An Investigation into the

Positive Visual Experience Design for the Elderly

by

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Abstract

Visual impression is the first impact on human perception through receiving and assessing the external information observed by the eyes. Therefore, product appearance is closely linked to the human's visual experience and can affect human's mood throughout the process of information perception and product manipulation.

Generally, visual ability declines as age increases, which can lead to visual impairment and unpleasant moods among the elderly. For the elderly, there is a need to improve the quality of the visual experience in design.

The aim of this research is to explore feasible methods to discover the consistency between subjective desires and objective environmental reactions in order to provide the optimal pleasurable visual experience conditions for elderly individuals in design.

The objectives are 1) To examine the common elderly visual experience features in relation to physiological and psychological effects, specifically reflected in vision, perception, and emotion; 2) To determine a positive visual experience framework for elderly-focused design based on visual experience consideration; 3) To develop positive visual experience assessments and test methods specially designed for the elderly in order to gather information and data about subjective desire and objective reaction to objects; 4) To analyze the results of consistency between subjective preference and objective attraction in order to form a positive visual experience for elderly individuals.

This research describes the research process and its findings. Initially, the introduction of the thesis presents the research motivations and background, with

its aim and objectives defined. Related literature supporting the research is then examined for further understanding of aging, visual experience and relevant emotional issues, and research methodologies. Based on this understanding of the elderly visual experience and visual experience behavior, along with observations of purchasing processes, interviews with the elderly, and interviews with experts, a set of assessment tools (VPTs) was developed for assessing the elderly visual experience factors from the two perspectives of subjective preference and objective attraction. Based on statistical analysis, the elderly general cognitive features, and a series of positive visual experience factors that affect the emotional mood of the elderly were determined.

The results of the investigation contribute to design for the elderly with positive visual experience factors identified for enhancing the elderly satisfaction in their visual experiences and manipulating product design to create a positive emotional state. This VPTs assessment tool can also be recommended as a reference for investigating into other various target groups' visual experience features.

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LIST OF ACRONYMS AND ABBREVIATIONS

A	Group A
AD	Alzheimer's Disease
AOI	Attention of Interest.
B	Group B
C	Consistency of S (Subjective) and MOAB (Mean of Objective of Group A and B)
CBC	Color-Brightness Code
CBCC	Color-Brightness Contact Code
CCD-1	Consistency Correlation Data-1
CCD-2	Consistency Correlation Data-2
CHC	Color-Hue Code
CHCC	Color-Hue Contrast Code
CNCA	China National Committee On Ageing
CPC	Color-Purity Code
CPCC	Color-Purity Contrast Code
DMU	De Montfort University
ECAC	Elderly Cadres Activity Center
ENE	Empty-Nest Elderly
Exp.	Expert
ET	Eye Tracking
F	Female
G	Group
IAPS	International Affective Picture System
IDAB(IABD)	Integrated Data of Group A and B
IR	Invited at Random

ISO	International Organization for Standardization
LNC	Layout of Newspaper Code
M	Male
MCI	Mild Cognitive Impairment
MD	Macular Degeneration
MOAB	Mean of OA and OB
MOABT	Mean of OAT and OBT
MTC	Materials and Textures Code
n	Number
NA	Not on AOI
N/A	Not Applicable
NH	Nursing Home
NMV	Normalization with the Maximal Value
NSU	Next Stage Use
NVE	Negative Visual Experience
OA	Objective Group A
OAT	Objective of Group A in time to First Fixation
OB	Objective Group B
OBT	Objective of Group B in Time to First Fixation
P.1, 2, 3…n	Participant Code
PD	Parkinson Disease
PC1	Pattern Code
PC2	Product Code
PVE	Positive Visual Experiences
Q	Question
RSI	Response-Stimulus Interval

RT	Reaction Time
S	Subjective
ShaC	Shape Code
SiaC	Size Code
SOP	Standard Operating Procedure
SPD	Subjective Preference Data
TB	Testing Board
TV	Television
UCD	User-Centered Design
UN	United Nation
UNDESA	United Nations Department of Economic and Social Affairs
UNFPA	United Nations Population Fund
UNPD	United Nation Population Division
UX	User Experience
VD	Visual Difficulties
V	Venue
VE	Visual Experience
VP	Visual Preference
VPT-1	Visual Preference Testing-1
VPT-2	Visual Preference Testing-2
Vs. /vs. / vs	versus
ver.	Version
VW glasses	Visual Witness glasses
VPT	Visual Preference Test
WHO	World Health Organization
1, 2, 3…n	Code of each stimulus

CHAPTER 1.

INTRODUCTION

1.1 Motivation

Design considerations for human factors have acquired a new meaning in the 21st century. Tom Inns (2007) described the need for new design approaches to address the new century issues like sustainability, heath and security. Therefore, around the new direction of design development and new issues emerging, it's necessary to further explore various types of new approaches in design theory, method and practice.

The design philosophy of User-Centered Design (UCD) has been proposed and developing for nearly three decades. It covers areas such as Usability and User Experience (UX). However, in recent years, new trends have emerged, such as Jordan's (2000) proposal of a new design philosophy going beyond "Usability" and into "designing a pleasurable product". Moreover, Norman (2007), the theoretical funder of UCD, proposed a new idea called "Emotional Design". Both focused on designing products that evoke feelings of pleasure and happiness to the user. Currently, research related to human emotion is now the cutting-edge in design theory.

Visual Experience (VE) is one type of UX, and its research is closely related to design purposely geared towards creating the aspects of user feelings mentioned above. It involves emotional states, and more specifically pleasant or unpleasant experience. It connects human vision with environmental factors, and focuses on the collaboration of the information between the two sides. Better VE can produce a better emotional state, namely, a positive visual experience (PVE), which brings pleasurable emotion reaction throughout the VE process. PVE concepts proposed are

a new perspective in design, dedicated to discovering PVE laws for improving VE conditions via its approaches. This puts it in line with the new design research trend.

China's rapid aging development trend requires that design to be done with better consideration of the elderly needs in order to more fully care for them. Design for the elderly will be a new long-term direction with deep social significance.

Due to cognitive and behavioral ability decrease with age increase, more obstacles are incurred in receiving external information, and with this negative moods tend to upsurge. As mood is so closely related to human health, negative emotions will bare a direct adverse impact on human health. From design perspective, finding the factors that improve the elderly VE by understanding their mutual VE features, pleasurable emotion can be obtained. This is to say, improving the quality of their VE experience can generate a pleasant mood, which will be to their health.

Little attention and research discussion on design for elderly Chinese exists today. From an ergonomics perspective, this research is focused on the universal definition and discussion of the human body’s capability and restriction, as well as linking different visual perception aspects. From a cognitive psychology perspective, the human cognitive mechanism and mental activity is focused on, which involves the elderly perceptions and cognitive barriers. Even though ergonomics and cognitive psychology are two independent fields, both are a main and important part of what connects the physiology and psychology of the elderly VE. They also help to add explanation of the elderly VE from a standpoint of perceptive function and emotional reaction. However, for the elderly population, VE still does not include a detailed definition of factors that can elicit pleasure and create a PVE. For example,

which color is generally preferred, most easily arouses their attention, can evoke pleasurable emotion, and so on. In fact, neither of the aforementioned theoretical bases, alone, can directly integrate the elderly VE with design in regards to visual perception and emotion, Therefore, the elderly VE needs to be re-identified, and the factors that can create a pleasant experience need to be established.

From a design theory perspective, many concepts involve design for the elderly, both in research and in practice. However, currently User Experience (UX) centered design research is most common, specifically looking at interface and usability testing. Focus is on the physical aspects that can affect “usability”, bringing a good mood to its users. For the elderly, however, visual perception and psychological preferences in the VE still lacks in-depth extracting, especially in regards to the PVE factors. A certain suitable method for combining cognitive reaction and psychological emotion to dig out these features is needed.

There has been some mention of experience consideration in design study; combining related concepts of cognitive psychology. These discussions, while ample, are limited to usability, lacking appropriate methods for unified consideration of psychological and physical exploration of the elderly VE. Some of these design concepts include: Inclusive design, emotional design, experience design, UCD and so forth. These concepts are moving in the right direction, but needs to discuss and explore methods that are designed specifically for elderly VE research.

Based on the above reasons and the present situation in design research, a new research focused on the probing of optimal VE factors for elderly individuals is presented here. This is a contribution to the exploration and clarification of the elderly VE, which combines the elderly’s physiological characteristics, VE features,

and emotions effected by the VE, for discovering a feasible method for discovering the pleasant VE experience brought about by appropriate design. Its value is not only reflected in its enriching of design theory and methodology, but is also suitable for meeting societal needs and design trends.

1.2 Background

According to Maslow's Hierarchy of Need and Patrick W Jordan's Hierarchy of Consumer Needs, VE research is in line with the inevitable trend of human needs. Therefore, it is important to further research on the relationship between humans and design based on user needs, specifically to satisfy the spiritual needs that go beyond a products' usability.

There are, in fact, a large number of poor VE factors around us in our everyday lives that bring about undesirable VE. Poor VE environments should be improved via design as a means to reduce the likelihood of this negative occurrence. Due to a lack of scientific theory and direction, most designers prefer to understand an individual's subjective desire, and tend to pay attention to the "function" and "usability" when designing. Although good "function" and "usability" are both dimensions that can produce pleasure, from a visual feeling in the VE process perspective, there is still a lack of clear discussion and results. This can lead to design results that easily cause adverse effects or misconception during the user's experience.

Furthermore, individual reactions can lead to different VEs. Therefore, it is necessary to focus on specified groups to further discover the real VE needs. This is especially true in relation to the elderly. Sufficient data demonstrates aging is accelerating worldwide, and the number of elderly people will account for 21% of the world's population by 2050. Obviously, design for the elderly will meet with huge demand in the future. Methods for solving these new problems, while put forth, are usually in the initial stage of exploration, and these methods are relatively insufficient particularly in regards to the relationship between design for the elderly and their VE features. There are no suitable approaches to gauge their subjective

desires or environment and object stimulus factors. In most of cases, design ignores the elderly's VE habits that are caused by physical and psychological change, and as such the designer's subjective or unscientific judgment is frequently incorrect. The reason may be that they lack a desire for pursuing suitable design, but hopefully the accumulation of VE research results can be used as reference. As this is a new area of exploration, it may need long-term method validation in order to gain a wide range of acceptability.

It is quite relavant to focus on the elderly when researching VE. It is not only because the elderly, with rapid growth in population percentage in China and the World, will need the most close attention in the future; but also because it is their VEs that are facing the most serious difficulties. These difficulties are attributed to the decline in physiological and cognitive ability, and the normal visual presentation of objects is likely to suffer causing visual discomfort thus harming the VE process. This can all lead to the generation of negative emotions. This VE result easily forms psychological pressure, and if this continues it can affect their physical and mental health. In the face of such a serious issue, from a design point of view, if necessary considerations are not made to analyze and understand the elderly's visual perception features, it will be difficult to create a product or environment that truly meets their physical and psychological needs.

The purpose of this research is to not only put forth a theory, but to produce results that support it. China is becoming an increasingly aged population with more than 1/5 of the world's aged living in China, which is an estimated 400 million persons by 2050 (Report of estimate research on China's aging population developing trend, China national committee on aging, CNCA, 2007). Additionally, in

general, developing countries lack an awareness for elderly when making design considerations. Therefore, this study has a deep significance.

Design pursues a pleasureable VE. In recent years, there have been a lot of developmental theories that support this concept. UCD's various methods and tools are used within organizations to improve the understanding of user and task requirements, supporting the iteration of design and evaluation (Schindlholzer, 2008). UCD has been demonstrated successfully in the field of Usability and UX (Jordan, 2000 and Desmet, Erp and Karlsson, 2008). Norman (2004) also proposed a new design philosophy beyond "Usability" that calls for "Designing a Pleasurable Product". He also indicated that "Good behavioral design should be human-centered, focusing upon understanding and satisfying the needs and the people who actually use the product" (Norman, 2004). Since then UCD has been successful exploring emotional design theory and practicality. Design research has now begun to focus on mood, feelings, experiences, and general pleasure. However, VE as the initial sense of a users' perception is required to be brought in as a new perspective within the UCD research method. With this in mind, investigation into the UCD-led Positive Visual Experience (PVE) will be the best way to find the factors that affect user's feeling of pleasure. Many research domains related to human cognitive behavior have practical achievements: Universal Design, Experience Design, Emotional Design, Pleasurable Design are all based on UCD concepts. Integrated knowledge will enhance the research, and be helpful in providing more pathways for issue solving. Jordan's design theory that states that products satisfy human spiritual needs on the basis of functional use is an approach that goes beyond "usability" alone. Besides this, many other scholars have proposed different views on functionality. Makepeace 1998 (cited in Myerson, 1998) has indicated, "The function needs a more generous

interpretation… It has been too narrowly defined. It means more than just use. Enjoyment and pleasure are part of the function of an object too." Furthermore, emotion is closely linked with VE, reflecting the verity of its research. In his book *The Design of Future Thing*, Norman emphasizes: "As for emotions, well, human emotions are central to our behavior and interpretation of the world" (Norman, 2007). In another of his books *Emotional Design*, he pays close attention to users' emotion, which constructed his theoretical framework and the core of emotional design. He explained the effect of cognition, emotions, action and reflection in design based on understanding and satisfying the needs of users with viewpoints such as: "In part because of new scientific advances in our understanding of the brain and of how emotion and cognition are thoroughly intertwined. We scientists now understand how important emotion is to everyday life, how valuable. Sure, utility and usability are important, but without fun and pleasure, joy and excitement, and yes, anxiety and anger, fear and rage, our lives would be incomplete." (Norman, 2004). These are key contributions to research on human interaction with products, namely positive, pleasurable, and effective interaction.

Therefore, based on the elderly's physiological changes, it is necessary to consider how pleasent emotion can be caused by environment and product's visual appearance, namely: Color, shape, space, light and so forth related factors. This is to verify clearly the existing problems that are affecting their experience of a product design or an environment, and to find the PVE factors in order to improve their satisfaction bringing pleasant emotions through product perception or use.

As such, concentration on the elderly VE features can, as far as possible, avoid poor VE occurrence and make allowance for the evoking of pleasurable moods via the PVE factors used in design.

The pursuit of pleasurable design moves beyond “usability” to a higher level of human needs. It includes responsible care for members of our society, and brings pleasure and emotional experience outside mere function. It also embodies design in the 21st century and embodies the trend of integration between function and emotion.

1.3 Aim and objectives

The aim of this research is to explore and adopt feasible methods to discover the consistency between subjective desire and objective environmental reactions for providing the optimal pleasurable VE conditions for elderly individuals. The purpose is to contribute, by providing a rational reference through results produced, to design for the elderly, and offer guidance, with the approaches developed, for clarifying the visual experience features of other special target groups.

The aim can be achieved by following the objectives of this research. They are:

- To examine the common elderly VE features in relation to physiological and psychological effects; specifically reflected in vision, perception, and emotion.
- To determine a PVE framework for elderly focused design based on VE consideration.
- To develop PVE assessments and test methods specially designed for the elderly, in order to gather information and data about subjective desire and objective reaction to objects.
- To analyze the results of consistency between subjective preference and objective attraction in order to form a PVE for elderly individuals.

1.4 Research framework

As the aim and objectives of the research across the conglomeration of several different aspects, this specified research area provided a clear framework and workflow. The framework was based on literature review of related fields: Aging, VE, and emotional issues. Thus gearing it towards four main parts:

The first part defines the motivation of this research. For this, the explicit aim of research and objectives were established. Based on these objectives, the overall research framework was constructed, and selected methods that can reach these objectives were settled on. Additionally, related work limitations and anticipated outcomes were preliminarily declared. This step was a cornerstone of this research and provided a clear direction for completing this exploration.

The second part was extensively reviewing literature related to aging issues, VE related perception, environmental factors, and pleasurable emotion related to the VE. This included looking at items from multiple fields with various perspectives in order to more fully support this research with different theoretical insights, concepts, and methods. Primary documentary survey allowed for the discovery of the main research territory and methodology eventually utilized throughout this study.

The third stage was the primary study, which was method oriented in its approach and focused on tool development. The available methods and approaches adopted were observation, interviews and assessments in order to collect subjective and objective data on the elderly VE. It includes points of view based on past experience and professional knowledge as the foundation of subjective information, and stimulus reacting testing as the main body of objective data. During this stage, it

was necessary to utilize both qualitative and quantitative analysis approaches to determine subjective preferences and objective reactions. Consistencies between these two aspects were then gathered for further discussion on the elderly PVE.

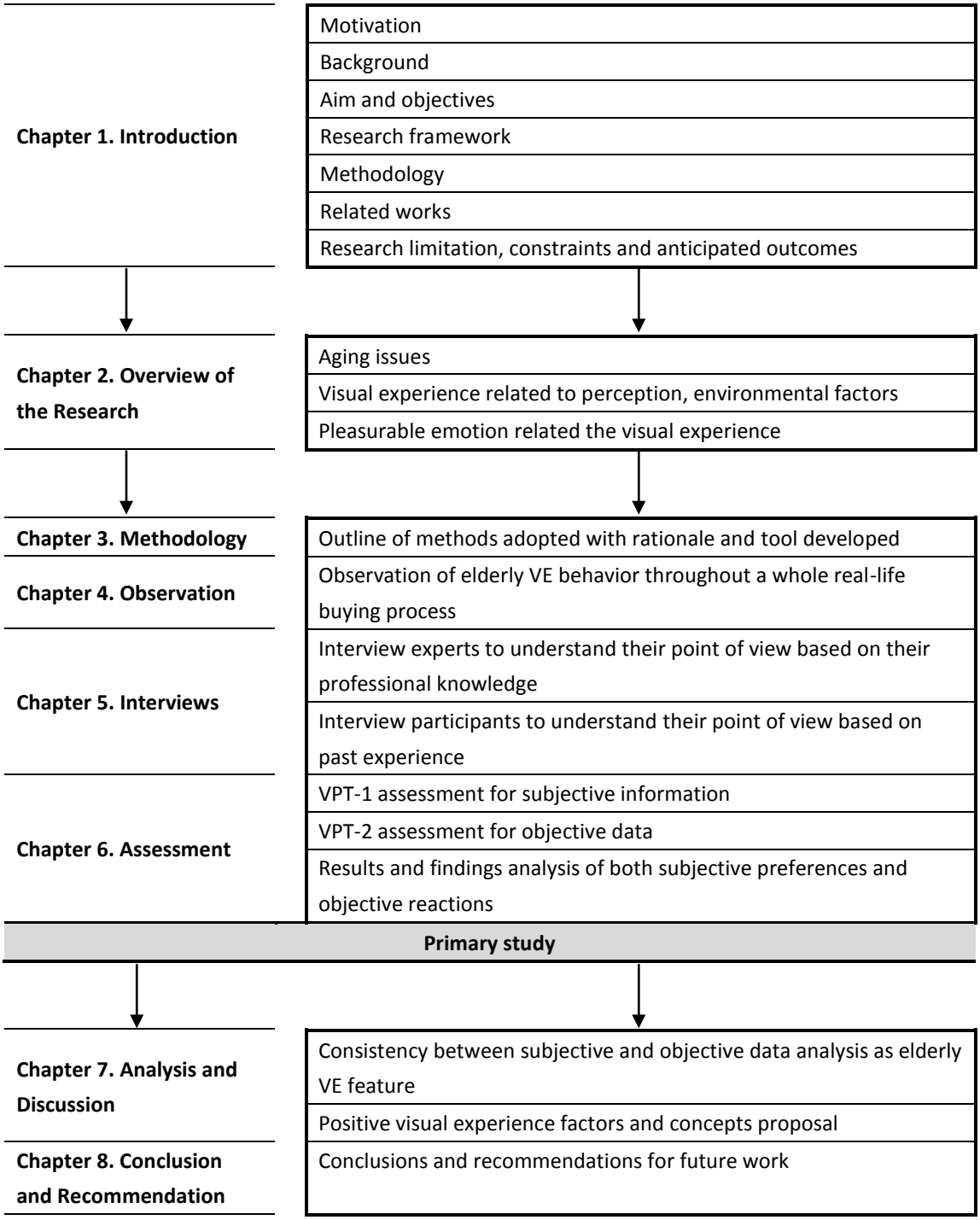

Figure 1.1 Research framework

The fourth and final stage focused on analysis and discussion of PVE and provided suggestions for optimizing elements of VE for elderly individuals. The conclusions and contributions of the research as a whole were then summarized. The research framework is in shown in Figure 1.1.

1.5 Methodology

Based on the research framework, this report is structured with 8 chapters that act to present the completed process of this research; with each independent chapter corresponding to an independent portion of the study. Furthermore, each chapter has a clear logical interrelationship to the research, while gradually deepening with the study. That is to say that each chapter, with its results and findings, will be the supporting materials used in next the chapter. The chapter contents are briefly summarized below:

- **Chapter 1, Introduction:** This chapter explains the initial motivation of the study; section 1.2 provides an overview of the background on this research and related issues; the research aim and objectives will be drawn out in section 1.3; section 1.4 presents the outline of the research with illustrated framework; the methodology adopted for the study across each research stage with its content is described here in section 1.5; section 1.6 states the related research works previously related to this field, specifically relevant definitions, concepts and academic terms; section 1.7 will define the research limitations and constraints encountered in the study; and sections 1.8 will summarize the anticipated research outcomes.
- **Chapter 2, Overview of the research:** This chapter offers reviews of the relevant academic literature focusing on three main parts: Aging and the elderly, VE mechanisms and factors, and emotion related to VE. It combines knowledge from multiple disciplines and various design fields. Through broad literature search, understanding of the elderly physiological and psychological feature changes with age was gained. Additionally, the influence factors on the elderly VE from the external environment and object, as well as the rationale of

pleasurable emotion are outlined. Aside from these, other relevant concepts and terms, as well as suggested methods related to this research are explored. The chapter concludes with an overview of relevant literature regarding issues on VE. Most importantly, it provides the important basis for determining research methods for the rest of this study.

- **Chapter 3, Methodology:** This chapter defines and justifies the appropriate research methodology, integrated from multi-method approaches, particular to this project. They include: Observation of complete elderly VE behavior; participant and expert interviews for gathering information on VE, VE barriers, and suggestions; and assessment via a specially developed testing tool. The methodology used in this primary study assured information and data gathered included both subjective and objective perspectives, which ensured the qualitative and quantitative nature of the analysis in order to reach the research objectives. This chapter also details the purpose, process, and analysis methods used in each stage of the research process.
- **Chapter 4, Observation:** This chapter presents essential elderly VE information collected from subject behavior observation in a real shopping situation. Observation provided vital information on what environmental factors influence the subjects' VE, and established the relationship between their interest and the environment or objects they were viewing. It also reveals the barriers to VEs during the purchasing process, as well as their emotional reaction experienced during the VE. This chapter concludes with effective information extraction, providing the key factors to be combined with the interviews results for better assessment content formulation.
- **Chapter 5, Interviews:** This chapter contains information for qualitative analysis gained through participants' and experts' explanatory understanding of VE

issues for elderly individuals. It reflects the presuppositions and prejudices this study hope to more fully understand. This chapter finds the common features of elderly participants from multiple aspects based on their own past experiences and experts' opinions. Assessments formulated in this research are based on these personal and professional views. This chapter concludes with information extraction from participant and expert interviews, providing the key factors that were combined with observation results for assessment content formulation.

- **Chapter 6, Assessment:** This chapter provides both subjective and objective data gathered from two assessment approaches: VPT-1 and VPT-2. These were specially developed for assessing subjective visual preferences and testing objective reaction to stimulus. The information and data identifies subjective perception preferences, as well as discovers what external factors most easily gain attention and capture long-term gaze. This chapter also summarizes the elderly VE subjective preference and objective attraction features in relation to pleasurable emotion formation. These features form the core basis for further VE and PVE discussion.
- **Chapter 7, Analysis and Discussion:** This chapter provides comparison of the 12 VE factors that were consistent between the subjective preferences found in VPT-1 and objective reaction data found in VPT-2. Proposal of PVE concepts are based on this data comparison and PVE factors are suggested based on consistency between the two assessments.
- **Chapter 8, Conclusions and Recommendations:** This chapter concludes with evaluation of the whole research project, and extracts the key contributions for recommendations of possible future work.

1.6 Related works

The speed of population aging is increasing worldwide, and the society is paying more and more attention to the care of the aging population, particularly in China. Research on all walks of life in China has shifted from concern to concrete action, and research concerning aging issues is no different. At a national policy level, China's aging related work has been focused on improving the aging policy system and developing old-age services and industry. Home care environment; community services for the elderly, developing of public pension welfare facilities, and a sound social security system are all the main focuses of National Level research.

In the field of design, the elderly have also gained attention. There are a lot of design researches related specifically to the elderly experience. In product design for the elderly, most work is based on user experience, and highlights the relationship between usability and satisfaction. They are usually corresponding to a specific project, for instance, living space or mobile phone. The common feature of these kinds of research is that the aim is on elderly cognitive dysfunction, and how to achieve a reasonable design to enhance the usability of a product in order to satisfy psychological needs. These studies combine psychological knowledge, taking into account the elderly decline in cognitive ability, with adopting a means to solve barriers in design for them. Generally speaking, the contents that are directly related to the elderly VE are often described as a part of the whole sensory experience and psychological features. Many specified studies tend to point out some general concepts for instance, font size or color strength; but appropriate range of size and color to be used in design for the elderly is still lacking. Additionally, appropriate research methods to obtain substantive verification of these ranges are currently not available.

Some similar research cases provide a different direction for the elderly VE due to the different purpose in each study. A research on elderly perceptions of interior environments by Lee (2009) examines and applies multiple methodologies to improve environments based on data gathered from elderly respondents. In the research, one of the methods adopted was the use of a recording device – a mini camera attached on glasses, named Visual Witness glasses (VW glasses) - that was created by Lee to record and track the elderly participant's eye sight motion. These VW glasses were used to gather data on a natural observation state and can reflect objective visual reaction. Lee's research provided VE properties with emphasis on more human oriented features. The research method and results had a very important reference value.

There have been studies that exhibit design for the elderly centered on a multi level experience of demand. Huang (2016) integrated sensory experience, behavioral experience, and emotional experience to form the multi level experience concept he applied to bathtub design for the elderly. This simple design, which transformed a simple design into an innovative design driven by multi level experience requirements, expanded new thoughts on product design for the elderly. This study considers elements in VE in its integration of components. These integrated concepts hold suggestive significance in design related experience. However, there is no in-depth description of elderly visual research, and there is also a lack of specific methods to define the conclusions of his discoveries.

Interactive design, universal design, and barrier free design all involve the elderly experience. However, these studies are more focused on product usability and accessibility. Relatively speaking, interactive design shares a more direct link to VE. A study on the elderly experience has provided a point of view that the best user

experience is a no-brain experience. It refers to the use of products being done correctly through habit only without needing specific thought to carry out instruction. This study is linked to physiological condition and reflex behavior. This focus on human unconscious behavior was very conducive in promoting the importance of user experience during product use (Liu et al., 2015). The 'best user experience' concept offered in this research helps to support the idea of optimal VE, and supports the necessity of testing natural reactions to stimuli during the VE process. However, as far as this research is concerned, it lacks conceptual interpretation and is deficient of specific testing and validation results.

Human factors of engineering or ergonomics are involved in various branches of knowledge: Physiology, psychology, cognition, environment and so forth. They are inherently cross-disciplinary in nature. As such, the study on elderly VE is not only reflected in the measurement and definitions of physiological capability, such as visual ability, but also includes the human - machine - environment system as a unified and comprehensive study. Ergonomics connect human physiological function and psychological knowledge, as well as includes visual perception, perception processes, and affect mechanisms in the experience process. Sanders and McCormick (1992) indicated that human factors experts not only collect information based on experience to use in object design, but also collect empirical data for evaluating their designs' effectiveness. There are three types of empirical data research methods: Descriptive study, experimental study, and evaluation study. The holistic and crossover concepts in ergonomics, along with its research methods, provide rich reference to the study of elderly VE. Its overall goal, however, is the human subject, and although there are generalized definitions on the physical

properties of objective stimuli's effect on the elderly, it stills lacks specific factors of external stimulus with more specific definitions.

There are currently some research methods approximately related to those methods developed here. Lundell and Morris (2005) proposed a research approach, which integrates 4Ts: Tales, tours, tools, and troupes for revealing a series of elderly values, behaviors, coping styles, requirements and universal technologies. As a tiered research method to discover universal designs for the elderly, it provides a comprehensive process for gathering needs and concept development including environment, social interaction, values, and emotional factors. This integrated and tiered research method, while similar in its approach, has a focus that is totally different.

Research on subjective visual preference linked to emotional aspects is usually conducted via a self-appraisal method. This conventional method is most commonly used in psychological activities or emotional evaluations. Lee et al. (2002), when proposing a comfortable design for railway staircases especially considering the elderly, adopted an interview and evaluation approach to survey visual perceptions in order to understand the subjective preferences of stairs among elderly and younger subjects.

These related works provide different interdisciplinary and field focused theoretical roots and concepts, both conventional and exploratory in nature. The research methods and approaches all work to achieve a variety of research purposes. Although there are clear discrepancies with specifically focused elderly VE research, there are some similarities in the methods used and developmental results. The research methodologies adopted in this research need to view the elderly VE as a

holistic experience process. Combined with physiological and psychological features, external environment and stimuli, as well as links to pleasurable emotion formation, it uses a subjective self-appraisal and objective testing method to produce a multi-tiered approach for finding the elderly PVE factors. The detailed methodologies will be discussed in chapter 3.

1.7 Research limitation and constraint

This research has broadly absorbed the theories, methods, and knowledge from multiple disciplines, as well as concepts and approaches from multiple design domains. However, as with any research concept proposed or its methodological exploration, it reflects the rationale of a framework in a particular field. This research was also influenced by existing knowledge and supporting framework, and as such produced results reflecting these. From a dialectical point of view, the results will inherently contain certain limitations, while still reflecting its uniqueness from different perspectives. In this research, limitations are embodied in four main aspects: the researched individuals, visual perception, visual experience, and design factors. Moreover, this study is restricted by some objective conditions reflected in:

- A limited capacity: It was infeasible to carry out the collection of information and data on a huge scale. This is reflected in the number of representative samples.
- Elderly Chinese as the focus group: Due to geographical constraints, cultural influences, elderly cognition and associated VE characteristics across different regions being different, the statistical results of this study cannot be fully applicable to elderly individuals who live in other regions.
- Results reflect the common elderly VE features: Because the elderly show a difference in physical and psychological status throughout each stage of life, the results of the statistical analyses of information and data only reflect an average data. It should be noted, however, that although this study can undergo more subdivision and statistical analysis, it was not the focus of this study.
- As this was a special study on the elderly Chinese VE, the majority of the

literature and discussion refers to Chinese scholar's viewpoints based on their familiarity and understanding of the present situation of elderly Chinese. These may not reflect absolute consistency with scholars in other regions.

- Furthermore, as a new concept with innovative methods proposed, PVE needs to undergo continued reasoning in future works. This can constantly enrich and improve its methods and systems.

■ Research outcome

This research revolves around its aim and objectives, and will use its various methods and completed processes to reach its purpose. The anticipated research outcomes from this research include following four contributions to design knowledge:

- PVE concepts, with composition and framework developed for creating a better VE conditions through design for the elderly;
- A reasonable method specifically aimed at finding elderly PVE factors and identifying their VE features;
- A set of common PVE factors to serve as invaluable reference in design for the elderly;
- A set of Test Boards with assessment contents geared towards collecting subjective preference information and testing objective reaction data representative of the elderly VE.

CHAPTER 2.

REVIEW OF RESEARCH AREA

2.1 Introduction

Because of the trend of aging population growth worldwide, aging is an issue that will inevitably influence society in many aspects. The physiological and psychological changes that occur with age have come into the focus of design research in recent years, particularly in China. From the perspective of design, it will be conducive to understand and then promote the design of products in accordance with the elderly's psychological and psychological features.

Contemporary design is a recognizably cross-disciplinary field with other disciplines and subjects interlinking. In order to discover the satisfactory visual experiences that elicit pleasurable emotion in design for the elderly, this research covers many disciplines from certain specific dimensions. For this investigation, which is focused on discovering those positive factors in the visual experience that can bring pleasure to the elderly, contributions from many diversified perspectives and theoretical insights and methods have been conducive to further broaden the understanding of this research and relevant rationale.

This chapter combines certain knowledge from Gerontology, Psychology of and Cognitive Psychology fields, as well as absorbs a number of contributions from specific research domains such as: User Centered Design, Inclusive Design, Experience Design, and Ergonomics. The literatures reviewed formulated the underpinning theories and methods related to this research.

The framework of literature review contains three main parts centered on the research theme: Aging, visual experience and emotional issue. They are briefly shown in Figure 2.1.

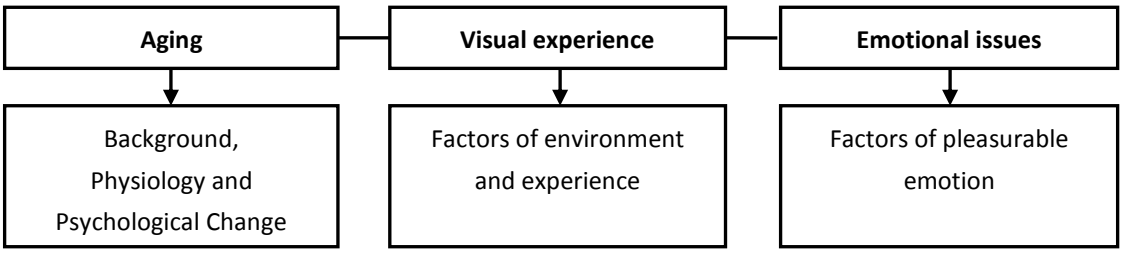

Figure 2.1 Framework of literature review and three main themes in chapter 2

Based on the framework established, in the first part of Section 2.2, the current situation of aging and tendency worldwide, especially in China, is discussed in depth. In Section 2.3, physical diseases and sensory perception changes among the elderly are reviewed to gain a general understanding of their physiological and psychological needs. In Section 2.4, the visual experience (VE) concepts and their relation to the perceptive mechanisms based on sensation and perception change, as well as their roll in physiological and VE factors are expounded upon. Section 2.4 also provides the relationship between VE and emotion, the elderly emotional features and pleasurable factors in the VE, as well as surmising the currently known relevant clues in creating a Positive Visual Experience (PVE). These discussions will form the core that the following research is based upon. Finally, Section 2.5 is a summation of the literature reviews and relevant findings.

2.2 Aging

In the 21st century, the World's aging population is growing very fast. According to estimates and projections from the 2012 Revision of the United Nations Population Division (UNPD), the world population of 7.2 billion in mid-2013 is projected to increase by almost one billion people within the next twelve years, reaching 8.1 billion in 2025, and to further increase to 9.6 billion in 2050 and 10.9 billion by 2100. Meanwhile, data indicates that the elderly, 60 years or over, proportion of the population is increasing rapidly from 8 percent in 1950 to 12 percent in 2013. It will increase more rapidly in the next four decades to reach 21 percent in 2050 (UNPD, 2013). This means the aging population will reach 2 billion, accounting for 22 per cent of the global population. There will be 64 countries where older people make up more than 30 per cent of their population.

Aging population results from two aspects: A process whereby reductions in mortality are followed by reductions in fertility. These reductions eventually lead to smaller proportions of children and larger proportionate shares of older people in the population. Moreover, the figure also shows that currently the majority of older persons reside in developing countries. By 2050, nearly four in five people who are aged 60 or over will live in the developing world.

The reason of aging population growth worldwide has mainly been affected by two factors：

- **Fertility has been falling:** Fertility has been falling in most regions of the world over the last several decades, and this decline has been the main factor driving population aging. The United Nations Population Fund

(UNFPA) and HelpAge International (2012) prediction report shows that the world's total fertility rate will have dropped from 5.0 children per woman in 1950 to 1.8 children per woman in 2050. Therefore, UN Department of Economic and Social Affairs (UNDESA) (2013) indicated that the decline in global fertility would continue during the coming decades, and push the rapidly aging growth that is already**.**

- **Oldest old aged persons, 80 years or over, increasing:** Aging is taking place in the world's adult population and within the older population itself. The proportion of persons aged 80 years or over (the "oldest old") within the older population increased from 7 percent in 1950 to 14 percent in 2013 and is projected to reach 19 percent in 2050 and 28 percent in 2100, seven times as many as in 2013 (UNDESA, 2013). Such a variation in the demographic of the older population itself is caused by growth in human longevity (Figure 2.2).

Aging population is an important issue that all countries must encounter and face in the twenty-first century. The influences, in various aspects, on any country or region of the world are significant and far-reaching.

Thus, facing such rapid growth in this huge elderly group and understanding the various aspects of elderly life via research founded on the solving of their difficulties and improving their living conditions and quality of life is very meaningful. In China, as a

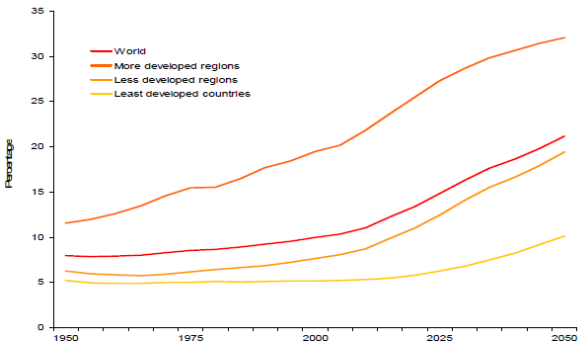

Figure 2.2 Proportion of the population aged 60 years or over: world and developing regions 1950-2050 (World Population Aging 2013, UNDESA, 2013)

typical representative of developing countries, with rapid growth of aging population, the aging issue affects an enormous amount of people. One fifth of the total elderly population of the world resides in China, a significant proportion of the world's aging population.

Aging is a universal phenomenon during the twenty-first century, and although it will progress with different intensity and speed across countries and regions bringing new issues of development challenges and opportunities in fundamental social, economic, and so forth areas, not the least of these is an increasing priority to satisfy the needs of the older persons while enabling them to have longer, healthier and more productive lives (UNDESA, 2013).

