When referring to the sense of sound, background music may be the first thing to come to mind. However, hearing as related to sensory design, is more complicated than that. Sound has strong association with human emotion. “Sound not only surrounds but can penetrate to the very core of the sentient. This primitive power, which bypasses the cerebral and directly addresses the heart, elicits an emotional response”(Pocock, 1989, p.194).

Sound also plays an important role perceiving a space and enhances sight sensory perceptions. “Sound provides an important link to reality and has a protective and enriching function. Without sound, visual perception is different: less contrastful, less attention-demanding, and less informative” (Southworth).

Sound may complement vision to perceive space in respect that it enlarges one’s spatial awareness to include areas behinds the head that cannot be seen. Therefore, sound dramatizes spatial experience (Tuan, 1977, p.16).

Finally, sound contributes a certain environment a space. Sound is significant for human to participate, experience, and remember places. Without sound, an environment is lifeless and unreal, without flow or rhythm, and frightening.(Pocock, p.194)
Haptic

“The skin reads the texture, weight, density and temperature of matter….the tactile sense connects us with time and tradition; through marks of touch we shake the hands with of countless generations” (Pallasmaa, p.33). Like sight, the haptic sensory system plays a significant role in perceiving the world. Aristotle claimed that tactile perception was the most critical and fundamental sense (Aristotle, 1986, p.218). The haptic system includes perception of temperature, pain, pressure, and kinesthesia, which refers to body sensation and muscle movement. It is the system by which people literally contact the physical environment (Gibson, p.53).

According to Joy Monice Malnar and Frank Vodvarka, the haptic system includes three branches: touch, temperature and humidity, and kinesthesia (Malnar & Vodvarka, 2004, p.57). This following pages discuss haptic sensory in regard to these three branches.

Touch

In touch sensory design, designers mainly focus on texture. Surfaces people can reach generally have more exquisite texture than those not available for touch. For example, with F.L. Wright’s Imperial Hotel in Tokyo, the brick and native lava stone are used on both exterior and interior space, however, the texture becomes progressively smoother. Therefore, while guests walk from the public space to semiprivate space to private space, they can feel the change of surface texture. (Malnar & Vodvarka, 2004, p.144).

Color, texture, and pattern of materials are means of decoration (Malnar & Vodvarka, 2004). Designers may pay more attention to surfaces which customers regularly touch, applying different textures through the use of wood, wicker, fabric, fur, leather and other materials to achieve warm, smooth, tough, and other touch perceptions.
Temperature and Humidity

Temperature delivers a specific sensation. For example, the warmth of a fireplace contributes a space “ultimate intimacy and comfort” (Pallasmaa, p.33). The warmth of fireplace reminds people of intimacy and comfort, which breed a relaxed atmosphere.

Kinesthesia

“Movement such as the simple ability to kick one’s legs and stretch one’s arms is basic to the awareness of space”. (Tuan, 1977, p.12). People understand a space best while walking through it. While ascending or descending a staircase, people perceive floor texture and see diverse scenes at different vantage points. “Basic-orienting system and haptic system in concert would go far toward explaining our sense of place and our tactile awareness of walls and doors, compression and expansion, ascent and descent” (Malnar & Vodvarka, 2004).

Stairs

Stairs not only meet function to support people moving up and down, but are a significant element to perceiving kinesthesia. Stairs are paths dramatized. Its motif is particularly emphasized in monumental architecture. (Thiis-Evensen, p.297).

First, staircase guides people’s movement, “dimension of risers and treads govern cadence of the gait” (Malnar & Vodvarka, 2004, p.147). “Staircase engages the user’s motions and their senses to a remarkable degree, perhaps more so than any other architectural elements”. (Templar, 1992, p.23). An architect acts like a drama director, and people in the building are characters, following the command to step up and down, therefore, fulfill a whole drama all together. In some buildings, staircases, together with ramp, create an extraordinarily dynamic space, which awes people at the entrance and stimulates curiosity to
explore the whole building. According to this point, staircases are not accessories of a building, but a critical component of the building.

Second, symmetric stairs not only meet practical function, but achieve balance, since human perception seeks a symmetrical balance. The symmetry and scale of staircase also showcase social intent, just like the dimension of an entrance. It is not coincidental that there are always huge staircases before palaces (Malnar & Vodvarka, 2004, p.147). Large, symmetrical staircases display high social status, authority, or wealth. Further, the process walking on the staircase is a prelude of the whole space and foreshadows the corresponding atmosphere.

Third, changeable risers or treads deliver specific sensation. For example, in the garden of Vaux-Le-Vicomte, a staircase down to a pool has “constantly increasingly tread size from top to bottom, which has the effect of forcing a gait of ever-increasing stateliness” (Malnar & Vodvarka, 2004, p.147) (Figure 1).

Figure 1. Garden stair at Vaux-le-Vicomte, France (Malnar & Vodvarka, 2004, p.147)
Uneven Floor

People not only feel touch sensation through their hands, but perceive texture and temperature by foot. Generally, people barely pay attention to a flat floor and disregard sensations from their feet while walking. However, an uneven floor may awake this perception. “A lively, uneven floor in the public area means a regaining of the human dignity, which man is deprived of by the leveling tendencies of urbanism”. (Hundertwasser, 1997, p.282). An uneven floor compels people pay attention while walking on it. “Uneven pathways heighten our awareness of surfaces by obliging us to bring our sensory organs into the best alignment to perceive them” (Malnar & Vodvarka, 2004, p.104).

Designers may apply an uneven floor to reinforce touch and kinesthesia sensation. Combined with diverse floor materials and texture, interior space is perceived not only by mouth, nose, hand, but by foot (Figure 2).

![Figure 2. Uneven pathways heighten our awareness of surfaces. (Malnar & Vodvarka, 2004, p.105)](image)

Spatial Dimension

Human beings rely on spacing mechanisms to maintain an appropriate distance from others; a specific spacial dimension depends on accommodation of culture and emotion. According to studies by Edward T. Hall, there are four sets of interpersonal distances based on sensory awareness. “These are intimate distance (0-18inches), from love-making to
physical immediacy; personal distance (18-48 inches), from intimacy to casualness; social
distance (4-12 feet), from informal business to formal business; and public distance (12-25
feet or more), public speaking to celebrity status” (Malnar & Vodvarka, 2004, p.150).
Choosing a specific distance depends on the transaction and the relationship of the
interacting individuals, moreover, associates with their feeling, and what they are doing.
(Hall)

**Ascent and Descent**

Ascent or descent, over things or through them, is significant to shape a space (Thiis-
Evensen, 1987, p.25). In the book *space and place*, Yi Fu Tuan indicates how people
perceive space and place. “First, there are the biological facts of human comprehension of
space, which includes notions such as front/back, upright / prone, and so forth. Second, there
is the relationship between space and place, the manner in which the former gradually –
through experience – becomes the latter. Third, there is the effect of experience and
knowledge in our perception of space – an experience that can be direct and sensory or
indirect and conceptual, mediated by symbols”. (Tuan, 1977).

**Time**

Time is an important element while people walking through a space. People get
comprehensive image of a space through a series of views at different vantage points over a
period of time. This succession is multisensory and temporal (Wilson, 1984, p.90). The
procedure of walking through a garden is composed with time and space. (Moore, Mitchell,
and Turnbull, p.103). “Time has several layers of meaning: the amount of time in the act of
movement itself, the interval spent at any one site; and references to some quasi-historic
point of interest” (Malnar and Vodvarka, 2004, p.105).
Path

The path to enter a space functions to prepare a person for arrival. For example, in Japanese tea garden, the trail to tearoom is paved with gravel and stepping stones. It passes through a simple maze of mosses and other plants. On a small scale, it reproduces the long journey from the city to a teahouse in the mountains. It is a procedure for visitors to release the concerns of daily life and prepare for entering a “tea” state of mind. The garden has function of spiritual cleaning, and the trail before tearoom produce preparation for arrival. (Malnar and Vodvarka, 2004, p.10).
CHAPTER 3. FRAME WORK

"It doesn't matter whether I'm designing a sleek elegant room or a lively family-style bistro. I want to make certain that diners experience their meals with their sight, sound, touch, as well as with taste," said Alexander, a principal architect at AXIS Architecture + Design, with 20 years experience in design/architecture (Alexander). This chapter provides restaurant market analysis and proposes a framework for restaurant interior design, which can be generally adopted for varied restaurants.

Restaurant market analysis

People go to restaurants not only to dine, but also to conduct social and business activities. As more and more restaurants emerge, competition among eatery operators increases. Favorable interior design is a significant element beyond food and service to promote customer retention. Therefore, it is the designers’ responsibility to understand customer preference and apply specific principles to satisfy these desires. A memorable and favorable dining space is vital for restaurant owners to survive in a competitive market and maintain or acquire high revenue. Baraban, a lecturer at Harvard Graduate School of Design and a consultant specializing in hospitality design and marketing is a co-author of Successful Restaurant Design. She notes "environment affects people's attitudes and behavior. The design scheme influences ... how long they linger over a meal, how comfortable they feel, what they remember about the restaurant and even whether or not they want to return" (Allen, March 22, 1993).
Trend

The restaurant market is expanding. “The average American eats 198 meals out a year and spends $855 million on an average day on meals away from home” (Gorodesky & Madigan). At the same time, in order to meet different requirement, there are trends emerging that are dependent on, location, target customer, food styles, and other certain elements. According to Gorodesky and Madigan, there are four trends

A. An upscale, but casual theme. The upscale, but casual design trend delivers spirit of modernism, fashion and luxury.

B. Entertainment-themed restaurants - Planet Hollywood and Hard Rock Cafe are examples of this trend.

C. An exhibition cooking area where your chef is visible. The American public likes to see who is cooking for them, therefore, the exhibiting kitchen expose the chef to public. If the chef is famous, it is a good marketing tool for the restaurateur.

D. Neighborhood feel - People do business with people they know and like. It is same with restaurant. According to restaurant interior design, it is important to let customer feel they belong. (Ron & Eileen)

Restaurant owners should orient their market position appropriately. According to interior designers, they should acquaint themselves to the food industry and be familiar with trends and other changes which may affect the market.

Target customer

Aside from providing dining space, restaurants are becoming significant social venues. People at restaurants conduct business communications and negotiations, meet with friends, hold a variety of celebrations and banquets, et cetera. Therefore, foodservice areas are actually complex integrations which meet different requirements. According to restaurateurs and designers, it is vital to analyze target customers by considering their
preferences, habits, and communication styles, and then breed approaches to attract these customers and stimulate their consumption.

In addition to different target customers according to specific location and market orientation, what is the general range of customers? Amelia Levin, Associate Editor of Foodservice Equipment & Supplies, claimed that the millennial generation is the target customer for most foodservice operations, “those individuals that are today between the ages of 17 and 27 years old. According to the Hale Group, a whopping 36 percent of the population in this country will make up the majority of the restaurant/ foodservice customer base by 2015” (Levin, 2009). Accordingly, foodservice operators and designers must understand the consumer mode and communication style of this generation, combined with their preferences, habits, and so on, to make a restaurant meet their needs and thereby eventually increase revenue. “As a result, gathering places need to be social, interesting and exciting. We’re looking at less institutional, more fun, more relaxed, and in general, creating an entertaining ambiance to fit our customers today and in the future” (Levin, 2009).

In sum, in order to survive in this competitive market and earn high revenue, it is crucial for restaurateurs and designers to become familiar with the market, trends, and target customers, and as a result orient food style and specific interior ambience.

**Framework**

The purpose of this thesis is to propose a framework for restaurant interior design based on sensory study and restaurant market analysis. Because the framework is devised for restaurant sensory design, color, formation and other elements concerning modeling and styling are not included.

The framework has four parts, which are: sight sensory design framework, smell and hearing sensory design framework, haptic sensory design framework and interaction sensory
design framework. Every framework has four components: title, sensory theory, design method description and goal. Interaction sensory design framework has an extra component to illustrate interaction senses. Title refers to general content of the design method; sensory theory provides theory background; design method description illustrates strategies in restaurant interior design practice; goal delivers intention of the design method. According to goal, there are some intentions, such as comfort, provide expectation, impressive experience, enhance movement, and function accommodation.

**Sight sensory design framework**

**Ornament and Scale**

Ornament and scale exhibit status and wealth. In addition, ornament is applicable to control rate of movement. According to restaurant design, a sitting area may have more decoration to provide visual emphasis and entice a customer stay longer, therefore stimulating his/her consumption. The entrance area may have less decoration and large scale doors and stairs. The former encourages a quicker rate of movement and the latter shows high-grade status. The service area may have little or no decoration and a smaller gate and stairs. Less decoration produces a high rate of movement and a smaller scale reveals the service area’s subordinate status and while highlighting the dining area.

**Light**

Light is usually applied to provide focus, for example, illuminating a piece of artwork, a wall with a specific theme, or the tabletop. In restaurants, tabletops need be well illuminated to stress plate presentation. Dim lighting is appropriate for aisles, which contrast
tabletops and increases focus. Bright spaces with high ceilings breed sense of energy and vitality, and dim spaces lighted by wall sconces or lamps convey a cozier feel (Alexander).

Light not only has function of illumination, but affect people physiologically and psychologically. Where lighting approximates the spectral quality of natural sunlight, there is less perceptual fatigue and improved acuity (Maas, Jayson, and Kleiber, 1974, p.524-26). The kitchen is always illuminated by fluorescent lamp and no natural sunlight. The absence of sunlight affects the staff’s concentration and cooperation, and can breed illness. Consequently, kitchens need have enough sunlight to avoid those detriments.