- **Aging society and aged society**

An aging society, as a population structure model, refers to the elderly population that has reached or exceeds a certain percentage. According to the traditional standards of the United Nations (UN): People who are 60 years or over with 10 percent share in total population proportion in a region; or new UN standards: People who are 65 years or over with 7 percent share in total population proportion; the region will be deemed entering an 'aging society'. If those who are 65 years or over have 14 percent share in total population proportion, the region is named an 'aged society' (China.com, 2009).

The 2013 World Aging Population country ranking by percentage of population aged 60 years or over indicated that Chinese aged 60 and over hit 13.8 percent, ranking 67. In fact, comparison of the two UN standards (traditional or new) of aging society, whichever is used, China now has entered the 'aging society' completely.

■ Trend of aging population

Because of the shifting and developing in social, cultural, technological, living conditions and so forth aspects in different countries and regions, aging society and aging population is general contemporary worldwide issue demonstrating the following characteristics:

- **Live independently**[1]**:** According to the report of UN World Population Aging 2013, it indicated that 'independent living among older people is becoming more common'. Independent life is one of the important trends in elderly living in the future.
- **Oldest old, aged 80 years or over, increasing:** This concept has already been discussed in Section 2.2 in same heading above.
- **Women live, on average, longer than men:** Females tend to live longer than their male counterparts. These gender ratios are expected to increase moderately during the next several decades, reflecting a projected slight narrowing of the female advantage in survivorship (UNPD, 2013). This data shows another aspect, female elderly, with higher proportion of the population than their male counterparts, is a group that needs to be focused on and studied for.

The three major changes of the elderly population listed above, further illustrate the global trends and characteristics of aging both now and in to the near future.

[1] Living independently: is either living alone or only with one's spouse. (*World Population Aging 2013, United Nations Department of Economic and Social Affairs, Population Division.* p.84)

■ Definition of the elderly age

For the division of age, UNDESA considered older persons those who are aged 60 years or older. Further, the World Health Organization (WHO) has carried out the new standard for the division of age based on the measurement of average life expectancy and human body quality to the people worldwide. Among these, age from 60 to 74 years old is demarcated as the young elderly; age from 75 to 89 is the elderly; and more than 90 years old is the longevity elderly.

Fisk et al. (2009) defined “Older Adult” as those individuals who are 60 years of age and above. But he also indicated that such classification is not always straightforward, because there are no definitive boundaries on the young and old precisely.

Regarding the definition of the ‘elderly’ age, there are also differences in different countries and regions based on the demographic of their respective countries in degree of aging, societal situation, the elderly health state, life expectancy and retirement time. The starting point of the ‘elderly’ age determined by different countries and regions is not same, ranging from 50 to 65 (Fisk et al., 2009).

The age definition of starting point that a human enters into the elderly phase basically is based on human's chronological age. It is indicates that aging occurs on many levels and can be categorized on at least three dimensions: 1) biological; 2) psychological; and 3) social (Fisk et al., 2009). However, due to the reason of individual differences in the three dimensions, within the degree of aging existed

differences across the demographic. Obviously, age definition is not just chronological age.

Adopted Chinese standards of the 'elderly' age are those age 60 and over. 60 is also Chinese people's retirement age, as of the writing of this paper. Therefore, the targeted research group involved in the thesis is based on that standard.

■ Aging in China

Based on the World Population Aging 2013 (UNDESA, 2013) report：Macao, China has a population aged 60 years or over that reached 13.3 percent of the total. China has entered into the aging society.

China has the world's largest aging population, now and in the future. UNPD (2009) estimated that in 1980, there were 378 million people in the world aged 60 or above. In 2010 that figure has doubled to 759 million, and it is projected to more than double again in the next 40 years rising to 2 billion by 2050. This data indicates that the speed of aging of the world's population is accelerating (Figure 2.3; World Population Prospects: The 2008 Revision, 2009). According to the Report of Predictive Research on China's Aging Population Developing Trend, in 2050, China's total population of the elderly will be more than 400 million, and it will be the most aged society，with one fifth of the elderly population in the world (China National Committee On Ageing (CNCA), 2007).

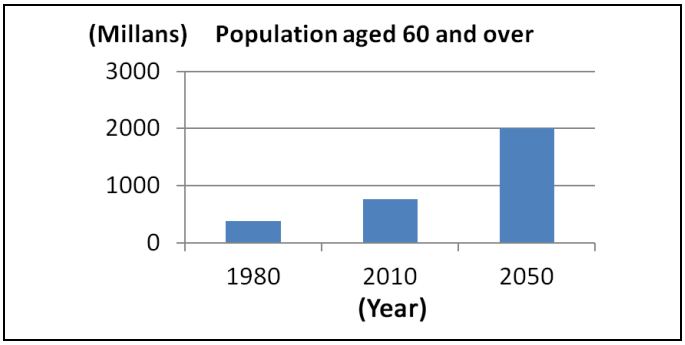

Figure 2.3: Population aged 60 and over: 1980, 2010, and 2050 (World Population Prospects: The 2008 Revision, UNPD, 2009)

According to China's sixth census data in 2011, the population of Mainland Chinese who are aged 60 and above is 13.26 percent, a total of 179 million, aged 65 and above is 8.87 percent, or close to 120 million. In 2020, the Chinese aged population will reach 248 million; the aging level reaching nearly 17 percent. Its predicted that by 2050, the Chinese people over 60 years old and above will account for 30 percent of the population, the aged population will be over 437 million people, the elderly who are age 80 years old and above will be no less than 80 million. At which time China is considered to enter a severe aging phase. That is to say, there is one 'old' person per every three or four people (Table 2.1; CNCA, 2007).

Table 2.1 Three stages of China's population aging from 2001 to 2100 (Report of Predictive Research on China's Aging Population Developing Trend, CNCA, 2007)

Phases	Length of Encounter	Degree of Aging	Size of Aged Population	Aging of the Basic Level	80 Years Old Accounts for the Ratio of The Elderly Population
One	2001-2020	Rapid aging	248 million	17.17%	12.37%
Two	2021-2050	Accelerated aging	400 million	30%	21.78%
Three	2051-2100	Steady and severe aging	437 million (Peak)	31%	25-30%

Globally, the situation in China is similar to the World's, with strengthening degree of aging caused by low birth rate and prolonged life (Figure 2.4; UNPD, 2013).

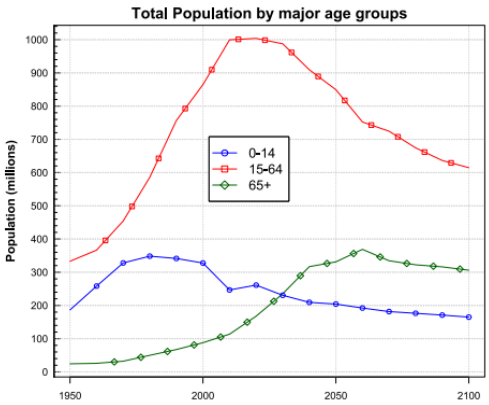

Fig 2.4 China total population by major age group (The 2012 Revision, Volume II: Demographic Profiles, UNPD, 2013)

■ The Chinese elderly characteristics

Based on findings from the participant interviews and observation

(outlined later), the Chinese elderly, age from 60 to 65, are sensitive to the quality of life. This includes requirements for health, safety and pleasure products. From another perspective, those over 65 are not sensitive to these. Besides, more and more Chinese elderly have begun choosing independent living. Therefore, it is significantly important that design consideration for the elderly, specifically those living independently, be done with satisfaction in product usability and pleasure in mind.

- **The elderly expectation:** Having a life of health and happiness. Physically, the elderly have already entered a decline phase in which their physical condition will gradually decline. Aging affects their mood, and they want to have health and happiness in order to better enjoy the waning years of their life (Guo and Sun, 2003).
- **Paying attention to satisfying psychological and spiritual demand:** A lot of investigation data reminds us that the contemporary elderly endowment concept is not only the pursuit of substance and physical satisfaction, but emphasizes needs for psychological and spiritual satisfaction (Guo and Sun, 2003). For example: Empty Nest Family[2] in China is gradually increasing. Many elderly people exist with negative induced emotion of anguish, loneliness, depression, dysphasia, fidgeting, suspicion and so forth psychological conditions. Therefore, the obstacle in physiological and

[2] Empty-Nest Elderly (ENE): the elderly family in which after the children left home.（35）based on 2007 china national census, in 340 million families in china, there are at least more than 2340 ENE who over the age of 65. ENE prone to mental problems, Performance is: the feeling depressed, depression, loneliness and loss of appetite, sleep disorders, and even cry with tears, self-accusation tendency". ENE's demand is greater than other elderly people in basic necessities of life and self-realization demand. Therefore, ENE needs to be paid close attention to by the society. (Han, B. and Li, J.(2013) *Report on the elderly mental health research*. Beijing: China science and technology press. p.35)

psychological change is now becoming an increasingly widespread social issue.

As such, this research is more or less based entirely on the specific conditions of China's aging population.

- **Effect of science and technology:** According to traditional thinking, the understanding of the elderly tends to habitually purport that they are technology averse. However, based on Fisk et al. (2009), research found that older adults' wish to avoid new technology was generally a fallacy. 62 percent like, whereas 38 percent dislike. However, it is true that older adults are less likely to use technology in comparison to younger adults. These findings confirm that older adults are using technology and they perceive the benefit of that use as outweighing the costs.

  Older individuals' perception contains the accumulation of past experiences. As the growth of the elderly people with level of education is constantly rising, their dependency on a product can be based on their prior experience of using a product. Thus, bringing a new product into their life more naturally, new technologies have been accepted in to their consideration. For example, surveyed results on mobile phone usage amongst 1,300 older people indicate that 61 percent of older people use a mobile phone.

  Actually, technology development can increase certain conveniences for the elderly life. When elderly people are getting older they spend more and more time at home and in the surrounding areas. They no longer make

efforts to go and meet people that are living far from them, and their social network gets narrower. Face-to-face communication and mobility are, in that sense, hand-in-hand. When mobility decreases, face-to-face communication also decreases. Technology should not encourage the elderly to stay at home but to be more mobile in order to keep up their physical condition (Tiitta, 2002). Tiitta (2002) also emphasized the importance of relevant government policy making: 'Finnish parliament's future commission's requirements for technology aimed at elderly people, the two most important criteria being: 1) Technology should contribute positively in communication between elderly people and with other age groups; 2) Technological solutions should contribute to travelling outside the home and daily activities at home and near home'.

While many studies consistently show that the elderly have adopted technical advancements slower than others, in addition there is research claiming that the elderly are not interested in technology and don't want to use it at all (Tiitta, 2002). Nevertheless, it is the point of this article that in products for the elderly, technical factors should be considered on a moderate scale. With increased longevity, their technical knowledge and cognitive ability has strengthened increasingly, their experience and ability to use technology will accompany them as they step into the aging phase. Therefore, design considerations merging science and technology factors will realize certain helpful functions in order to balance any deficiencies they may have in product utilization ability.

Results of studies show not only that the elderly population is growing rapidly, but also that their physical and psychological features are changing with age, further

reflecting their cognitive and behavioral abilities undergoing unique change. For this research on the particular features of elderly VE, a variety of literature reviews will be highlighted in order to offer better understanding throughout the research.

2.2.1 Physical aging

Zhang et al. (2008) point out that physiological change is often more significant during the aging process. The elderly physiological structure and function decline progressively. Their physiological decline is divided into three broad categories: Perception system, musculoskeletal system and cognition. The sensory system in its entirety will have changed by the age of 70, specifically, losing sense of sight, hearing, smell, taste, and touch to varying degrees. These changes are the result of normal aging and should not be considered as a disease (Zhang et al., 2008). Due to physiological changes, their demands of articles for daily use also changes; accompanied with new design requirements. Additionally, as the elderly nervous system has a prolonged reaction time to stimulation, fatigue is common. In terms of their vision, most individuals present with presbyopia. The eye needs more light to focus, and becomes more sensitive to strong light. Their ability to determine color may also decrease. A portion can also appear with cataracts, glaucoma, and so forth eye conditions (McInnis-Dittrich, 2005). Therefore, understanding the elderly physiological changes, especially the features of sensory system recession, is the basis of analyzing their VE features.

(1) Disease

Along with the aging process, various diseases increase exponentially. This is reflected in their energy levels, agility, reaction, body strain capacity, and the ability

to adapt to changes in external environment. In regards to external information reception and VE, some diseases will form a cognitive barrier to diminish their perceptive experience. Zeng and Shen (2010) investigated 219 elderly, aged above 65, in 22 provinces of China regarding five aspects: Activities of daily living (ADL), physical performance, cognitive function, self-reported health, and life satisfaction. The results showed that percentages of good physical performance and normal cognitive function dropped dramatically with age increase (Table 2.2).

Table 2.2 Ratio of good cognitive function of the elderly

Gender	65	70	80	90	100
Male	96.5%	90.0%	72.1%	49.2%	35.0%
Female	94.1%	81.9%	57.2%	32.4%	17.5%

Senses are the means by which humans perceive the outside world's information, including: Visual, auditory, tactual, gustatory, olfactory. The elderly perception system's recession and changing perception capacity affect their reception of surrounding information. Sensory system decline begins about around the age of 65. The first signs are in auditory and visual capacity. These two are the important channels through which humans get the majority of information from the surroundings (Zhang and Zhang, 2007). According to WHO (2014), globally the major causes of visual impairment include: uncorrected refractive errors (myopia, hyperopia or astigmatism) 43%, inoperable cataract 33%, and glaucoma at 2%. The report states that about 65 % of all people who are visually impaired are aged 50 and above; this age group comprises about 20% of the world's population. With an increasing elderly population in many countries, more people will be at risk of visual impairment due to chronic eye diseases and natural aging processes. Although 80% of all visual impairment can be prevented or cured, eye disease still directly affects the elderly VE and affects their daily life both physically or psychologically. For

example, it can cause inconvenience in action and operation, and elicit poor VE of the environment or an object because of dull visual reaction. Also, because of common problems in visual impairment and poor adaptability of light intensity, pleasure of experience is reduced.

Visual performance deterioration can be caused by cornea thickening, decreased lens elasticity, decline in ability to regulate ciliary muscle, presbyopia, and blurred vision at close range. Color discrimination decline, i.e. yellow filtering out purple, blue, and green; hinders their ability to distinguish colors from adjacent colors. Their judgment ability is in turn weakened through high difference or too slight of changes in light and shades. Therefore, in terms of product design for the elderly, it should be appropriate to enhance the brightness and color contrasts. The elderly over 70 require an increase in quality of light. The adaptation process of the eye is longer than younger individuals when moving from light to dark (Zhang, 2007). Therefore, lighting design in elderly living spaces needs to maximize the use of reflected light as much as possible. Additionally, light switches also need a weak light indication and placement in a more accessible location, in order to increase ease of use.

Additionally, the following diseases can affect perceptive abilities and VE effectiveness:

- **Alzheimer's disease (AD)**

From the Oxford Advanced Learner's Dictionary: *Alzheimer's disease,* noun, A serious disease, especially affecting older people that prevents the brain from functioning normally and causes loss of memory, loss of ability to speak clearly, etc.

AD is a kind of cortical dementia, mainly caused by neural degenerative diseases, main performance are memory impairment and memory dysfunction, at the same time accompanied by mental aberrations and behavior disorder. Wang (2005) points out that Mild Cognitive Impairment (MCI) is as early stage of AD, and the main performance in executive function show obvious damage, especially a decline in planning and sustained attention ability. Around 10%~15% of MCI patients progress to AD.

Age is one of the most important factors leading to dementia. The study found that the incidence of dementia in the elderly aged 65-74 is only 1%, The incidence in elderly over the age of 85, however, is more than 25% (Zhang et al., 2008). AD has a huge impact on the elderly VE.

AD is the most common type of elderly dementia, accounting for 50~80% of all dementia patients. There are about 30 million advanced dementia patients, occupying 0.5% of the world's population, and this number continues to increase each year. Alzheimer's Disease International (ADI) 2010 predicted that within 20 years, advanced dementia figures would double throughout the world (Life Omics, 2012). At present, there are more than 5 million patients with senile dementia in China, accounting for a quarter of the total number of cases in the world, and on average more than 300 thousand elderly join this group annually.

According to a study，Chinese elderly with advanced age, that live alone, are introverted, possesses low cultural level, lack exercise, and with a genetic history hold the biggest potential for onset of dementia, particularly AD (Wang et al., 2014).

- **Parkinson Disease (PD)**

Parkinson is a disease of the nervous system that gets worse over a period of time and causes the muscles to become weak and limbs to shake. In recent years, studies have shown that Parkinson's Non-motor symptoms, such as visual, social, emotional and so forth cognitive function disorders seriously affect the patient's quality of life (Pang et al., 2013).

Obstacles to visual ability are a kind of cognitive disorder suffered by Parkinson's patients, which can elicit comprehensive cognitive function decline and presents early in patients with Parkinson's disease. As visual function is one of the important channels for perceiving the world, visual function damage not only influences basic ability, i.e. walking with repeated falling; but further affects cognitive function, i.e. ability to judge a constantly changing object or the relationship between themselves and an exterior space is inhibited (Pang et al., 2013).

- **Glaucoma**

Glaucoma is an abnormal increase in intraocular pressure, exceeding the maximum tolerance of the eye, resulting in damage to the optic nerve, visual field defect, and final vision loss or even blindness of an eye. It is one of the three major eye diseases that cause blindness.

As age increases, generally 40 years of age and over, the eyes' crystal nucleus will be gradually hardened, and the larger, anterior chamber will become shallow.

This may cause obstruction of the aqueous fluid external drainage channel, and cause the increase of intraocular pressure. Moreover, patients who have family history of glaucoma, diabetes, or high myopia are more likely to induce glaucoma.

Glaucoma disease among the total population is 1%, but after the age of 45 is 2%. The elderly are the highest-risk population for contracting glaucoma. Glaucoma can bring about depression, melancholy, and spiritual unpleasantness. In regards to visual perception, most patients see a halo or similar rainbow around lighting as well as general eyesight decline (Huo, 2011). The main type of glaucoma in China is primary glaucoma, comprising about 86.7% of cases, with a rate of blindness approximately 10%. Therefore, glaucoma can affect the elderly VE experience and quality of life (Sun, 2008).

- **Cataracts**

A medical condition affecting the Lens of the eye causing a gradual loss of sight (Pang et al., 2013), cataracts is a disease of the eye in which the lens slowly clouds over, obscuring sight. Many elderly experience some form of cataract, affecting their visual ability**.** According to the survey, 18% of elderly, ages 65 to 74, have cataracts. It can be treated by surgical operation effectively, and more than 90 percent of the elderly patients who have done this corrective surgery enjoyed improved vision (Zhang et al., 2008). Cataracts prevalence is increasingly high, one hospital's survey of 967 individuals age 65+ produced 699 persons (72.3%) with senile cataracts. This shows，senile cataracts is a very universally eye condition impacting the elderly (Meng et al., 2000).

- **Presbyopia**

It is a condition associated with aging in which the eye exhibits a progressively diminished ability to focus on near objects (Wiki 2015), and is a common feature of aging, as the ocular lens loses elasticity (Binagwaho et al., 2015).

Presbyopia is a kind of normal physiological phenomenon. People can begin to shows signs of presbyopia as early as 40 years old. Caused by a pupil that cannot automatically enlarge to receive the amount of light needed to see something clearly, in the face of strong light, a pupil with presbyopia also cannot be automatically reduced to prevent too much light entering into the eye (Wiki, 2015). The reason is that the adjustment ability of the crystalline lens declines gradually with the increase of age. Practically, it means the eyes' focal point is moving further away. Studies showed that at 10 years old the closest focal point is 7 cm, 25 years old is 12.5 cm, 45 years old is 33 cm, and 60 years old reached 100 cm. This is called hyperopia or presbyopia (Yang, 2001).

The first signs of presbyopia are eyestrain with difficulty seeing in dim light or problems focusing on small objects and fine print, and are usually first noticed between the ages of 40 and 50 (Zhang et al., 2008).

- **Macular degeneration (MD)**

MD (often age-related, macular degeneration) is a medical condition that usually affects older adults and results in a loss of vision in the center of the visual field (the macula) because of damage to the retina. It occurs in "dry" and "wet" forms. It is a major cause of blindness and visual impairment in older adults, afflicting 30-50 million people globally (Wiki, 2015). With this kind of eye disease, macular

degeneration can make it difficult or impossible to see things in the frontal visual field as well as read or recognize faces. However, enough peripheral vision remains to allow other activities of daily life (Dahl, 2015).

The greatest risk factor being age, studies show that people over 60 are clearly at greater risk than other age groups. Middle-aged people have about a 2% risk of getting MD, while people over 75 have a nearly 30 percent risk (Dahl, 2015).

Cataracts, glaucoma and macular degeneration all cause a certain degree of damage to elderly vision. Visual impairment will not only cause inconvenience in daily life, but also increase safety risks, especially when they are in outdoors (Zhang et al. 2008). Therefore, design for the elderly should fully take into account the significant factors of physiological condition decline. It should increase ease of perception, acceptance, operation, and use while meeting the special physiological needs of the elderly. If the design of a product can strengthen the ease of use, comfort, and security, it will have a positive effect on the elderly life. Contrarily, it will not only weaken the elderly proficiency eliciting a poor experience, but can also, to a certain extent, form a safety risk.

2.2.2 Psychological aging

A substantial amount of information has gone to show that contemporary elderly endowment concepts not only include the pursuit of material, and physiological satisfaction, but also emphasizes the need for psychological and spiritual satisfaction (Gou and Sun, 2003). For example: In China, the "empty nest family" phenomenon is gradually increasing, and many of the elderly experience anguish, loneliness, depression, irritability, suspicion and so forth negative emotions.

Therefore, the physiological and psychological challenges among the elderly are increasingly becoming a common social problem.

(1) Psychologists have found that the elderly have the following psychological features:

- Pay attention to accuracy, but neglect speed. If the elderly are doing one thing, they tend to pay more attention to the accuracy of the completion of that task. That is, more attention to avoid making mistakes, and less concerned on the length of time in completion of task.
- Generally have nostalgia (Zhao, 2013).
- Hope to receive others' value and attention.
- The elderly show some aspects of their life that they are more satisfied with and proud of. Therefore, they will consciously or unconsciously maintain some habits and behavioral pattern of the past.

(2) The elderly psychological needs come from six aspects:

- **Dependency needs:** the elderly easily have a sense of loss and loneliness. They want to be taken care of and enjoy help in their lives, especially psychological emotional warmth and care.
- **Assistance Needs:** With increased age and declining health, the elderly are more and more dependent on help from others. If these needs cannot be satisfied, they will experience depression, resentment and other negative emotions, possibly arousing a sense of abandonment.
- **Security needs:** safety is an important psychological need for the elderly. Cognition and action will face many obstacles. These obstacles can lead to

some potential safety issues in their use of products. Design needs to consider the circumstances in which the elderly use products, and meet their psychological needs. For instance, how to avoid bodily harm caused by a crouch or squatting position.

- **Emotional needs:** In the visual experience, unreasonable information feedback mechanism design for older users creates sensory burden. If function, color, light, digital display or even size of an icon is not reasonable, older users experience negative emotions.
- **Self-esteem needs:** The elderly, although aware of themselves stepping into an old age, still very much hope that others respect them in a similar manner as before. Therefore, design should pay attention to this mentality in order to avoid damaging their self-esteem.
- **Self-confidence needs:** In general, the elderly hold a defensive emotion in regards to new science and technological products, frequently caused by a sense of inferiority. This sense of inferiority comes from their decline in learning, reaction, acceptance, cognition, and a strange feeling elicited by product technology. Aside from this, the elderly have cognitive and operational barriers in terms of product use; leading them to lack a feeling of control with a new product.

Therefore, in the design process, it is necessary to strengthen the feeling of control of a product, improving self-confidence. The feeling of control is derived from the interaction between the elderly with the product. It is derived from their ability to obtain control, and its performance has two aspects:

- **Psychological sense of control:** The elderly have a certain expectation of the situation, change and result of a product use, and the ability to control a

product's changing process to achieve the expected final results directly impacts their psychological sense of control.

- **Physiological sense of control:** Physiological sense of control of a product and their psychological emotion are inseparably connected. Losing sense of control will directly affect their psychological feelings, and result in harmful psychological reactions such as a sense of inferiority, frustration, resistance and so on. Therefore, the design for the elderly, in as much as possible, needs to have a product information delivery that is simplified and orderly.

2.2.3 Cognitive aging

In a certain age stage, people have corresponding psychological behavior feature changes. Along with the increase of age, the elderly cognitive system similarly undergoes corresponding change. Cognitive function gradual decline, restricting the gain and accurate grasping of information and stimulation, Their ability in cognitive coordination, thinking, analysis, and judgment are significantly affected. The most obvious cognitive changes include：

- **Sensory changes:** Because the sensory organs change in susceptibility with increasing age, abnormal reactions of the senses ensue.

- **Perceptual changes:** Because of sensory changes with age increasing, the rate of perceptive and reactive speed is relatively slow. People's perception to the current surrounding is based on past experience. Zhao (2013) found and indicated that elderly perception contains the accumulation of past experiences. As the growth of elderly with some level of education is constantly rising, the habitually and naturally link a product to their

younger experience of similar product use (Zhao, 2013). The elderly experience is full and rich, and the validity of their perception is generally still high. However, there are frequently arising capability obstacles that create disorientation, and this can affect their recognition of time and persona.

- **Memory changes:** Memory decline is quite different across individuals. The specifics of which are measured in terms of recession with early or later, speed with fast or slow, and degree with mild or severe. Short-term memory ability is also on the decline.
- **Thinking changes:** Cognition features show a reduction in ability to steadily concentrate on thinking, slower cognition, as well as lowered association and calculation speed. This is mainly reflected in calculation ability decrease, namely mental arithmetic.

Overall, cognitive function appeared to be gradually declining, and is mainly reflected in: Sense and motion perception gradually slow and desensitize, narrowing of attention range, memory function decline, reduced agility and flexibility of thought process, and imagination is relatively lacking. Objectively speaking, however, elderly cognitive features also have positive aspects, such as they have a certain independence of view and relatively strong problem discernment ability based on their rich experience. They usually consider problems more comprehensively and profoundly with strong reasoning and easy to comprehend analogies. Their way of thinking tends to be practical with less formality or frivolousness. Moreover, the elderly cognitive function still has great potential for development. American psychologist David Wechsler’s research results in recent years show that human's learning ability at age 60 is equivalent to 90 percent of that at 20, and at the age of

70 is 80 percent. Although their learning ability has declined, they can still improve their cognitive ability through continuous learning.

2.3. Visual experience (VE)

The VE is a living process that a person experiences every day. External information stimulates vision, and affects psychological feeling. Therefore, literature was reviewed on issues related to VE in order to discover and discuss the concept of VE. This includes: Visual perception and related environmental factors, VE factors including the formative mechanisms, the existing views and discussions on experience influencing factors, and the elderly VE features.

2.3.1 Concept of VE

The concept of VE is most often discussed in philosophy and psychology, and even brought out in the cognitive neuroscience of vision. However, it is rarely discussed in design research. Therefore, in this study, the VE concepts are abstracted away from the concept of user experience (UX). UX contains two main factors: Technical factors i.e. human-machine interaction and non-technical factors. Technical factors refer to system functionality and usability and are key in affecting user experience. Non-technical factors, on the other hand, refer to enjoyment, visual sense of beauty, and content attraction. Therefore, the VE concept is focused more on the non-technical factors of UX.

UX concepts are involved in all product and service design, whether now or in the future. UX has many different definitions, but the formal definition of UX from ISO 9241-210 (Ergonomics of human-system interaction) states: “A person’s perceptions and responses that result from the use or anticipated use of a product, system or service”. UX includes all the user’s emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviors and accomplishments.

Hassenzahl and Tractinsky (2006) said that UXs have been classified into three main categories: User's state and previous experience, system properties, and the usage situation. Besides, understanding representative users, their working environments, interactions and emotional reactions also are also stressed for helping in designing. An important view stressed here is that single experiences influence the overall user experience, which means that the overall UX is not simply a sum of smaller interaction experiences. Rather, other external factors can also influence the overall UX, e.g.: brand, pricing, friends' opinions, etc. (Forlizzi and Battarbee, 2004).

In design research, the UX focuses on emotions, for example, how design can affect interaction by evaluating emotional aspects. Norman and Nielsen (2016) give full affirmation to the experience effect that comes from usability in UX, followed by psychological pleasure. The expressly noted that the first requirement for an exemplary UX is to meet the exact needs of the customer; next comes simplicity and elegance in order to produce products that are a joy to own and a joy to use.

UX based design is concerned with all integrated factors. For instance, interface, layout, text, brand, sound, and interaction need to be coordinated for the best possible interaction with the users. In UX processing, usability seems to always hold a paramount position. However, some scholars believe that the usability of UX is not all users focus on. Deng (2008) suggests that usability is one of the attributes of successful UX, but mere usability cannot create a positive experience for the user. Although there are a diversity of opinions on UX, the overall model framework of UX, will be conducted with a unified consideration on aesthetics, practical, emotional and cognition. As an example, Vyas and Veer (2005) put forward the UX APEC framework that closely links the four aforementioned aspects. APEC highlights the

interactive system and the user's characteristics, and researches the relationship between them.

The VE concept is also mentioned in the study of visual art. It emphasizes viewer’s perception of visual art works and arouses the aesthetic emotion in the VE process. For instance, when a viewer sees a painting, their primary focus is detected, recognized, and identified by seeing what is involved with the eye while continuously moving and tracking from one interest point to another. The VE concept in visual art shows that the artist can control the viewer’s eye movements to some degree through Image composition, line and shape configuration, or arrangements of areas of lightness and darkness. It shows such reason that design can affect people's VE and emotion through the change of product design in relation to environmental factors.

2.3.2 Visual perception

VE is a human perceptive process of the external world. Therefore, visual perception is the premise of VE, and as such visual perception is an important factor in this research. Visual perception reflects the results that combine action to physical and psychological effects.

According to the Psychology dictionary, visual perception is the consciousness of visual feelings that stems from the interaction between the physiology of the visual system and the interior and exterior surroundings of the viewer. It involves two important factors emphasized that are the external objective environmental and personal subjective psychology. The human visual sensory organ is the necessary element for visual perception.

Vision offers humans the first impression for perceiving external information. Vision is usually the first sense that engages when we experience a product. It can provide the first experience of a product before human's other senses can detect it. Furthermore, the eye transmits a vast amount of information with processing of visual stimuli and alone consumes over half of the neurons in the brain's cerebral cortex. During every day life, vision is interacting with the external surroundings at all times the eyes are open. Vision has to face various information stimuli and accept these actively or passively, and then produce different psychological reactions. In a broad sense, VE is occurring throughout human life.

From a design perspective, all designs are associated with the human VE. For instance, product information perceived through the eyes, is then assessed. Moreover, Adank and Warell (2009) point out, "vision both communicates the descriptive characteristic of a product and also allows us to assess the aesthetic qualities of what we see". From a psychological point of view, in general, the human eye likes to view preferred products with appearance factors that cause pleasurable emotion.

In fact, a large number of adverse surroundings and product designs with negative visual experiences have real-life impact on human visual sense, such as the overflow of advertising, the lack of aesthetic construct and daily necessities. A good book with complex layout and gaudy color can be difficult read; advertisements with mutual interference between each piece; and light pollution all affect design negatively. Poor design easily causes poor visual perception, and can lead to a negative VE. Additionally, it is not conducive to physical and mental health; for instance, some scholars believe that black and white printing has adverse effects on the visual senses because a white background can increase the reflected light and

cause glare, possibly causing myopia (Zhou, 2005). There are relevant surveys based on test that report browsing a poorly designed webpage long-term can lead to stress and ill-tempered spirit. Negative emotions are brought on by slow speed, navigation chaos, excessive pop-up window, and unnecessary advertisements as well as non-functioning links and so forth. There are studies that also show that when humans have to observe negative images, it can elicit physical discomfort and psychological distress. Eco-visual specialists pointed out: visual pollution is endangering human health and has resulting negative impact on all aspects of our lives.

2.3.3 Environment factors

Environment factors, as one of the important conditions and components of VE, make up the spatial dimension between the object and human visual contact. The various objects in a space made up of different object combination forms the connection or interference between each item. Eventually, it frames the visual perception and generates the generic experience and psychological feelings of the external environment.

From the perspective of environmental psychology, environmental factors involve the artificial environment and natural environment. The most important feature of research is to emphasize the relationship between environment and behavior as a whole, rather than divide them into assumed separate parts that can be clearly distinguished. This experience process, which has time and space as part of a continuous perception of a picture composition, relies on a visual grading and visual attraction to generate an end result. Its space is constantly transformed through a hierarchy system.

Two aspects influence human's vision: Artificial environment and natural environment. In the VE, the environmental factors affect the human perceptual experience through three main aspects: Material experience, spatial experience and time experience.

- Material experience is the human's experience of an object within the environment in regards to color, texture, light, temperature, materials and synthesis of these;
- Spatial experience refers to the human's experience to the spatial shape, scale, and combination of the space in the division of the architecture;
- Time experience refers to the human's expectation, pause, intermittent, experience, meditation and memories contained in the environment.

Environmental factors can change the human behavior and emotions. For example, when a person is in the shopping environment, because of the comprehensive factors influenced and stimulated by the environment, their eyesight will continue to be attracted by products that are able to attract their attention. For the elderly, the environmental factors focused on in this study consider the environment based VE through three aspects: Material, spatial and time experience. These elicit related affects on physiology and psychology in the following ways:

- **Search pressure:** An environment that is too chaotic will cause difficulty in finding the route and perceiving expected relevant information. As a result, it can create a burden, and affect their experience and emotion.
- **Energy dispersion:** Early on, the elderly's energy will be more concentrated, but with prolonged experience time, they will gradually lose patience, reduce interest attention, and begin to carry out selective attention.

- **Easy fatigue:** Due to the Interference from excessive information from the environment as a whole, bad stimulation such as noise, strong or weak illumination, provocative color, easy slip material, cramped space, excessive crowd and fast dynamic movement can easily cause negative experiences.

These above effects will cause consumption of energy, and also affect the quality of experience. Bell et al. (2009) also pointed out that design can alleviate the pressure which environment caused to a certain extent, and should consider possible physical and psychological difficulties. He suggested that a sense of security and convenience are very important, and if the environment can promote the optional perception and sense of personal control, it will make the elderly more at ease.

This point also shows that the influence of environment on the elderly VE should not be a distraction on their experience. Instead, it can retain the possibility of coming into a positive VE. Therefore, it is necessary to further determine their cognitive preferences and features.

2.3.4 Visual experience factors

Human VE not only refers to a physiological mechanism; it is closely related to the psychological activities formed by visual perception. This perception contains two levels of understanding: One is the visual perception of the process itself, and the other is the physical factors of the external world that frame the visual stimulus. Therefore, the VE factors in this study include two related aspects, processing and visual presentation factors of an object. Reviewing the knowledge on the human perception process and physical attribute of stimuli will be conducive to understanding the possibility of the formation of factors involved in the elderly VE.

(1) VE processing

Vision is a basic and important physiological and psychological phenomenon. As a physiological phenomenon, it is the embodiment of the visual organs – eyes – and forms the visual sense. As a psychological phenomenon, due to the visual perception, thinking, memory, emotion, and so on, it forms the visual perception. Wu (2008) indicated that the eyes' sense includes two aspects of understanding and interpretation, but can't simply be reflected as visual function.

A Person's overall capability is reduced with age, as reflected in sensory (Hearing, Vision, Tactile, Taste and Smell), motion (Locomotion, Reach and Stretch, and Dexterity), and cognition (Communication, Intellectual Functioning). The Great Britain official statistics in 1999 show that hearing and vision capability loss ratio is higher (3.9 million GB population) than cognitive capability (2.9 million GB population). Especially in reference to vision, the functional capability of the eye decreases with age.

In this investigation, although VE covers the whole cognitive process, it is more closely related to the perception and response systems. Although there are differences existing among cognitive theorists, most models include sensory, memory, processing, and response components as a part of the overall cognitive processing system. Herschbach's (1998) illustrated model of cognitive processing reveals the human's cognitive processing. He also pointed out that the sensory component is the site through which information enters the cognitive system in the form of coded messages before being transferred, after a very brief period (milliseconds) to the memory. External information enters into the sensory system

through auditory, visual, and tactile stimuli in response to text material, visuals, graphics, drawings, and real objects.

According to the approximate feature of cognitive processing in VE, the VE process proposed is shown in Figure 2.5.

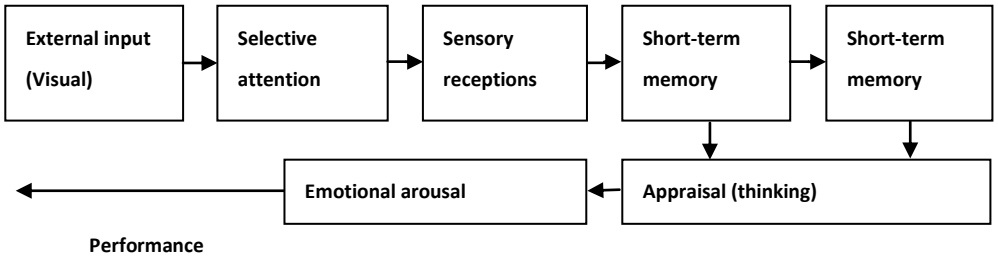

Figure 2.5 VE processing

(2) VE physical features

Realization of the VE is dependent upon the physical factors of stimulation on visual sensory. An object presents stimulation factors that are very complex and diverse such as: Light, color, shape, size, material and so on. They then further bring the viewer different psychological feelings.

Wu (2008) in his book, states that the real VE starts with express observation and analysis of an object's form factors and the finding of points of interest or pleasant object images. It emphasizes the form factor in terms of stimulus and the pleasure desire in the experience. According to different objects, its required VE factors are also different. For instance, for architecture, the construction forms, light, color and material are the key visual factors in spatial cognition and experience. For products, however, the color, shape, texture and surface, size, pattern and so forth are the key visual factors. In this study, four factors: Light, color, shape, and

information are categorized as the main physical factors of a product. The reasons are based on studies related to recognition and emotion, and universal factor features.