**Complexity**

Complexity refers to the intricacy of elements in a space. A high positive correlation exists between complexity and preference; therefore, it is desirable to design a restaurant with high complexity. According to one study, a high score of complexity relates to larger and irregular shape spaces, which are subdivided by varied architectural elements, furnishings, and plants. The complex geometrical space has vertical orientation and multiple directions of visual emphasis (Scott, 1993). Consequently, in order to make a restaurant space has high complexity, plants, furnishings, and other architectural elements are necessary. Moreover, the interior space should avoid simple boxlike geometric shape because irregular space is more favorable. A space may be subdivided by curtains, booths, plants, furnishings, and other elements, which make the interior space have multiple visual foci and greater complexity.

In addition to spatial geometry, complexity also refers to the composition or pattern of elements in the scene. Thereby, the floor plan should be complex, which means an intricate pattern of elements is preferable. Further, arrangement of tables and chairs should vary. Consequently, creating variety of space for dining not only provides multiple choices
for customers, but engenders a more complex space, which makes it more preferable for customer.

**Mystery**

Mystery is the degree to which people are attracted to pursue more information by proceeding further into the scene. A moderately high positive correlation is observed between mystery and preference. Consequently, it is advisable to design a restaurant space with high mystery. According to Scott’s study, some approaches are elemental to achieve mystery. First, “offer shorter distances of view to the first points of interest.” In terms of restaurant design, the entrance area should have points of interest to attract customers to go further. Second, “provide accessibility to the larger environment via paths, particularly ones that were shorter, wider, and turn out of view.” This idea may be applied to design aisles. Third, the space should be “neither small and enclosed nor large and wide open.” Fourth, “include architectural features, furnishings, or plants that simultaneously permitted a degree of visual access to other spaces while prohibiting total understanding of the setting.” This point is similar with the approach to achieve complexity. Architectural features, furnishings, or plants not only produce multiple visual focuses, but screen the space and then prohibit clarify whole space at first glance. Fifth, “show dramatic brightness contrast between the foreground and areas deeper in the scene.” Light contrast not only stress visual emphasis, but enhances the sense of mystery. (Scott, 1993)

The relationship between immediate location and promised information affects different levels of mystery and preference. Scott points out that when immediate location is desirable and the promised information is similar, mystery and preference are high; when promised information is more attractive than immediate location, mystery and preference are enhanced (Scott, 1993). Therefore, the attraction value of promised information is a
significant element to affect mystery level. In order to achieve high mystery, it is important to avoid exposing every element at first glance, but still provide promised information with high level attraction.

**Sitting style**

Create varied dining spaces, including exposed sitting, loges, booths, and so on. Different sitting styles meet various requirements. For example, cozy space with couches may breed intimate ambience and long, communal tables accommodate groups of customers. Varied seating space provides customer multiple choices, and therefore may attract more customers (Levin, 2009).
<table>
<thead>
<tr>
<th>Title</th>
<th>Sensory Theory</th>
<th>Design Method Description</th>
<th>Goal</th>
</tr>
</thead>
</table>
| Ornament and Scale  | Ornament and scale play display status and wealth   | 1. More details and larger scale are applied in areas used by guests, and less details and small scale are applied in service areas.  
2. Ornament may be used to control rate of movement. In aisle space, ornaments may be diminished to increase movement rate; in the seating area, more decorations prolong dining period, and stimulate consumption. | Functional accommodation |
| Light               | Light affects humans physically and psychologically | 1. Kitchen design should have enough sunlight to enhance staff’s concentration and cooperation and avoid illness derived from the absence of sunlight.  
2. Tabletops should be illuminated well to stress plate presentation.  
3. Dim lighting is appropriate for aisles. | Functional accommodation |
| Complexity          | Complexity refers to intricacy of elements         | 1. Interior space should evade simple boxlike geometric shape; irregularly shaped space is favorable.  
2. A whole space may be subdivided by curtains, booths, plants, furnishings, and other elements to make an interior space have multiple visual focus and greater complexity.  
3. The floor plan should be complex, which means intricate pattern of elements including a variety of table and chair arrangements. | Provide expectation  
Impressive experience |
| Mystery             | Mystery is the degree people are attracted to pursue more information by proceeding further into the scene | 1. “Offer shorter distances of view to the first points of interest.” Entrance area should have points of interest to attract customers to go further.  
2. “The space should be neither small and enclosed nor large and wide open.”  
3. “Include architectural features, furnishings, or plants that simultaneously permitted a degree of visual access to other spaces while prohibiting total understanding of the setting”.
4. “Show dramatic brightness contrast between the foreground and areas deeper in the scene.” (Scott, 1993)  
5. To achieve high mystery, avoid exposing every element at first glance, while still providing promised information with high level attraction. | Provide expectation  
Impressive experience |
| Seating style       | Create varied seating options, including exposed sitting, loges, booths, and so on. |                                                                                                                                                                                                                                                                                                                                                 | Function accommodation |
Smell and hearing sensory design framework

Release odor intermittently

Smell sensory fatigue rapidly, therefore, when discharge fragrance, it is advisable to release it intermittently.

Discharge fragrance

Fragrance is an element of spatial judgment. For example, in a test to detect the function of fragrance, a room containing a low level of fragrance was considered by subjects as brighter, cleaner, and fresher, but no subject realized the fragrance (Clifford, 1985, 115-17). Therefore, discharging a light fragrance into a restaurant may allow the space to appear more favorable.

Eliminate noise

Nothing ruins a space like bad acoustics and noise. Customers go to restaurants in order to have relaxation; a noisy environment may result in fatigue and nervousness. Therefore, it is critical to produce a desirable sound environment, which may be achieved by effectively using sound-absorbing materials, such as draperies, carpets, and acoustical ceiling tiles, all of which can go a long way toward eliminating unwanted sound effects. Additionally, application of texture and shapes are also feasible approaches to carry out pleasurable sound space.

Background music

“An environment without sound is lifeless and unreal, without flow or rhythm, and frightening” (Pocock, p.194). Appropriate background music is one way to reduce or
eliminate lifeless and frightening elements. Moreover, it makes a space more favorable and conveys a relaxing atmosphere.

| Table 2. Smell and hearing sensory design framework |
|---------------------------------|---------------------------------|---------------------------------|
| **Title**                      | **Sensory Theory**               | **Design Method Description**    | **Goal**                       |
| Release odor intermittently     | Sense of smell rapidly fatigues | Odor should be released          | Function                        |
|                                 |                                 | intermittently to fight with     | accommodation                   |
|                                 |                                 | sensitivity fatigue.             |                                |
| Discharge fragrance             | Fragrance is component of       | Slight fragrances make a space   | Comfort                         |
|                                 | spatial judgment                | feel brighter, cleaner and fresher.  |
|                                 |                                 | Therefore, discharging light     |                                |
|                                 |                                 | fragrance in restaurant may make |                                |
|                                 |                                 | the space more favorable.         |                                |
| Eliminate noise                 | Noise increases fatigue and     | 1. Effectively use sound-         | Comfort                         |
|                                 | nervousness                    | absorbing materials,             |                                |
|                                 |                                 | such as draperies, carpets, and  |                                |
|                                 |                                 | acoustical ceiling tiles, to      |                                |
|                                 |                                 | reduce unwanted sound effects.    |                                |
|                                 |                                 | 2. Application of texture and     |                                |
|                                 |                                 | shapes is also a feasible        |                                |
|                                 |                                 | approach to carry out pleasurable |                                |
|                                 |                                 | sound space.                      |                                |
| Background music                | “An environment without sound is | Background music makes a space    |                                |
|                                 | lifeless and unreal,            | more favorable and conveys        |                                |
|                                 | without flow or rhythm, and     | relaxing atmosphere.              |                                |
|                                 | frightening” (Pocock, p.194).    |                                 |                                |

Haptic sensory design framework

Surface texture
Surface materials not only have a protective function and provide pleasant visual images, but also engage the sense of touch is an especially significant sensation during the eating process. People touch the surface of tables, chairs, dishware, flatware, menus, and
other accessories on tables; meanwhile, they feel floor texture by foot. Consequently, the texture of materials in the dining area should make customer feel comfortable and pleasant, to induce staying lengthier stay and stimulate consumption.

**Warmth of fireplace**

Often, a fireplace is a familiar component in a living room. Therefore, by adding a fireplace to the dining area, the warmth conveys a cozy environment and reminds customer intimacy and comfort, just like a living room. Fireplaces produce homelike atmosphere, which promotes a relaxing atmosphere.

**Stairs**

Stairs are dramatized paths. Their diagonal direction suggests function, which is connecting two different levels. A staircase engages the user’s motions and senses to a remarkable degree. This can be enhanced with changeable risers or treads to provoke specific feelings. Stepping up and down through stairs produces dynamic view of the space (Malnar & Vodvarka, 2004). Therefore, beyond the simply connecting multiple levels, stairs allow a person to perceive a space dynamically. Accordingly, it is desirable to place stairs in central area, and make it a visual focus to encourage customers to perceive the space dynamically and form a more impressive perception of the space.

The symmetry and scale of staircase indicate social status. Large scale of stairs not only meets heavy traffic, but display high status and authority. Therefore, in restaurant design, stairs in the dining area should have a larger scale than those in service area.
Uneven floor

People get used to even floor and ignore the floor texture while walking. However, uneven pathways heighten awareness of surfaces. Variations in the level, and position of the path, compel people to pay attention as walking on it (Malnar & Vodvarka, 2004). As such, an uneven floor is an excellent strategy to reinforce kinesthesia, and it enhances customers’ awareness of surface texture while heightening their touch perception. It is desirable to apply uneven floor in dining area, in addition with specific floor texture, to enhance touch sensation.

Spatial dimension

Humans rely on spacing mechanisms to maintain an appropriate distance from others, a distance highly dependent on culture and emotion (Malnar & Vodvarka, 2004). There are four sets of interpersonal distance based on sensory awareness, which are intimate distance (0-18 inches), personal distance (18-48 inches), social distance (4-12 feet), and public distance (12-25 feet or more) (Hall). In restaurant design, “personal distance” (18-48 inches) should be applied to arrange tables and chairs. Otherwise, too close a distance invades privacy or causes discomfort while distances that are too large may lead to difficulty in communication, and inconvenience in reaching for dishes.

Ascent & descent

Ascent or descent, over things or through them, is not only universal but also significant to the shape of a space (Thiis-Evensen, 1987). Applying various floor levels to create ascent and descent may be a good approach to achieve a “space.” In terms of restaurant design, create various floor levels to achieve ascent and descent, especially in spacious dining areas.
**Path at entrance**

The path to the entrance of a space prepares a person for arrival. Applying the “path” idea in the restaurant entrance produces a preparation process, which is clearance ceremony for customers transferring from the stressful office and concerns of daily life to relaxation and recreation.
Table 3. Haptic sensory design framework

<table>
<thead>
<tr>
<th>Title</th>
<th>Sensory Theory</th>
<th>Design Method Description</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface texture</td>
<td>Touch sensory system plays a significant role to perceive the world. Aristotle claimed that tactile was the most critical and fundamental sense (Aristotle, 1986, p.218).</td>
<td>Texture in dining area should make customer feel comfortable and pleasant, compelling their longer staying and then stimulating consumption.</td>
<td>comfort</td>
</tr>
<tr>
<td>Warmth of fireplace</td>
<td>Warmth contributes a space intimacy and comfort</td>
<td>Apply a fireplace in dining area. The warmth conveys a cozy atmosphere and reminds customer intimacy and comfort.</td>
<td>comfort</td>
</tr>
<tr>
<td>Stairs</td>
<td>Stairs are dramatized paths dramatized Changeable risers or treads convey specific feelings Stepping up and down stairs produces dynamic view of the space (Malnar &amp; Vodvarka, 2004). Symmetrical and big scale staircases display high social status, authority, or wealth.</td>
<td>1. It is desirable to place stairs in central area, and make it a visual focus to stimulate the customer perceive space dynamically. 2. Stairs in a dining area may have larger scale than those in service area.</td>
<td>Enhance movement Function accommodation</td>
</tr>
<tr>
<td>Uneven floor</td>
<td>Uneven pathways heighten awareness of surfaces by bringing the sensory organs into the best alignment to perceive them (Malnar &amp; Vodvarka, 2004).</td>
<td>Apply uneven floor, in addition with specific floor texture, to enhance customers’ awareness of surface texture and therefore reinforce touch perception.</td>
<td>Impressive experience</td>
</tr>
<tr>
<td>Spatial dimension</td>
<td>There are four sets of interpersonal distance based on sensory awareness, which are intimate distance (0-18 inches), personal distance (18-48 inches), social distance (4-12 feet), and public distance (12-25 feet or more) (Hall).</td>
<td>In restaurant design, “personal distance” (18-48 inches) should be applied to arrangement of tables and chairs.</td>
<td>Function accommodation</td>
</tr>
<tr>
<td>Ascent &amp; descent</td>
<td>Ascent or descent, over things, or through them, is not only universal but also significant to shape a space (Thiis-Evensen, 1987).</td>
<td>Various floor levels deliver ascent and descent, which is a good approach to achieve “space”.</td>
<td>Impressive experience</td>
</tr>
<tr>
<td>Path at entrance</td>
<td>A path at entrance prepares guests for arrival.</td>
<td>Applying the “path” idea in a restaurant entrance creates preparation procedure for customers.</td>
<td>Function accommodation</td>
</tr>
</tbody>
</table>
Interaction sensory design framework