- **Light factor**

Light plays an important role in the process of the human visual experience. It is the primary condition of human perception of the external world. No light and nothing would be visible. For humans, light is as indispensable as air, water and food.

Eyes are the most significant sense organ in the body, and the human eye has an innate ability to adapt to illumination. The pupil can automatically be adjusted with the environment according to light and shade. However, if people see something under too weak or strong of an illuminated environment for an extended period, their eyesight will be damaged. Therefore humans must work under appropriate illumination environments.

Light will have a significant impact on the elderly VE. Schieber's (1994) study shows that glare recovery time for older subjects required 3-times more time. These findings suggest that the dynamic components of glare effects must be considered when designing environments, especially where older observers are involved. According to the result of research by optometry and vision science expert Haegerstrom-Portnoy et al. (1999), glare reveals significant impairment in a large portion of the aged. Many older individuals also have greatly reduced stereopsis, poor color discrimination, and severely restricted peripheral fields under conditions of divided attention, but suggest that high contrast acuity is reasonably well maintained on average for reduced contrast or luminance.

■ Color factor

Nature's various colors are important environmental factors in human visual perception. Color also plays an important role in emotion (Suchitra et al., 2004). It is closely related to feelings and can cause mood changes through different color perceived and different emotions generated. The emotion formed during the VE and perception of color are the comprehensive results of information that Suchitra et al. (2004) put forth that color is a phenomenon of sensation, involving three basic components: light sources, stimuli and human eyes. The eye records information without understanding, unless the brain interprets it based on previous experience such as culture, knowledge, personal preference and so on. Kaya and Epps (2004) also stress that a color-related emotion seems to be highly dependent on personal preference and one's previous experience with that particular color.

Psychologists have studied the relationship between color and human emotion with the general indications：Red means happiness, passion, it makes one's feel warm, full, and can inspire feelings of love. Yellow represents happiness, bright, rapture and full of joy. Green represents peace, which makes one's mind calm, tranquil and gentle. Blue gives a quiet, cool, comfortable feeling, and makes one open-minded. Gray makes one's feel depressed and empty. Black makes one feel solemn, frustrated and sad. White makes one feel simple and elegant, pure, brisk. In short, all kinds of colors will give certain impacts on mood and lead to the psychological activity changing.

Everyone has his or her own color preference. Bell et al. (2009) stressed that if a person cannot avoid their disliked color, it is likely to threaten their sense of control. He also pointed out that color is the most emotion conductive dimension of the

environment. This view reflects the importance of color, but also echoes that color is the most easily controlled emotional impact within the VE. Therefore, the role of color in the VE is not only important, but also a critical factor in design.

- **Information factor**

Information overload is a well-known phenomenon in this current information age (Nazemi et al., 2011). But for different regions and age groups, the amount exposed to information will be different. In general, for older people, who are more focused on the specific use of a product, too much complex information will lead to the confusion and their selective attention will be affected forming cognitive barriers. Bell (2009) points out that when human information processing capacity is overloaded, attention tends to narrow and secondary information is ignored. He also pointed out that too much or too little information can stimulate negative behavior and emotions. According to Helson's (1964) adaption level theory, everyone has an optimal level of information stimulation. The theory concluded that amongst three levels, the middle level of stimulus is the most attractive and produces the most pleasant sensation. Therefore, from the perception perspective, product design information needs to be reduced, enabling the information to be adapted to the actual need of the elderly.

In terms of the overall composition of the environment, all objects in nature can be seen as a carrier of information. Therefore, when one's eyes view something from a distance, the relationship between the object and environment will appear in a relatively harmonious state. However, the material, color, and form of visual stimuli presented in the near distance may not necessarily be in such state; with disorder or mutual interference. It is possible to give the viewer an unpleasant visual sense.

Therefore, in the visual environment, various visual stimuli and information carriers can be used in design as a means to achieve overall environment harmony in respect to visual perceptive features, and in accordance with aesthetic laws.

- **Shape feature**

Natural and artificial environments as well as products created by human beings are inseparable from shape. The definitions of shape are varying, but the attributes are convergent. For instance, shape represents a form of existence or expression of specific things or substances i.e. rectangular, square, and round. Other descriptions include shape as the appearance presented which object or figure is composed by the combination of external surface or lines (Xin, 2002). Shape is as an important factor of an object's feature recognition. It seems to be a natural and simple thing, but in fact, it is extremely complex (Eysenck and Keane, 2000). A large number of overlapping objects are integrated in the visual environment. The shape of an object can allow it to be distinguished from other objects. As a result, shape is one of the basic features of an object. It can have effect promptly as well as emphasize and enhance the VE experience.

Although artificial and natural shapes are very abundant, their role in recognition is paramount (Eysenck and Keane, 2000). Wang and Zhang (2015) also indicated that in daily life, we can see a variety of shapes, especially some simple shapes such as circle, triangle, and rectangle and so forth everywhere. Even the most complex configuration of an object, can be simplified into some simple shapes. As such, shape is one of the basic features of an object, and holds very important meaning for us in object recognition (Wang and Zhang, 2015).

Shape can be divided into natural and artificial shape, or can be divided into geometric and arbitrary shape. Geometric shapes are divided into linear and curved geometric shape (Huang, Zhou and Ding, 2004). There are three basic forms in geometry: Square, triangle, and circle. Overall, these geometric shapes give a sense of sensibility, rationality, and order; but easily produce monotonous and mechanical feelings. Organic shapes flow and change without violating the laws of nature and order, as well as providing pleasurable, harmonious, natural, and primitive simplicity feelings.

Different shapes used will elicit different psychological feelings. Wang and Zhang (2015) tested the emotional effects of simple shapes, and found that happiness was closely associated with round shapes, whereas the opposite was associated with triangular shapes. These emotions can be automatically activated to produce different influences (Huang and Liu, 2004).

Shape and ratio are inseparable. Single shapes can be transformed with various ratios of length, width, and height leading to change in experienced feeling. For example, a triangle can be presented with even ratio and produce a solid feeling, or can be stretched into a sharp shape that can elicit a disturbing feeling.

Some shapes do not entirely fit each person's pleasant psychological experience, so for each person's VE, the feelings experienced will be different. In terms of design for the elderly, consideration of a product’s shape must include usability as well as recognizability, which is to say they should be able to easily recognize a product in its environment based on past experience. The Helson’s Adaptation-Level Theory should also be a worthy reference to the elderly in terms of visual recognition.

■ The elderly sensation and perception

Sensation and perception play important roles in VE processing. Sensation refers to the human's reflection of individual attributes of the things that are directly acting on their sensory organs. Perception, however, is the brain's whole reaction to an objective thing, which is directly acting on the senses with multiple feelings and collaborative activities (Li, 2003). According to cognitive psychologists, perception is not instantaneous, it is cumulative. Perception includes: Spatial perception, shape perception, size perception, depth perception, and orientation perception. Additionally, perception in essence has the following features:

- **Selective:** rapidly selected perceptual objects from the context. It is depending on the features of the objective stimuli, and the subjective factors of perception.
- **Integrity:** different attributes of the object and different parts as a multiple sensation interaction and unity of the whole.
- **Understanding:** people with different knowledge and experience of the same object experience different perception.
- **Constancy:** Perceptual constancy in certain conditions can change, for example in instances such as distance and light change, perception will change.

Sensation and perception are the basis of other complex mental activities. Sensation is the main body to provide internal and external environment information. Based on the information acquired by sensation, not only can more complex perception, memory, thinking and other cognitive activities be carried out, but also a variety of emotional experience can be produced.

With the increase of age, the sensory organs will have certain decline in varying degrees. Elderly often present with weak perceptibility and slowed reaction to a variety of external stimuli. These are reflected in cognitive ability, memory, and critical thinking. When people enter in to old age, the brain will experience atrophy, and brain weight will reduce gradually. The number of brain cells will decrease by 20%-50%, nerve conduction function will decrease, and reaction time is prolonged. Most senses decline or even disappear. These changes mark weakened mental ability and labor capacity, and slow rhythm activities and light workload are preferred. Due to the central nervous system function decline, the elderly become easily fatigued, and they experience increasingly poor sleep. Besides, intellectual deterioration caused by brain dysfunction can lead to Alzheimer's disease (Shan, Mao, and Wei, 2012).

The elderly sensation and perception impairment is mainly reflected in the following aspects:

- **Sensory change:** Sensory organ decline.
- **Perceptual change:** Reaction and recall are in decline.
- **Memory change:** Memory ability decline as well as confused or incomplete memory occurrence.
- **Cognition change:** Reduced calculation and critical thinking ability. Time of full cognition is lengthened, or full cognition ability is impaired.

2.4 Emotion issues

Emotion is an important part of psychology. It is the result of subjective psychological reflection during the VE process, and reveals individual features. Due

to physiological and psychological differences and change with age, as well as differences in comprehensive factors such as social experience, cultural background, living habits, regional variation and so forth, emotional reaction is widely varied. From the perspective of development psychology, the elderly psychological reaction also has the property of convergence, for example, the elderly are influenced by local culture and perception of an object can be different across various regions.

In the field of design, the components of the product or the environment will affect a person's emotion in an objective state of unconsciousness. Therefore, it is imperative to understand the factors affecting the elderly VE in design, and how to enable them to experience a positive emotion within the VE. Moreover, good emotional state is related to people's health, and as such this understanding will more comprehensively contribute to the PVE development.

The purpose of review on emotional issues is to detect the relationship between emotion and the elderly VE based on previous literature and research. The literature reviews mainly focuses on three aspects: Emotional concepts, emotional factors, and pleasurable factors; with the objectives:

- To understand the role of emotion;
- To review the progress and findings of research on emotion related to VE;
- To discover the keys of elderly emotional needs;
- To clarify the common emotional features;
- To find the pleasurable factors in the elderly VE.

2.4.1 Emotional concepts

Emotional concepts are closely connected to the PVE conclusions of this investigation, but do not construct the main foundation of this research. Due to the connection between PVE and elderly emotional reflection, emotional concepts need to be understood. The purpose of this review is to discuss which factors can elicit positive emotion in creating a PVE for the elderly.

- **The definition of emotion**

There are a variety of definitions for emotion, for instance**,** the Oxford English Dictionary explains emotion to literally mean “a strong feeling such as love, fear or anger; the part of a person’s character that consists of feelings”[3]. The Dictionary of Psychology identifies emotion as “an organism that reflects the relationship between objective things and the needs of the main body". From cognitive theory, Lazarus' theory holds that “Emotion is derived from physiological and psychological reaction to good or bad information in an ongoing context depending on short - term or continuous appraisal” (Lazarus, 1984). Lazarus stressed that the quality and intensity of emotions are controlled through cognitive processes. These processes underline coping strategies that form the emotional reaction by altering the relationship between the person and the environment (Wikipedia, 2015).

American social psychologist, Sanley Schachter formulated a two-factor theory of emotion, he states that emotion is based on two factors: physiological arousal and cognitive label. According to the theory, when an emotion is felt, a physiological

[3] Hornby, A. S (2004), *Oxford Advanced Learner’s English-Chinese Dictionary*, Sixth edition, The Commercial Press, Beijing, p.556

arousal occurs and the person uses the immediate environment to search for emotional cues to label the physiological arousal (Schachter and Singer, 1962).

The basic premise of the James-Lange theory states that physiological arousal instigates the experience of emotion (Cannon, 1927). Instead of feeling an emotion and subsequent physiological (bodily) response, the theory proposes that the physiological change is primary, and emotion is then experienced when the brain reacts to the information received via the body's nervous system (Wikipedia, 2015).

Although the definition of emotion is not the same, all put forth that emotion is composed of the following three components:

- Emotion involves physical change;
- Emotions are a conscious experience;
- Emotion contains a cognitive component that involves the appraisal of external things.

From these three components, we see that emotion is the psychological phenomenon of the relationship between the individual and the environment involving physical change, experience, cognition, and appraisal. Therefore, in the study of the elderly PVE, the effect of a PVE is ultimately related to the onset of positive emotions.

Based on the strength, duration, and tension of the emotion, it can be divided into three states, these are:

- Mood is a relatively weak and long-lasting emotional state, i.e. pleasurable mood and so forth.

- Passion is an emotional state which rapidly and strongly erupts in a short time, i.e. rapture, fury and so forth.
- Stress is an intense emotional state that is caused by unexpected or anticipated outcome or emergency.

From this we can see, emotion is often intertwined with mood, temperament, personality, disposition, and motivation (Wikipedia, 2015). Whether positive or negative, emotions will cause motivation to action.

■ **The elderly emotional feature**

Wilson (2000) indicated that human needs are divided into three categories: physiological needs (food, water, shelter etc.), emotional or affective needs (attainment, domination, etc.), and cognitive needs (plan, to learn a skill, etc.). These three types of needs are personal and used for triggering information seeking behavior. However, the behavior could be influenced by personal, interpersonal, and environmental barriers based on impact on environment and role. It can be seen that the emotion is a basic human need. Norman (2004) indicated that "we scientists now understand how important emotion is to everyday life, how valuable. Sure, utility and usability are important, but without fun and pleasure, joy and excitement, and yes, anxiety and anger, fear and rage, our lives would be incomplete". Therefore, from the design perspective, design needs to pay attention to emotion, and more importantly to create positive emotions.

The role of emotion is becoming more and more important in contemporary design**.** Norman (2004) expressed that because of new scientific advances in our understanding of the brain we now know how emotion and cognition are thoroughly

intertwined. He also indicated that we now understand that emotion is a necessary part of life, affecting how you feel, how you behave, and how you think.

As humans become older, the relationship between objective things and human needs is very complicated. The elderly needs often cannot be met, and objective things are often contrary to their expressed desires. This easily leads to all kinds of emotional disorders (Yang, 2001). Therefore, we see that need satisfaction is a basis of emotion (Yang, 2001). If needs can be satisfied, they will produce positive emotion. However, if their previous experiences do not correspond with new products use, it can cause helplessness and tension throughout the utility process (360doc, 2010). When the elderly are unable to overcome encountered obstacles of motivation and behavior, they experience unhappiness, annoyance and depression.

Wang (2005) indicated that the elderly are less inclined to control their emotions especially in terms of joy, sadness, anger and disgust than middle-aged or young people. The elderly emotion is more dynamic and easily shifted. Due to the body organ function decline and aging of the central nervous system, their nerve function is lowed, learning and memory capacity has slowed down, tolerance in bearing various stimulus is reduced, adaptive capacity to the surrounding is dulled, and resistance to disease is lowered; all of which ultimately cause a negative mood. Disease and poor health has a deep effect on their emotions, often characterized by agitated or unpleasant feelings. The main negative emotions expressed are: aloneness, disappointment, dissatisfaction, doubt, melancholy, fear, and pessimism. Additionally, elderly cognitive disorders can also cause negative emotion. A decrease in self-learning ability, reaction, acceptance, and cognitive performance, as well as lack of system knowledge, aversion to new technology, obstacles in cognition and

product operation, and the lack of feeling control all bring the elderly negative emotions and feelings of inferiority (Liu, 2010).

Intelligence, attention, and memory as well as movement flexibility and speed also undergo obvious decline. This decreases learning speed and produces anxious emotions. Due to the lack of attention distribution, their fine degree and deepness of coding of information are also decreased. Additionally, memory is prone to interference or inhibition. All of these affect daily life, bringing them a certain emotional disturbance, which may lead to depression, anxiety, anger, and so forth negative emotions (UNPD, 2013).

In general, elderly emotion has the following features：

- The elderly more easily experience negative emotion. This is due to various reasons, such as changes in social status and social role, disease and so forth easily bringing on negative emotion of pessimistic, boredom, and depression.
- They are more irritable, and their emotional experience is more strongly felt.
- Duration of emotion is longer and unsteady.

Based on the elderly emotional feature, design can play a role in reducing certain negative emotions. The first step is to respect and understand their cognitive features, and pay attention to their normal psychological needs. The second is to positively improve any experienced negative factors by digging out the factors that elicit an increase in their self-confidence and pleasurable emotion. It is key to make a

design that benefits them and promotes elderly optimism, stabilizes their emotional change, as well as brings benefit to their health.

■ Emotion and health

A large number of studies have shown that longevity, with good physical and mental health, has a common characteristic; optimistic emotion (Yang, 2001). The psychological and emotional state of the elderly can affect physical changes. A person's mood, whether good or bad, directly affects physiological function. When a human is in a good mood, their breathing, pulse, blood pressure, metabolisms and so on are in a stable, coordinated state, and conducive to good health. However, when humans are in a bad mood such as depression, sadness, anger and so forth; it can cause tachypnea, quickened pulse, elevation of blood pressure, extreme tension, sadness, fear, and so on which can cause shock, and is very harmful to the elderly. If a person has a negative mood for a long time, it can cause a decline in immune function and increase vulnerability to disease.

The results of a recent survey showed that more than 56% of the patients with esophageal cancer in Shanxi province and other places in China had a negative mood of anxiety and impatience, and many researchers pointed out that elderly with a pessimistic outlook have the highest mental disease occurrence and the highest prevalence of depression. In people with emotional irritability, the incidence of heart disease more than 6 times higher. Modern medicine also shows that people who are in a bad mood are more susceptible to illness. Obviously, positive emotions play an important role in the physical and mental health of the elderly (Liu, 2010).

■ Emotion and research

Research on emotion has increased significantly over the past two decades within many fields. In the design research field, the attention to emotion has steadily increased. For the role of emotion in the design, many experts have original ideas, such as Norman (2004) who said “what role do these states (mood) have in design? First, someone who is relaxed and happy, is in a pleasant mood… Second, when people are anxious, they are more focused… designers can get away with more if the product is fun and enjoyable.” He also stresses on a more important note that three components: Visceral, behavioral and reflective; all interweave emotions and cognition in design. He goes on to state, “in the world of design, we tend to associate emotion with beauty… Emotions reflect our personal experiences, associations, and memories.” Creating a positive mood should be one of the highest goals of design (Norman, 2004).

Also, current areas of research on the concept of emotion even include the development of materials that stimulate and elicit emotion (Cacioppo and Gardner, 1999).

From an emotional cognitive theory perspective, emotional tendencies need to appraise stimulus in order for emotions to be generated. As emotional experience is subjective, it can only be truly felt by the party experiencing the emotion. Therefore, the main gauge of emotion is introspective self-rating in terms of the individual's stated feelings. This is the concept that supported the decision to assess subjects’ emotional experience in the self-assessment portion of this investigation.

The International Affective Picture System[4] (IAPS) plays an important role in research of emotion and attention. However, IAPS's applicability is not necessarily suitable for different countries and regions due to its stimulus material. Huang and Lou (2004) stressed that their experimental investigations show a significant difference between Eastern (Asia Major) people and Western (Europe and America) people in emotional cognition. The reasons are likely caused by factors of culture and education (Liu, Xu, and Zhou, 2009). This reveals that the Chinese elderly emotion and attention throughout the VE will have a common feature representative of the regional culture.

2. 4.2 Emotional factors

Lzard (1977) as cited by Wang 2009, the psychologist, indicated that emotion and affection are formed by three factors of each person's unique subjective experience, external performance, and physical arousal. This opinion shows that the emotional factors have three main aspects: Emotional experience, emotional expression, and emotional physiology. From emotional composition theory, we see five basic elements must be carried out harmonically and synchronously within a short time in order to attain emotion (See Figure 2.6).

[4] The International Affective Picture System (IAPS) is developed to provide a set of standardized emotional stimuli for experimental investigations of emotion and attention. IAPS is assessment affective stimulus picture system quantified, edited by US affective and attention research center of NIMH (National Institute of Mental Health). The 2001 version selects 812 pieces of color photos which come from different fields, standardized and can arouse emotion via the strict screening and assessment. IAPS's basis of compilation is Osgood and others' emotional dimension theory, from three aspects; Valence, arousal, and dominance. Reactions were self-reported and rated. Finally, a standardized emotional stimulation system was formed (Huang and Lu, 2004).

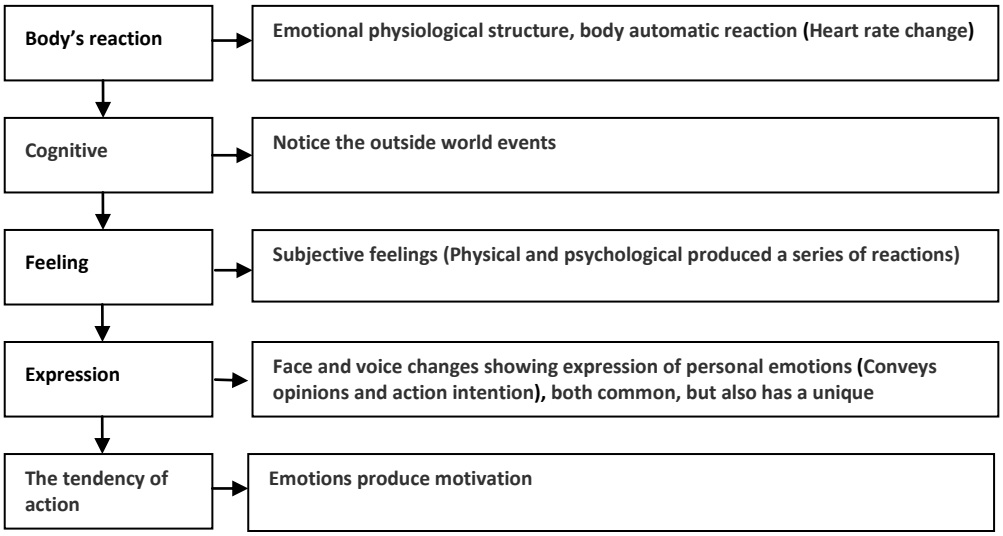

Figure 2.6 Emotion production process

■ Emotional experience

Emotion is both a subjective feeling and objective physiological reaction as a whole integrated experience process.

Emotional expressions have obvious poles, that is, positive and negative such as happiness and sadness, joy and anguish, relaxed and tense and so forth. In the VE, pleasant emotions represent PVE, and unpleasant emotions represent a negative visual experience (NVE).

Because differences in knowledge, experience, needs, pursuits, cognitive appraisal and so forth personal aspects, the same environment may mean different context for each individual, and as such the emotion produced could also be different. However, the presence of emotions is not unique to any one individual regardless of nationality, gender, or age. The invariance of the presence of emotional experience is assured throughout all people, and therefore needs careful consideration.

- **Emotional expression**

Emotion has a unique form of external representation, that is, the expression. Expression is the denotation of a changed emotion through use of each part of the body in an emotional state. Expression motion is a unique language, and is a tangible way to reflect the emotion of the subjective experience, thus becoming a tool for interpersonal emotional communication and mutual understanding through facial expression, posture and tone.

- **Emotional physiology**

Emotion is accompanied by significant physiological changes. The central nervous system plays a role in the regulative and integrative effects of emotion. The cerebral cortex plays an important role in emotion and subsequent reaction evoked by sensory information identification and appraisal. The activation of reticulate structure is a necessary adjustment to produce emotion. The James–Lange Theory puts forth the direct relation between emotion and physiological change; with the effect of the autonomic nervous system on emotion specifically emphasized (Li, 2003).

In the three emotional factors stated above, the emotional experience is closely related to the VE for elderly individuals. It illustrates the differences in emotion generation, but also shows commonality amongst all individuals. Therefore, in order to create a PVE for elderly, it is necessary to understand their experienced feelings via personal description, and to grasp their ideas of what is associated with positive emotions and emotional needs.

2.4.3 Pleasurable factors

Pleasurable, as an emotional term, refers to pleasurable experiences or sensations that are pleasant and enjoyable. It is related to a positive experienced result.

The experience of pleasure is subjective and different individuals will experience different kinds and amounts of pleasure in the same situation. Many pleasurable experiences are associated with satisfying basic biological drives (Schultz, 2015).

The stimuli associated with these emotions are regarded as pleasurable factors. Modern medicine believes that good mood is conducive to improving the body's function. As a positive emotion, the joyful element can inspire the experienced person's optimism, which is beneficial to their health.

Due to the richness of human experience and emotional reaction, it is very difficult to clearly define the subtle differences between individuals. However, emotional classification in the experience process can be sorted. American experimental and social psychologist Krech, pointed out that the emotions which are associated with sensory stimuli can be pleasant or unpleasant with obvious physiological reactions and external behavior. Some psychologists describe emotion in different dimensions (Wikipedia, 2015), for instance, Russell (1980) proposed "pleasant - unpleasant ", "activation - deactivation", as two dimensions of emotion reflected in the table in figure 2.7. Therefore, we can see that 'pleasant' is as a core indicator for emotion and as such a better VE. Specifically referring to design, related positive and pleasurable emotion formation is directly related to sensory stimulation.

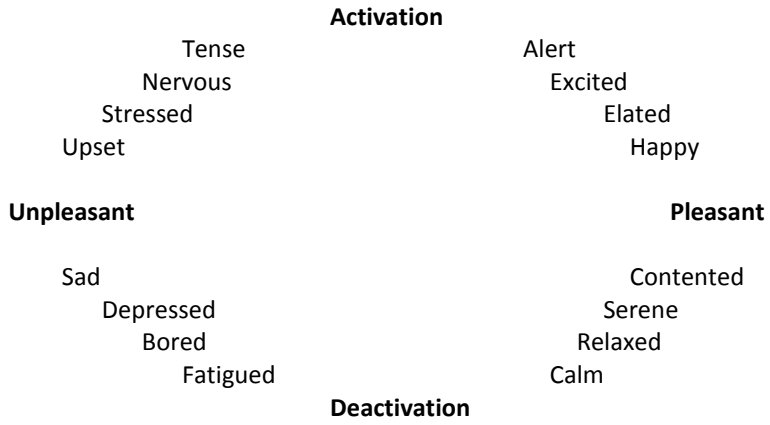

Figure 2.7 Two dimensions of emotion, Russell & Lanius (1980)

More so, something experienced as pleasurable feelings not only depends on its objective attributes (appearance, sound, taste, texture, etc.), but also on its other non-tangible attributes such as rarity, fame, price, and other non-intrinsic attributes, such as the social status or identity it conveys (Bloom, 2010). Thus pleasurable factors are not only produced by external stimuli, but also formed via subjective understanding of the object's intrinsic value.

Visual design is closely linked to human emotion. Different designs will always lead to different emotions, and creating pleasure is an inevitable responsibility of the design. In this study on the elderly VE, pleasure is an important evaluation indicator. This is because pleasurable factors in VE and product design are indicative of changes in the trend of human needs and desires. Based on Patrick W Jordan's hierarchy of consumer needs (Figure 2.8), a product design should not only strive for usability to create a pleasurable mood, but also employ an active role allowing the user to enjoy using the product with ease.

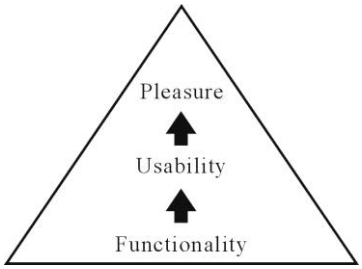

Figure 2.8 Jordan's hierarchy of consumer needs (Jordan, 2000)

Furthermore, pleasurable factors in throughout the VE not only bring positive sensations, but can also promote physical and mental health. Studies have found that people under a pleasant emotional state have ideal brain and endocrine system functions; reducing the occurrence of disease (Xiong, 1999).

Pleasurable factors caused by visual aspects refer to an experience's arousal of pleasurable emotions by the stimulus' external representation as well as various synthetic factors. These factors are composed of two aspects:

- **Aesthetic pleasurable factors**

Beauty can bring joy, and as such humans can experience joy from an aesthetic experience. Therefore, aesthetic feeling has always been regarded as a kind of pleasure (Yang and Gan, 2016). An object's external features, formed by aesthetic components, arouse visual senses and evoke pleasurable emotion. Aesthetic perception leading to pleasurable emotion is because of consistency between an object's aesthetic potential and viewer's aesthetic expectation, aesthetic ability, and aesthetic ideal. Therefore, there is an emphasis on the consistency between the subjective and objective. As human's creative behavior is often based on the standard of beauty and the pursuit of pleasurable experience; design is geared towards eliciting that pleasurable emotion. Moreover, the aesthetic factors for

creating pleasure should be to meet general needs across different regions and age groups to be considered effective. The composition of these factors can be classified into two categories: Commonality and Individuality.

- **Commonality:** That is, any environment and product with common color, shape, size, material, proportion and scale;
- **Individuality:** Refers to the specific features of the product itself, such as its unique external features.

During the VE for elderly individuals, aesthetic factors deeply arouse bonding with the product. Aesthetic factors that perform well can influence the formation of positive emotional reactions.

As all Individuals are different, only when the objects conditions are in line with a specific group of people's expectation, can it produce pleasant feelings. Therefore, based on the aesthetic factors of color, shape and so on external features, it is imperative to find the common cognitive basis of good aesthetics in order to make an object more attractive to the whole, and produce a perception of pleasure.

Additionally, Yang and Gan (2016) also indicated that a pleasurable sense aroused by aesthetic feature includes two perspectives: Physical pleasure and spiritual pleasure. Physical pleasure manifests via comfort experienced by the sensory organs coming into relation with the object. However, as seen above, purely physiological pleasure cannot be considered a complete aesthetic feeling, it must contain spiritual factors. Spiritual pleasure can be produced via further cognition and appraisal of the stimulus and consistency with personal aesthetic preference is found.

Norman (2004) also stresses, “along with emotions, there is one other point as well: aesthetics, attractions, and beauty… usable designs are not necessarily enjoyable to use.” He goes on to mention that beauty is a prerequisite of attraction.

Aside from this, because of varied elderly life experiences, aesthetic appreciations, and psychological situations; their inherent emotional accumulation is possibly different from an object’s aesthetic intention. For example, some product designs or images from their younger years may inherently elicit their collective memory and nostalgia emotion. This can be positive or negative.

Thus, pleasurable factors through aesthetic features can be created in design, but they must align with the aesthetic preference of the elderly in order to form a pleasurable emotion. Color, shape, size, texture, light, proportion and scale can all become factors that arouse pleasurable emotion in design. Additionally, various more complicated factors in design, for instance, interface design layout, font size, font selection, and so forth all have the ability to create a pleasurable experience.

- **Inherent property pleasurable factors**

These are intangible pleasure evoking characteristics. Perceived factors of the object or its surroundings can create different psychological feelings. Inherent factors are the natural factors of an object that cannot be controlled. They form the emotions independent to each individual, but are equally important in the evoking of emotions. These features can bring both positive and negative emotions, for instance a beautiful and orderly environment can bring pleasurable emotion from an aesthetic point of view, but on the contrary, it can lead to a negative emotion due to association. However, because this research is based on the understanding of the

factors associated with the design that can intentionally create a pleasurable emotion, the effect of evoked factors by inherent characteristics is regarded only as a phenomenon explained here, and is not the focus of discussion.

In order to find the pleasurable factors in the elderly VE, analysis of surroundings or objects' exterior factors must be conducted. Li (2003) stated that a positive visual experience (PVE) should direct the attention so that the viewer can choose the most suitable stimulus to fit their personal needs and is consistent with the purpose of the larger objective of the collective stimuli, thus avoiding strain or interference from irrelevant stimuli. PVE fully reflects the human's purpose and enthusiasm in awareness. Which stimulus an individual can select is related to individual characteristics, needs, emotions, knowledge and experience (Li, 2003).

In design, pleasurable factors are often given individual psychological appraisal based on the holistic experience. However, the role of emotion in the design is gaining more and more attention. Unfortunately, literature on the pleasure factors in reference to VE is currently lacking. Currently, the most discussed topic is the arousal of pleasurable factors from a usability standpoint. As Norman (2004) said, "When we think about emotion, design, and usability, we typically think of it as 'keeping the user happy', this includes designing to minimize the common emotions related to poor usability such as frustration, annoyance, anger and confusion". This further illustrates the significance of this study on PVE.

2.5 Summary

The conducted literature review and its relevant findings listed in this chapter provide the necessary background and knowledge for supporting this research's motivation and concentrations. The scope was relatively broad due to the lack of formal definition and research on VE and PVE concepts. Generally speaking, the aging issue, whether in the world or in China, is an irreversible trend. Moreover, design requires a reconsideration of the elderly physiological and psychological features from diverse perspectives and methods in order to understand how design can meet their needs and desires. With this as the premise, the literature review turned up valuable information on elderly physiological and psychological change with age, as well as evidence on how diseases can create a lot of inconvenience, while making them more easily prone to bad mood, further affecting their physical health. In terms of VE, the literature thoroughly showed that vision is the primary sensory organ, and its role in perception of the outside world is accompanied by an emotional connection that arouses two kinds of emotional reactions, namely pleasant or unpleasant emotion. The review results also demonstrated that consistency between the physical features of the environment and stimuli factors is a necessary condition for pleasure. This result is important for PVE research approach, providing conceptual direction from both subjective and objective perspectives.

The literature review provided background knowledge, definitions, concepts and methods as well as the evidence that underpinned the research motivation and methods to be used. Due to the research focus being specifically elderly Chinese, in order to more easily understand their VE features, more knowledge and case studies

were drawn from official Chinese statistics, information, and literature. The main identified issues are as follows:

- Presented situation and trend of aging in China as an important representation of the world. Substantiating design for the elderly Chinese has an important significance.
- Outlined the elderly psychological and spiritual demands that need to be cared for and satisfied; especially, when dealing with physical and eye diseases that directly influence the VE.
- Provided information on the environment factors and main physical factors that influence the VE and understanding of the VE process.
- Revealed many aspects of the elderly sensation and perception features in relation to manifestation of impairment and decline in cognitive function.
- Highlighted the importance of emotion and its mechanism and generation linked to the VE, as well as provided the evidence on pleasurable emotion as a benefit to health.
- Indicated the psychological research methods on emotion for PVE research approaches, adopting a two perspective, subjective and objective, approach to research; opening the possibility of influencing pleasurable factors.

These results are the foundation on which the research methods in Chapter 3 were developed and later adopted in Chapters 4, 5 and 6 for primary study. Related findings in this chapter will be discussed in depth throughout the remaining chapters.

CHAPTER 3.

METHODOLOGY

3.1 Introduction

The focus of this research is to find the elderly Positive Visual Experience (PVE) factors, based on their Visual Experience (VE) features. Therefore, its methodology and related assessment tools were designed tightly focused around the collecting of related information and data.

This investigation mainly relies on four methods: Literary review, observation, interview and assessment. By using each method at the different research stages, the four methods have different roles in information and data collection in order to achieve the desired results.

Of the four research methods, assessment method plays a key role in the collecting of subjective and objective data related to the elderly VE. Due to the special requirement of this research, and as there were no standard testing tools that could be adapted for this evaluation; assessment tools, called visual preference test (VPTs), needed to be developed that were suitable for information and data collection of the elderly cognitive laws and higher functions.

Initially, the literature review identified three major issues:

- Understanding aging related issues caused by physical change with age increase;
- Understanding the connection between VE and elderly VE in regards to emotional features;
- Finding similar themes in point of views, methods, and so forth.

After review, multiple methods were employed to gradually investigate. Observation refers to the surveillance of elderly VE behaviors in real purchasing situations, in order to find the objective considerations in the VE process. Interviews of elderly participants and experts allowed for the further understanding of the elderly VE features, issues, and psychological and behavioral motivations.

Based on the information collected, in order to sort out, categorize, and analyze the general features extrapolated from gathered information; the key points extracted acted as the basis for assessment content and testing tool development. There were two types of testing tools, including manual and computer-aided, in order to generate subjective preference and objective reflection calculation. Through the manual assessment, developed in the early period of the trial, subjects' preliminary test results were used to detect the deficiencies that needed follow-up, improvement, and development. This became the basis of the computer-aided assessment, which allowed for an optimal evaluation outcome. After this, formal assessments and testing tools were used on additional subjects, thus completing the primary body of this research.

3.2 Methodology framework

The multiple methods of investigation adapted in this study were specially designed to solve the specific problems throughout the different analysis stages. Each method used reflects the logical connection between the different investigation stages producing different evaluative content; with observation, interview, and assessment as the main methods of key information and data collection. Additionally, the VPTs assessment tools development was a key component of the extended methods with continuous improvement. Each method and its use throughout the different phases of research are showed in the framework of methodology in Figure 3.1.

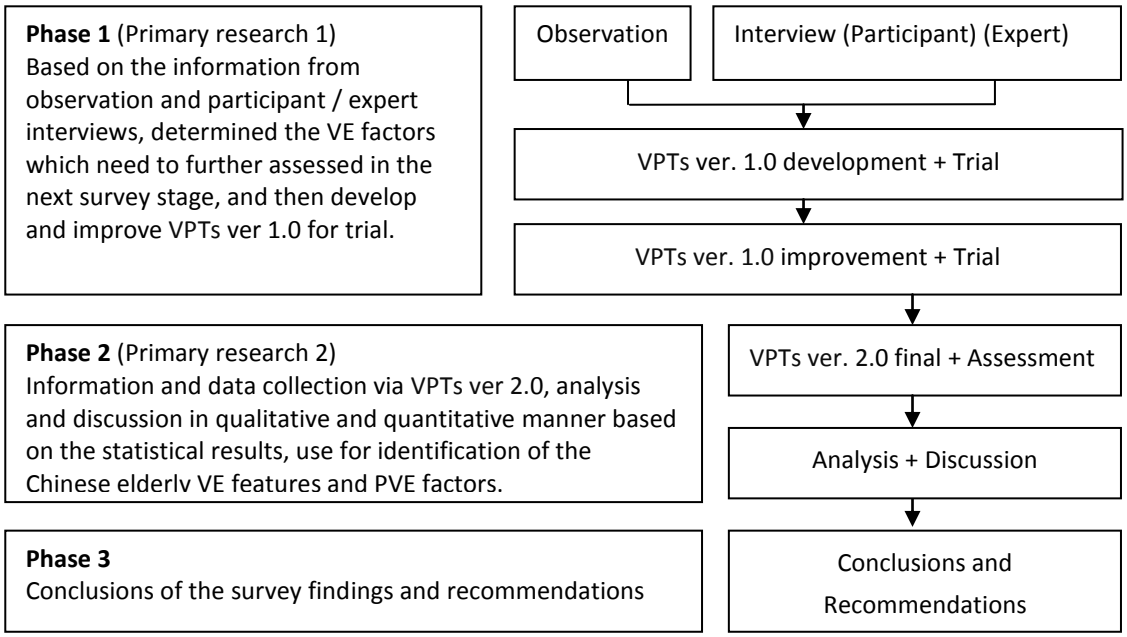

Figure 3.1 Framework of methodology

3.3 Observation

Observation is one of the foundational tools used in this investigation, with the purpose of collecting basic and initial information on the elderly VE, through their behavioral process in a real shopping environment.