Kitchen in dining area

People usually have their kitchen open to the dining area in a home. In restaurant design, transferring part of kitchen to dining area may create a homelike environment. Moreover, since sound enhances other sensory perceptions, placing the kitchen in the dining area provides customers with sound produced from the cooking process, which may stimulate appetite as well as reinforce taste and smell sensations. Susan Wilkie, principal of Susan Wilkie Enterprises, believes this approach may create a sense of fresh food being cooked. She said: “We call it the ‘sizzle’ factor, using a lot of burners, Mongolian grills, revolving griddles where you can cook anything from tortillas to pancakes, eggs and bacon. Collectively, these pieces of foodservice equipment create that sizzling sound consumers associate with fresh, hot food. The type of sensory communication I try to create is that customers are getting food fresh, and it’s made just for them.” (Levin, 2009)

A style of Japanese restaurant called Teppanyaki illustrates this idea. In Teppanyaki, an operation station for the chef is placed in the center, and customers sit around it. After ordering, the chef cooks in front of them. Customers watch cooking process, see raw food turning into delicate dish, and listen to the sounds, from clipped tones to very subtle ones. This process minimizes the boring waiting period and changes it to a show time. Moreover, the show enhances customers’ anticipation of the food and enhances the eating activity from simply taste and smell to a sensory complex of vision, hearing, taste, and smell. Furthermore, American likes to know who are preparing their food. If the chef who cooks in public area is well-known, it is a great marketing approach to attract more customers (Gorodesky & Madigan).
Attractive odor at entrance

Favorable smells enhance the sense of taste. For the purpose of attracting more customers, a food smell may be transmitted to the entrance through the ventilation system or directly moving the cooking facility to entrance area. The following example illustrates this point. Susan Wilkie, principal of Susan Wilkie Enterprises, purposely moved the ovens to the entrance while designing a Disneyland bakery-cafè. “They sell more sandwiches than baked goods, but whenever there are cinnamon rolls baking at the front, that really gets people to come in. You smell the cinnamon, the freshly baked bread, and then you see people pulling them out of the oven and icing them and it makes you think, ‘I have to have that,’ no matter what the price or reason,” she said (Levin, 2009).

Remind pleasant odor memory

Interior designers may introduce certain elements which may remind pleasant odor memory. For an instance, in a relevant test, sleeping places and other intimate rooms where one feels at home and secure was mentioned by subjects in connection with pleasant odor memories (Malnar & Vodvarka, 2004). Therefore, it is desirable to introduce elements in intimate spaces, such as a fireplace, to the restaurant area to remind customer pleasant odor memory.
<table>
<thead>
<tr>
<th>Title</th>
<th>Interaction senses</th>
<th>Sensory Theory</th>
<th>Design Method Description</th>
<th>Goal</th>
</tr>
</thead>
</table>
| Kitchen in dining area | Sight              | Sight enhances other senses. | 1. Transfer kitchen to dining area, produce homelike environment.  
2. Sound produced from kitchen in dining area can stimulate appetite and enhance taste and smell sensation.  
3. Exposed kitchens produce sense of fresh and hot food.  
4. Well-known chef in visible kitchen is a great marketing approach | Impressive experience    |
|                       | Smell              | Smell enhances taste perception. |                                                                 | Enhance movement            |
|                       | Hearing            | Sound enhances other sensory perceptions. |                                                                 |                             |
|                       | Taste              | Sound plays a crucial role in the participation, experience, and remembering of places. |                                                                 |                             |
| Attractive odor at entrance | Smell              | Smell enhances taste perception. | 1. For the purpose of attracting more customers, attractive odor may be transmitted to entrance by ventilation system.  
2. Transfer cooking facility to entrance area. | Provide expectation      |
|                       | Taste              |                                                                 |                                                                 |                             |
| Remind pleasant odor memory | Sight              | Sight have association with other senses. | Introduce sight elements which may evoke pleasant odor memory. For example, apply a fireplace in restaurant to remind homelike odor; employ wood materials to remind forest odor. | Impressive experience      |
|                       | Smell              |                                                                 |                                                                 |                             |
CHAPTER 4. CASE STUDY

In this chapter, the framework is applied in a real project: redesigning a Chinese buffet in Ames, Iowa. The purpose of this case study is to test the validity of the framework. Although the case study is redesigning a buffet restaurant, the framework is created to be applied to general restaurant. This case study has following significant functions:

First, it is a way to test the feasibility of the framework. It displays how to apply the framework to design a restaurant, and demonstrates if the framework is easily applied and suitable for a specific restaurant like a Chinese buffet.

Second, it is a way to exhibit how the framework works. Original design and redesign analysis are conducted according to items in this framework one by one.

Third, it is a way to value the framework. Through redesign drawings, it is possible to test the framework and evaluate if the framework provides a feasible solution. By comparing the original restaurant photos and redesign drawings, one may decide if the framework is effective, and if it is adaptive to restaurant design.

Finally, it is a way to show the significance of sensory design. By comparing redesigned renderings to photos of existing restaurant, the advantages of sensory design can be highlighted.

There are three parts in this chapter: existing design, framework application and redesign, and the result of case study.

Existing Design

Background

King Buffet is a Chinese restaurant in Ames, Iowa. It lays a one-story commercial complex, neighbored by a movie theatre and supermarket, in southeast Ames, near a main
highway. This area is a commercial district, with many restaurants and stores. A Best Buy store and Staples store are located nearby, in addition to American restaurants in the vicinity. There are no other Chinese restaurants or buffets in this district. King Buffet is one of ten Chinese restaurants in Ames, but is the only one to boast a buffet. It consequently has competitive marketing position.

Since Iowa State University is based in Ames, a high percentage of residents are students, faculty, and other staff who work on campus. The owners of King Buffet came from southern China and established this restaurant twelve years ago.

**Interview**

The author interviewed the owners of King Buffet, and with questions focused on customers range, marketing status, existing problems, and suggestions. The following is selected information stated by the owners of King Buffet.

**Customers range:** Although King Buffet serves many Chinese customers, the main customers are American. Most customers are young persons and the middle-aged, with age range approximately from 20 to 50.

**Marketing status:** On weekdays, approximately 50 percent seats are full; on weekends, nearly all seats are full, and there are sometimes people waiting outside.

**Existing problems:** King Buffet was designed in 1997. The design is outdated and some materials are worn.

**Employees:** There are fourteen employees, four employees work in dining area, and the rest work in kitchen.

**Suggestion:** Owners claim they need an updated interior design.
Design overview

The original interior design of King Buffet was made in 1997, designed by a Chinese interior design company based in New York City, focused on Chinese restaurant interior design in America. The first part of this section contains general information of the original design. In the second part, applies a sensory analysis tool created by Monice Malnar and Frank Vodvarka to analyze interior space on six different points.

The building of King Buffet is rectangular boxlike shape, located between two commercial stores. Therefore both side walls which shared with the other two stores are solid. The only entrance has a façade and window.

The entrance foyer is also boxlike with a reception station positioned face to it. Upon entering the restaurant, the dining area is nearly exposed at first glance. There are two kinds of sitting styles, which are exposed sitting area and booths. The kitchen is located close to backward wall. Between the kitchen and dining area, there are food and beverage station which customers serve themselves. There is a discrete window on the wall of kitchen where wait staff may place dishes conveniently. Restrooms are on same side as the kitchen (Figure 5).
Figure 3. Entrance facade

Figure 4. Back facade
Figure 5. Existing floor plan
Sensory analysis

Overview

Joy Monice Malnar and Frank Vodvarka create schematics to analyze sensory environment. They devised a sensory slider which is composed of bars, “each one describing the extent of figure/ground clarity for a particular sense” (Malnar and Vodvarka, 2004). A simplified sensory slider, composed of four bars, is applied to analyze King Buffet. These bars are visual, sound, odor and haptic (Figure 6).

![Figure 6. Sensory slider](image)

There are six vantage points where sensory analysis is carried out. Point A is in the foyer; point B is at entrance; points C and D are in middle of dining area; point E is around food stations; point F is between the food station and seating area (Figure 7).

![Figure 7. Sensory analysis on six standpoints](image)
Sensory analysis on six stand point

Point A:

The foyer is a small boxlike space, where sound, odor and haptic are all rated very low. Since the interior spaces are exposed only a little, visual is rated a bit higher. There is no attractive odor in this area to appeal to the customer and the foyer is too enclosed, which greatly lower visual and haptic responses. To achieve ideal sensory design, all four senses need be enhance; odor need be more stressed to attract outside people come in. (Figure 8, 9)
At the entrance, the whole dining area is exposed, so visual and sound are rated high. Although food stations are located far away, there is still a light food odor here, which is an attractive element for an incoming customer. There is little haptic sensory experience here, so it receives a low rating.

Since there is no partition to separate the dining area from the entrance, it is somewhat noisy at this vantage point. Further because of too many visual elements, there is no visual focus. Attractive odor is positive factor, but it is faint. Haptic sense should be
enhanced. To achieve ideal sensory design, partitions are needed to block extra visual and sound; odor need be enhanced to attract customer; haptic need be enhanced. (Figure10,11)

Point C:

Figure 12. Left: C stand point; right: perspective of this area

The partitions between lodges block some vision, which drops visual response a little lower. Sounds from the dining area and food stations can be heard, therefore sound is rated very high. The proximity of the food stations increases the odor rating. According to a

Figure 13. Sensory slider analysis on point C
customer sitting in lodges, haptic sense is favorable, due to multiple materials and texture which are glass and wood partitions, leather chairs and “artificial wood” on tables. However, the seating area between lodges receives a low haptic sense.

Based on the author’s observation, customers prefer booths over exposed sitting, and nearly all customers choose booths if it is possible. Noise drifts into this area due to the proximity to the food stations and the seating area. To achieve ideal sensory design, certain approaches are needed to decrease extra visual, sound, odor; haptic need to be enhanced. (Figure12,13)
Point D:

Figure 14. Left: D stand point; right: perspective of this area

Figure 15. Sensory slider analysis on Point D

Sensory rating on this point is somewhat similar with point C, except visual and sound are rated lower, due to partition of booths. The strategy to achieve ideal sensory design is similar as point C as well. (Figure14,15)
With respect to the exposed dining area, visual response is still rated high. Beverage machines and an ice cream machine produce loud noises intermittently and cooking noise from the kitchen is transmitted to this area through window on the wall. There are some other sounds produced from process of customers fetching dishes and service activities at the food. In addition there are chatting and clicking sounds from dining area, so sound is very strong element here. Odor is rated high, since in addition to the smell from food station,
cooking odors from kitchen can be perceived as well. Due to multiple materials and texture in this area, haptic is rated moderate.

The sound environment in this area is terrible, and the mirror on the wall amplifies the problem since it does not absorb noise. To achieve ideal sensory design, visual and odor need be weakened to get a moderate high level; sound need be weakened greatly to get a moderate level; haptic need be enhanced. (Figure 16, 17)

Point F:

Figure 18. Left: F stand point; right: perspective of this area

Figure 19. Sensory slider analysis on Point F
This area is beside food stations, therefore visual, sound and odor are nearly similar with point F, just rated a little lower. Without multiple materials, haptic is rated low.

Due to high rating of visual, odor and sound, this area is not fit for dining. According to observation, no customers sit in this area, if another seating space is vacant. Actually, this area is used as service place and some employees work here. To achieve ideal sensory design, visual, sound and odor need be weakened greatly to get moderate level; haptic need be enhanced. (Figure18,19)

Framework Application and Redesign

Redesign Overview

- In order to break from the rectangular boxlike shape of original building space, diagonals and arcs are introduced to make the space have specific character and appeal.
- Since two side walls are shared with another two stores, and there are no windows on them, the front and back walls need have as many windows as possible. The front facade is constructed with French windows and a diagonal entrance box. The original back wall is solid, and there is a service parking lot and garbage bins outside. In redesign, there is a window on back wall in kitchen area, which changes the kitchen from a closed box to a space with sunshine.
- Some landscape elements are applied, such as a shallow pool at entrance, and plants as partition elements in dining area.
- Other than typical food stations, a specific buffet style called Mongolia Grill is introduced, and settled into the entrance area, to attracting customers by the cooking smell.
• In addition to typical sitting style, loges and booths are employed to produce the illusion of a more private space. Moreover, instead of totally flat floor, redesign integrates various floor levels which produce ascent and descent. Accordingly, the ceiling has varied height as well.

• To emphasize sensory design, with the exception of some materials applied in entrance and dining area, there is no other color other than white and black in rendering pictures.

• Redesign is made on computer. Auto CAD is used to draw floor plan, and 3D Max is applied to modeling and rendering.
Figure 20. existing floor plan and redesign floor plan
Figure 21. Bird view of redesign

Framework application

In this section, the original interior space and redesign are analyzed according to previous framework. Not all items are discussed, because of limitations of the original building. For example, King Buffet is a one floor building, so “stairs” in haptic sensory design framework cannot be applied.
**Sight:**

- Ornament and scale

**Existing design:**

In terms of ornament, there are some pictures on the wall of dining area, and some fake flowers on top of food stations. With regard to scale between the dining and service areas, there is little difference.