This was achieved through the observation of elderly purchasing behavior and purchasing results throughout a purchasing process, in order to further judge how they can find product information which they are interested in, which factors of product presentation can attract their attention and help them feel satisfied, and what are their preferred factors in the VE process. By analyzing the information collected, the aim was to more clearly understand the product's visual factors, and learn if they have a positive role in the VE process. Further, the main factors were then extracted as a basis for assessment in the following research phase to be comprehensively analyzed against both expert and participant interview results, in order to provide a basis for the VE assessment and VPTs development. The objectives of observation are reflected in the following four aspects:

- To find effective factors which capture elderly attention, as well as their preferences in the VE process;
- To find the main factors especially associated with product appearance, both in successful and failed purchases;
- To find the VE barriers to the elderly in the purchasing process;
- To find the emotional reactive factors which affect satisfaction with a product.

Around the aim and objectives of the observation, was carried out via information collection through notes and images in order to interpret elderly behavior and determine motivation, thinking, preference, and restrictive problems in the purchasing process based on their facial expression, gesture, and emotional reaction. After the observation survey stage, eventually these records needed to be integrated and summarized with qualitative analysis for the extracting of general features related to the elderly VE. The observation process is outlined in Figure 3.2

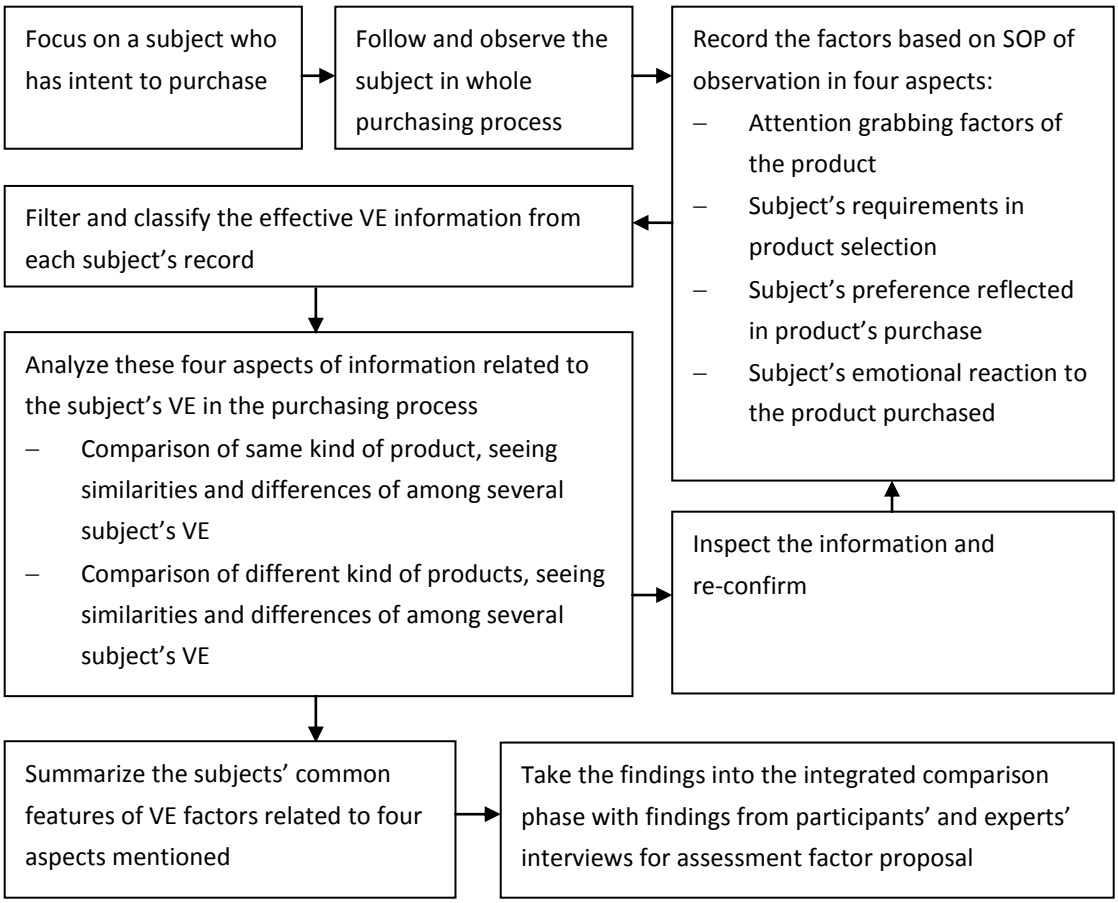

Figure 3.2 Outline of observation process

■ Observation method and analysis

In order to provide an analysis basis for elderly reaction to VE elements within the natural state, the observation place was selected as a real shopping location. This

was done in order to find how the elderly find, compare, and make final selection decision based on a product's appearance factors; including rich and numerous types within the natural shopping state. Through the observation records, the elderly VE behavior, visual elements with visual appeal can be analyzed, and the elderly comprehensive product satisfaction factors based on their visual preferences can be determined.

In this observation, there was a possibility that the elderly people shopping in some product monopoly area of a supermarket, mall or household store would incur a higher probability of observation. In order to obtain the relevant information of the behavioral experience, we need to observe the number of product categories. In order to obtain a reliable basis and more relevant information for the analysis of the general characteristics in later stages, it is necessary to respectively observe the subjects who were observed across several categories of products. Before conducting observations, it was firstly important find out several product areas which the elderly are relatively more likely to visit via site observation, in advance, and then pinpoint the main locations of observation.

Observation adopted the following mode of distance control, that is the observed distance between observer and observed subject was consistently 5 to 10 meters in order to avoid disturbance to the observed subject. Moreover, the observer can adjust within the range of 5 to 10 meters based on actual situation in order to keep the sight and hearing line unobstructed, and with minimal interference on information gathering during observation. This allows the observer to be able to recognize observed subject's actions and key verbal communication clearly. At the same time, in the process of observation, allowed for the making of necessary photographic and written records of the observed subject on key behaviors and

findings.

- **Observation analysis method**

The observation survey is the qualitative study in terms of integrity research on the elderly VE behavior via a real and natural shopping phenomenon. The purpose of this phase is to constitute the descriptive understanding of the elderly general behavioral characteristics based on their individual reaction to the real product.

Information analysis in qualitative research mainly adopts the method of induction. Firstly, the group features of subjects' VE behavior within the same category of product was inducted out based on each subject's raw information collected via observation. Then, the general features, which integrated all group features of subject's VE behavior, were sorted out in detail. This was done in order to obtain clear and consistent information to integrate the similar or identical features among each group, and finally to gather the subject's overall descriptive qualitative VE behavior.

In this research, collation and analysis of information was divided into six steps:

- Form several information classification tables according to different group of products, a list of all observation points was made on one side of the table. Each category of observed information and observation point was listed in different columns, one by one.
- Statistical analysis and listing of all observed information within the same observation point.
- Gather all the general features of subject's VE behavior and information within each group.

- Re-form one integrated information classification table and list all of observation points on one side of the table. The gathered results analyzed of the several groups observed are listed in one observation point column.
- Re-check input information.
- Extract overall interpretive understanding of each observation point.
- Summarize the valuable factors for assessment content development.

The summary generated after observation, induction, comparison, and analysis of each subject's purchasing process will be re-compared and re-analyzed with the synthesized results from participant and expert interviews to finally determine which test factors would be used in assessments and VPTs development.

3.4 Interviews

Interviews were one of main methods used in this investigation. The purpose was collecting information related to the elderly VE from a personal perspective based on interviewees' past experience, knowledge, and understanding, for the further verification of the observation results, and eventually forming preliminary assessment contents and VPT-1 as a pilot survey.

Interviews were able to obtain the interviewee's explanatory understanding of elderly VE aspects, and reflect their presuppositions and prejudices towards this investigation in order to reach a mutual understanding.

The interviews covered two target groups with separate methods utilized: expert interviews and participant interviews. The two types of interview provided two perspectives related to elderly VE aspects.

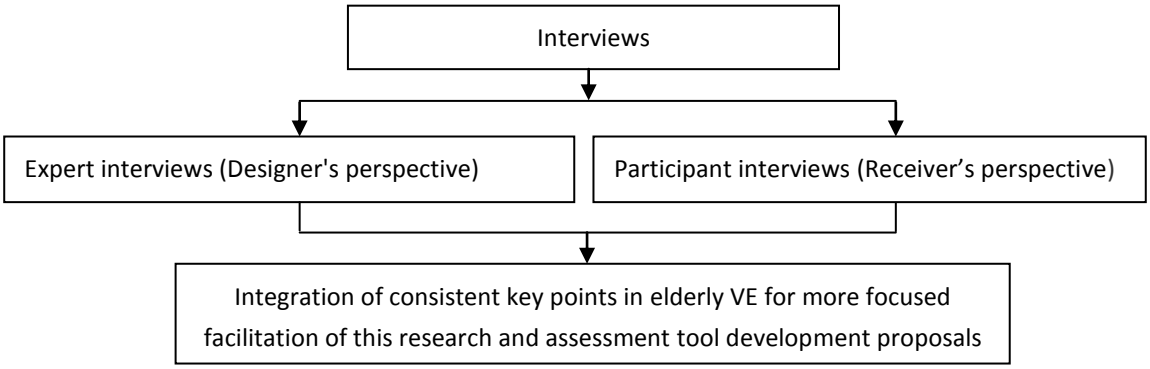

Figure 3.3 Framework of interview survey

Some information collected from the two types of interview is different, while some was consistent. Information that was common to both interview types was used to offer comparison between the two groups' answers in order to verify the

common and dissimilar points of view gathered. All interviews were conducted with prior consent. The framework of the interviews is showed in Figure 3.3

- **Interviews analysis method**

Interview survey is the qualitative study in terms of integrity research on a specific phenomenon. The purpose of this phase is to constitute the descriptive understanding of interviewees' previous individual experiences and implications from their perspective.

Information analysis in qualitative research mainly adopts the method of induction. It is based on information collected bottom-up, in order to establish analysis categories and theoretical hypothesis, and then through the relevant test to enrich and systematize that information. Therefore, the results of the survey are only applicable to specific contexts and conditions.

In this research, collation and analysis of information was divided into six steps:

- Transform the voice recording into text format.
- Form an information classification table, and list all of questions on one side of the table. Each interviewee's answer to this question is listed in different column one by one for comparison.
- Compose statistics and lists of all interviewee's answers to the same question; those in accordance with one another are tallied (i.e. "Yes (19)").
- Re-check input information.
- Extract overall interpretive understanding of each question.
- Summarize the valuable factors for assessment content development.

3.4.1 Experts interview

The aim of expert interviews was to more clearly understand and judge the elderly VE and product design for related issues, as well as the pleasurable emotion elicitors from an expert's perspective.

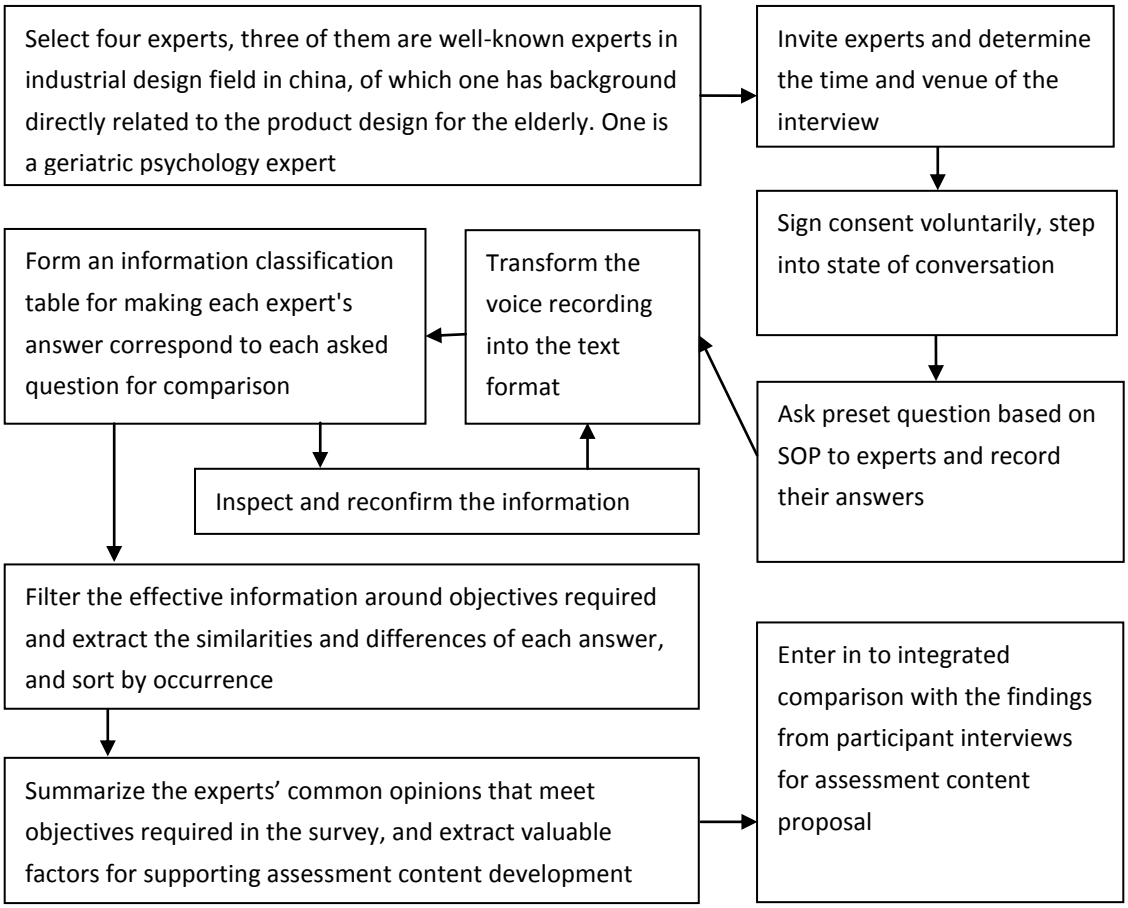

Figure 3.4 Outline of expert's interview survey process

This survey was conducted via personal interview with experts in industrial design and geriatric psychology. By obtaining information centered on the questions, from their personal and professional knowledge, opinion, and suggestions, the following objectives were met:

- To verify the existing VE issues in design for the elderly;

- To understand the elderly VE features;
- To detect the VE factors;
- To find the elderly VE barriers;
- To discover the possibility of the elderly emotional reactions.

Based on questions answered by the experts, the information was converged and general and varying points were obtained, in order to find the valuable factors for assessment tool development.

Inductive analysis method was used for information analysis. All information collected was sorted out into general and varying points of view via comparison and analysis. This was to further the qualitative analysis of their views, thoughts, experiences, and advice for interpretative understanding. Based on the analysis, the key opinions and suggestions were extracted for comparing the results of the participant interviews. The outline of expert interviews is shown in Figure 3.4.

The final results of expert interviews will be combined with the results of the participant interviews in order to compare both interviews and discover their similar and different understandings related to the existing VE issues; specifically in design for the elderly, VE features, VE factors, VE barriers, and possible emotional reaction. The advice gained in this investigation and the factors that were extracted for the assessment phase were an important reference for supporting the assessment content and eventual VPT-1 development.

3.4.2 Participant interviews

Participant interviews were an important component in the interview phase of this investigation. The aim was to more clearly find the subjective point of views

involved in elderly VE and product design, as well as establishing what factors, from their perspective and understanding, bring about pleasurable emotion in the VE process.

This survey was conducted via interviews of voluntary participants who are over 60 years of age. The goal was to collect information from answers to questions presented based on their previous personal experiences, opinions, and suggestions. The objectives were:

- To gather elderly awareness of products designed for them;
- To verify the existing VE issues in design for the elderly (consistent with expert interview);
- To detect important VE factors (consistent with expert interview);
- To find the VE barriers (consistent with expert interview);
- To understand VE features based on cognitive change;
- To discover the possibility of common emotional reactions caused by product appearance (consistent with expert interview).

Every participant invited to the survey was selected at random and participated voluntary with signed consent form. Throughout the whole interview process, the participant answers to each preset question from the participant interview SOP were recorded. All recordings were converted into text format after the whole interview was completed. Information analysis also adopted the same inductive analysis method as expert interviews. Through information collation, comparison, classification and analysis, ultimately a general interpretative understanding of important issues was formed.

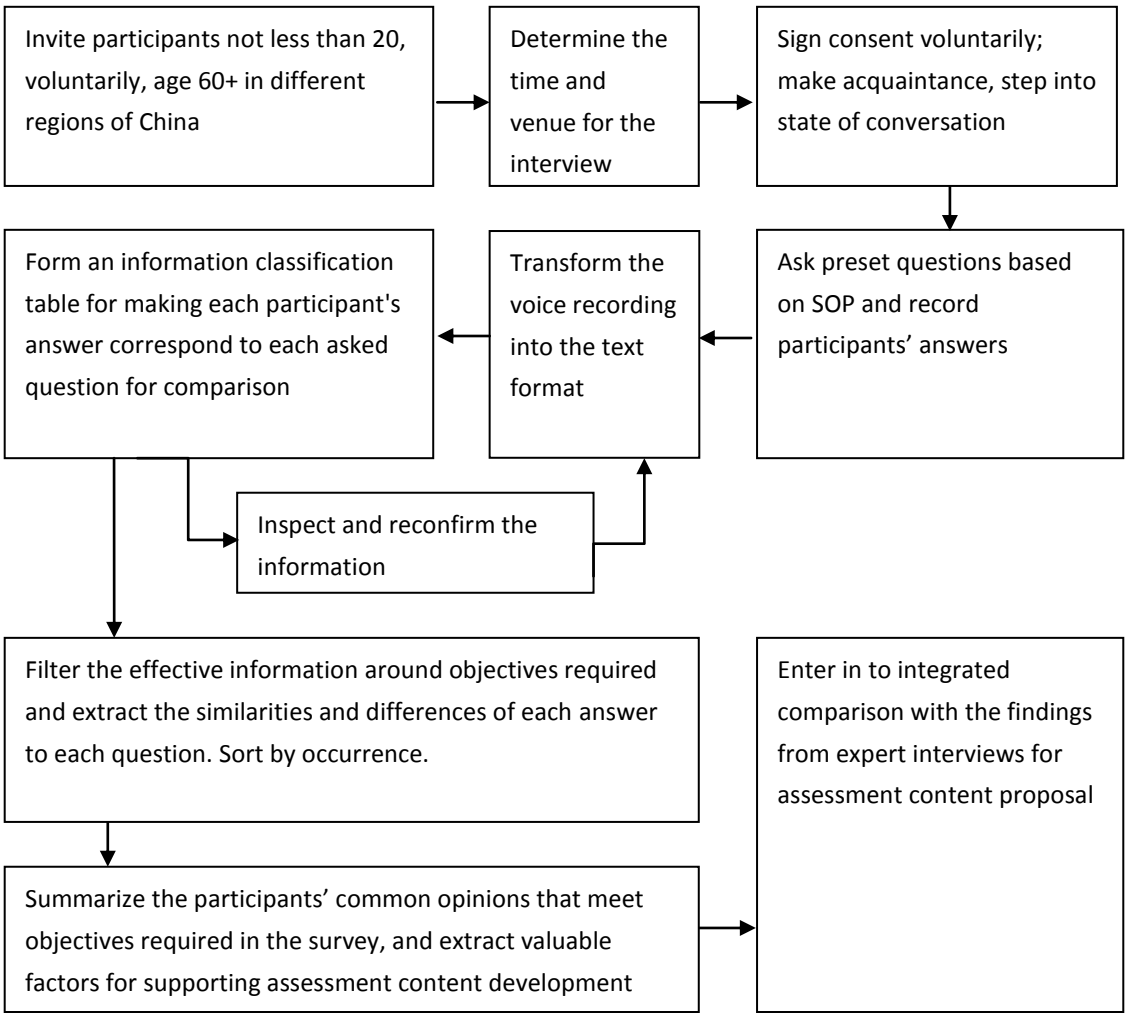

Figure 3.5 Outline of participant interview survey process

Finally, the convergence of answers extracted out similarities and differences in points of view for qualitative analysis of the commonality between opinions and desires. Based on these results, the general and valuable factors, merged with the opinions from expert interviews, displayed key factors for assessment content formulation and VPT-1 development. Additionally, some of the remaining views and suggestions can be used as valuable material in future related topic research. The outline of participant interview is shown in Figure 3.5.

Through the participant interviews conducted, the elderly VE tendencies and participants' true desires revealed both diversified and unified features.

3.5 VPT development and assessment

Visual Preference Tests (VPTs) are core components of this assessment used to collect the information and data closely surrounding the factors of VE from two perspectives; subjective and objective.

The aim of the VPT assessments is to further verify the relationship between elderly VE related factors based on specially designed test content, and through collected information and data analysis, find the positive visual experience (PVE) factors for elderly Chinese.

As a special VE assessment tool that was created by the author specially designed for elderly VE survey, it was composed of an integrated series of various contents and aspects. Considering elderly adaptability and physiological function decline; i.e. visual difficulty, slow response, inattention, confusion, forgetfulness and fatigue, it reduced the amount of content and testing stimulus as much as possible in order to maximize the assessment and test effect. This also allowed the subjects to easily recognize, understand and select outcomes within a reasonable time. In the study, four main categories were used in VPTs.

VPTs combine two approaches: VPT-1 assessment and VPT-2 assessment. The VPT-1 assessment is a manual assessment for collecting subjective visual preferences and related information. The VPT-2 assessment is a computer-aided assessment for testing objective reaction. Both sets of data generated will be used in data analysis for data comparison and determining of PVE factors.

VPTs are assessment tools specifically developed for gathering elderly VE information and data collection in this investigation. The results directly link to

ultimate PVE factors. The statistical results of the information and data were able to effectively support the quantitative analysis. As there was no existing approach with similar VPTs found after the literature review; the VPTs development needed to carry out preliminary design and corrective adjustment through a pilot test. Its development experienced two stages from the initial version 1.0 to the final version 2.0.

3.5.1 VPT-1 concept development

VPT-1 was specially designed for collecting information and data related to subjective visual preference (VP) in elderly participants. Its purpose is to summarize what factors of visual perception are commonly preferred within the VE scope. From the VPT-1 test results, the elderly Chinese general VP features were found.

VPT-1 concept development was based on the qualitative analysis results of observation, as well as expert and participant interviews. Through the reference provided from the two survey methods, possible test factors were considered to further carry out supplemental assessments, improve these and finally design one preliminary VPT-1 plan. In order to achieve optimal test results, the initial VPT-1 concept proposed was developed according to the following three principles:

- **Representative:** Extracting the most important and basic visual perception factors, and comprehensively test these elements;
- **Easy to identify:** Adopting familiar visual perception factors, easy to understand the meaning of the test, and easy to identify results;
- **Suitability:** Suitable number of tests and time range.

Composition of the VPT-1 assessment used a series of contents including: Demographic data, product preference, VP and emotional reaction. The VP testing section was the core component in the VPT-1, and was adapted and presented via a series of test boards (TB) with different test categories. In VPT-1 assessment, the TBs consisted of 8 pieces of cardboard of standard size, 420 mm x 297 mm, with printed contents in 11 categories, i.e.: Color (Hue, Hun Contrast), Color (Purity, Purity Contrast), Color (Brightness, Brightness Contrast), Shape, Size, Pattern, Product, and Newspaper layout.

In each TB category, each tested factor had an arrangement of coded stimuli with gradual change among them. A sample TB is shown in Figure 3.6. The detailed content of TB are presented in *appendix. III-I.*

Figure 3.6 Example of VPT-1 assessment TB

The contents of the TB assessments were tested many thoroughly amongst the elderly to assure understandability，and eventually met the requirements of test time and degree of difficulty acceptable by the elderly. Detailed samples of TBs are shown in appendix.

3.5.2 VPT-1 assessment

The VPT-1 assessment is a holistic assessment, which included four sections: Demographic, product preference, VP, and emotional reaction. Its statistical results were not only able to directly provide the subjects' subjective VP factors to a

significant degree, but could also be taken directly to the PVE factor discussion stage. The VPT-1 assessment manual lists all of the contents in the four sections in paper form along with the consent slip. Additionally, the SOP provides the standardized survey mode.

The TB assessment stage was broken into three sections. During this period, the tester showed the TB, one by one, to the subjects for their observation, consideration and selection of their preferred stimulus in each category. Answers were recorded accordingly in the assessment manual.

After all VPT-1 assessment contents were completed by no less than 80 subjects, the assessment information and data collected was classified for statistical analysis. Ultimately, common subjective information and data on their VP factors surfaced. The outline of VPT-1 testing process is in Figure. 3.7.

- **VPT-1 assessment analysis method**

The method of analyses was based on the quantitative statistics of subjects' selection across each category. Due to age and understanding differences among the subjects, it is a normal phenomenon that some selections appeared wrong, missing, or absent. In this case, these data points were considered invalid data and eliminated from the statistical calculations. Because the statistics were built on a relatively large number of samples, a small number of invalid data points do not affect the overall tendency of data.

Also, the statistics are calculating the most favored factors of every subject's, therefore, only the first selection was calculated. For multiple selections, it also adopts the first selection method into the statistical calculation.

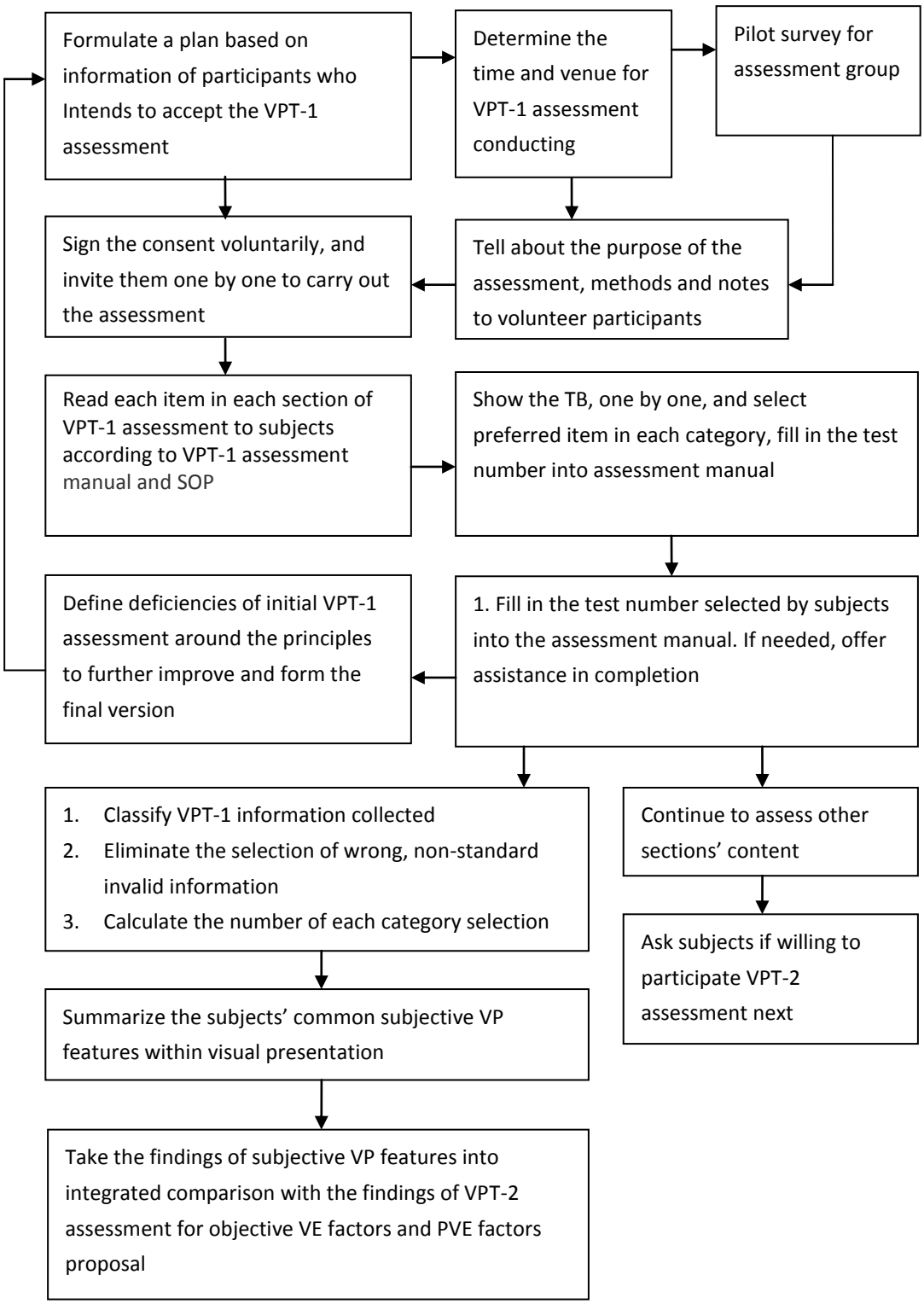

Figure 3.7 Outline of VPT-1 testing process

Finally, the statistics revealed the order of preference among each factor in a category. This VPT-1 assessment survey method generated statistical results, although in a limited sample scope, that can be used as a sample for revealing a general law to be referred to for design application and strengthening the elderly VE.

3.5.3 VPT-2 concept development

The VPT-2 is another core component in the assessment phase. It reflects the fact that VP subjective assessment may not be consistent with expectations, particularly in real surroundings. As a matter of fact, a VE result may be quite opposite to their stated preference. This shows that subjectivity and objectivity are not consistent in realistic surroundings. Therefore, the aim of the VPT-2 assessment was to explore the factors of objective attraction and interest present in the elderly. Through data collection and statistical analyses, the goal was to find what visual factors could stimulate and arouse the subject's interest. These statistical results were used as a main basis in the PVE discussion.

The VPT-2 assessment depends on computer aid to achieve its aim via data collection from an eye tracking (ET) device and analysis with professional software.

ET is a precise device for capturing and recording subject's eye movement, tracking glance and gaze time, all in a natural state. It can provide objective data and statistical results. The ET first tests the fixation point and its distribution, fixation duration, fixation time and fixation order. Through data collected by the ET devices, it was easy to judge participant's attention, preferences, the effects of product design, purchase desire. The elderly's reaction and visual preference towards objective visual elements presented can be found, and provide support of analysis

for the elderly visual experience features. Among the various data sets produced, two sets of data, time to first fixation and observation length, reflect quick attention grabbing by and sustained gaze on a stimulus. Because the ET is a professional device, its operation needed a professional operator to support the test.

- **Tobii X60**

The brand and model of ET device is selected in this study. It is a standalone ET unit (320mm*163mm*85mm in volume) with a separate monitor adopted by VPT-2assessment for subjects' objective reaction data collection to a stimulus (Figure 3.8).

Figure 3.8 Objective reflection test device (Tobii X60, 2013)

According to the Tobii Eye Tracker User Manual, Tobii X60 needs to connect a primary screen for stimulus presentation and a computer for control host with secondary screen with Tobii Studio[5] software installed for a live viewer, operation control, and data calculation. In VPT-2 assessment, a laptop was used with Tobii Studio software installed, and the VPT-2 assessment project contents created for executing commands and processing data， as well as an independent monitor used for VPT-2 assessment content display. (Figure 3.9).

[5] Tobii Studio™ offers a comprehensive platform for the recording and analysis of eye gaze data, facilitating the interpretation of human behavior, consumer responses, and psychology. Combining an easy preparation for testing procedures and advanced tools for visualization and analysis, eye tracking data is easily processed for useful comparison, interpretation, and presentation. *User's manual Tobii Studio Version 3.4.5*, 01/2016, Tobii, p.1

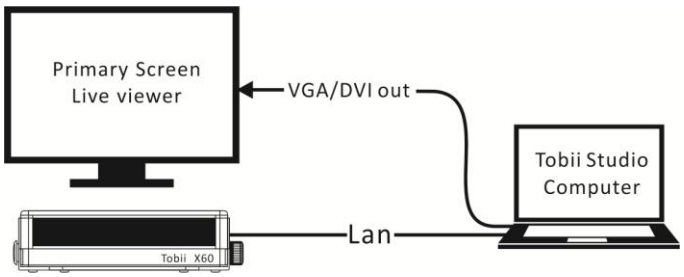

Figure 3.9 Schematic diagram of the link of Tobii X60

Tobii X60 provides typical analysis schematics: 1) hotspot; 2) scan path; 3) area of interest (AOI) all presented with a statistics tag. Its calculation of ET indicators is based on AOI and its data representation is ultimately converted into a graph or table.

- **Eye-Tracking device recording in VPT-2 assessment**

One tester, responsible for Eye-Tracker operating and test materials shown in VPT-2 assessment followed the following steps:

- Confirm correct connection of Eye-Tracking device;
- Open Tobii Studio software with preset VPT-2 assessment content;
- Create a new test name code on Design and Recording page;
- Let one participant sit on a chair before the monitor and adjust the participant's sitting position and remind the participant's to keep the head as motionless as possible during the whole test process with their eyes focused on the center of the screen in relaxed and natural state;
- Calibrate the Eye-Tracker via conventional 5 point calibration setting for making sure it can accurately calculate participant data on the screen via the track status window;

- Confirm Eye-Tracker can detect the participant's pupil with distance indicator showing numerical value that is in the range of 50 cm to 80 cm between participant's eye and Tobii X60 based on Tobii Studio User's Manual;
- Prompt the participant to watch five points, which will appear directly on the screen, and start to calibration process, and confirm its success after all calibration rods have been completed;
- Start displaying the testing stimulus material and record Eye-Tracker data. After an instruction page 'please gaze at the following pictures' is displayed, each page of category content within the VPT-2 assessment will display subsequently on the screen in five seconds intervals, one by one;
- End recording process after all stimulus materials have been completely displayed and observed by the participant;
- Check Eye-Tracking recording results by viewing the Replay page, use for data and statistical analysis in the next phase.

■ **Eye-Tracking data statistics in VPT-2 assessment**

- The Tobii Studio statistical tool is used to calculate and present descriptive eye-tracking statistics based on the AOI for a defined user and across selected time segments. The statistical results can be showed in table or bar graph form. However, in the process of the eye-tracking test, there are several cases that lead to missing data, such as participants with high myopia, large amplitude nystagmus, constant blinking, visual field loss or drifting eye that caused the participant's gaze to exceed the range of the eye-tracker.

- Tobii Studio provides a variety of statistical data. Different data can be analyzed for different results. Based on the VPT-2 assessment analysis' need for statistical data, 2 sets of statistical data were adopted: 1) First time fixation; for recording the time taken to reach the target area as well as the average order, which reflects the attraction of a stimulus to the participants' attention objectively; 2) Observation length, for recording which area was the longest observed by the participant, reflecting the participants' interest in a stimulus.
- AOI can analyze participant's average fixation duration and give specific data on a specific area. AOI's setting was adjusted through the AOI tool of the Tobii Studio software, allowing to define each stimulus in each category page displayed manually.

■ **Statistics and processing of ET test data**

Eye tracking as an interpretive method in user research, describes and illustrates behavior that reflects objective results and reveals true human behavior. It can discover how the participants search for information, the length of time spent in that process, different behaviors amongst different groups, interest areas etc., and can provide visual results for better understanding and more significant results.

■ **Calculating eye tracking metrics and statistics**

The Tobii Studio Statistics tool calculates and displays descriptive statistics of eye tracking metrics. These metrics are calculated based on user defined Areas of Interest (AOIs) and data selection time intervals. The data that results from the analysis is displayed in the form of a table and / or chart.

- **Eye-tracking testing data statistics processing**

  - Start the Tobii Studio and import the VPT-2 assessment test project to the Design and Record tab;
  - Select one category on Media List under Visualization tab;
  - Create an appropriate drawing tool (Polygon / Ellipse / Rectangle) under AOI tool tab;
  - Draw AOI outline around each stimulus category in the same shape, size and AOI sequence code generated automatically;
  - Define Timline from start 00:00:01:000 (second) to 00:00:05:000 (second) under Statistics tab;
  - Select required statistical data of the research, Time to First Fixation / Participants vs AOIs, and Observation Length / Participants vs AOIs;
  - Calculate and display eye tracking metrics automatically based on AOI's using the Statistics tab;
  - Export the gathered data using mean value.

- **VPT-2 content**

The contents were formed by a series of stimuli within electronic document format that were consistent with the TB from VPT-1. They were installed into the Tobii studio before assessment. The stimuli are shown on the primary screen without code reminder throughout the testing time. The first displayed page showed a viewer tip "Please relax and pay attention to the following pictures", and then each testing category with corresponding stimuli was displayed one by one.

- **VPT-2 testing time**

No special instructions pointed out the specific time the test should be taken in. In this survey, attempts were made to find some reference from previous studies for time settings, such as: Vercnyssen et al., (1997)[6] suggested that the optimal attention capacity as indicated by the swiftest reaction times occur at the response-stimulus interval (RSI) of 2 seconds. In fact, the reaction rate is also different between male and female, previous longitudinal analysis on reaction rate specifically for the male and female elderly indicated that the reaction time increased with age, and men were faster than women (Fozard, 1997)[7]. Therefore, because this investigation involved reaction time (RT) of elderly attention and information processing aspects, and considering the elderly fall in reaction speed capability; each test category adopted a 5 second display time on the screen for collecting the subject's reactive metrics data and calculating their raw gaze data that were indicated by regions of interest with a high fixation density.

3.5.4 VPT-2 assessment

The VPT-2 assessment was a relatively complex process based on a series of objective data collection and calculations from Tobii X60.

Testing preparation needed to be completed in advance by a professional operator in the desired testing location. Set up included: Finding a location that did

[6] Vercnyssen, M. et al. (1988) Effects of age, gender, activation, stimulus degradation and practice on attention and visual choice research time. In: Rogers, W. A. (ed.) *Designing for an aging population: ten years of human factors/ergonomics research*. Santa Monica, CA: Human Factors and Ergonomics Society, p. 78.