**Redesign:**

In addition to decorations, there are a variety of design elements which have ornaments function, such as plants, lamps, furniture, and textures. Comparing with doors in service area, the entrance door is larger.

- Light

**Existing design:**

1. Light in dining area has no focus. Tabletops and aisles are treated equally, therefore, tabletops illumination is too dim and aisles are too bright.
2. There is no natural light in kitchen, which will affect work efficiency and decreases employees’ health.
3. Although there are windows on the front wall, sunshine is blocked the reception station, a coat rack, and curtains (Figure 22).

**Redesign:**

1. Every tabletop is illuminated with its own lamp, and there is no lamp to illuminate aisles, which produces a contrast, and emphasizes focus.
2. There is a window on the back wall of kitchen, which brings sunshine to this space and benefit employees psychologically and physically.
3. The dining area is located in front of the windows; therefore customer can enjoy sunshine and scenery outside (Figure 23).
Figure 22. Existing design: sunlight is blocked

Figure 23. Redesign: sunlight illuminates dining area
• Complexity

Existing design:

1. Interior space has a simple boxlike shape.
2. There are no subdividing elements, such as curtains, booths, plants, and so on.
3. The floor plan is tedious and arrangement of tables and chairs is monotonous.

Redesign:

1. In order to break the rectangular boxlike shape of original building space, diagonals and arcs are introduced to make the space have specific character and appeal.
2. To produce subdivisions, elements such as low partitions with plants on the top placed in middle of dining area, curtains to separate booths and public area, walls which segregate entrance and dining area, and so on are introduced.
3. Introduction of diagonals and arcs, various floor levels, diverse arrangement of tables and chairs, and some other elements produce a complex floor plan.

• Mystery

Existing design:

1. There are no points of interests in entrance area to entice customers go further.
2. The whole space is widely exposed, and there is no screen to prohibit seeing the whole space at first glance.
3. There is no brightness contrast.

Redesign:

1. Introduce two walls to enclose the entrance area, which prevents exposing everything at first glance; this means the promised information has high level attraction to encourage customers to go further. (Figure 27).
2. Interior wall of foyer becomes totally glass, which exposes some parts of the interior space to foyer and attracts customers go further; the exterior wall of foyer is almost solid, which prevents exposing everything. (Figure24,25).

3. Introduce some subdividing elements in the dining area which prevent exposing everything at first glance, such as low partitions with plants on the top in middle of dinning area, curtains which separate booths and public area, and so on.

4. With regard to brightness contrast between the foreground and background produces a feel of mystery. Illumination of the foyer is dim, and it gets brighter while customers go further into entrance and then turns to dimmer again while walking to dining area. Moreover, in the dining area, aisles are dimmer than tabletops, which are also produces a brightness contrast.
Figure 24. Exterior perspective

Figure 25. Exterior perspective
Figure 26. Existing design. Left: perspective of foyer, right: perspective of entrance

Figure 27. Redesign. Left: view from foyer. Right: view from entrance
- Table and chair arrangement:

Existing design:

1. Other than exposed sitting style and booths, there are no other sitting choices. The exiting arrangement cannot meet the privacy requirements of some customers.

2. There are two storage places in dining area, and one is a cubic exposed space. Storage rooms should lie in the service area because exposed storage leaves customers with unpleasant feelings (Figure 28).

3. The layout of tables and chairs is tedious. According to observation, between two peak dining periods in a day while there are fewer customers, they all sit in southern sitting area beside the food station, and leave the other seating space vacant. Aside from the proximity to the entrance and food stations, one reason for this may be the tedious arrangement of tables and chairs: customers have no reason go further if there is no difference.

4. Customers seldom sit in the area between kitchen and food station. It is very noisy, because the service machines near the food stations produce intermittent noise, and cooking from the kitchen transmits to this space through the small window on the wall. This is compounded by the clicking of dishes at the food stations, where customers choose food and employees change pans. Therefore, this area turns into part of kitchen when some employees work here. (Figure 28).

Redesign:

1. There are three sitting options: exposed sitting, loges and booths. Various arrangements of tables and chairs deliver multiple choices for customers (Figure 29).

2. Eliminate storage from dining area and place them in kitchen.
3. Apply a diagonal partition to separate dining area, and a partition to enclose loges, which yields a dramatic floor plan.

4. Employ various partitions to block noise and disturbance from other customers, which makes seating area more comfortable.

Figure 28. Existing design. Left: two storages in dining area. Middle: some dining space used as "kitchen". Right: a covert window on the wall of kitchen.

Figure 29. Redesign: dining area
Smell and Hearing

- **Release odor intermittently**

Existing design:

Other than food odor from dish venue area, there is no other pleasant odor.

Redesign:

To fight with smell fatigue, fragrance is discharged in restrooms intermittently.

- **Discharge fragrance**

Existing design:

There is no fragrance discharged.

Redesign:

A fragrance, like lemon, is discharged in restroom, which promotes feelings of freshness and cleanliness.

- **Eliminate noise**

Existing design:

Acoustical ceiling tiles and carpeting are applied to decrease noise.

Redesign:

Other than acoustical ceiling, carpet and other noise-absorbing materials, some partitions and plants in the dining area block noise, and ensure a quieter space.

- **Background music**

Existing design:

There is background music in the original design. However, there are just two speakers on ceiling; therefore, music is too loud in some areas and too weak in others.

Redesign:
In order to have high quality background music, install more speakers on ceiling and distribute them evenly.

**Haptic**

- **Surface texture**

Existing design:

There are some materials and textures in dining area; however they are plain and unimpressive.

Redesign:

Apply some natural materials such like wood, stone, and plants as partition, and fabric and leather on the chairs. These materials have either a natural or artificial texture, as well as a warm or cool temperature, which deliver customer ample touch perception.

- **Uneven floor**

Existing design:

There is no uneven floor.

Redesign:

A path paved with pebble creating an association between an outside door to dining area in entrance space. While walking on it, the uneven surface enhances customer’s awareness of surface texture, and therefore reinforces touch perception.

- **Ascent and descent**

Existing design:

The whole floor has same level, and there is no ascent and descent.

Redesign:
There are three floor levels: entrance floor is 6” higher than the food stations area, and loges and booths area are 1’ higher than it. In addition, the shallow pool is 6” lower than entrance floor. These different floor levels force ascent and descent, which reinforce shaping a “space.” Different levels impel customer step up and down, which enhances kinesthesia perception and delivers a more impressive environment (Figure 30).

**Path at entrance**

Existing design:

There is no path at the entrance.

Redesign:

A path paved with pebble lies in entrance, in association with an exterior gate to dining area. The path prepares a costumer for dining, and, it is clearance ceremony for customers from offices or concerns of daily life to relaxation and recreation. (Figure 31)
Interaction senses

- **Kitchen in dining area:**

Existing design:

There is no open kitchen in dining area.