[7] Fozard, J. L. et al. (1997) Longitudinal analysis of age-related slowing: BLSA reaction time data. In: Rogers, W. A. (ed.) *Designing for an aging population: ten years of human factors/ergonomics research*. Santa Monica, CA: Human Factors and Ergonomics Society, p. 89, 92.

not have disturbance, connecting device, debugging, and so forth. Before test conducting, the operator read some notices about the test, and adjusts subject's access to the test in accordance to their requirements. Subjects were required to do a device adaptability test to examine their attention, for instance, whether their sight line was focusing on the primary screen effectively, whether they were suitable for this test, or whether they cannot accept this test due to serious visual impairment. Those not suitable we excluded from the test group.

In the formal test, the viewer notification was displayed, then each category page for 5 seconds, one by one. Subjects' eye movement tracking data was recorded until all testing was complete. Data corresponding to associated TB stimuli were automatically recorded. When each test was finished, data collected was inspected by the screen operator, determining its validity. Then a code corresponding to the subjects' name is noted with their test case for later classification. Finally, all data was saved and exported for statistical analysis. The detailed outline of VPT-2 assessment is showed in Figure 3.10.

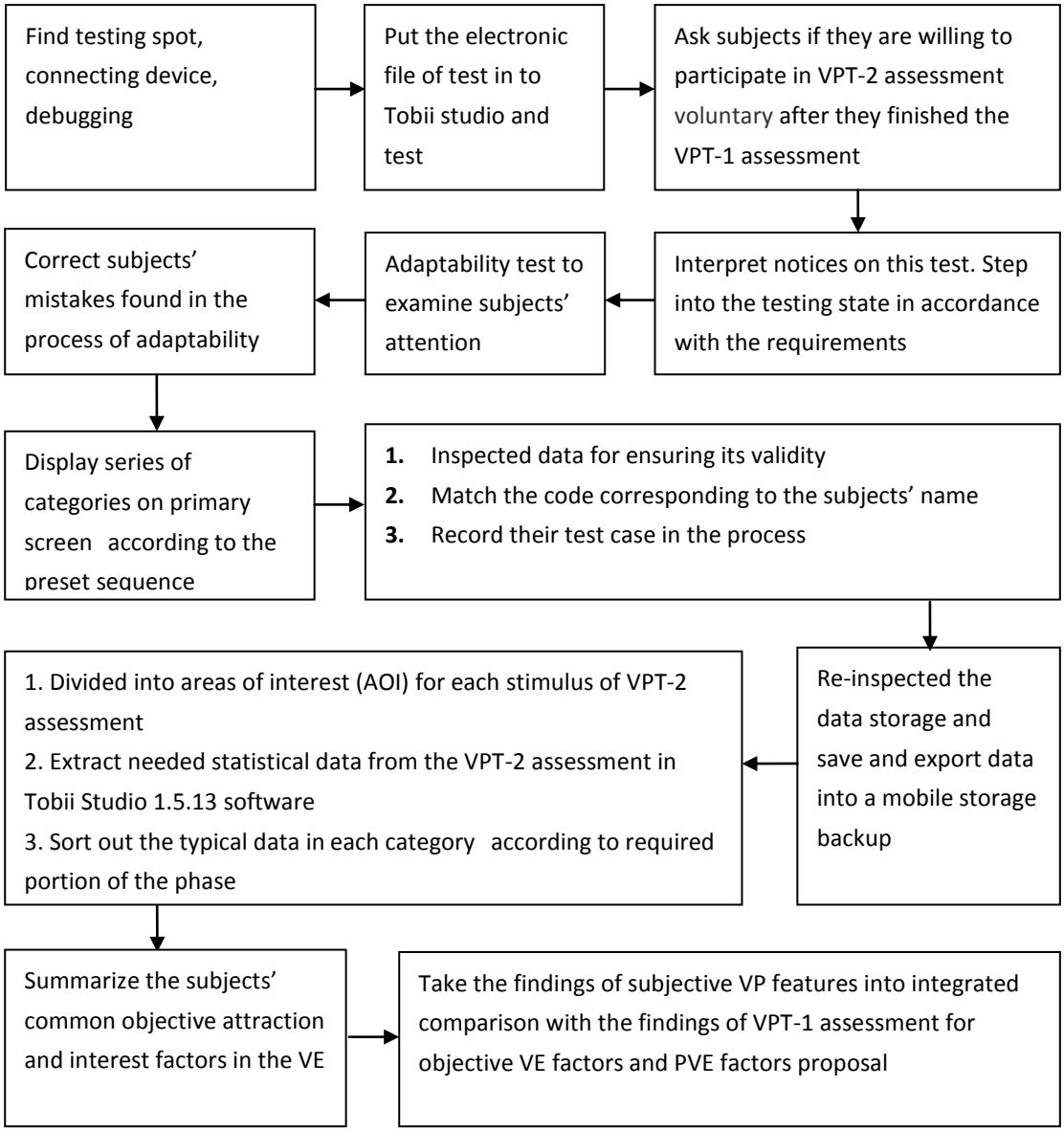

Figure 3.10 Outline of VPT-2 testing process

■ VPT-2 assessment analysis method

VPT-2 assessment analysis utilized a quantitative statistics method. It directly used the statistical data automatically generated by the ET device and software. From the VPT-2 data, two sets of statistical data were extracted as the indicators to reach the assessment purpose of identifying objective response to the VE factors in attraction and interest, these are:

- Time to first fixation[8] - seconds, for finding what factors are the faster to attract the subject's attention objectively;
- Observation length[9]- participant VS area of interest (AOIs) - seconds, for finding what factors arouse subjects' interest.

In order to ensure data statistics were rational in conjunction with the purpose of this survey, the analysis methods were based on the following three main principles:

- **Availability of data**

In the generation of VPT-2 data, each stimulus is divided into area of interest (AOI[10]), and then automatically generated as statistical data.

All subjects' data were adapted into statistical format, including those not recorded.

Because the purpose of the survey is to find comprehensive features, the statistical results calculated present the mean value without gender separation.

[8] Time to first fixation - seconds: This metric measures how long it takes before a test participant fixates on an active AOI or AOI group for the first time[8]. In the assessment, the indicator means that the stimulus first attracted the subject's visual attention within the shortest time calculated. Tobii Studio User's manual v.3.4.5 - en-US 9 Calculating eye tracking metrics and statistics 101, p 101

[9] Observation length - seconds: This metric measures the duration of all visits within an active AOI (or AOI group). In the assessment, this indicator means that the stimulus aroused the subject's visual attention for a longer time. That is, the most interesting stimuli have the longer observation length by the subject. Tobii Studio User's manual v.3.4.5 - en-US 9 Calculating eye tracking metrics and statistics 101, p 110

[10] Abbreviation of area of interest. In the assessment, all stimuli were divided into deferent AOI as an independent AOI group.

■ **Validity of data**

Because the elderly fall in reaction speed and may have correspondingly different degrees of visual disorders, two tendencies, their eye reaction to screen not concentrated or very centered at the centre of screen even before image display, occurred. After experts consulted, it was suggested that the better starting point of statistical time calculation one second after the image was displayed. That is to say, the calculated time starts from the second seconds.

Additionally, two subject groups, A and B, were tested separately in order to compare the two sets of data for rational verification of the similarities and differences.

■ **Representation of data**

Some of the individual data could not be fully collected under natural test conditions. However, the large number of data with absolute advantage produced in this survey completely supported this assessment's statistical needs.

In general, higher values of data, 30 percent and above are interpreted as typical samples.

3.5.5 VPTs improvement

VPTs are the amalgamation of VPT-1 and VPT-2 across different applications. VPT-1 is the base for the VPTs as VPT-2 is similar to VPT-1, utilizing its TB for stimulus generation. The VPTs experienced comprehensive development based on the initial plan derived from relevant results of observation, expert interviews and participant interviews. Combing and analyzing these results gradually extrapolated factors for

assessment. It then underwent modification several times to gradually mature into a preliminary version, named VPT-1 version 1.0.

In order to verify VPT-1 assessment feasibility, 24 subjects acted as the pilot survey sample to examine the adaptability, specifically in five aspects:

- Whether the subjects can easily understand the assessment content.
- Whether the subjects think the assessment content is too much or too complicated, creating psychological pressure.
- What is the optimal time range for undertaking the assessment?
- How is the subject's performance throughout the assessment process?
- Whether there are special cases, which may not have been considered.

Table 3.1 Comparison of VPT-1 ver. 1.0 and ver. 2.0

Content			**VPT-1 assessment ver. 1.0**		**VPT-1 assessment ver. 2.0**	
Time			60-80 mins.	Main problems	30-40 mins.	Improvement
Pages			7	1.Length of survey time cause subjects state: fatigued and agitation, irritability, energy is not concentrated, decline in individual reaction and understanding speed, 2.There are some understanding difficulty to several assessment options due to more professional vocabulary, need to be explained 2. Too much stimuli on each page of TB lead to subject's confusion.	4	1.Rationality of reaction time setting 2.Suitable length of test time setting 3.Clear and easily understood
Text			English and Chinese		Chinese, only consent form used English and Chinese	
Section			4		4	
Items			26		20	
Stimulus	Color	Hue	7		12	
		Hue contrast	21		21	
		Purity	10		10	
		Purity contrast	55		55	
		Brightness	11		11	
		Brightness contrast	55		55	
	Shape		35		16	
	Size		11		7	
	Texture and material		18		18	
	Pattern		9		6 (improved)	
	Products design		18		18 (improved)	
	Layout of newspaper		4		4 (improved)	
	Light		3		3	
	Total		257		236	

Through the pilot assessment, some inadaptability aspects were found. The VPT-1 content was improved to correct defects, and the final version 2.0 was

formed. Based on VPT-1 ver. 1.0, VPT-2 was developed by taking the TB section and crating an electronic format that could be used in the ET test. The comparison between VPT-1 assessment ver. 1.0 and ver. 2.0 is showed in Table 3.1.

Both VPT-1 and VPT-2 had improved versions that were formally applied in this assessment, giving significantly promoted quality and efficiency in general. It is reflected in seven aspects：

- The subjects have a serious attitude and a high sense of responsibility, and ultimately can successfully complete the assessment tasks, except very few of the subjects with the poor vision.
- ET test is carried out quickly and smoothly with all subjects completing.
- Test easier. All subjects easily understand assessment content and the device operator's guidance without complex explanation.
- In line with the acceptable time for the elderly.
- Easy to identify, less prone to fatigue, reduce recognition hesitation.
- Appropriate capacity of assessment contents and time range without psychological pressure.
- Method of statistical data analysis is feasible, and its data appears with significant correlation between subjective preference and objective response.

3.6 Summary

This chapter has focused on the methods for information and data collection utilized throughout this study. Four phases of research, which included: Literary review, observation, interviews (participant and expert), and assessment, were detailed discussed. Except literary review, all phases were primary research methods used to collect raw information and data for qualitative and quantitative analysis, and to ensure the aims and objectives of this investigation could be achieved.

The methods adopted in each phase closely centered on the objectives of their respective stage. They logically connect to each other's key aspects, and gradually deepened the research across the different stages. These methods followed the survey process outline and analysis methods in order to ensure rational usage and sound study results. The aims of each phase and associated test tool developed are briefly shown in Table 3.2.

Table 3.2 Method used with its aims

Aims	**Phase**				
	Observation	**Interview**		**Assessment**	
		Experts	**Participants**	**VPT-1**	**VPT-2**
VE behavior	VE in a real surrounding				
VE features		Explanatory description			
Subjective preference				Selection priority	
Attention grabbing					Time to first fixation
Gaze capturing					Observation Length

The VPTs, with TB and ET tests specially developed for the subjective and objective information and raw data collection related to elderly Chinese VE, in

particular, form the core of this research. Both provided statistical results that were compared against one another as the foundation of PVE discussion.

The observation phase will be discussed in Chapter 4. Its results and analyzed findings are taken into Chapter 5, the interview phase. These were used for the comparing and excavating the similarities and differences between both sides. The assessment phase, with VPT-1 and VPT-2, is further discussed in Chapter 6, offering subjective and objective data collection and statistical analysis.

CHAPTER 4.

OBSERVATION

4.1 Introduction

Observations are one of the important parts of the investigation. Collecting information from the elderly on behavioral processes in a certain range of time periods in natural and real surroundings, their interactive relationship with the surroundings, and psychological reaction is needed.

Specific to the research of the elderly Visual Experience (VE), the aim of observation is to detect the elderly VE preference and aesthetics via their purchasing behavior based on a true and natural shopping surrounding.

The objective specific indicators are embodied in six aspects:

- To observe the factors of product design which capture the elderly attention in real surroundings;
- To discover the elderly preference of VE factors via specific real life purchasing activities;
- To find the elderly needs, desires, and interest points of a product;
- To observe the elderly emotional response and identify factors of satisfaction with a product;
- To observe the issue of VE barriers during the elderly purchasing process;
- To arrange observed finding results into an assessment survey.

With the objectives of the observation as the focus, data collection was done with note and image taking, as well as behavioral interpretation of behavior, facial expression, body language, and emotional response in the real purchasing context. The elderly's motivation, process, thinking, preference, and restrictions should be understood through the observational stage of the

investigation based on subject's behavior while purchasing. Additionally, their VE features and emotional response can also be found. Eventually, these records need to be integrated for qualitative analysis and undergo behavior interpreting, thus extracting the general features of the elderly VE.

4.2 Observation Journey arrangement

Observation in a natural environment is a complex effort. There can be a lot of uncertain factors that affect the observation; especially in the process of observing the subject's behavior. Their thoughts and behaviors are in a dynamic process, and the results of their behavior are uncertain. External factors or psychological conditions affecting the subject can lead to the disparity in integrity of the observation process. Therefore, it is very important to record the key point of observation as well as the surrounding environment's impact on the subject, as well as analyzing the influential factors of an object on the subject's visual experience.

The observation must be conducted in a specific area; to accurately observe the subjects' experienced behavior and activities. It mainly involves three main aspects, which need to be considered in advance: Venue, object, and subject. At the same time, in order to keep observations within a relatively controlled range and easy to grasp the observation point for information analysis, the relevant planning and arrangements must be made in advance of observation. Additionally, it is important to establish a standard operation procedure (SOP) for observation as a working guideline, in order to ensure the effectiveness of the results.

4.2.1 Subjects selection

The subject's selections are individuals over 60 without gender limitation, and that can complete a relatively whole shopping experience process. Some people who are not uncertain of their desired experience, even though they have had a purchasing behavior occurrence, due to various subjective and objective factors, their experience behavior are usually incomplete and unrepresentative. Sometimes

this is also reflected in the shopping time constraints or limitations (i.e. blindness) to behavior factors. Therefore, the subjects selected need to meet certain basic conditions:

- The subjects selected should accomplish relatively complete purchasing process, show the relevant experience indicators, for instance, the experience of preference or aversion, and clearly show emotional state;
- Observation records should be able to reflect the focus of the observation;
- Speculated age of subject should be over 60, without gender limitation;
- The time duration of the experience is as long as needed to complete the process of buying.

Following these conditions some target subjects were found unsatisfactory for observation, and a total of 22 subjects were selected at random for observation within the specified locations.

4.2.2 Venue / date selection

Products considered were those that are closely related to and usually paid attention to by the Chinese elderly. The venues selected for observation: Supermarket, shopping mall and household electrical appliance store, were selected because the wide variety of products provided in these selling sites and as such the elderly VE process can be relatively lengthy and complete.

The observation spots mainly focused on four areas：mobile phone, article of daily use, garment, and household appliance. All venues were places within Guangzhou city proper that underwent pilot observation and inspection in advance.

The observation data was collected over five weekends: Saturday, Sunday or China National Day holiday. The reasons being that the elderly are more mobile on these days and considerations were made that most of the elderly are inconvenienced to do shopping outside from Monday to Friday. This is mainly because they need assistance from their family members to accompany them, and provide suggestions for decision-making. Besides, on these days, there will be many promotional events and products on sale, which tend to attract elderly interest, and they can take more time for shopping. Therefore, the two elements above mentioned can increase the probability of observational opportunities of the elderly.

4.2.3 Objects selection

The main considerations of object selection were the products with higher use frequency and more closely related to daily life of the elderly. As a sample selection, these items can represent which kind comprehensive factors attract the subject's attention in a natural way. Objects selections were made without any deliberate restriction to specific product. The purpose is to discover the subject's interest points

Table 4.1 List of observation (n=22)

No.	Category	Venue	Detail of Product (Number)	Subjects
1	Smart phone	Home appliances store and mall	Smart phone (3)	3
2	Vacuum cup	Supermarket	Vacuum cup (3)	3
3	Articles for daily use	Supermarket and mall	Drying bucket with mop (1) Peeler (1) Stainless steel slicer (1)	3
4	Garment	Supermarket and mall	Western-style clothes Sweater (1) Sport wear (2) Polo (1) Wedge heel (1) Women silk coat with short sleeves (1)	7
5	Household appliances	Household appliances store	Washing machine (1) Hanging iron (1) Heater (1) Hearing AIDS (1) Electronic Sphygmomanometer (1) Soy milk machine (1)	6
Total	5	5	18	22

among a large number of products and see how they compare them with others using as many aspects as possible. Accordingly, these objects were selected: Smart phone, vacuum cup, articles for daily use, garments, and household appliances. The detailed information is showed in Table 4.1.

4.3 Standard of procedure

The observation process includes a workflow of four steps including: Observation arrangement, Observation beginning, Observational preparing and Conclusion. These help to standardize the observation process and results.

In order to ensure the information from a subject's observation can be easily compared amongst other various subject's experience behavior, criteria for clustering of quantitative analysis is specially organised into a standard operating procedure (SOP) for the regularizing of the investigation.

Each step in the SOP determined for conducting the observation of elderly VE process have unified and normative keys in order to provide convenience in arranging the final informational statistics. There is a worksheet with checklist of each step, contents, and the sequence of the observation survey that can be conducted one by one in accordance with the order prescribed in advanced. After each step is completed the associated box can be ticked.

The contents of observation set are aimed to meet the objective requirements. They are separated into five key observation points, which focuses on: Route of attention, finding and purchasing, time spent, buying factors, and emotional response.

- **Route of attention:** Explains how attracted the individual was and expresses what caused them to step into the sales area;
- **Finding and purchasing:** Clarifies the observable factors of the product that attract them and their preferences during the VE;
- **Time spent:** Expresses the time needed for the subject's entire VE process;

- **Purchase main factors:** Highlights what factors led to a successful purchase of an object;
- **Purchase failure main factors:** Highlights what factors led to an unsuccessful purchase of an object;
- **Emotional response:** Highlights the subject's mood change during their experience and interaction with the object;
- **Obstacles of VE:** Identifies bad or negative factors in VE via a purchasing process.

Table 4.2 SOP of observation

Step	Content	Checklist
1	Preliminary work	☐Venue selection
		☐Date selection
		☐Subjects Focus
		☐Object selection
		☐Record tool selection
2	Preparation	☐Observation checklist ☐Note format ☐Recording device
3	Confirmation	☐Time:
4	Observation	☐Route of attention ☐Direct ☐Indirect ☐Occasional ☐Nil
		☐Find and purchase (Product:) ☐Definite ☐Occasional ☐Passive ☐Unwilling ☐Not Searching
		☐Time spent in the whole process (minutes) ☐10- ☐11-20 ☐21-30 ☐31-40 ☐41-50 ☐50-60 ☐60+
		☐Purchase main factors ☐Color ☐Sharpness ☐Material and texture ☐Quality ☐Brand ☐Functionality ☐Usability ☐Design ☐Style ☐Others ( )
		☐Purchase failure main factors ☐Color ☐Sharpness ☐Material and texture ☐Quality ☐Brand ☐Functionality ☐Usability ☐Design ☐Style ☐Others ( )
		☐Emotional response ☐Delight ☐Pleasure ☐Satisfaction ☐Dissatisfaction ☐Depressed ☐Amazed ☐Concerned☐Happy ☐Hopeful ☐Interested ☐Surprised ☐Other (Description:)
		☐Obstacles of VE in purchase process (Description:)
5	Record	☐Checking
Note		

Otherwise, a blank column provided for note the subjects' experience behavior via observation. The concrete contents SOP of observation survey showed in Table 4.2.

4.4 Findings and results

Based on the aim and objectives of observation, the process conducted is to identify each requirement listed on the SOP while observing the elderly purchasing process, and record with images and notes that are as detailed as possible. Then, through comparative analysis of the individually observed elderly purchasing process amongst a set of products, to find the consistency within VE behavioral features, and final analysis conducted compared five types of products and identified the common issues of the elderly purchasing process VE in order for the results to be contributed to the next steps of the investigation: Test tool development, definitive questions of assessments, and avoiding interference from irrelevant VE factors.

Observation mainly focus on six aspects：

- The length of VE time;
- Kind of attractive products with features for the elderly;
- Key factors in the VE process for the elderly;
- Obstacles in the VE process for the elderly;
- Findings and summary;
- Proposal for VE test tool development.

Moreover, it should be noted that VE is an unconscious behavior in the context of the purchase process. Good or bad experiences are not embodied in whether some products are successfully purchased, but also once the product is purchased, it should be accompanied with good experiences.

For technologically complex items, such as a smart phone or portable health-measuring instrument, usually there is a relatively higher price. In general, the demand of such products for the elderly is clearly obviously. However, its purchase needs the seller's introduction on the performance and effects in order to assist the VE process and offer understanding.

Note: The sites and subjects of observation are without concrete name. The results indicated adopted the code: V1, V2, V3,…Vn and S1, S2, S3,…Sn for replacing the sites and subjects observed.

- **Group one / smart phone (n=3)**

In general, the price of a smart phone is usually higher with increases in the complexity of technology. The needs it is meeting for the elderly subject are clear and obvious. For these kinds of product, the sales' introduction and demonstration to the elderly are very essential to illicit understanding of the product. This includes manipulation, function testing, and finally making sure which one is suitable for them. Therefore, the VE is based both on rational understanding and perceptual experience.

Three subjects in group one were observed purchasing mobile phones at sales areas in different stores. Their average age was estimated at 65-70 years old. Two subjects were accompanied by their family, and one was alone. One subject, whose age seemed to be more than 70, selected a smart phone which was relatively simple and special for elderly Chinese. Two subjects, whose age seemed to be under 70, selected relatively higher tech smart phones. The result indicates that while the smart products can be accepted by the elderly, the accepted complexity level is

relative to the age. Which is to say, it seems that the younger elderly subjects can accept a more complex technology than the older elderly subject.

Purchase records reveal that two of the subjects bought their smart phones with a definite purpose in mind, and was not a result of their direct or casual search of the sales site. The subject who completed the purchasing process in 20 to 29 minutes had more direct finding and definite purpose, and spent a shorter time than another one who completed the purchasing process in 40 to 49 minutes with casual search but definite purpose. The main factors of purchase in general were larger typeface, larger volume, and larger screen. The conjunction of colors red, white and black was preferred. The shape trends were inconsequential and similar amongst most products in the range. Function requirements were conspicuous i.e. fundamental and multi-functional e.g. Wi-Fi. Usability requirements were focused on easy-to-use interface, convenience, and simple operation. The brand also played some role in the decision making process.

All subjects cared about the cost of the product. High performance to cost ratio and moderate price will influence their final purchasing behavior. Even a small promotional gift will be effective in increasing the probability of purchase (Figure 4.1).

Figure 4.1 Samples of on-site observation (date detail on: 2013.9.15/2013.10.2/2013.10.4)

The features of smart phone purchasing experience revealed that in general:

- The subjects who purchased smart phone are clear of their specific needs and a higher possibility of purchase;
- For high value products, the purchasing act was relatively rational;
- For relatively complex products, the experience time was longer;
- The elderly are willing to accept new things;
- The subjects cared more about functions than appearance of product, especially additional functions;
- The elderly express strong emotion, with specific happiness once they master the usage of new products;
- Personal options were important when they faced complex products and without the influence of a salesmen, but they can select higher price product with caution and autonomy;
- The cost is a factor of consideration to the elderly. Discount price products, high performance to cost ratio, and promotional offers were a main focus;
- Focused on the material object without much brand concept;
- They followed common trends of mobile phone style, mainly to satisfy their family;
- Salesmen assistance was a necessity to introduce the product;
- They like more robust size, and darker colored products (men) and flower colored products (women);
- The obstacles of VE during the purchasing process include time spent (longer in general) and salesmen Introduction, which affects the understanding of the product (See Table 4.3).

Table 4.3 Group one / smart phone (n=3)

Venue	Home appliances store (H3)	Home appliances store (J4)	Mall (W1)
Target age (estimated)	65-69	70+	65-69
Accompany	Accompany	Alone	Accompany
Range and route	Electronic product area	Mobile phone area	Mobile phone area
Product	Smart phone	Smart phone (for Chinese elderly)	Smart phone
Route of attention	Casual	Direct	Casual
Find and purchase	Clear thought	Definite	Definite
Length of Time	20-29 min	20-29 min	40-49 min
Results of purchase	Unknown	Purchased	Purchased
Purchase main factors	Larger typeface	Larger typeface / Larger volume / Red and black color / brand /festive color / conspicuous / rounded shape/ stylish	White / large screen / concise
Cost	Moderate cost	1. High performance to cost ratio 2. Promotional offers	1. Cared about the cost. 2. Hope to have the gift
Function	Multi-function (e.g. Wi-Fi) required	Multi-function required	Fundamental function required
Usability	Simple operation	Simple / Convenient / Easy-to-use interface	Simple / Convenient
Emotional response	Interested	Satisfaction / Happy / Interested / Pleasurable / Fill the heart with hope / Inspired	Satisfaction / Happy / Pleasurable
Features of Experience	1. Robust size 2. Impregnability by the seller's introduction 3. Willing to accept new things 4. Autonomously	1. Clear purchasing needs 2. High performance to cost ratio of products and promotional offers can attract the elderly 3. Cared more about function than appearance of product 4. Cautious selection for higher price product 5. Darker colored products preference for men and flower colored products preference for women in general 6. Salesmen introduction assistance	1. Clear purchasing needs 2. Additional function preference 3. Special happy once the subject mastered use 4. Paying more attention to material object and less about brand concept 5. The style follow trend of mobile phone, to appease family 6. Seller Introduction assistance
Obstacles of VE in purchase process	Salesmen's Introduction interfering	Salesmen's Introduction interfering	Salesmen's Introduction interfering

■ Group two / vacuum cup (n=3)

Three subjects in group two were observed throughout their purchasing experience. They were buying vacuum cups within the promotional zone and

kitchenware zone in different shopping centers. Subjects' average age was estimated as 65-70 years old, and all were accompanied by their family. Two of the subjects purchased the target product within 20 minutes. However, the other subject spent 25 minutes but did not complete the purchase, which shows that the experience time does not correlate to successful purchase, in this case. Two of the subjects expressed indirect interest and casual route to the product, and only one of the two finished the purchase. This shows that the purchase behavior can occur in indirect and casual states. The other subject who also finished the purchase expressed definite purpose of purchase on a casual route. See Figure. 4.2.

Figure 4.2 Samples of on-site observation (Date detail on: 2013.9.16/2013.9.16/2013.10.28)

The features of vacuum cup purchase show that in general:

- The main factors that attract subjects are stainless steel + color coated with fashionable color, plastic and metal with tooth gray color. In all, plastic and metal materials with fashionable color are more preferred by subjects buying this kind of item. It also shows that the elderly are not averse to fashionable elements. Additionally, too bright a color of vacuum cup is not suitable for the elderly but low saturation seems better.
- The elderly care mainly about fundamental function of the products, such as the heat preservation function and leakproofness. In reference to

usability, simple and convenient operation is required, practical shape, and a smaller size for easier prolonged carrying was preferred.

- Price was an element of common concern by subjects. Most of the elderly were interested in products with 50 % off retail price and more affordable. Most of them sought products of higher quality and inexpensive cost.

Table 4.4 Group two / vacuum cup (n=3)

Venue	Supermarket (H1)	Supermarket (H2)	Supermarket (W3)
Target age (estimated)	65-69	65-69	70
Accompany	Accompany	Accompany	Accompany
Range and route	Vacuum cup promotion zone	Vacuum cup promotion zone	Kitchenware zone
Product	Vacuum cup	Vacuum cup	Vacuum cup
Route of attention	Indirect	Indirect	Casual
Find and purchase	Casual	Casual	Definite
Length of Time	25 minutes	20 minutes	20 minutes
Results of purchase	No purchased	Purchased	Purchased
Purchase main factors	1. Fashionable color. 2. Stainless steel + Color coated	1. Fashionable color. 2. Plastic	1. Tooth gray / Green gray / Purplish red. 2. Metal
Function	Cared	Cared	Fundamental function required, for instance, heat preservation function and leak proof protection
Usability	Simple operation	Simple and convenient	1. Simple and convenient 2. Smaller size for easy carrying
Cost	Discount with 50 % off retail	Discount with 50 % off retail	1. Cheaper and affordable. 2. Higher quality with inexpensive price
Emotional response	Calm	Calm	Wondering / Placid / Satisfied / Relaxed
Features of Experience	1. Place of sale located in main entrance of shopping mall attracted the elderly attention and was easy to be found 2. No salesmen help 3. First choice is stainless steel, but finally choice is more fashionable material i.e. stainless steel + Color coated and plastic with fashionable color	1. Place of sale located in main entrance of shopping mall attracted the elderly attention and was easy to be found 2. No salesmen help 3. First choice is stainless steel, but finally choice is more fashionable material i.e. stainless steel + Color coated and plastic with fashionable color	1. Careful selection 2. Instructions seen by subject. 3. Capabilities testing 4. Too bright a color is not suitable for vacuum cup but low saturation is better 5. Heat preservation function testing and better sealing is required 6. The metal is more preferred by the elderly compared to plastic 6. Style with succinct shape, less decoration is more preferred
Obstacles of VE in purchase process	Longer time	Longer time	Salesmen's Introduction interfering

- Emotional response indicates that two subjects were quite calm while the other showed wonder, placidity, satisfaction and relaxation. In general all of them were rational and without impulse.
- The salesmen's Introduction and guidance provided an obstacle to the elderly VE in this purchasing process.
- The promotional product located at the main entrance of the shopping mall more easily attracted the subject's attention and were more easily found.
- The elderly preferred concise style, terse shape, and less decoration.
- The quality of the product was a main focus. The subjects selected the products carefully, e.g. specification viewing, testing the capabilities, heat preservation function, and sealing test etc. (Table 4.4).

■ **Group three / articles of daily use (n=3)**

Three subjects in group three were observed throughout their purchasing experience in the articles of daily use sales area in different stores. Subjects' average age estimated was 65-70 years old. All of them were accompanied by their family. They all choose difference items: Drying bucket with mop, peeler, and stainless steel slicer respectively. The older subject who appeared 70 years or older completed the purchase of the stainless steel slicer in shortest time (two minutes), and under the condition of casual finding product. The two others who had direct intention entered the sales areas without completing the purchase. Unclear motivation and dislike of the quality may be the main reasons for unsuccessful purchase. This indicated that the behavior of purchaser under a casual state was on even higher likelihood to purchase than the goal-directed shoppers.

The features of articles of daily use purchase show that in general:

- Metal material of products for daily use is preferred, for instance, stainless steel material with silver gray color, metal frosted in black, and metal product with green color. It may be related to the mentality of the elderly seeking durability, especially in a daily used product. Moreover, different usage of products needs to have corresponding materials and colors to match the product's properties.
- For daily used products, the function requires practicality, and preferably it can save strength in terms of usability.
- Price was an element of common concern by subjects. Cheaper products with discount offered and higher performance-price ratio were preferred by most of the elderly. In general, they like to compare the prices among several products.
- All subjects' emotional response in experience process was a state of delight, happiness, hesitation, interest and satisfaction.
- In the process of VE, subjects were full of curiosity and interest. The elderly were prone to stop and watch new products when they encounter them. It shows that the fresh items are of interest and can be accepted by the elderly, but it doesn't mean they have a strong desire to purchase them.

- Subjects prefer packaging which leave the products' surface exposed and its material can be touched directly. The features of product's function, surface, material, and usability were more likely to satisfy the elderly desired feeling. When they plan to buy some item, the elderly experience process will be more careful and cautious than that of younger shoppers.

For instance, they view items one by one and compare prices carefully when they face a wide selection of items.

Table 4.5 Group three / articles of daily use (n=3)

Venue	Home Appliances Store (H4)	Supermarket (W2)	Mall (Z4)
Target age (estimated)	65-69	65	70
Accompany	Accompany	Accompany	Accompany
Range and route	Electrical section of living goods	Living goods	Department store in supermarket
Product	Drying bucket with mop	Peeler	Stainless steel slicer
Route of attention	Direct	Direct	Casual
Find and purchase	Casual	Casual	Casual
Length of Time	5 minutes	10 minutes	2 minutes
Results of purchase (reason)	No purchase (unclear motivation)	No purchase (bad quality)	Purchased
Purchase main factors	Green color	1. Silver gray color 2. Stainless steel material	1. Black 2. Metal frosted
Function	Cared	Practical	Cared
Usability	Strength saving	Not found	Cared
Cost	Negligent	Cheaper and higher performance-price ratio	Promotion with discount
Emotional response	Delightful	Happy / Hesitating / Interested	Satisfactory / Delightful
Features of Experience	1. In the process of VE, the elderly was full of curiosity and interest, for instance, they stopped to watch when they encounter new things. 2. Salesmen's dynamic, voice with product demonstration and introduction easy attract the elderly attention 3. Promotion at main passageway easily attracts the elderly attention 4. In purchase process, even though the elderly stay in the living goods area for a long time, their purpose of purchase is not too strong	1. Indifferent. 2. The time of observation is relatively long 3. Facing of a bunch of items, seeing one by one. 4. Like to compare the prices of each item 5. Compared with bright color of plastic products, practical products made by stainless steel material are preferred more by the elderly. 6. Item selection more careful and cautious than younger buyers	1. The elderly are easy interfered by surrounding things 2. Products' surface exposed and can be touched Direct in a package are preferred by the elderly
Obstacles of VE	No found	No found	No found

- In comparison with bright colored plastic products, the elderly prefer more practical products made with stainless steel material.
- Time spent on the VE was 2 to 10 minutes. However the subjects who spent 10 minutes did not complete a purchase, showing that a long time spent in

the sales area is not strongly related to the completion of purchase.

- During the purchasing process, the elderly VE was easily interrupted by side items, and the salesmen's introduction will most likely obstruct their personal cognition. Product promotion at the main passageway of store and the salesmen's active introduction, including sound effects, to demonstrate the product seemed most likely to achieve an attractive effect (Table 4.5).

■ **Group four / garment (n=7)**

Seven subjects in group four were observed throughout their purchasing experience at garment sales areas in different stores. The subjects' average age estimated at 65 years old. Six of them were accompanied by their family and just one subject was independent through the whole process of the shopping experience. They choose western-style clothes, sweater, sportswear, polo, wedge heel, and women's silk coat with short sleeves. Four subjects purchased a product, and did so within 10-20 minutes. Three of which found items in a sales area and paid attention casually, only one showed direct intent. In addition, three of them found and purchased a product under casual state while the other showed a definite, passive, confirmed, and purposive state. On the contrary, of the three subjects who did not purchase, two searched for the items in the sales area and paid attention casually, and one showed direct intent. Two of three who found an un-purchased product were under distinct state, while the other was under casual state. This shows that the subject's positive mentally is not related to their final purchase behavior. Additionally, the cost was an important element, as seen by all subjects' hope that the products were in promotion with price reduced, and they all liked shopping during the promotional period of each store.

The features of garment purchase show that in general:

- Material selection: Soft material such as purified cotton for clothes and sheepskin texture for shoes was preferred. Purple colors, bright or bright dazzling color such as yellow, red, mint, black and white was preferred. But relative to black, white was preferred. Red is a joyous festive color in traditional Chinese culture, therefore, uncolored items e.g. just black or white are not welcome by some of the Chinese elderly who are rooted in Chinese traditional culture. In general, males prefer darker color products, females prefer flower color product (clothing).
- Patterns selection was widespread between purplish grey and white stripes, blue and yellowish brown background with white or red flower. This reflects the elderly preference for gaudy patterns and decorative fabric, but for shoes, simple and traditional style without high heels was preferred. In terms of the overall mix of clothing, concise and decent, generous with more conservative-fashioned are preferred.
- All subjects care more about the function and fit of products relative to the appearance. They all try to test the basic function and practicality of the items. Four subjects considered the usability, seeking convenient, comfortable, and suitable. Three subjects didn't stress utility issues, but in general, subjects require that the item were suitable for them both in function or use.
- The subjects care about quality and pay attention to brand.
- The subjects' emotional response throughout the experience process of purchase included: Interested (3), pleasurable (3), contented (3), dispassionate (2), hesitant (2), satisfaction (2), happy, graceful, cheerful,

serious, pleased, hopeful. In general, most of the subjects showed positive emotional response and express relaxed, interested states.

- During the VE process, colorful clothes, gathered crowds of people, and salesmen's recommendation were the factors that gathered more subject attention.
- The subjects selected items carefully and cautiously. They showed careful observation and tested function, especially for higher price items. Their attitude tended to present two sides: Proactive with unclear needs of purchase or negative for the person who was independent and making the decision without suggestion from accompanying family (Table 4.6).

Table 4.6 Group four / garment (n=7)

Venue	Mall (J2)	Supermarket (Z3)	Mall (Z2)	Mall (Z1)	Mall (M1)	Mall (H5)	Store (J3)
Target age (estimated)	65	60	65	65	60——70	65	65
Accompany	Accompany	Accompany	Accompany	Accompany	Accompany	Alone	Accompany
Range and route	Boutique for menswear	Clothing sales area	Gym suit area	Living goods area	Clothing and footwear area	Clothing and footwear outlet	Silk cloths shop
Product	Western-style clothes	Sweater	Sports wear	Sports wear	Polo	Wedge heel	Women silk coat with short sleeves
Route of attention	Direct	Casual	Casual	Direct	Casual	Casual	Casual
Find and purchase	1. Definite 2. Passive 3. Confirmed 4. Purposive	Distinct	Casual	Casual	Casual	Definite	1. Casual 2. Passive
Length of Time	11-20 minutes	10-20 minutes	17 minutes	10 minutes	10-20 minutes	10 minutes	20 minutes
Results of purchase (reason)	Purchased	Un-Purchased	Purchased	Un-Purchased	Purchased	Un-Purchased	Purchased
Purchase main factors	Black color	1. Bright color (yellow, red) 2. Pattern and decoration 3. Soft material (purified cotton)	1. Opposed to black, white is preferred 2. Cotton material	1. Purple color preference. 2. Uncolored system (black, white) is not preferred 3. Cotton material 4. Cared about quality 5. Cared about style	1. Pattern in alternate with purplish grey and white 2. Stripes 3. Darker color is preferred	1. Mint cream color is preferred 2. Cared about style (old shoes style without special bright dazzling color and no high heels) 3. Sheepskin texture for shoes 4. Simple and generous style are preferred	1. Red flower pattern purchased finally (the red flower symbolize joyous and spirit looking based on Chinese common traditional culture) 2. Red, blue and yellowish brown background

							with white flower is favorable 3. Fancy patterns preferred by female shopper
Function	Cared about function	Cared about basic function such as well-fitting	Cared about basic function such as well-fitting	Practical	Cared about fit	Cared, did function test	cared
Usability	Cared about fit	Not mind	Not mind	Not mind	Cared about good quality	Comfortable	cared
Cost	Promotion with reduction of price	Cared about cost	Reduction of Price	Reduction of price	Reduction in price	Reduction of price (even 55% off)	Reduction of price
Emotional response	Pleasurable / Graceful / Satisfied / Cheerful / Serious / Contented / Pleased / Interested	Dispassionate / Contented	Contented / Pleasurable / Happy	Dispassionate / Hesitate	Hesitate	Interested	Pleasurable / Satisfied / Hopeful / Interested
Features of Experience	Relaxed	1. Seller Introduction 1. Attraction toward colorful clothes	Subject easily attracted by crowd of people	1. Careful selection 2. Negative	1. Unclear needs of purchase 2. Careful and cautious observation	1. Selection careful such as instructions reading and function testing 2. Independent, proactive, interested	Seller Introduction
Obstacles of VE	No found	No found	No found	No found	No found	No found	No found

- **Group five / household appliances (n=6)**

Six subjects in group five were observed throughout their purchase experience at household appliances sales areas in different stores.

The subjects' average age was estimated to be 65-70 years old. Half of them were accompanied by their family members, while the other half were alone. They focused on: Washing machine, hanging iron machine, Gas heater, hearing-aid / electronic sphygmomanometer, soy milk machine. Only one subject whose family member accompanied them purchased a product. For these kinds of products, most of subjects clearly knew their predetermined purchasing needs. Due to the higher price of household appliances, the price factor influenced the subjects purchasing decision quickly. Two-thirds of the subjects followed an eager and direct route to the sales area, while the other one-third seemed casual, with a random and unclear purchasing purpose. This also shows that the purchasing purpose of the subject is not directly related to purchasing result. The only subject who did complete a purchase took nearly 30 minutes, higher than average time of 21 minutes. This indicates that this kind of product needs more time spent to complete a purchasing behavior.

Brand and quality were the most important consideration by subjects; for example: Two-thirds of the subjects cared about appearance, and two-thirds of the subjects cared about brand. This shows that the brand is just as important as the appearance of the product, particularly speaking of high cost items.

The features of household appliance purchase show that in general:

- On the choice of material, metal material was preferred, for instance,

purple stainless steel. For small household appliances, medium rough material like stainless steel was preferred over plastic. For some products, the plastic material can be accepted based on the properties of product. The priority of color selected was green, blue, and red in a bright style for attracting the elderly. Subjects also preferred white and gray, as well as bright colors.

- Price was an element of a common concern by the subjects. Most of the subjects were interested in the cheaper products, promotional period discount, and money saving.
- For household appliances, most subjects care about practical function and comfort as well as power and electricity saving aspects. Complexity was easily detected, and not preferred. The function was even more important than the appearance of the product to the subjects. They all tried to test some functions for evaluation purposes. Moreover, safety, convenience in operation, conspicuous identification, and affordability were required with usability.
- The emotional responses through the whole process showed that the subjects were: Interested (5), happy (2), willing, wondering, pleasurable, patient, curious, excited, longing, and helpless.
- Experience influenced by the salesmen's guidance, recommendation and introduction.
- The elderly selected products carefully and prudently; for example: They like to compare products one by one, especially, the products of higher price.
- The elderly can accept hi-tech products aimed at assisting elderly life and they showed interest in them, but because of the higher price of this kind

of product, generally the subjects did not rush to buy them if they are without family member accompaniment.

- The subjects showed curiosity if they saw a product in which they were interested.
- The subjects were puzzled but patient; as seen with one subject who was puzzled with a gray fully-automatic washing machine with large capacity and numerous function buttons. Facing the complex product and operating system, the subjects expressed hesitation and preferred to test the buttons. If the product's working principle can be observed, it was easier to attract their attention; for instance: Being able to observe the fresh yellow and green soy milk which was freshly squeezed from the soy milk machine.
- Subject's experiences were natural and loose, but sometimes they displayed insecurity and a defensive mentality.
- In general, household appliances purchases need more time spent on the whole experience due to its relative complexity.
- Obstacles of the VE throughout the purchase process included complexity, unclear purpose, and unmarked product price. Moreover, the experiences needed the guidance from salesmen to give full introduction. Subjects' unclear purpose also seemed to influence their VE (Table 4.7).

Table 4.7 Group five / household appliances (n=6)

Venue	Home Appliances Store (H6)	Supermarket (H7)	Home Appliances Store (H8)	Mall (M2)	Mall (M3)	Supermarket (J1)
Target age (estimated)	65-69	65-69	70+	70+	70+	65-69
Accompany	Accompany	Alone	Accompany	Alone	Accompany	Alone
Range and route	Washing machine area	Small electronics area	Heating appliance area	Home appliances / small electronics product area	Home appliances / small electronics product area	Commodity / Electrical area
Product	Washing machine	Hanging iron machine	Gas heater	Hearing-aid / Electronic sphygmomanometer	Soy milk machine	Soy milk machine
Route of attention	Direct	Casual	Direct	Direct	Direct	Casual
Find and purchase	Direct	Random and unclear	Casual	Eager to buy	Direct	Random
Length of time	21-30 minutes	5 minutes	30 minutes	5- 10 minutes	20-30 minutes	31-40 minutes
Results of purchase (reason)	No purchase (cost)	No purchase (cost)	Purchased	No purchase (cost and quality)	No purchase	No purchase (cost)
Purchase main factors	Gray color	1. Plastic material 2. Red is priority selection compared to the green, blue 3. Warm and desirable color	White, red, and bright color are preferred	Not found	1. Silver and purple color selected 2. For the small household appliances, medium rough material of stainless steel is better to instead of plastic	1. White preferred 2. Plastic preferred
Function	1. Better function is required 2. Suspicion for complex function	Not found	Practical, small power, and electricity saving are required	Function tested	Cared	Function is more important than appearance
Usability	Not found	Not found	1. Safety, convenient in operation and usage. 2. Easy to identify	Usability tested	Not found	Not found
Cost	Not found.	Cared	Money saving	Cheaper	Cheaper	Sales promotion with discount
Emotional response	Willing / Interested / Wondering / Pleasure / Patient	Interested / Happy / Curious	Excited	Interested / Longing / Helpless	Interested / Happy	Interested
Features of experience	1. Guided and recommend by the seller 2. Careful selection with	1. Guided by the seller 2. Defensive mentality 3. The elderly will be	1. Guided by the seller. 2. Comfortable	1. Selection carful, cautious 2. Subject very	1. Guided and recommended by seller	1. Guided by the seller with Introduction 2. Spent a long time to

	comparison of products one by one, and doing button test 3. Patient 4. Brand first 5. Puzzled on a gray washing machine in full-automatic, large capacity and more functions button	curious if they saw products that interest them	requirement 3. Long time in purchase process	interested in products that can assist their daily life with technology and science. But because this type of products' cost are higher, the decision of purchase is generally influenced by accompanied family members' opinion and there is no rush to buy	2. Selection carful, cautious 3. Generally do not rush to buy unless with family member accompaniment 4. Observed the yellow and green soy milk which was freshly squeezed from a promoted soy milk machine displayed with salespersons' introduction	purchase 3. Natural and loose 4. insecurity and defense mentality 5. Careful selection of relatively higher price items
Obstacles of VE	More function button easy causes confusion	Unclear purpose	No found	Not displayed price tag created discouragement and unwillingness to purchase	No found	No found

Based on the organized information of each result from the five different groups observed, expressive records of similar content were merged into clusters among the five groups, and overall qualitative features were extracted via sorting of the high frequency words for direct cluster analysis. Finally, the overall convergence of features was summed up in terms of subject experience in real purchasing environments and processes (See Table 4.8).

Overall, according to these 22 subjects' observation via their purchase behavior in real surroundings, the following findings were found：

- **Accompany：** It is usually necessary to provide assistance to the elderly.
- **Demand：** Purchasing awareness and demand are mostly clear, but their purchasing behavior can also be influenced by the incidental factors in the real time VE context, which can shift their purchasing motivation.
- **Results of purchase：** Active searching does not indicate a link between purchase behavior and degree of interest, as seen by the rate of purchased product with casual searching being higher than the goal-directed.
- **Length of Time：** Time spent in sales area is not related to purchasing behavior or VE.
- **Purchased features of main factors：** Larger size benefits an elderly person's feeling and perception of a product. Pithy shape and clean lines desired. Festive color such as red desired and non-color system such as white or black are accepted. Darker colored products are favored by men and flower colored products are favored by women in general.
- **Brand：** In general, the Chinese elderly lack the concept of brand and

trademark. Unless looking for a high value item, then it is even considered of more importance than appearance of product.

- **Quality：** Quality of a product is an important element.
- **Preference of material and surface：** This feeling of metal material is related to durability and may influence the perceived value of the product. Plastic in bright color, metal material such as stainless steel, metal with silver gray color, metal fostered with black and material with fashionable elements are favored by the elderly. This shows that the elderly do not refuse the fashionable elements. Different products with corresponding materials and colors for matching the different properties of product were desirable. For small household appliances, medium rough material like stainless steel instead of plastic material is preferred, but for some products, plastic can also be accepted. Soft material such as purified cotton and exquisite fabrics for cloths and sheepskin texture for shoes was desirable.
- **Preference of style：** Terse shape, plain with less decoration, decent, traditional, conservative-fashion, and patterned colored clothes (clothes or shoes) are preferred.
- **Preference of color：** The color selecting is based on deferent attribute of product. The elderly can prefer both bright and low saturation colors. Priority color preference is green, blue, red, yellow, purple, mint, and white and gray. Generally, cool-color system is more noted by the elderly. Black and white usage needs to be done with consideration to the regional differences in culture and customs in China, because of the black and white reflect different preferences in different ethnic groups in China. Commonly,

black and white are ominous and will be disliked by the elderly. But, opposed to black, white is better than black. Products with warm and bright colors easily attract the elderly, especially red, which is a symbol of joyous spirit in Chinese traditional culture. Bright and special bright dazzling colors easily capture their attention. Purplish grey and white alternating stripes pattern, blue and yellowish brown background with white flower, and red flower pattern are examples that caught their attention and gained favor. Comparatively speaking, darker color is suitable for men; whereas brighter colors and floral patterns are commonly preferred by women, particularly clothing.

- **Function：** Function is primary focus. Elderly are willing to accept products with new functions.
- **Usability：** Utility requirements include: Easy to use, identify, and carry; simple and convenient; comfortable; suitable; affordable; safe; user friendly, with low power requirements and electricity saving.
- **Cost：** Affordability is a precondition. So the cost of a product is a factor which influenced all purchases.
- Low price is a common attracting feature to elderly Chinese shoppers; it can easy arouse their purchasing interesting. Higher quality with inexpensive price.
- **Emotional response：** The emotional response was very diverse, but positive emotional responses such as interested, pleasurable, happy etc. were more common than negative responses. Happiness gained when mastering an operator skill. Self-confident.

- **The key factors of VE：** Rational. Curiosity and interested in new things. Focus on function, surface, material, and usability. Cautious and careful, patient with various observations, comparisons, reading instructions, and function testing. Color easily affects attention. Purchases were relaxed, and in an interested state. Sales staff guidance and family member suggestion affects decision-making. Active demonstration assists experience and understanding. Promotional products in the main aisles are more conspicuous to attract the attention. It is best if the surface and material of product can be directly touched. Higher price items elicit a clearer self-understanding of the purchasers needs. Hi-tech products aimed at assisting daily life are desired, but decisions are usually in need of family member suggestion. Younger purchasers more easily accept more complex technology.
- **The obstacles of VE:** Relatively long time of VE in purchasing process. Salesman Introduction will taint personal cognition and judgment. Easily distracted. Complex operation and more functions easily lead to hesitation and bewilderment. Unclear purpose of purchase influences the VE attitude. The elderly do not prefer the products with hidden price during their VE.

Table 4.8 Integrated information and cluster analysis of all five groups observed

	Contents	Results
1	**Accompany**	– Most subjects (m=17, 81%) were accompanied by their family
2	**Demand**	– Subject demand was clearly obviously
3	**Results of purchase**	– Ten subjects (46%) purchased a product – Successful purchase occurrence was higher for casual shoppers rather than goal-directed
4	**Length of Time**	– Most completed purchase process is within 20 to 29 minutes – Length of time in ales area not related to success of purchase
5	**Purchased features of main factors**	– Larger shape, typeface, volume, and screen, and more robust size can incite better perception – Pithy shape within the style of product in the range – Festive colors, red and white or black were preferred – Darker colored products preferred by men and flower colored products preferred by women in general – Label not always important
6	**Brand**	– Cared about brand and trademark of products – More important than appearance for high value items
7	**Quality**	– Important element
8	**Preference of material and surface**	– Comparing to plastic in bright color, metal material, stainless steel material with silver gray color, metal fostered with black color and material with fashionable elements are preferred – Soft material such as purified cotton for cloths and sheepskin texture for shoes – For the small household appliances, medium rough material of stainless steel instead of plastic material. But for some products, plastic can also be accepted
9	**Preference of style**	– Cared about style – Preferring concise shape, less decoration, decent, generous with more conservative fashion and color integration for cloths (clothes or shoes) – Fancy patterns in decorative fabric (shoes)
10	**Preference of color**	– The color selection is based on deferent usage by the subject, it can include bright or low saturation colors according to context and atmosphere of usage – Priority color preference is green, blue, red, yellow, purple, mint cream color, and white and gray – The preference of black and white came with different opinions, even within cultural characteristics amongst different ethnic groups in China. But in general colorless schemes are an ominous symbol and met with dislike. But, opposed to black, white is better – Products with warm and bright colors attract the elderly, especially, red which is a festive color fro traditional Chinese. Therefore, it often is used for festivals and elderly birthdays for persons over 60 years old in china – Bright and special bright dazzling colors were preferred – Alternating purplish grey and white stripes pattern, blue and yellowish brown background with white flower, and red flower patterns also received some preference
11	**Function**	– Most subjects cared about functions of product more than appearance – Better function being perceived as: Practical, fundamental, additional, conspicuous function, multi-function e.g. Wi-Fi – The elderly like to have a test for evaluating some of the functions of product
12	**Usability**	– Usability requirements for the elderly are: Easy-to-use interface, simple and convenient, comfortable, suitable, easy to identify, affordability, safety, small power usage and electricity saving – A smaller size will be strength saving and easier for carrying – Minority did not mind usability issues
13	**Cost**	– Low price is an element of a common concern amongst all the elderly – The product with high performance-cost ratio, and moderate price are preferred

		– Interest in the products with cheap price and money saving, even a small gift of promotion will increase probability of purchase – Shopping done in promotional period with discount offers available – Price comparison amongst multiple items – Higher price products influence the elderly purchase decision – No relationship between directly motivated and casual or random shoppers and the end purchasing result
14	**Emotional response**	– Especially happy after they learn how to use a new item – Self-confidence with complex products when self-chosen without influence of the salesman – Interested (9), pleasurable (5), happy (4) hesitating (3) satisfactory (3) contented (3), dispassionate (2), delightful, willing, wondering, curious, excited, longing, hopeful, graceful, cheerful, serious, helpless, quietly calm, wondering, placid – Most of the subjects had positive emotional response
15	**The key factors of VE**	– Most clearly knew their purchasing needs and if the target item was suitable for them. Particularly, the high-value products purchased were relatively rational and without impulse – Like to compare the prices one by one – Full of curiosity and interest, specifically when they encounter new items – Realistically and intuitively feeling the features of a product's function, surface, material, and utility was necessary – More careful and cautious than younger buyers, patient in buying something via observing and comparing products one by one, reading instructions, or trying on (cloth), as well as capabilities and function testing, specifically true of product with higher price – The elderly were interested in fresh things, but it did not mean they had a strong desire to purchase – Colorful items easily attract the subject's attention – The elderly in general were relaxed, interested, natural, unrestrained, and loose during the shopping process, but sometimes they showed insecurity and defensive mentality – The salesmen with active and dynamic verbal approach, clear introduction or display of the product's function seemed to attract attention better and helped assist their experience through the process by offering better understanding – Affordability and functionality easily attract the subject's attention – The promotional products located at main the passageway more easily attract subject's attention and made items easier to find – Preferred packaging which the products' surface and material exposed so they can be touched directly – Technological products of higher price elicited more clear and directed motivation of purchasing needs – Technological product for assisting daily life can be accepted and desired, but because of the higher price, the subject generally does not rush to buy if they are without family member accompaniment – The product with more complex technology can be accepted more easily by younger subjects than older
16	**The obstacles of VE**	– The purchasing process time is longer for elderly shoppers than average – Salesman introduction can spoil the personal cognition and judgment – Easily distracted – Complex and full-automatic operating systems, large capacity and more function buttons can cause bewilderment and hesitation – Unclear purpose of purchase – Hidden price affects the desire and interest in the experience and the purchase

4.5 Summary

The observation results provide information on true reflection related to the elderly VE behavior. It shows that elderly have different visual preferences for different products throughout the shopping process, and these products' external characteristics reflect how easily their attention is attracted and good mood affected.

Through the generation of this observed information, common characteristics of desire, attention, perception preference, product interest points, emotional reaction and satisfaction, and VE barriers were sorted out in great detail. The results display that factors of product function, usability, cost, and quality all influence the elderly product experience and purchasing process. However, product brands did not receive the same attention. Aside from these, the factors which relate most to their VE and emotion are reflected in the following aspects:

Generally speaking, color is the most important factor in the elderly VE process. It is not only reflected in which kind of colors best stimulate their vision and their preference or dislike, but also which colors affect their emotions and cultural linking. Terse shapes, traditional style, conservative fashion, and patterned colored clothes were seen as preferred styles among the elderly. While they do not refuse fashionable elements, the elderly can accept all kinds of materials based on different product usage. However, an affinity towards medium to rough texture was observed. Otherwise, larger size is conducive to visual perception of a product. The general reactions reflected throughout the purchase behavior process shows that their emotional reactions are very diverse, with positive i.e. interested, pleasurable, happy

and so forth emotions being more common than negative responses. When the elderly were able to master an operator skill it specifically enhanced their self-confidence, and a feeling of happiness was evident.

In order to develop a testing tool for assessment that can assist in collecting subjective information and objective data, key words from these observations which relate to the elderly VE were extracted and integrated as developmental reference (See Table 4.9).

Table 4.9 Key words extracted from participant's observation related to the elderly VE

The length of VE time	16.25 minute average time
Attractive factors of VE process	**Shape** 1. Larger size. 2. Simple shape and clean lines **Material and surface** 1. The elderly also do not refuse the fashionable elements 2. The feeling of metal material is related to perceived durability of product and may influence cognitive decision 3. Different products with corresponding materials and colors for matching the different properties of product 4. Touchable surface and material **Preference of style** 1. Concise, plain and traditional styles are preferred 2. Exquisite fabrics **Preference of color** 1. Bright, low saturation colors 2. Cool-color system is more compatible 3. Non-color system is accepted, but black and white usage needs to be done with consideration to the regional difference of China 3. Festive color preferred 4. Special bright dazzling color. Conspicuous colors easily attract attention 5. Darker color for male and flower color for female 6. Colors affect the decision
Key factors of VE process	1. Rational and not easily agitated emotionally 2. Hoping the product is affordable which affects emotional responses 3. Observations careful with patient comparison 4. Purchase made with relaxed, interested state 5. Dynamic and active and product demo 6. Accepting of and interested in product hi-tech product for assisting daily life. 7. The product with more complex technology can be accepted by younger elderly
Others	Brand, quality, function, usability, cost
VE of obstacles	1. Salesmen's Introduction will taint cognition and judgment 2. Longer time required 3. Easily distracted 4. Complex operation functions 5. Unclear purpose 6. Undisclosed price

Moreover, there are several important implications from these observations that need close attention in order to determine the contents of the assessments and interviews. These corresponding optimized considerations are shown in Table 4.10 and adopted in Chapters 5 and 6.

Table 4.10 Attention and response to the elderly VE's obstacles from observation

The obstacles of the elderly VE from observation	Attention and response
Relatively long VE during the purchasing process	To specify the appropriate length of time for the elderly assessment and participant's interview
Salesman Introduction will taint personal cognition and judgment	To provide instructions in assessment and interview stage, avoiding interference
Easily distracted	To control the quantity of content in assessments and participant interviews
Complex operation and more functions easy lead to hesitation and bewilderment	To reduce the complexity of testing and participant interviews
Unclear purpose of purchase influences the VE attitude	To explain the purpose and basic contents of the investigation to participants and subjects in advance

CHAPTER 5.

INTERVIEW

5.1 Introduction

There were two types of interviews conducted: Expert interview and Participant interviews. The purpose was for gaining related information on six aspects: Awareness, design, cognition, emotion, VE, and needs of the elderly. They were then used to broaden qualitative analysis and extract key opinions and suggestions which were combined to embody valuable information that could assist in making an assessment tool and questionnaires for the following stage of research and methodology improvement (Figure 5.1).

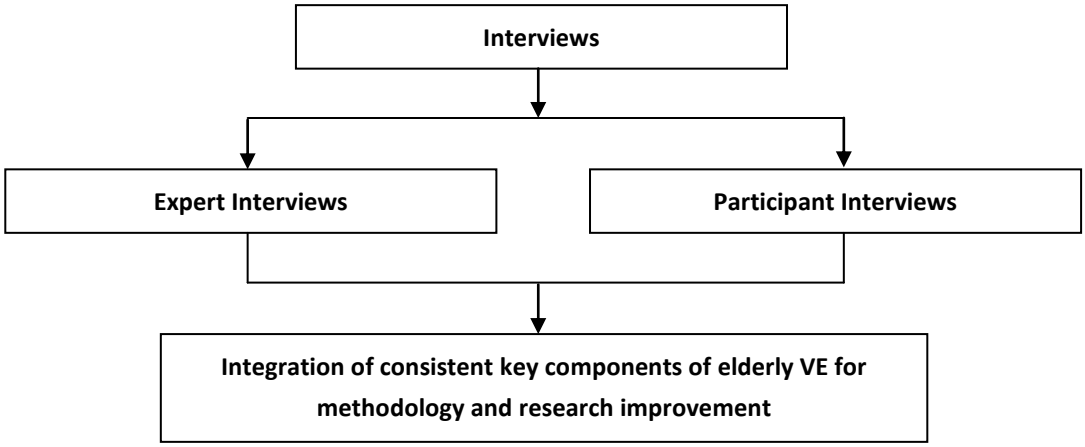

Figure 5.1 framework of chapter 5

5.2 Experts interviews

The aim of the expert interviews was to collect information related to design for the elderly from diverse expert perspectives focusing on four aspects:

- To verify the issues encountered in designing for the elderly;
- To understand cognitive issues;
- To discover emotional issues;
- To detect VE issues. The final results were combined with the results from participant interviews in order to discover their similarities and differences.

This information deepened understanding on design issues related to generic needs, preferences and pleasure gained by product use, as well as existing VE issues with visual and product communication, VE traits and positive visual experience (PVE) factors.

The interviews were conducted in two cities in China (Guangzhou and Beijing), and four experts were invited and participated voluntarily in the interviews. All experts selected are representative scholars in industrial design and aging psychology field in China with high reputation within Chinese higher education and research institution. The four experts' rich experience and profound knowledge on design for the elderly and VE were a fundamental contribution to the quantitative research. Their information is listed in Table 5.1. Moreover, the code: Exp.1, Exp.2, Exp.3, and Exp.4 were used instead of the expert's actual name for classification of analysis purposes. All experts sign up a consent form before interview (*see appendix V-I*).

Table 5.1 Expert list

Exp. Code	Title / Working title	Special area	Date	Location
Exp.1	Professor	Industrial Design	30/09/2012	Guangzhou
Exp.2	Professor	Industrial Design	02/08/2013	Guangzhou
Exp.3	Ph.D. / Associate Professor	Industrial Design	09/11/2012	Beijing
Exp.4	Ph.D. / Assistant Research Fellow	Aging Psychology	09/11/2012	Beijing

5.2.1 Standard Operational Procedure

The interview process abides a workflow of six steps, which relate closely to the different phases of the research, and identify these activities within the whole process. They are: Question formation, expert identification and invite, scheduling, interview permissions, interview conducting, and data sorting. See Figure 5.2 below.

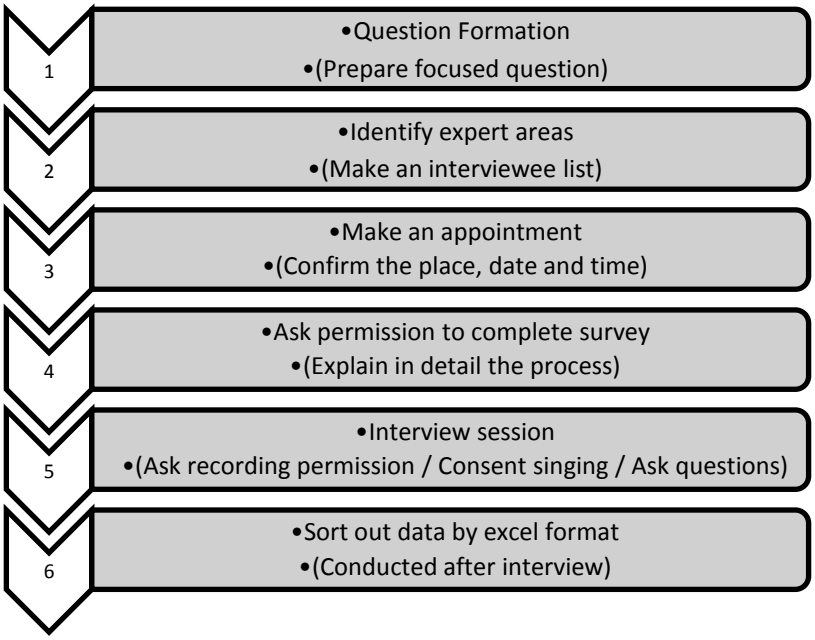

Figure 5.2 Requirements of expert's Interview

In order to ensure the interview were conducted according to a standard operational procedure (SOP) and ensure the information gathered was in conjunction with the desired objectives, the interview questions were

standardized across all interviewees. The questions were given to all experts in the same manner, and arranged for cross-reference in order to assess the points of similarity or discrepancy for qualitative analysis and statistical review (Table 5.2).

The SOP developed was based on the requirements of the whole expert interviews process, and separated into seven steps with detailed tasks and contents that supported the aim and objectives of the investigation. It included the preparation and arrangements for the work, such as confirmation of relevant information, the topics proposed to each expert, and recording device selection and preparation.

The interview questions were developed based on four key themes to further explore the expert's understanding on the issues which the elderly faced. They are:

- **Design issues:** Discovering expert's thoughts and viewpoints on caring for the elderly in design, acquiring knowledge on elderly cognitive and VE characteristics, and as a way of improving product design which can elicit a good mood for elderly persons;
- **Cognitive issues:** Clarifying the cognitive features and cognitive problems with age change, as well as the possibility of improving approaches in creating the elderly VE;
- **Emotional issue:** Understanding emotional factors that affect the elderly, and factors which could elicit pleasurable emotion from a VE aspect;
- **VE issues:** Collecting information on existing VE issues in regards to the relation between visualization and the product, and gaining the further

understanding of a PVE, that is, the pleasurable factors in the VE for the elderly.

Table 5.2 SOP for expert's interview

Procedure	Step	Content	Check list
	1	Identify expert areas	☐ Identify expert ☐ Interviewee list
	2	Conduct series questions	☐ Questions sheet with note space
	3	Make an appointment	☐ Confirmation the date and time for interview
	4	Permission on this interview survey	☐ Asking permission ☐ Recording permission ☐ Taping ☐ Videoing ☐ Photo taking ☐ Note taking ☐ Consent signing[11]
	5	Interview beginning	■ Section one. Design issues
			☐ Consideration on care for the elderly in design ☐ Difference of cognitive feature between 60-69 and 70+ ☐ Possibility of improvement for the elderly product deign ☐ Case or example interpretation
			■ Section two. Cognitive issues
			☐ Cognitive error with age changing ☐ Cognitive feature with age changing ☐ Possibility of improvement approaches for the elderly cognition
			■ Section three. Emotional issues
			☐ Emotional factor effected by product to the elderly ☐ Relationship between pleasurable emotional and visual experience
			■ Section four. VE issues
			☐ Existing VE issues on visual and product communication ☐ Thought about PVE ☐ Suggestion for PVE research based on professional knowledge ☐ Needs related to pleasurable factor
	6	Recording	☐ Checking
	7	End	☐ Thanking

[11] The consent is an ethics requirement for human research in the form of a consent form organized by the interviewer and approved by DMU Human Research Ethics Committee (HREC) for this investigation. It contains the details that need to be understood and agreed upon by interviewees that sign up for the survey.

5.2.2 Results and findings analysis

Four experts accepted the invitation to participate in the interview voluntarily and with very positive attitude. The questions of the interview were answered in accordance with the requirements of each stage of the investigation. All of the answers provided valuable information for qualitative analysis conducted based on the interview results. Invited experts demonstrated their strong knowledge on design for the elderly, and provided both common and differing opinions. Nevertheless, the statistical results indicated that the interview was quite valid and objective based on the large number of questions answered.

According to the provision within the consent form which pre-established that the expert's information be omitted, the code Exp.1, Exp.2, Exp.3, and Exp.4, replaces their real name. Additionally, real brand names of products mentioned in the interview are also omitted in the English interpretation as to avoid an advertising effect or bad brand influence.

Before the interview, all the invited experts signed the consent forms. The detailed information answered by experts is classified and summarized in *appendix V-II.*

All interviews adhered closely to the questions specially designed for the experts who accepted the interview voluntary with signed consent. All of them were positive, thoughtful, and patient in their answering of each question. There were 13 specific questions in 4 sections that needed to be answered by 4 experts. Although the experts interviewed had different backgrounds and used different examples to

illustrate their point of view; the suggestions and views were quite valuable for supporting the qualitative research. They provided deeper understanding on four topics in general: Design Issues, cognitive issues, emotional issues, and existing VE issues, namely visual and product communication. The statistical results show that the validity and credibility of these interviews are high. Valuable opinions for supporting the research rational were gained and some of the opinions, suggestions, and experiences were implemented into the next research stage. A summarization of the complete expert information that focused around the aim and objectives was extracted through qualitative analysis and eventually condensed down to form the expert interviews record. They include:

- **Design issues**

  - Product design for the elderly needs to consider their specific requirements based on memory loss, dulled perception, reduced control and operation ability, slowed response, impaired learning of new things, poor color sensation. Therefore, size and color in product design for the elderly needs to be researched. The concepts and methods of barrier-free design, universal design and inclusive design can be used to better product design.
  - Cognition is quite different between 60-69 and 70+. People aged 60-69 show only slight differences from those that are middle-aged, but have begun a process of psychological transition. Whereas those aged 70+ feel serious strain in their cognition and psychology with lowered acceptance ability. Therefore, larger typeface, and larger keys are required. They hope to be able to look at their smart phone without taking off their glasses.

- The possibility of improvements on product design for the elderly provided from experts' viewpoint is reflected in the following aspects: Government's guiding role; further study of the elderly as being essential for understanding their different needs in many aspects among different age phases and in different context; design for the elderly in earliest positioning phase should integrate different fields of expertise allowing the designer to deeply understand the elderly from a fresh prospective.
- Improving their auditory, visual and tactile sensation is highly necessary. In the visual aspect, visual acuity needs consideration of a larger typeface, brighter color, simple and larger buttons, appropriate size screen, etc. Simultaneously, in the tactile aspect, the elderly hands' perceptive ability of feeling some delicate product surfaces are in decline, larger and less keys, easy touch functions, and new skid-resistance materials are all conducive to their safety considerations. For psychological consideration; stability, affordability, and automation of health products should reduce the inapproachable feeling of medical instruments; test instrument should avoided over-medicalization.

■ **Cognitive issues**

- Cognition changing with age demonstrates that generally usability and a direct user context is very important. The elderly's sensitivity to color, vision, tactility, spatial recognition, memory, abstract thinking, ability to learn new things, and reaction capacity are all in decline with markedly slowed

reaction. They seem to prefer bright-colored clothing and do not show an interest in over-intelligent or complex things.

- Possible improvements for visual perception could include: Simplified operation, strong color contrast, strong color purity, gray and bright color contrast, robust tactility, simple design, larger font, rounded corners, central volume keys for eased recognition, enlarged and enhanced traditional experience, abstract patterns evaded, and complexity avoided.

- **Emotional issues**

  - Emotional factors of a product affect the elderly. Simple procedures, one-touch function, independent operation, cheaper cost, simplistic usability, pleasant texture, agreeable color elements and shapes linked to previously frequently used items can all improve emotion elicited by a product. Red is a color related to previous life experiences and cultural background, while pure black and white are usually not welcome, instead color contrast and purity should be sought after.
  - On the relationship between pleasurable emotion and the visual experience, the elderly that have previously had a similar experience will be more likely to induce pleasure, avoid exhaustion, and be more sensitive to affective pictures. Simplicity where possible, bright and vigorous colors that avoid too calm of colors is preferred. Red, yellow, orange, green, or gray paired with the aforementioned colors can be accepted. Blue, black, and plain gray are not welcome. Color should not be too crass as they have an affinity for smooth visual feeling that can allow for quick information uptake while

keeping in line with their reading habits. Positive visual experience should be based on user-centered concepts.

- Existing VE issues of product communication and appearance need to link up with their similar past experiences. Too many TV channels, keys on mobile phones without strong tactile impression, or words that are too small all are met with problematic tolerability.
- PVE is currently passive or negative. There is a need for the development of some training and measurement tools that combine the practical psychology and basic research and help to measure general elderly features If we can combine past life experiences with current science and technology, we can design product appearances that are better and more similar to the product's frequently used in the past. Finally, three to four key presses would be an optimal max for product function.
- Suggestions for PVE research were to track their attention, allowing us to find the accord between observation and their physiological characteristics. We need to record information and data collection, possibly following one of the elderly individuals throughout their daily life, observing and recording. We can then compare several records of different individuals to find common problems as well as commonalities and discrepancies between what they say and what they actually do. It is likely that there are many discrepancies, so we need a lot of collecting of color preferences, for example, in order to use them in design practice and re-feed the design according to the evaluation of the elderly cognition. Cognitive training tools can also be found within products for the elderly.

- **Needs issues**

  - Needs related to pleasurable factors that acted as suggestion for PVE researches were based on professional knowledge. The general features mentioned were functionality, enjoyment, and usability.
  - Traditional symbols, characters, colors, contexts, preferred materials, health maintenance and general health needs were all mentioned as important factors. Both narrow and overly spacious areas are not suitable for the elderly with their mobile precision in decline. Proper lighting is necessary.

The results show that the expert interviews achieved the aim and objectives of this research stage. They produced a number of results through qualitative analysis based on the expert's professional knowledge and research experiences related to issues of design for the elderly centered on four aspects: Design, cognition, emotion, and needs. They identified the possibilities of caring for elderly in design, offered understanding on the difference of cognitive features between 60-69 and 70+, expanded ideas of improvement for elderly product design and case studies, shared knowledge on the elderly cognitive error features, made suggestions on cognitive improvement and approaches, uncovered the emotional factors elicited by products, and mentioned the relationship between pleasurable emotion and the visual experience. Aside from this, they shared their understanding on the existing VE issues of appearance and product communication, their thoughts on PVE, their suggestions for PVE research, and the known needs related to pleasurable factors.

All of the experts showed a complete ability to express clear answers, and were able to answer question accurately in line with the theme of this research. From a

results point of view, the abundant information related to the needs of this research is invaluable for the next investigation stage.

5.3 Participants interview

The interviews were conducted in four cities throughout China, and 22 participants were invited and accepted the interview voluntarily. Most of the participants were recommended or introduced by the interviewer's relatives, friends or family member. Some participants were approached at random by the interviewer and asked if they were willing to accept the interview in their residential areas. All were very willing to participate and express their views via such opportunity. The details of participant information are shown in the following participant's list in Table 5.3.

The past experiences and thoughts on VE were diverse. For clarity, each participant's answers were classified and at times summarized to include only general qualitative features.

The aim of the interviews was to gather subjective views involved with product design issues for the elderly and their experience related to barriers, perception, emotions, and desires. Aspects collected via the focused question asking were then merged with the expert interviews, to find common views based on the two perspectives, and integrate into the next research step.

The interviews were conducted with twenty-four questions broken into six sections. All gathered information is based on the participants' personal previous product use experience and understanding of relevant issues of product design for the elderly. Further clarifying summarization collected overall tendency of awareness,

view, barrier, mood, and needs for qualitative analysis. The objectives were focused on five aspects:

- To detect the factors that possibly affects pleasurable emotion;
- To measure their degree of product design awareness;
- To discover unique product needs which are based on their experiences and cognitive change;
- To clarify visual preference factors of a product's appearance, which may affect pleasurable perception, feeling and emotion when they see or use a product;
- To find perceptional errors based on their previous VE that elicited feeling of comfort or discomfort when they used a daily product.