Redesign:

A cooking style called Mongolia Grill is introduced in redesign. Mongolia Grill is another type of buffet, in which customers choose raw food stuffs, bring them to chefs, and watch the chefs cook on a circular stove. The customers then fetch back the prepared dish. This process not only leads customers to enjoy specific taste sensations through varied combinations of foods, but also enhances sight, smell, and hearing sensation. While chefs cook dishes for them, customers watch the “cooking performance”, smell the attractive scent released from cooking, and hear sizzles and other subtle noises. Further, since sensory
systems influence each other, taste is reinforced by activating other senses. Therefore, customers may be inclined to find their dish more delicious. In addition, this cooking style produce “fresh and hot” dish which strengthen customers’ appetite. Customers participate in cooking process as well, which transfers dining activity from eating to a more engaging procedure. All of these make the dining experience more specific and impressive, which stimulates customers return later (Figure 32).

Figure 32. Mongolia Gill in dining area

- **Attractive odor at entrance**

Existing design:

There is no intriguing odor in entrance area which attracts customers.

Redesign:

A Mongolia Grill is settled besides entrance, and an attractive odor produced from cooking procedure appeals to potential customers outside.
- **Remind pleasant odor memory**

Existing design:

> There are no elements which produce pleasant odor memory.

Redesign:

1. Apply some natural elements, such like plants in the dining area and a shallow pool in the entrance, which produces pleasant odor memories about nature in customers.
2. Apply some natural materials, such as granite and wood to remind customer pleasant odor memory in nature.

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**Result of Case Study**

The purpose of this case study is to test the application of the proposed framework and reveal the significance of sensory analysis and design. The original design analysis is conducted by an analysis tool called the sensory slider, devised by Joy Monice Malnar and Frank Vodvarka. Redesign sensory analyses are all based on the outlined framework.

Through case study, the framework is identified as feasible to be applied in real practice. By applying this framework, a more favorable interior space with desirable sensory perception is achieved. Due to different space conditions, not all items in framework need to be met. For example, in the King Buffet redesign, stairs are not used to enhance kinesthesia due to the one-story building and a fireplace is not applied to create a homelike atmosphere due to limited space.

Further, this case study reveals the significance of sensory analysis. Sensory analysis is an effective methodology to analyze a certain space. Through the application of a sensory slider, every sensory aspect is rated. Through analyzing senses of visual, odor, sound, and
touch, some advantages and disadvantages of original design are demonstrated. For an instance, based on sensory rating in the food station area, an advanced finding is that although the window on the wall allows for convenient service, it transmits cooking odor and noise to outside area, which impair sensory experience in the dining area. Further sensory rating reveals design deficiency. For example, the seating area near the food stations is not favored by customers. Sensory analysis demonstrates this may be due to high ratings of visual, sound, and odor experiences.

Finally, this case study reveals the significance of sensory design. The redesign of King Buffet achieves a more pleasant dining environment and more attractive interior space which better appeals to customers. This is a feasible demonstration of the significance of sensory design.
CHAPTER 5. CONCLUSIONS

In this chapter, the research procedure is stated. It is a summary of this document and the entire research process. Conclusions and implications are discussed in the end.

Research procedure

This research is based on sensory study of sight, smell, hearing, and haptic. Since the sensation of taste sensation is not easily influenced by interior design, it is not included in this research. Theories related to each sense with regard to restaurant interior design are examined, including physical and psychological research.

To make the framework fit better for restaurant design practices, contemporary restaurant marketing is analyzed. In this section, some articles about design theory and design practice are studied. They provide strong support to the creation of the outlined framework. Grounded in literature review and marketing analysis, a framework for restaurant sensory design is proposed. The framework is composed with four parts: sight sensory design framework, smell and hearing sensory design framework, haptic sensory design framework, and interaction sensory design framework. Based on sensory theory within each sensory design framework, potential applications in restaurant interior design are analyzed and listed individually as sensory design methods in tables.

A case study is applied to test the application of the proposed framework and explore effects of sensory analysis and sensory design. The King Buffet is chosen as the subject. There are two major sections in this part. The first one analyzes the existing interior space of King Buffet by applying the sensory slider. Through conducting sensory analysis and rating different vantage points within the restaurant, perception of the whole space is enhanced and some overloaded or deficient sensations are detected. Through observation of marketing
status and activities of customer and employees, some problems with original design are discovered. These deficiencies usually have a strong correlation with an overloaded or deficient sensory rating. The second section about the case study applies the framework in order to redesign King Buffet. Nearly all items in the framework are analyzed and applied in redesign, and redesign drawings are accomplished using computer software. By comparing the original interior space pictures and redesign renderings, distinct advantages of redesign are demonstrated, which display the significance of sensory design and a feasible application of framework.

**Conclusions and implications**

Through sensory research, framework proposing, and a case study, the significance of sensory analysis and sensory design are demonstrated. A framework based on sensory theory and interior design practice has tested applicable.

Sensory analysis is an instrumental method to analyze an existing interior space. This method may be applied in interior design education and design practice. In terms of design education, it is a feasible method to help students perceive a space in-depth, and comprehend the strong association between interior design and sensory perception, from obvious visual images to subtle details. In terms of design practice, sensory analysis is an effective means to value an interior space, and detect problems and deficiencies. For example, analysis of the original interior space of King Buffet using sensory rating in different areas displays some overloaded or efficient sensory scores, which point to defects in the original design.

Sensory design is elemental to achieving a comfortable and pleasant interior space, and effectively stimulates consumption. All sensory studies and framework are focused on these two points. In addition to delicious food and satisfactory service, an impressive interior
space is significant to engender a strong appeal to the customer. A successful sensory design promotes prosperous restaurant business and this is the eventual target of restaurant design. Therefore, this research benefits designers as well as restaurant owners.

The framework is applicable; nevertheless, it will need continual refinement. There are volumes of existing theories and studies about the senses and human perception. It is impossible to study all of them and transfer them into a single framework. For this reason, only a few major theories and articles are investigated. Therefore, further sensory study and a more comprehensive framework is necessary. Moreover, color is not studied in this thesis; however, it is a significant element to influence human emotion and need be added as refinement. Additionally, light research is not enough; hence more comprehensive light study is needed. Furthermore, it is critical to remember that with the development of the economy and technology, restaurant markets change accordingly. It is essential to keep the framework up to date and applicable to cater to the existing market. Therefore, the framework need be refined consistently.


Drexler, Engineer’s architecture


Gibson, The senses considered as perceptual Systems, p.53


Hall, The Hidden Dimension, p.116


Pocock, “Sound and the Geographer,” p.194

Pallasmaa, Architecture of the Seven Senses, p.33

Southworth, “The sonic Environment of Cities,” p.52

Tuan, Yi-Fu. (1977), *space and place*.


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