Table 5.3 Participants' list

Coding	Gender	Age	Interview Date	City	Venue	Recording
P.1	F	73	19/07/2013	LL	H	S
P.2	F	60	22/07/2013	LL	H	S
P.3	F	65	26/07/2013	LL	I	S
P.4	F	67	26/07/2013	LL	I	S
P.5	F	62	19/07/2013	LL	H	S
P.6	M	60	27/07/2013	LL	I	S
P.7	F	Not Given	27/07/2013	LL	H	S
P.8	F	70	29/07/2013	LL	H	S
P.9	M	71	20/08/2013	XX	H	S
P.10	F	65	20/08/2013	XX	H	S
P.11	M	65	20/08/2013	XX	H	S
P.12	F	Not Given	22/08/2013	XX	H	S
P.13	F	63	22/08/2013	XX	H	S
P.14	M	62	22/08/2013	XX	H	S
P.15	F	70	22/08/2013	XX	H	S
P.16	F	71	24/08/2013	XX	H	S
P.17	F	72	22/08/2013	XX	H	S
P.18	F	64	04/09/2013	ZH	RA	S
P.19	F	60	04/09/2013	ZH	RA	S
P.20	F	61	04/09/2013	ZH	RA	S
P.21	F	60	04/09/2013	ZH	RA	S
P.22	F	77	24/02/2014	GZ	H	S

M=Male; F=Female; LL=Liling City of Henan Province; XX=Xinxiang City of Henan Province; ZH=Zhuhai City of Guangdong Province; GZ=Guangzhou City of Guangdong Province; H=Home; I= Institution; RA=Residential Area; S=Smart Phone

5.3.1 Standard operating procedure

The SOP was based on the whole process of the interview, and separated into seven steps with detailed tasks and contents that revolved around the aim and objectives of the investigation, sorted into an interview checklist. Taking into account the participants' tolerance, and in order to answer questions as clearly and as detailed as possible, the length of time for the interview was not to exceed 40 minutes, and was controlled by the interviewer.

The questions proposed in the interview gradually deepened in logical relation to the objectives from the first question to final question across six main sections including: Awareness issues, design issues, cognitive issue, emotional issue, VE issue, and needs issues. In each section, there are certain questions composited for clarifying the theme required. The standardized questions allowed for a maximum amount of quality information in the limited time allotted. The details are shown in Table 5.4.

Regarding the protection of individuals who participated in research, a consent form gained ethical approval in advance by the DMU Human Research Ethics Committee, was provided to the participant before the interview and voluntarily signed. All participants who accepted the interview agreed and completed the form voluntarily (*see appendix V-III*).

Table 5.4 SOP of interview for participants

Step	Contents	Check list
1	Question Formulation	☐Questions sheet with note space
2	Identify participants	☐Identifying the requirement ☐Group ☐Gender ☐Number ☐Interviewee list
3	Location	☐Confirmation of place ☐Institution ☐Public place ☐Participant's home
3	Make an appointment	☐Confirmation the date and time for interview or institution
4	Permission	☐Asking permission ☐Recording permission ☐Taping ☐Videoing ☐Photo taking ☐Note taking ☐Consent singing
5	Interview	■ Section one. Awareness
		☐How are you? ☐How old are you? ☐Have you noticed product design for the elderly? ☐Today there are some topics on this I would like to hear your opinion on, could we start? ☐What is your favorite product used in your daily life? ☐Do you think it can bring a joyful feeling to you whilst you use it? ☐Do you like the product design? Why? ☐Do you think a good product design should consider the unique needs of the elderly based on their experience and cognitive changes?
		■ Section two. Design issues
		☐Do you encounter problems when using a product which you are dependent on for daily life. E.g. comfort or discomfort, safe or unsafe, easy or m not easy to use etc.? ☐Do you think the product designed lacks consideration on care for the elderly? ☐If you do not encounter problems, how do you think improvements to the product can be made to suit elderly use and needs? ☐Could you describe a previous experience with a product that gave good or bad feelings?
		■ Section three. Cognitive issue
		☐Do you think it is important that your emotion is affected by the visual presentation of product? ☐If yes, please describe the most important factor such as color, shape, texture etc.?

		☐Did you often notice cognitive errors as age increases? ☐If yes, would you please elaborate? ☐Which of these kettles is your preferred design? Why? ☐Could you describe the feeling or pleasurable emotion, in detail, when your see or use it?
		■ Section four. Emotional issue
		☐Do you think health affects mood? ☐What kind of product do you think can bring you pleasure? ☐What product use condition is able to give a pleasurable experience?
		■ Section five. VE issue
		☐Do you have any good or bad experiences with pleasurable emotion and visual feeling when you use a product? ☐Which daily used products cause visual comfort or discomfort? ☐Do you ever encounter problems with receiving information from your surroundings or products such warnings, instructions, etc?
		■ Section six. Needs issue
		☐Do you think elderly needs should be considered in product design? ☐Do you have any ideas about designing such products, what pleasurable elements would they include?
7	Recording	☐Checking
8	End	☐Thanking

5.3.2 Results and findings analysis

Twenty two individuals were invited to participate in the interview, and did so voluntarily with a very positive attitude and distinctive personal perspectives. Their responses represented clear thinking through each stage, and their answers give useful information for sorting and qualitative analysis. In general, most of the questions were answered as expected. However, there were some answers which were un-replied. The main reasons can be attributed to the participant's inability to understand the oral expression, indicating their educational background and experiences are limited, leading to ineffective or omitted responses. Nevertheless,

the statistical results indicate that the interview is valid with extremely objective information based on the larger cardinal number of questions answered and participants.

According to the provision of the consent form, which pre-established that the participant's identity be omitted, the code P.1, P.2, P.3, … Pn replaces participants' real names. Additionally, the brand name of products mentioned in the interview is omitted to avoiding inadvertent advertising or criticism.

The participants' answers and the qualitative summary of each question are presented in *Appendix V-II.*

At times, due to age, participants answered incoherently, particularly with colloquial expressions and speaking with local slang. Therefore, the information needs to be accurately interpreted and analyzed based on the temporal context, to further confirm their meaning expressed. Although a fraction of the questions cannot be answered by the participants, due to various reasons, the analysis is based on the questions answered by the majority of the participants. Therefore, the summary of results can represent the overall tendency of each question.

For VE research on product design, the stimulating effect of the object is a necessary condition for visual perception research. Therefore, the interview's first consideration is the selection of objects. A participant selecting a product presents their VE preference and objective reflection on the external factor of a product presented based on their previous experiences.

Favorite product selections allowed for top-three products, as it may be difficult to analyze the reason for a single selection. Therefore, three products can offer a better representation to further discover reasons for enjoyment.

The concepts of experience should use an integrated term that can encompass several sensory aspects e.g. visual, hearing, and tactile, smell, and taste eliciting many effective factors e.g. aesthetic, usability, function, safety, quality, light and environment etc.

In this interview, focus was put on five key aspects of the products' characteristics related to the investigation: experience, usability, function, safety, and quality. These can help to emphasize and extract in-depth results for qualitative analysis connected to the VE. Generally, the participants met requirements on each aspect, however, there are still slightly different demand types amongst the different types of product (See Table 5.5).

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Table 5.5 Classifications of reasons for preference

	Favorite reasons of the three products			Integrated reasons
Category	**TV.**	**Mobile phone.**	**Washing machine.**	
Experience	Beautiful Big screen Big font Intuitive	Good-looking color	Beautiful	Beautiful(2 P.s) Good-looking color Big font Big screen Intuitive
Usability	Convenience(2 P.s) Easy to operate (2 P.s) Simple(2 P.s)	Convenience(3 P.s) Easy to operate(2 P.s) Simple Easy to carry	Convenience Easy to operate	Convenience(6 P.s) Easy to operate(5 P.s) Simple(3 P.s) Easy to carry
Function	Vast program	Practical, Handwriting	N/A	Practical
Safety	Safe	N/A	Safe	Safe (2 P.s)
Quality	Durable Good quality	N/A	N/A	Durable Good quality
Summary	For the elderly, the requirements for TV are more in line with VE. It shows that larger size design would be benefit for ease of viewing. However, requirements about 'beautiful' are not specific. This shows that the elderly are unclear on elements of beauty. Intuitive should mean easy to understand	For the elderly, the color seems the most important factor in VE. For this kind of product, the usability and functionality are more important. This indicates that the elderly are willing to use high-tech products, but it's better to combine simplicity and technical advantages	For the elderly, the larger household appliances seem to have fewer requirements in terms of beauty and usability. In fact, these kinds of products are used for a long time with basic functions, by elderly who are familiar with the experience, therefore the demand is relatively simple	Based on the integrated results from three products selected, these terms occurred the most: convenience (6), easy to operate (5), simple (3), safe (2), and beautiful (2). Further classifying and extraction of three key words show the main demand of products in terms of usability, safety, and aesthetic experience

22 participants attended the interview voluntarily with consent form sign up. All of them were positive, serious-minded, and patient to answer each question that the interview required in a clear thinking state and consciousness. There were a total of 506 asked to 22 participants to 23 questions divided in to 6 sections. In total, 439 questions, 86.8% were answered, while 67 questions, 13.2 % were not answered. The results show that the statistical validity and credibility of the interview is high.

The participants offered subjective views based on their previous product experience and diverse thoughts on the following areas: Awareness, design,

cognitive, emotional, VE, and needs. The results were summarized and eventually condensed to show the general features of elderly characteristics based around the aim and objectives of the study through qualitative analyses (*see appendix V-IV*).

- **Awareness**

  - Most of the elderly notice that product design needs to consider their requirements.
  - Favorite products included: entertainment, communications and home appliances that are closely related to Chinese elderly life.
  - Pleasurable feelings are generated by satisfaction with: Quick use, convenient use, easy to use, easy to understand the outside world (mobile phone), and larger screen (TV with rich color and good sharpness).
  - Usability is the largest need for Chinese elderly; presently, pleasure is not in a core position of the Chinese elderly life; and safety and quality are two reasons for stated preference.
  - The Chinese elderly generally lack care about themselves.

- **Design**

  - Most of the participant's encountered problems with product use in daily life experiences; mainly related to quality in safety and usability aspects.
  - Product designs for the elderly lack consideration and need to be promoted.
  - Usability is most important / cognition is more important than functionality / as such the importance of experience should focus on usability and cognitive aspects. Mentioned aspects of usability, cognition, and function

include: **Usability:** Simpler / Ease to use / Safer / Convenient / Larger button / Larger font / Larger screen / Clear display / Chinese typeface. **Cognitive and understanding:** Generous / elderly cognitive consideration / education for the elderly on high-tech or popular technology / Developing certain specialized products for elderly enjoyment / service / special care. **Functionality:** Hand writing on cell phones and computers / Good quality.

- Bad feeling is more common than good feeling / Function, usability, and perceptive experience are equally important / Usability is tied to size i.e. button, font etc. / Perceptive experience is involved in identification i.e.: positive mood making, comfortable, and easily identifying the object.

- **Cognition**

  - Emotion is strongly affected by the visual presentation of the product.
  - The factors of color, material, shape, and font are very important in affecting emotion and mood.
  - Cognitive error is a serious issue which the elderly meet in their daily life. It needs consideration in product design. The main explanation on this provided in detail was: Memory decline, the elderly individual's ability is certainly not the same as with young people, faulty identification such as difficulty knowing which buttons need to pressed, and the elderly are unable to understand how to use many products.
  - Most of the elderly lack care about their experiences or are unclear of the experiences meaning. Design needs to improve in order to satisfy the requirements of feeling through experience. The barriers to experience

were mainly reflected in: faulty identification due to eyesight decline i.e. small font and inappropriate color causing visual discomfort. Memory decline is also an important factor that influences the elderly experience and use of a product; as such a remind function included in the product design is very important. Usability is always an important factor which is related to the products' use, and influences their mood both positively and negatively.

- Kettle No. 7 was picked most often as the favorite because of it was: Simple, practical, commonly used, convenient, safer, had a generous shape, and looked pleasing. This showed two elements important to a product: usability and appearance. Kettle No. 9 was picked second because of its color, shape decoration, and simple style. This reflected only product elements of appearance. Kettle No. 15 was the third most popular because of its materials, simplicity, and quality. This stresses the product's basic function and basic elements of appearance as key requirements for preference. Synthesis of the above three selection reasons shows that the element of product appearance elicited the elderly preference most often with usability to follow.
- The elderly will get joy from using their product of choice.

■ **Emotion**

- All agree to the concept of pleasurable mood benefitting health. Research is lacking to support this issue, and it needs to be further researched to identify their mood reflection, and the relationship between the elderly

pleasure and its inducement.

- Electrical appliances or electrical products; mainly covers aspects of entertainment, living, traveling, communication, cooking etc. This shows two things: The elderly life is closely related to technology development, and the usability of products needs to be reconsidered in order to satisfy the elderly living requirements and their good mood both now and in the future. Simplifying perception and ease of use are equally important; i.e. TV is the most commonly used daily article for understanding the outside world and entertainment. New technology development and functions require design that is suitable for their perception and understanding.
- Mood can be affected by a variety of aspects based on the visual perception; i.e. easy to identify at a glance. Appearance of a product should match perceptive features in a variety of factors: color, shape, texture and surface; in order to arouse their attention with clear identification. Simple and not flashy is another requirement to the elderly commonly stated. Simplicity can reduce their perceptive load and allow them to quickly identify an object or manipulate a product.

■ **VE**

- The elderly generally ignore feelings in their daily life, and as such products lack care for the elderly emotional and visual feeling.
- Good-looking and comprehensive appearance affects a viewer's mood and feeling. Lower visual stimulation without overpowering aspects and reduced eye fatigue with dimmer display reflect the receptivity relationship between

object and the user. Old-fashioned comfort is related to their nostalgic psychology. They are difficulty in using the computer and hope for a handwriting function reflects usability. A bad mood generated when watching a TV program is related to the artistic expression.

- The problem of receiving information from their environment or products encountered mainly focuses on informational understanding, words recognition, images missing/misrepresentation, complicated language, and textual limitation of product information.

- **Need**

  - Simple, convenient, visually identifiable, and safe are the main considerations the elderly stated they need. It reflects two main aspects that effect their VE and emotion: Usability and visual perception.
  - Most of the elderly have no ideas on product design with pleasurable elements, with the reasons being: misunderstanding, unwillingness, lack of know-how and incapability. There were also a few suggestions that ambiguously pointed to improved ease of use. The elderly hunger for a happy mood elicited by a product and desire design that can satisfy these kinds of needs.

The results show the participant's interview achieved the aim and objectives of the research stage, and satisfied the requirement of qualitative analysis because of the large number of answers provided and the subjective views based on their own experience and cognitive changes. It was seen that the elderly have common pleasurable emotion factors, awareness on product design for the elderly, unique

product needs, visual preferences on a product's appearance being linked to pleasurable perception, feeling and emotion when product is seen or used, and visual perceptional error.

Most of the participants had the ability to express a clear answer. Despite some of the individuals lacking sufficient understanding or being unable to cover the range set in their answers; occasionally, they could be helped to answer questions more accurately and in line with the theme by means of a reminder without affecting the overall results of the analysis. From a results point of view, the abundant amount of information which is related to the needs of the research is quite valuable for the next stage of the investigation.

5.4 Summary

Interviews were conducted from two perspectives: expert's professional viewpoint and participant's individual experiences to collect their feedback and further find necessary information on the importance of visual experience in design. Also discovered were further research possibilities with supporting suggestions, feelings of encountered experience with VE, and emotional factors that affect the VE. The results of this qualitative research are valuable in supporting this investigation and for future research work.

The interview process focused closely on questions that were specially designed for this research. Although experts' and participant's answers were based on their own individual views, there was common ground among the majority of the answers. Based on qualitative analysis of the interview results, key findings were integrated around central issues in VE and PVE for the following assessing and investigation stage of the assessment tool development as well as comparison of subjective and objective factors of VE. This valuable data and information is the important basis of reference for the next steps. The key qualitative information that was extracted that closely relates to the VE is as follows:

- **Awareness**

Interview results from experts and participants both showed: Elderly product design needs to consider their specific requirements; Chinese elderly individuals' favorite products involve entertainment, communications and home appliances; function, usability, and the perceptive experience of a product are equally important.

However, usability is their largest need, and seeking pleasure is not in a core position of the Chinese elderly life at this juncture.

- **Design**

Product design for the elderly is considered to be lacking, and need improvement from its current stage. Most of the participants experience bad feelings more than good feelings; experiences mainly related to quality in safety and usability aspects. They do, however, think that the experience should focus on usability and cognitive aspects.

Design needs to consider: Memory loss, dulled perception, diminished control, operation ability decline caused by slower response and information receiving, reduced learning, as well as other reduced senses. Therefore, research is needed to identify their specific needs such as: visual acuteness, font size, color preference, simplified style, larger size, brighter color, clear display, and Chinese fonts.

The concepts and methods of barrier-free design, universal design and inclusive design can be better used in product design.

- **Cognitive**

Elderly cognition is quite different across deferent age stages. Due to memory decline, many products are confusing. From a VE perspective, sensitivity to color, tactility, spatial relationship, abstract thinking, learning new things, and capacity of thought are declining with slowed reaction. These will all influence their VE. The factors of color, material, shape, size and font are very important, and effect

emotion and mood. Therefore, the appearance of the product, namely these factors, should match preferred perceptive features to arouse their attention allowing clear identification and eliciting pleasurable feeling.

Most of the elderly do not express care about their daily experiences. Their memory is in decline and they therefore need a function built in to remind them of certain things and processes. Moreover, the barriers to experience they share are mainly reflected by a difficulty to identify the object. Small size and inappropriate color can cause an uncomfortable feeling. Therefore, design should satisfy requirements of experienced feelings about color, shape, materials, decoration, style, and shape. These are the easiest to elicit a pleasurable feeling, specifically when they can use their favored product that is inclusive of these features. However, cognitive error is a serious issue accompanied by the lack of consideration for the elderly in product design. Visual presentation of a product strongly affects emotion, and for this reason, simplification and ease of perception is important. This is particularly true when speaking of new technology development and the new intelligence requirements.

Color plays an important role in VE. Bright color, strong color contrast, color purity, and gray tone contrasted with bright colors are better for the elderly.

Others factor i.e.: larger font, rounded corners, modified volume, more attention to traditional experience, and abstract thinking avoidance and lowered complexity are seen to be more easily accepted by the elderly.

- **Emotion**

Existing VE issues of visual and product communication reflect that information is accepted passively. Negativity in real surroundings and perceptional confusion can cause unclear identification and judgment, as seen with a font size being too small.

Most of the answers pointed towards the fact that a pleasurable mood can benefit health, but there is little or no research in China to support this. The elderly individual's emotion can be affected by a product, and their mood reflects the stimulus given by external environment factors, but this needs further clarification.

- **Visual experience**

VE is generally ignored by the elderly in their daily life, and products for the most part lack attention to their emotional and visual feeling. The problem of VE is reflected in informational misunderstanding, unrecognized words, image confusion, complicated writing, and limitation on a product's information. Better VE should embody a comprehensive mixture of appearance's affect on the viewer's mood and feeling. VE reflects the receptivity relationship between the object and the user. Beneficial VE for the elderly should include lower visual stimulation without an overwhelming feeling, as well as suiting their nostalgic psychology.

Although emotion is influenced by many factors, in reference to VE, color is the main element. This is usually related to previous life experiences or cultural background, and easily strengthens the emotion elicited by a product. The factors that arouse emotion are:

- **Color:** bright, vigorous without drastic contrast. Red, yellow, orange, green, or gray with any of the above colors are more easily accepted, while blue, black, and grey are not as welcomed.
- **Style:** Attractive, simple.
- **Texture:** Smooth.
- **Speed:** Fast.
- **Image:** Affective.
- **Habits:** Similar to past experiences.

PVE needs further exploration both within practical psychology as well as more basic research. More training and measuring tools need to be developed, suggestions for which came mainly during the expert interviews. PVE should also include such approaches in this investigation.

Products are best if similar to the products frequently used in the user's past combined with current science and technology.

PVE research is aimed at tracking the attention of elderly product users, understanding their order of observation according to physiological characteristics, data collection, and recording and elderly user throughout their daily lives.

Additional research needs include:

- Color preference collection;
- Discrepancy comparisons between what the elderly say and what they do;
- Evaluation of cognition features amongst elderly individuals;
- User-centered concept based PVE.

- **Needs**

Needs related to pleasure are embodied in three aspects of Jordan's Customer Needs Hierarchy: pleasure, usability, and functionality. However, visual identification and safety are the main considerations stated by the elderly individuals interviewed. They hunger for happiness elicited by a product, and their VE specifically requires traditional symbols, characters, colors, contexts, preferences, materials, suitable spaces, and light; while usability needs to be simple, convenient, and health conscious.

CHAPTER 6.

ASSESSMENTS

6.1 Introduction

In order to further verify the previous conclusions from aspects of observations and interviews, and to discover and supplement the missing research information; this investigation stage, the assessment phase, is specially designed for testing the elderly visual perception as needed. The purpose is to identify the comprehensive features of the elderly subjective preferences of visual perception and their perceptional responses generated by objective stimuli. As a result, it provides first-hand information, based on the statistical data of this assessment, to explore the Chinese elderly Preferred Visual Experience (PVE) factors in the following stage.

Consideration on the Visual Experience (VE) involves two aspects: Human subjective preferences and objective stimulus reaction. Therefore, the assessment proposed is composed of two parts: Subjective assessment and objective assessment. The subjective assessment includes three sections: First is to understand the elderly's personal point of view and awareness in regards to the research focus; second is to assess the details of visual preference (i.e. color, shape, size, material, texture, pattern, product design, layout of newspaper, and light spaces); third is to probe the emotions linked to VE. Then suggestions on improving elderly pleasurable mood via design products are given. The assessment of subjective preferences includes the results of a visual perception test.

With regards to this, two sets of assessment SOPs needed to be developed. The first was a manual for the visual preferences test (VPT-1) of subjective preferences assessment, and the other was for an eye tracking device used in visual preferences test (VPT-2) of elderly response.

In order for the contents of the assessments to be reflected in a reasonable range, the contents of assessment needed to be optimized several times, and the final test formed based on the physical suitability, duration, and acceptance of the subjects.

For the purpose of ensuring the representativeness of the statistical data, the subjects underwent a certain amount of VPT-1 or VPT-2 assessments.

Taking into account the differences in individual physical condition of the elderly during the assessment process, some of the assessments could not fully be completed. But, the overall number of samples should fully be able to support the

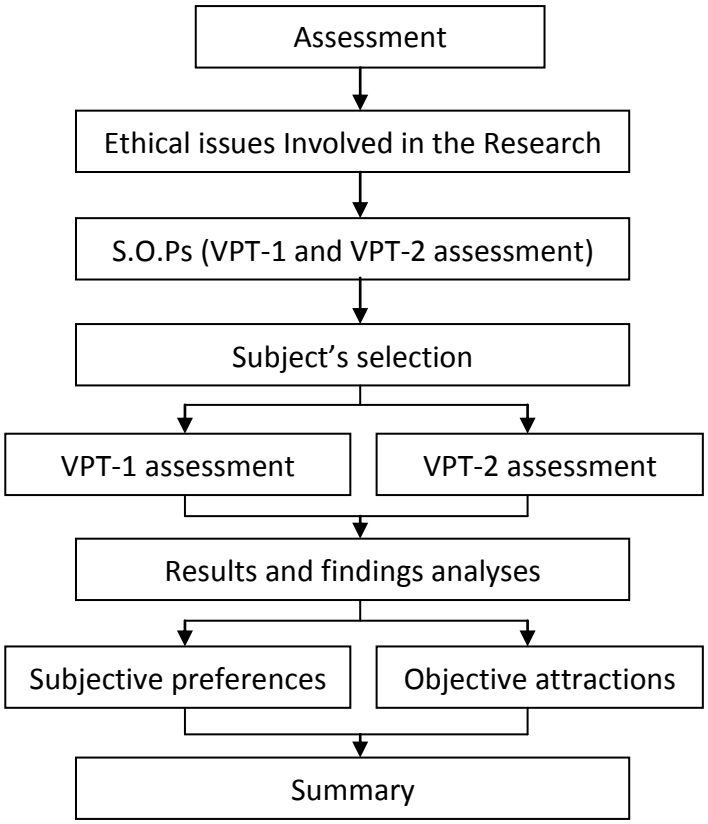


Figure 6.1 Framework of assessment

statistical result as an effective sample size.

The statistics were extracted with professional software to achieve results with scientific objectivity and credibility. The results and findings in this phase will be used in the PVE discussion in the next stage. The framework of this assessment is showed in Figure 6.1.

6.2 Ethical issues involved in the research

This investigation involved human behavior aspects through a series of research methods i.e. observation, interview, and assessment. The intention was to include all information that relates to the research objectives. The elderly, who acted as the "subjects" in this research, were inevitably needed to use their relevant individual data, information, and views for science analysis. Therefore, the usage of the information gathered in this research must be dealt with carefully in accordance with the requirements of academic morality, ethics, and supervision. In regards to personal information and the using of personal data and images, it was necessary to be conducted under the consent and agreement of the participants.

According to the De Montfort University (DMU) ethical committee requirements and regulations: In all research projects which are relating to humans, all human data collection need to undergo ethical review, specifically when the research may involve vulnerable groups, for example the elderly, those with a cognitive impairment, or mental health concerns. The information about human beings gathering via interview, survey, questionnaire, or observation, did not interfer in the normal physiological and/or psychological processes of the participants and using archived data in which individuals are identifiable.

This investigation involved access to records of personal information, including biological information, concerning identifiable individuals. Therefore, the research activities require human research ethics consideration for approval with the purpose of ensuring ethical boundaries were not crossed in the process of the investigation. Before the study, each activity was outlined and gained approval through consent

forms that were approved by De Montfort University (DMU) Research Ethics Committee (*see appendix V-V*).

■ **Ethical issues identified and addressed**

This research completely abides with the DMU policy statement on Human Research Ethics. The ethical issues were identified and addressed (See Table 6.1), and ensured no ethical issues arose according to the following：

- Participants' co-operation in a research project is entirely voluntary at all stages;
- Participants must first have been told to whom the information would be supplied and the purpose for which it will be used and relevant codes of conduct/guidelines with full details of the objectives in the research;
- Participants information will not be used for any non-research purpose include data collected and its related image from them and that the recipient of the information has agreed to conform to the requirements of any relevant Code of Practice;
- Participants first have been told whom the content of the research is for and agree to co-operation in the investigation with their signature on the consent from;
- Participants' name is ensured not to be disclosed;
- Participants' personal point of view was given under their consent;
- Participants are in no way directly harmed or adversely affected as a result of their participation in a research project;
- Participants must be told (normally at the beginning of the interview) if

observation techniques or recording equipment are used;

- Participants would not undergo any psychological stress, or be caused more than minimal pain or damage;
- Participants would not encounter such interventions, which may cause them to reveal information that causes concern, in the course of their everyday life;
- Participants would not encounter unsafe feeling, discomfort or inconvenience in the investigation.

Table 6.1 Ethical issues identified and addressed

Ethical issues identified	Ethical issues addressed
Disclosing the full details of research to participants	Attached project proposal, consent form and written information about the research for each participant
Allowing voluntary participation and freedom for withdrawal	Consent form detailing participant involvement, their freedom to withdraw or take part in the investigation
Signed consent by participant	Signed consent form with date required by every participant
Written description of involvement	All records keep in confidential filing system and to be seen only by myself for the period of primary research only
Appropriate records being kept confidential	Electronic records to be password protected with only a single copy available
Keeping records secure and with secure disposal	All physical records to be disposed via shredding, all electronic records to be wiped and destroyed after use
Language description of involvement	Clear Chinese and English interpretation to be used at all times with no localization of speech

Moreover, for the humanitarian and human rights considerations, subjects' full and informed consent was carried out at the time the study. The consent form for the investigation needed their approval with signature.

In the assessments stage, the elderly's individual visual preferences data was required to be tested and gathered via questionnaire and testing device. All

participants in China were voluntary subjects, fully notified, and gave consent before carrying on the investigations. All of them agreed and accepted, with their signature, to adopt and expose their individual information, data, and images in the research if required. The assessments conducted fully abided to the standard of social science research without any ethical issue occurrence.

In order to avoid ethical issues during the investigation of Chinese elderly, the assessment also adopted two specifications:

- During the research, the correct language was used to guarantee clear communication and avoid ambiguity. There were some communication difficulties with Chinese participants because focus was on the elderly group of China. Therefore, for Chinese participants, using Chinese as a working language for data collection, questionnaires, and interviews was a must. Nevertheless, all of the documents related to survey, shown to the participants were bilingual (English and Chinese), and answers eventually translated into English accurately.
- For the purpose of collecting investigated scientific data, the survey was carried out in different provinces of China: Guangdong (Guangzhou, Conghua, and Shantou city), Hunan (Liling city), and Henan (Xinxiang city). Because of the huge differences between different local dialects in china, the investigation in different regions was conducted through the assistance of volunteer language translators. This was to avoid misunderstanding caused by the barrier of language communication in the investigation.

6.3 SOPs

This Assessment followed an important process of describing, collecting, recording, scoring, and interpreting information on relevant factors of the elderly VE. During the investigation, the goal of the assessment was to gauge these factors. Based on the results of the assessment, the elderly VE features and their PVE were discovered.

The assessment was conducted via two approaches to achieve results with two perspectives: Subjective and objective.

The First assessment approach was the visual preference test-1 (VPT-1). This is a paper-based test that integrated four categories of assessment: Detailed content of selected items, assessment scale, and simple subjective description of relevant VE problems. The other assessment approach was the visual preference test-2 (VPT-2), which was computer based and consistent with the VPT-1 contents in order to test the subject's objective attraction through computer screen stimulation and eye movement recoding. The two different aspects of assessment were compared together to further discover the VE features and possible PVE factors for elderly individuals.

The assessment process abides two separate workflows, VPT-1 assessment and VPT-2 assessment. As a key component of the primary study, the assessment operation was complicated in regards to observation and interview survey, but this was in order to maximize the assessment's results and ensure high efficiency.

Therefore, the assessment phase was specially organised in to a standard operating procedure (SOP) for regularizing the work process and contents.

6.3.1 VPT-1 assessment SOP

The VPT-1 assessment SOP is an operational guideline used throughout the whole assessment process. As a standard of operational instruction, it adopted a paper based manual form with detailed contents for guiding the evaluating task that needed to be completed in each step. The VPT-1 assessment SOP included a six-step process, and assessment detail input five steps. The VPT-1 assessment SOP development was based on an originally developed process and then improved via a 30 subject pilot assessment, and upgraded to the final version (VPT-1 assessment ver. 2.0). The application of the updated version shows that the effectiveness was optimized, and was particularly more easily understood by the elderly, and as such the accuracy of the assessment improved. Also the time to complete the task reduced and with it the pressure to complete observably decreased without the complex contents. The comparison of VPT-1 assessment SOP improvement before and after is showed in Table 6.2.

VPT-1 assessment SOP is composed of six steps: Preliminary work, pilot survey, preparation, and permission on VPT-1 assessment, assessment, and post assessment.

In the fifth step of the assessment, four sections of contents are included: Demographics, product customer satisfaction, cognition feature and emotional reflection. These help to evaluate personal and subjective desires, preference, and

VE feeling. It incorporated a combined text prompt and image stimulus with associated choice scale. Additionally, as a subjective assessment, there are two main methods used to assess the subject's selection: 1) Order in degree of preference, 2) Preference on a scale of 1-5. These provided convenience and accuracy for the final information calculating (See Table 6.3).

Table 6.2 Comparison of VPT-1 assessment SOP between ver. 1.0 and ver. 2.0

Contents			**VPT-1 assessment SOP ver. 1.0**	**VPT-1 assessment SOP ver. 2.0**
Time			40-60 mines.	30-40 mines.
Pages			7	4
Text Language			English and Chinese	Chinese, only consent form used the English and Chinese
Sections			4	4
Items			26	20
Stimulus	Color	Hue	7	12
		Hue contrast	21	21
		Purity	10	10
		Purity contrast	55	55
		Brightness	11	11
		Brightness contrast	55	55
	Shape	-	35	16
	Size	-	11	7
	Texture and Material	-	18	18
	Pattern	-	9	6 (improved)
	Products design	-	18	18 (improved)
	Layout of newspaper	-	4	4 (improved)
	Light	-	3	3
	Total	-	257	236

Table 6.3 SOP of VPT-1

Step	**Content**	**Checklist**
1	Preliminary work	☐ Identify the main range of assessment contents
		☐ VPT-1 assessment content formulation (1.0 version)
2	Pilot survey	☐ Venue selection
		☐ Date selection
		☐ Subjects selection
		☐ Revise VPT-1 assessment content (2.0 version)
3	Preparation	☐ Venue selection
		☐ Date selection
		☐ Subjects selection
		☐ Assistant and interpreter selection
		☐ VPT-1 assessment list and consent form
4	Permission on VPT-1 assessment	☐ Asking permission ☐ Recording permission

		☐ Photo taking ☐ Note taking ☐ Consent signing
5	Assessment	■ **SECTION A: Demographics**
		☐ Age ☐ Gender ☐ Nationality ☐ Region ☐ Level of education ☐ Visual difficulties
		■ **SECTION B: Product Customer Satisfaction**
		■ **About the favorite product** ☐ Four products most important in your daily life ☐ The superiority of the product ☐ Use frequency ☐ Length of time you use these four products ■ **Evaluation of the above products** ☐ Brand and model ☐ Function ☐ Usability ☐ Appearance ☐ Evoked Emotion ☐ Safety ☐ Like those products design? ☐ Problems encountering using these products? ☐ The most satisfying product from the four products ☐ The most dissatisfying product from the four products ☐ Importance of design ■ **The most important factor of products (function, usability, appearance, evoked emotion, safety)** ■ **The elderly product design needs to consider their unique needs based changing age**
		■ **SECTION C: Cognition Feature**
		■ **Which factor most easily grabs your attention during visual information receiving?** ☐ Color ☐ Shape ☐ Size ☐ Material and texture ☐ Pattern ☐ Light ■ **Recognition preferences (easy finding, easy to ignore, personal favorite)** ☐ Colors (hue, Hue contrast, brightness, purity, purity contrast, brightness contrast) ☐ Shapes ☐ Sizes ☐Material and textures ☐ Pattern ☐ Products design (sort) ☐ Layout of newspaper ☐ Light spaces (warm, cool, natural)
		■ **SECTION D: Emotional Reflection**
		■ **Do you think pleasurable emotion can benefit health?** ■ **Do you think a good product should give the user a positive emotion?** ■ **Do you have a pleasurable emotion when the visual presentation of a product is in line with your cognitive preference?** ■ **Which factors will affect your pleasurable mood when you see or use a product?** ☐ Function ☐ Usability ☐ Appearance ☐ Concept ■ **Three factors which most affect subjects' pleasurable mood when the product is in use?** ☐ Function (helpful, simple, complex, health care) ☐ Usability (high-tech, intelligent, easy to operate, easy to identify, in conformity with the user habits, harmless, labor-saving) ☐ Appearance (colors, shape, sizes, material and textures, style, pattern, light spaces) ☐ Concept (environmentally friendly, recycled, healthy, safe, pleasurable experience, care) ☐ Preference color (hue, Hue contrast, brightness, purity, purity contrast, brightness contrast) ☐ Preference style (simple, complex, classical, modern, oriental, western, curved, straight, plain, flamboyant) ■ **What is the main reason that the product design cannot to bring pleasure?** ☐ Unsafe ☐ Difficult to understand information ☐ Inconvenient ☐ Difficult operation ☐ Poor appearance ☐ Product is not suitable for the elderly ☐ Other ■ **Do you think of how to design products for the elderly to enhance their pleasurable mood?**
6	Post assessment	☐ Record checking
		☐ Invitation for VPT-2 assessment permission
		☐ Ending with thanking

6.3.2 VPT-2 assessment SOP

The VPT-2 assessment SOP is an operational guide for assessing the elderly VE feature from an objective attraction perspective. The result of this assessment is quite deferent from VPT-1 assessment. VPT-1 reflects initiative and subjectivity, while VPT-2 reflects passivity and objectivity.

VPT-2 assessment is a computer-based approach for achieving these results from the elderly VE by natural state response collection. VPT-2 assessment was also a key component of the primary study and needed technical support. On a technical Level, the assessment requires an eye tracking device, as well as an operator who has professional operation training and practice background. Meanwhile, the assessment contents, in terms of stimulus from computer monitor display, need to be set according to the test requirements. These include appropriate length of time stimulant shown, and reminder text input. Therefore, for this relatively complex assessment process, developing a SOP in advance was very valuable and significant for promoting the efficiency of the assessment, and reducing the inaccuracy of results caused by operational mistake.

The VPT-2 assessment SOP is also composed of six steps: Preliminary work, preparation, permission on VPT-2 assessment, pre-assessment, formal-assessment, and post assessment.

The VPT-2 extracts detailed contents for its stimulus from section C of VPT-1 ver. 2.0, organized into an electronic version with 11 pieces of displayed pages involving the VE factors: Easy to find, easy to ignore, and personal favorite. These were fed

into an eye tracking device and computer system with the primary purpose of collecting the eye movement and heat mapping eye interest. For the subjects, this approach was very strange to them, therefore, the assessment needed to provide the proper guidance by the operator, and abide by the SOP detailed in Table 6.4.

Table 6.4 SOP of VPT-2

Step	Content	Checklist
1	Preliminary work	☐ Identify the main range of assessment contents.
		☐ VPT-2 assessment content formulation extracted out from VPT-1 (2.0 version, section C: cognition feature, and to developing an electronic test files.
		Test device selection
		Assistant selection for device operation
2	Preparation	Installing the VPT-2 (2.0 version) into eye tracking device
		Debugging the eye tracking device and checking the stability of the test
		☐ Venue and testing location selection
		☐ Date selection
		☐ Subjects selection
		☐ VPT-2 assessment consent form
3	Permission on VPT-2 assessment	☐ Asking permission for VPT-2 assessment (After VPT-1 assessment) ☐ Recording permission ☐ Consent signing
4	Pre-assessment	☐ Informing the content, method, and process of VPT-1 assessment is computer based ☐ Adjusting the subjects sitting position and eye focuses ☐ Experimental tests ☐ Finding problems if any from subjects in experimental test and put forward opinion which needs to be noticed in the formal-assessment stage
5	Formal-assessment	■ **Easy to find**
		☐ Colors (hue, Hue contrast, brightness, purity, purity contrast, brightness contrast) ☐ Shapes ☐ Sizes ☐ Material and textures ☐ Pattern ☐ Products design (sort) ☐ Layout of newspaper
		■ **Easy to ignore**
		☐ Colors (hue, Hue contrast, brightness, purity, purity contrast, brightness contrast) ☐ Shapes ☐ Sizes ☐ Material and textures ☐ Pattern ☐ Products design (sort) ☐ Layout of newspaper
		■ **Personal favorite**
		☐ Colors (hue, Hue contrast, brightness, purity, purity contrast, brightness contrast) ☐ Shapes ☐ Sizes ☐Material and textures ☐ Pattern ☐ Products design (sort) ☐ Layout of newspaper
6	After-assessment	☐ Record checking
		☐ Ending with thanking

6.4 Subjects selection

99 subjects selected were invited to voluntarily participate in VPT-1 assessment for subjective data collection. 44 of those accepted the invitation to participate in the VPT-2 assessment for the data collecting of their objective response. The result of subjects' VPT-1 and VPT-2 assessments were used for comparative analysis and to further discuss the consistency of subjective preferences versus objective attraction.

The subject selection was based on 8 requirements:

- Age must be over 60 years old;
- No limitation to gender;
- Fully volunteer to participate;
- Having basic cognitive ability;
- Understanding and speaking Chinese (or speaking local dialect with interpretation support;
- Good health and can maintain a state of alertness through the whole assessment process;
- Completed the VPT-1 assessment within the prescribed period of time and with enough energy to participate in the VPT-2 assessment;
- Truly expressing their individual view without effect from others.

There were significant difficulties and challenges in subject selection, because most of the elderly refused the invitation to participate in the assessment for reasons such as: They doubt that the data collected from them would not be used in commercial purpose, they worry about trouble and being deceived, no time available,

uninterested; or their state of health may have been the main reason. Furthermore, decline of physical and cognitive ability easily made them fidget, or lack patience. The 99 subjects that could be accepted for the assessments, was mainly dependent on the support from two Chinese institutions that offered assistance and site provision. The institutions respectively are the Elderly Cadres Activity Center (ECAC) at South China University of Technology, Guangzhou City, Guangdong Province, and a nursing home (NH) of the Civil Affairs Bureau, Conghua City, Guangdong Province. In spite of this, the numbers of subjects willing to participate in the assessment voluntarily was still limited. Therefore, in order to increase the amount of subjects for statistical reliability, it was necessary to be invited at random (IR) individuals to the assessment. The subjects selected are as follows:

ECAC: The subjects were randomly selected from a name list with 240 senior citizens as candidates provided by ECAC, ages ranged from 60 to 80 years old. All subjects selected were invited via phone, one by one, and given the essential information on the assessment. Most of the candidates refused the invitation, but eventually, 54 candidates accepted the invitation to participate in the assessment voluntary.

NH: The subjects were selected from a certain number of residents in NH by the staff based on the requirements of selection in advance. 21 subjects were selected and participated in the assessment voluntary.

IR: The subjects were selected from different cities through introduction by colleagues, relatives and friends, or invited randomly in the subjects' residence zone.

Finally 24 subjects were selected and participated in the assessment voluntary (Table 6.5).

Table 6.5 Subjects comprised for assessment

Venue		VPT-1	VPT-2	Date	Assessment Version
ECAC		30	19	13/8/2012-10/10	Ver. 1.0
		24	5	19/11/2012	Ver. 2.0
NH		21	20	18/06/2013	Ver. 2.0
	Liling	8	-	19/07/2013-29	Ver. 2.0
	Xinxiang	9	-	20/08/2013-24	Ver. 2.0
	Zuhai	7	-	04/09/2013	Ver. 2.0
Total		99	44	-	-

Based on the statistic of demographics of the 99 subjects, all subjects are Chinese aged 60 years and above. 56 of them are female, and 43 of them are male. 7% of them are from Eastern China, 61% are from Southern China, 23% are from Central China, 2% are from North China, 3% are from Southwest China, 1% are from Northeast China, and 2% did not answer. In regards to education level: 12% are without any education, 17% are primary school level, 15% are middle school level, 10% are high school level, 1% are vocational high schools level, 7% are polytechnic school level, 9% are senior college level, 26% are BA/BSC level, 1% are MA/MSC/MPhil level, and 1% are without answer (Table 6.6, and 6.7).

Table 6.6 Subject's demography (n=99)

Age		60-64		65-69		70-74		75-79		80+		Total	
Gender		M	F	M	F	M	F	M	F	M	F	M	F
Number		8	23	12	10	9	10	10	10	4	3	43	56
Region	East	-	1	1	-	-	1	1	3	-	-	2	5
	South	5	9	10	5	7	5	7	5	4	3	33	27
	Centre	3	7	1	4	2	4	1	1	-	-	7	16
	North	-	2	-	-	-	-	-	-	-	-	-	2
	Southwest	-	1	-	1	-	-	-	1	-	-	-	3
	Northeast	-	1	-	-	-	-	-	-	-	-	-	1
	N/A	-	2	-	-	-	-	1	-	-	-	1	2
VD		6	15	4	7	5	10	7	9	1	2	23	43

Table 6.7 Subject's educational level

Age	60-64		65-69		70-74		75-79		80+		Total	
Gender	M	F	M	F	M	F	M	F	M	F	M	F
Number	8	23	12	10	9	10	10	10	4	3	43	56
N/A	-	-	-	-	-	-	-	1	-	-		1
None	-	1	1	3	-	1	-	1	2	3	3	9
Primary School	1	5	2	1	5	-	3	-	-	-	11	6
Middle School	4	5	2	-	1	2	-	1	-	-	7	8
High School	1	2	1	2	1	2	-	1	-	-	3	7
Vocational High Schools	-	1	-	-	-	-	-	-	-	-		1
Polytechnic School	-	2	1	1	-	1	-	2	-	-	1	6
Senior College	1	4	1	1	-	-	1	1	-	-	3	6
BA/BS	1	3	3	2	2	4	6	3	2	-	14	12
MA/MS/MPhil	-	-	1	-	-	-	-	-	-	--	1	

The demography statistics also shows that the majority of the subjects have certain visual difficulties (VD). Among the 99 subjects, 57 subjects have VD, 9 have partial VD, 29 subjects have no VD, and 4 subjects did not provide information on VD.

Excluding the 4 subjects who did not provide information on VD, the statistics calculated based on 95 subjects, combining the 57 subjects and 9 subjects who have full or partial VD, 66 subjects have VD problem (70%) including 43 female subjects and 23 male subjects. In 56 female subjects, 43 (77%) have VD. In the 39 male subjects, 23 (59%) have VD. This indicates that the female VD proportion is higher than male by 1.31 times. In other words, male elderly vision is better than female's at an elderly age (Table 6.8).

Table 6.8 Subject's VD (n=99)

Age		60-64		65-69		70-74		75-79		80+		Total	
Gender		M	F	M	F	M	F	M	F	M	F	M	F
Number		8	23	12	10	9	10	10	10	4	3	43	56
Visual Difficulties	Y	3	13	4	7	5	9	6	7	1	2	19	38
	P	3	2	-	-	-	1	1	2	-	-	4	5
	N	2	8	7	3	3	-	3	1	1	1	16	13
	N/A	-	-	1	-	1	-	-	-	2	-	4	-
Note: M=Male; F=Female; Y=Yes; P=Partial; N=No; N/A=No answer													

Overall statistics show that the elderly individual with VD's age is very high, and female incidence is higher than male. These statistical results will contribute to the needs which need considering, and fitting the elderly VE to their feeling on product design.

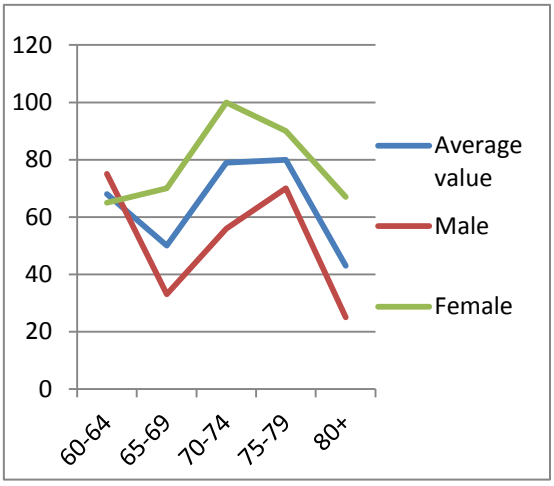


Figure 6.2 VD variation in deferent age stage (unit: %)

Furthermore, the statistics also show that the elderly VD are increasing along with age, especially between 70 and 79 years old, the change is very obvious. This needs close attention when considering the elderly VE (Figure 6.2).

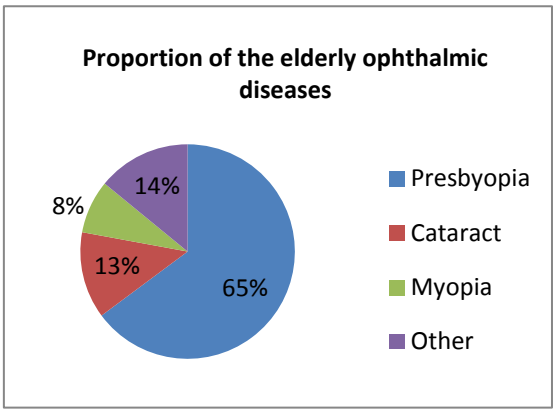


Figure 6.3 VD proportion of ophthalmic diseases

According to the results of VD statistics which were selected by subjects, there are 13 types of VD reasons which involved human eye disease and eye health: Presbyopia, cataract, myopia, hyperopia, neurodeatrophia, floaters, hypochromatopsia, vitreous opacity, senile macular degeneration, trachoma, aqueous humor lacking, and single eye disability (Table 6.9, and Figure 6.3).

The subject selection for VPT-2 assessment was a relatively simple procedure, which was done by invitation to the subjects who had completed VPT-1 and were still willing and able to continue. In fact, the VPT-2 assessment invitation was given

to the subjects before the VPT-1 assessment beginning. Most of the subjects understood the next assessment followed was the VPT-2 assessment, but some of them were not willing to accept the invitations due to various personal reasons, for example, they really want to go to the market, cooking, or doing housework etc. There were also some subjects that felt tired, and did not have the desire to continue to participate in the assessment voluntarily. Other subjects that showed a desire to participate voluntarily were not selected due to their relatively poor state or serious vision problems after the pre-test of eye tracking device.

Table 6.9 VD reasons selection from subject (n=99)

Age	60-64		65-69		70-74		75-79		80+		Total	
Gender	M	F	M	F	M	F	M	F	M	F	M	F
Subjects number	8	23	12	10	9	10	10	10	4	3	43	56
Subjects VD number (including partial VD)	6	15	4	7	5	10	7	9	1	2	23	43
Presbyopia	1	11	1	5	4	8	1	8	1	-	8	32
Cataract	-	1	1	3	-	-	1	2	-	-	2	6
Myopia	-	2	-	-	1	1	1	-	-	-	2	3
Unreason	4	1	-	-	1	1	3	2	-	2	8	6
Neurodeatrophia	-	1	-	-	-	-	-	-	-	-	-	1
Floaters	-	1	-	-	-	-	-	-	-	-	-	1
Hyperopia	-	1	-	-	-	-	-	-	-	-	-	1
Hypochromatopsia	-	-	1	-	-	-	-	-	-	-	1	
Vitreous opacity	-	-	-	1	-	-	-	-	-	-	-	1
Trachoma	-	-	-	-	-	1	-	-	-	-	-	1
Senile macular degeneration	-	-	-	-	-	1	-	-	-	-		1
Aqueous humor lacking	-	-	-	-	-	-	1	-	-	-	1	-
Single eye disability	-	-	-	-	-	-	1	-	-	-	1	-
Note: Some subjects' VD is multiple. M=Male; F=Female												

The VPT-2 assessment was assigned two groups, Group A and Group B. The purpose was to compare and analyze the two aspects of the data and for verifying the consistency and differences. The two groups had obvious differences in educational level, group A subjects being higher, as well as their age was relatively lower than group B's. Eventually, 44 subjects were selected from the volunteer

candidates and separated into groups A and B, with the detailed information showed in Table 6.10.

Table 6.10 Group B subjects list for VPT-2 assessment (n=44)

	Subjects No.	Age range	ET No	Age	Gender	Date	Venue
Group A	1	60-64	1	62	M	2012.11.19	SCUT
	2		3	60	F	2012.11.19	SCUT
	3		5	60-64	F	2012.8.13	SCUT
	4		9	60-64	F	2012.8.13	SCUT
	5	65-69	14	67	M	2012.11.19	SCUT
	6		19	67	M	2012.11.19	SCUT
	7		10	68	M	2012.11.19	SCUT
	8		20	69	M	2012.11.19	SCUT
	9		2	65	F	2012.11.19	SCUT
	10		13	68	F	2012.11.19	SCUT
	11	70-74	16	70-74	F	2012.8.13	SCUT
	12		8	70	F	2012.11.19	SCUT
	13		22	71	F	2012.11.19	SCUT
	14		23	72	F	2012.11.19	SCUT
	15		6	73	F	2012.11.19	SCUT
	16	75-79	12	75	M	2012.11.19	SCUT
	17		7	77	M	2012.11.19	SCUT
	18		15	78	M	2012.11.19	SCUT
	19		11	78	M	2012.11.19	SCUT
	20		21	79	M	2012.11.19	SCUT
	21		18	75-79	F	2012.8.13	SCUT
	22		4	75	F	2012.11.19	SCUT
	23		24	75	F	2012.11.19	SCUT
	24	80+	17	80+	M	2012.8.13	SCUT
Group B	1	60-64	20	63	M	2013.06.18	CH
	2		17	64	F	2013.06.18	CH
	3	65-69	03	68	F	2013.06.18	CH
	4		04	66	F	2013.06.18	CH
	5		11	65	F	2013.06.18	CH
	6		09	68	F	2013.06.18	CH
	7	70-74	02	72	M	2013.06.18	CH
	8		07	72	F	2013.06.18	CH
	9		08	71	F	2013.06.18	CH
	10		13	71	M	2013.06.18	CH
	11		21	73	M	2013.06.18	CH
	12	75-79	15	75	M	2013.06.18	CH
	13		16	75	F	2013.06.18	CH
	14		18	67	M	2013.06.18	CH
	15		12	78	M	2013.06.18	CH
	16	80+	01	85	F	2013.06.18	CH
	17		06	81	M	2013.06.18	CH
	18		17	80	F	2013.06.18	CH
	19		05	86	M	2013.06.18	CH
	20		14	91	M	2013.06.18	CH

Note: ET=Eye tracking test; SCUT= South China University of Technology Guangzhou City, Guangdong Province China; CH=Conghua City, Guangdong Province China

6.5 Results and findings analyses

In this stage, the primary issues of the research need to be identified through the statistical information and data from the VPT assessments. The further analysis of the results and findings determined the elderly VE features and laid a solid foundation for the PVE discussion.

99 subjects selected participated in the VPT-1 assessment, and 44 of them accepted the VPT-2 assessment invitation voluntarily. Consent forms were signed for all tests.

During the research stage, the results and findings were analyzed based on the statistical results and data from VPT-1 and VPT-2 assessments across three sections: Elderly product satisfaction, subjective visual preference features, and emotional assessment from VPT-1. VPT-2 was only used to assess the objective visual aspect.

The following statistical results are presented visually in two ways:

- Subjective preference data from VPT-1, bar chart;
- Objective visual tracking data from VPT-2 assessment was automatically generated in a table by Tobii Studio 1.5 version, the eye tracking professional software.

These results and findings will be further interpreted after information and data is displayed in each section.

6.5.1 Subjective preferences

Based on the analyses of statistical results from VPT-1, subjective preference was gradually identified. Due to the subjects' differing level of understanding, a small portion of the information could not be precisely assessed. For the purpose of statistical objectivity, for some uncertain information assessed, a uniform standard of amendment was adopted. Additionally, on some single option questions a few subjects answered with multiple or no answers. Within the multiple selection case, the first answer is considered to be valid. Any irrelevant, unfinished, unconfirmed, and wrong selections were considered as invalid information and the data were eliminated from the statistics.

6.5.1.1 Importance of design for product using

In order to assess the subjects' understanding of the role design played in their preference, the assessment provides a five-level scale of options for selection. The results show that 71 of 99 subjects answered this question. Among the all subjects, 63 subjects believe design is important by answering 3 to 5. This shows that they are mainly in consensus on the role of design, which influences their daily life (Table 6.11).

Table 6.11 Importance of design for product using (n=99)

Scale	1	2	3	4	5	N / A	Total
Subject's selection	5 (5.1%)	3 (3.0%)	10 (10.1%)	19 (19.2%)	34 (34.3%)	18 (18.2%)	99 (100%)
Note: 1= Not at all; 2=A little important; 3=Important; 4= Quite important; 5=Very important							

6.5.1.2 Most important factor of products

To understand the weight of product design elements on the elderly consciousness, the assessment provided five selections for assessment: Function, usability, appearance, positive emotion, and safety. 82 of 99 subjects completed the sorting. Based on the 82, safety was selected 34 times (41.5%), function was selected 32 times (39%), usability was selected 11 times (13%), positive emotion was selected 3 times (4%), and appearance with 2 selections (2%).

The results show that safety, function, and usability are the most important requirements. These factors are located at the front-end of the product's experience and are the base of the experience. It also shows that the factors of positive emotion and appearance are not fully realized by subjects. This also shows that further investigation in this area is necessary (Table 6.12).

Table 6.12 Order of the most importance factor of products (n=82)

Order	Item	Subjects selection	Total
1	Safety	34 (41.5%)	82(100%)
2	Function	32 (39.0%)	
3	Usability	11 (13.4%)	
4	Pleasurable emotion	3 (3.7%)	
5	Appearance	2(2.4%)	

6.5.1.3 The elderly product design needs to consider their unique needs based on age change

For the purpose of assessing whether the subject's needs can be valued and reflected through product design, this section of the assessment provided 3 options: Yes, no, and do not know. 77 of 99 subjects (77.8%) answered the question. Among

the 77 subjects, 69 (89.6%) think that product design for the elderly needs to consider their unique needs based on age change, 6 (7.8%) don't think so, and 2 (2.6%) don't know how to select.

This assessment shows that the vast majority of elderly recognize that their unique needs can be solved via design. It also indicated that the investigation reflects the needs both for the Chinese elderly and societal tendency.

6.5.1.4 Subjective visual preference features

(1) Easy finding factor in perceptional information processing

The assessment provided 7 factors which are related to the VE for subjects' selection: color, shape, size, texture, light, font, and pattern, based on the order of importance. 87 of 99 subjects (87.9%) completed the assessment, excluding 10 no selections and 2 wrong selections (12.1%).

Based on the statistics of what was their first choice; color with 46 selections (52.9%), Shape with 11 selections (12.6%), size with 10 selections (11.5%), texture with 10 selections (11.5%), light with 8 selections (8.2%), font with 2 selections (2.3%), and pattern with 0 selections.

The results of the statistics show that the color is the most striking factor that can be easily found. It also indicated that color is extremely important in the elderly VE and suitable colors for the elderly need to be further verified based on visual perception features. Moreover, the shape, size, and texture are of almost equal importance. In fact, pattern is a more considerable factor for easy finding, from the

author's personal view, but, conversely, the subject did not select this. This precisely reflects the assessment's importance for understanding the subjects' true thinking.

Through analysis; light, font, and pattern are not inherent in the product itself, and as a consequence, it can be interpreted that the factors which the elderly pay more attention to reflect in the inherent physical features of the product itself (Table 6.13).

Table 6.13 Easy finding factor (n=87)

Range of age	Color	Shape	Size	Texture	Light	Font	Pattern
60-64	14	4	4	1	3	0	0
65-69	8	1	1	3	2	1	0
70-74	10	5	5	5	1	1	0
75-79	13	1	0	1	1	0	0
80+	1	0	0	0	1	0	0
Total (100%)	46 (52.9%)	11 (12.6%)	10 (11.5%)	10 (11.5%)	8 (9.2%)	2 (2.39%)	0 (0%)

(2) Visual preference

This portion of the assessment relied on a 9 piece of testing board (TB). It includes 7 categories of assessment that cover: colors, shape, size, textures and material, pattern, product design, and layout of newspaper.

Of the 9 categories, and because of the complexity and importance of the color composition in visual experience, the colors section is separated into 6 sub-categories: Color-hue, color-hue contrast, color-purity, color-purity contrast, color-brightness, and color-brightness contrast.

It should be noted that colors, shape, size, textures and material, and pattern are the most important basic factors of products composition for VE assessing. The

product design images and layout of newspaper were integrated into the assessment for comprehensive factors of VE. Assessment of light preference was conducted for additional assessment, but was not listed in the TB.

Due to the subjects' different understanding and ability among individuals in different age ranges (their various physical and mental state in assessment process), there were a few sections without selections entered.

This portion of the assessment allowed for only one option by the subjects, if multiple selections occurred, only their first priority was considered. In addition, the wrong and irrelevant selections were eliminated. Analysis was carried out on the statistical preference data from the top 30-50% of the statistical results, according to the sequence. The final numerical range is based on multiple adjustments of applicability. It can also be adjusted depending on the specific items of the assessment in sub-categories for the purpose of ensuring a specific preference is fully demonstrated.

Final results of the assessment explain the general features. The final statistical results and its interpretations show the following:

- **Color**

The TB provided a variety of stimulus options of color for the subject's selection in each sub-category, there were 12 options in colors-hue, 21 options in colors-hue contrast, 10 options in color-purity, 55 options in color-purity contrast, 11 options in color-brightness and 55 options in color-brightness contrast. As an example, one of the TB, color-hue and color-hue contrast is showed in Figure 6.4. The detailed

analyses of the results and findings are based on statistical assessment with interpretation in regards to each sub-category.

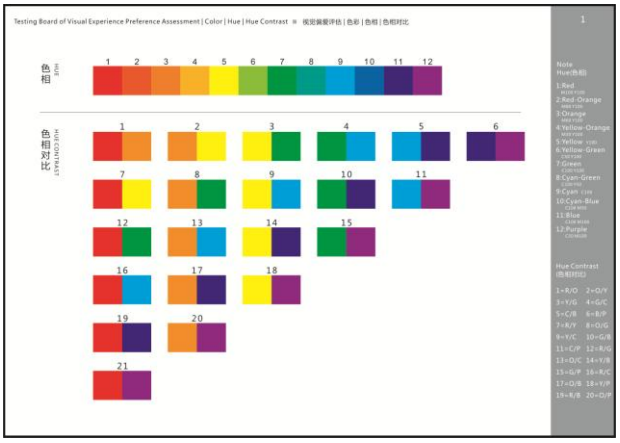


Figure 6.4 Example of testing board for color-hue and color-hue contrast

– **Color-hue:** Color-hue is a professional term used in color science. It is the properties of color for distinguishing the color's difference: Red, yellow, green, blue etc. The color-hue assessment will identify the subjects' common features on which color-hue they tend to favor. Color-hue is the most basic and initial impression for human visual perception of color. The color-hue stimulus adopted is the 12-color standard hue wheel.

There are 96 subjects that looked at the 12 stimulus of color-hue. The statistical results show that the subjects' subjective preferences of color-hues were 1, 9, 3, 5, 7, 6 and 12 (Table 6.14). This indicates that the warm color series (red, orange and yellow) was preferred by most subjects. Additionally, subjects also preferred the green, yellow-green with neutral and soft feeling, and cyan with quiet, refreshing feeling. The result visualization is demonstrated in Figure 6.5.

Table 6.14 Subjective preference of color-hue (n=96)

CHC	1	2	3	4	5	6	7	8	9	10	11	12
60-69	15	1	4	0	10	2	5	1	9	1	2	2
70-79	9	2	8	2	1	3	2	0	8	0	0	3
80+	2	0	0	0	0	1	0	0	0	1	1	1
Total (96)	**26**	3	**12**	2	**11**	**6**	**7**	1	**17**	2	3	**6**

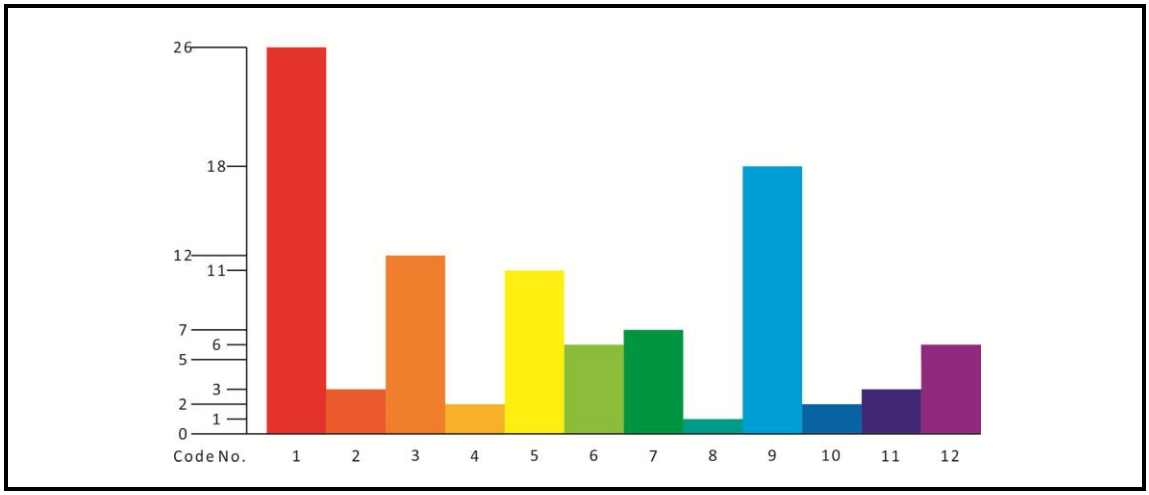


Figure 6.5 Subjective preference of color-hue (n=96)

- **Color-hue contrast:** Color-hue contrast is another professional term used in color science. It is any two or more colors on the color hue wheel juxtaposed, showing the hue difference in comparison, thereby forming a contrast phenomenon. The contrastive effectiveness of strong and weak formed by juxtaposed different color hue are highly correlated with visual stimulus and cause the visual sense reaction and elicit attention. In the assessment, 21 stimulants were provided with contrast formed by two color-hues.

  72 participants completed this section. The statistical results show that the subjects' subjective preferences of color-hues contrast are 1, 7, 9, 10, 12 and 13 (Table 6.15). This indicates that the contrasts formed with red, yellow, and orange were the most preferred by subjects. Additionally, orange with cyan, yellow with cyan, and green with blue were also preferred by subjects. The color-hue contrast preference list was basically comprised of the color-hue selections with the addition to blue. This

reflects some relevance existing between preference of color-hue and color-hue contrast. The result visualization is demonstrated in Figure 6.6.

Table 6.15 Subjective preferred of color-hue contrast (n=72)

CHCC	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
60-69	7	1	1	2	1	1	6	1	7	2	0	2	4	1	1	2	0	0	1	0	1
70-79	2	0	1	0	0	0	7	2	1	1	0	4	1	0	0	2	1	1	2	0	1
80+	0	1	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0
Total	**9**	2	3	2	1	1	**13**	3	**8**	**5**	0	**6**	**5**	1	1	4	1	2	3	0	2

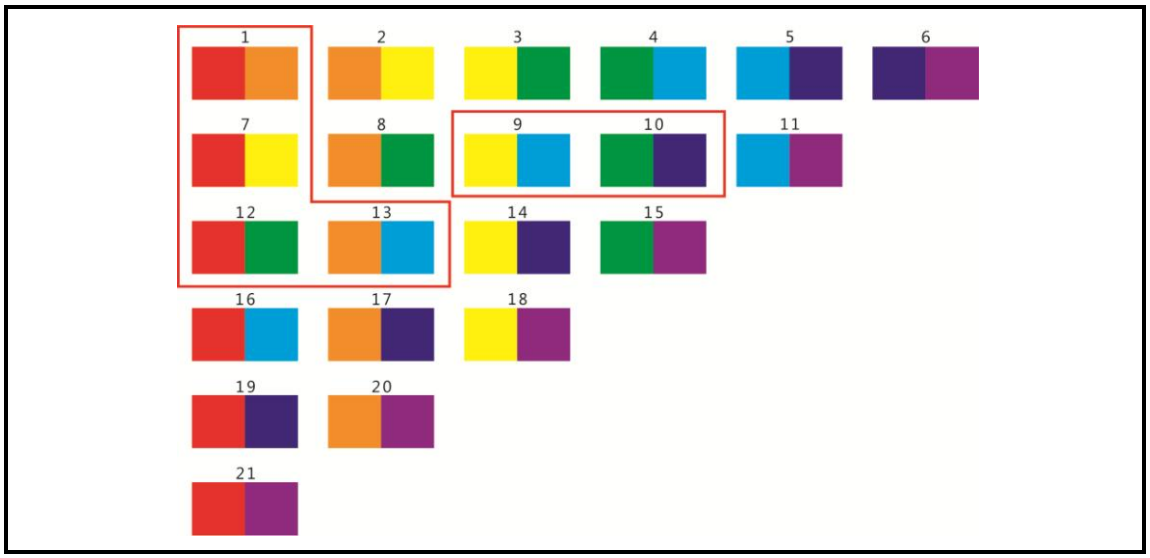


Figure 6.6 Subjective preferred of color-hue contrast (n=72)

- **Color-purity:** Color-purity is another professional term used in color science. It refers to the degree of color saturation. Primary colors have the highest purity, and as the purity lowers the hue is lost. The color-purity assessment will identify the subjects' common features of color-purity preference and which is most suitable for matching their visual acceptance. Color-purity cannot be measured at first glance, but can meet the needs of long-term visual attention. The color-purity stimulus adopted red as the sample, with 10 shifting gradient levels from highest to lowest.

69 participants completed this section. The statistical results show that the highest color-purity, 1, was preferred. In addition, others, 2, 3, 4, 6, and 10 met with subjective preference, but, overall, the tendency of the range reveals that higher purity was relatively more favored (Table 6.16).

Surprisingly, 7 subjects without known reasons also selected the lowest purity. As a scientific statistical basis, it can be extracted from the result. In fact, it did not impact on the general trend and will be further verified in the PVE phase. The result visualization is demonstrated in Figure 6.7.

Table 6.16 Subjective preferred of color-purity (n=69)

CPC	1	2	3	4	5	6	7	8	9	10
60-69	21	2	3	3	1	2	1	0	0	4
70-79	14	5	1	2	0	2	0	0	0	2
80+	3	1	0	0	0	0	0	1	0	1
Total	**38**	**8**	**4**	**5**	1	**4**	1	1	0	**7**

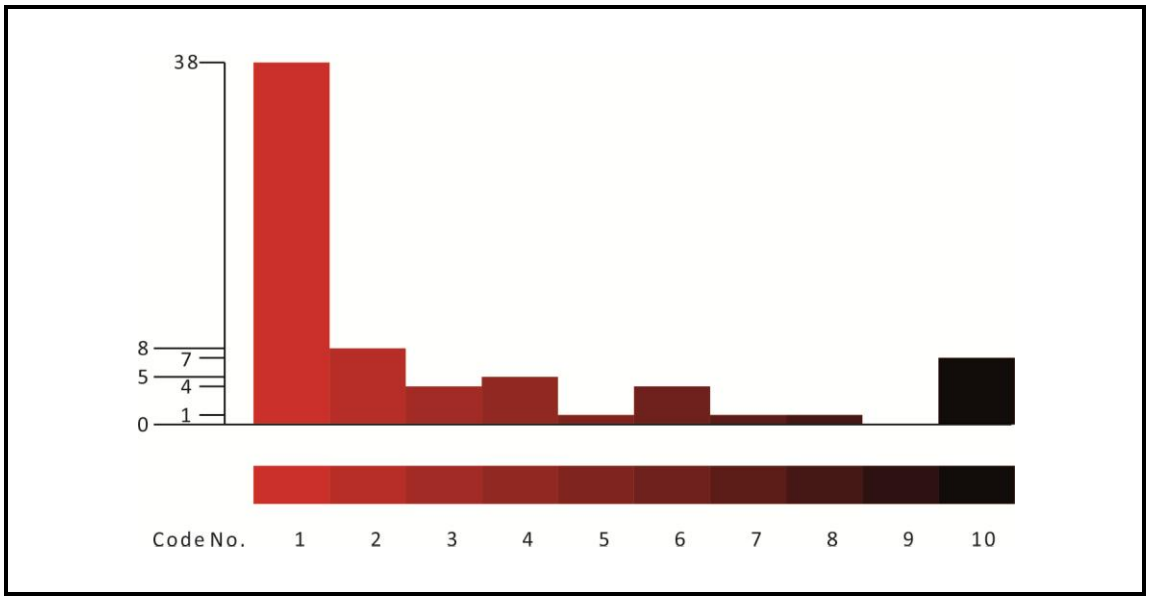


Figure 6.7 Subjective preferred of color-purity (n=69)

– **Color-purity contrast:** Color-purity contrast is another professional term used in color science. It is a color contrast phenomenon between two or

more colors with a deferent degree of saturation placed together. Purity contrast, in terms of strong or weak, is related to human visual identification as clear or not clear. In the section of the assessment, 55 stimulants were provided with contrasts formed by red and black in shifting gradient levels from strong to weak.

67 participants completed this section. The statistical results show that the subjects' subjective preferences of color-purity contrast are 1 and 10 (Table 6.17). This indicates that the contrast formed by red 100% with black 100% was the most preferred by subjects. Besides this, 10, the weak and bright contrast, was also preferred by some subjects. 3, 6, 7 and 9 are also located in the range of more weak and bright contrast. Clearly, both strong contrast and weak, bright contrast were preferred by the subjects. The result visualization in demonstrated is in Figure 6.8.

Table 6.17 Subjective preferred of color-purity contrast (n=67)

CPCC	1	3	5	6	7	8	9	10	12	13	18	26	Other
60-69	9	1	1	2	2	2	1	3	1	2	2	1	9
70-79	8	2	1	1	1	0	1	5	0	0	0	1	4
80+	0	1	0	0	0	0	1	1	1	0	0	0	3
Total	**17**	**4**	2	**3**	**3**	2	**3**	**9**	2	2	2	2	16

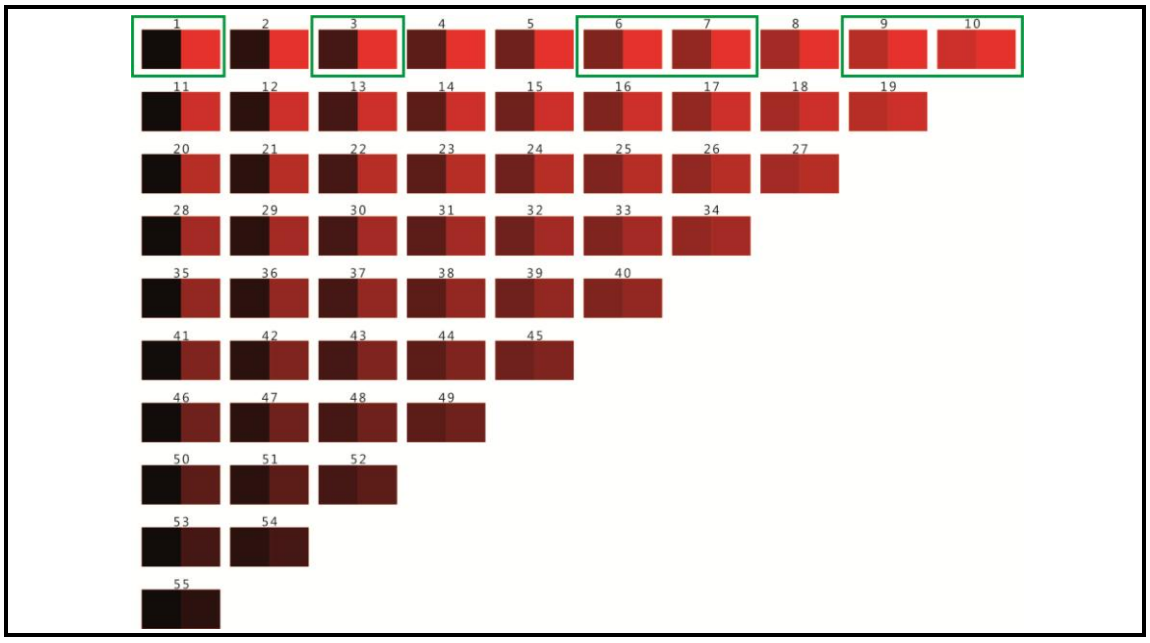


Figure 6.8 Subjective preferred of color-purity contrast (n=67)

- **Color-brightness:** Color-brightness is another professional term used in color science. It refers to the degree of light and dark of a color. The assessment of color-brightness will identify the subjects' common features of preferred color brightness and how it matches their visual acceptance comfort level. Color-brightness is not noticed at a first glance, but is needed for long-term attention. The color-brightness stimulus adopted used a range of 11 shifting gradient levels from the lightest 1 to darkest 11.

  61 participants completed this section. The statistical result shows significantly that the subjects' subjective preference of color-brightness was located on two sides of the spectrum, the brightest and darkest. 1 was picked ahead of 11 absolutely, but the whole range from 7 to 11 was preferred by subjects (Table 6.18). This special phenomenon, especially the darkness preference was outside expectation, and needs further evaluation in the PVE phase. The result visualization is demonstrated in Figure 6.9.

Table 6.18 Subjective preferred of color-brightness (n=61)

CBC	1	2	3	4	5	6	7	8	9	10	11
60-69	15	2	1	1	1	1	2	4	0	1	6
70-79	11	1	1	0	1	0	2	0	0	0	5
80+	0	2	0	0	0	0	0	1	1	0	2
Total (61)	**26**	**5**	2	1	2	1	4	5	1	1	**13**

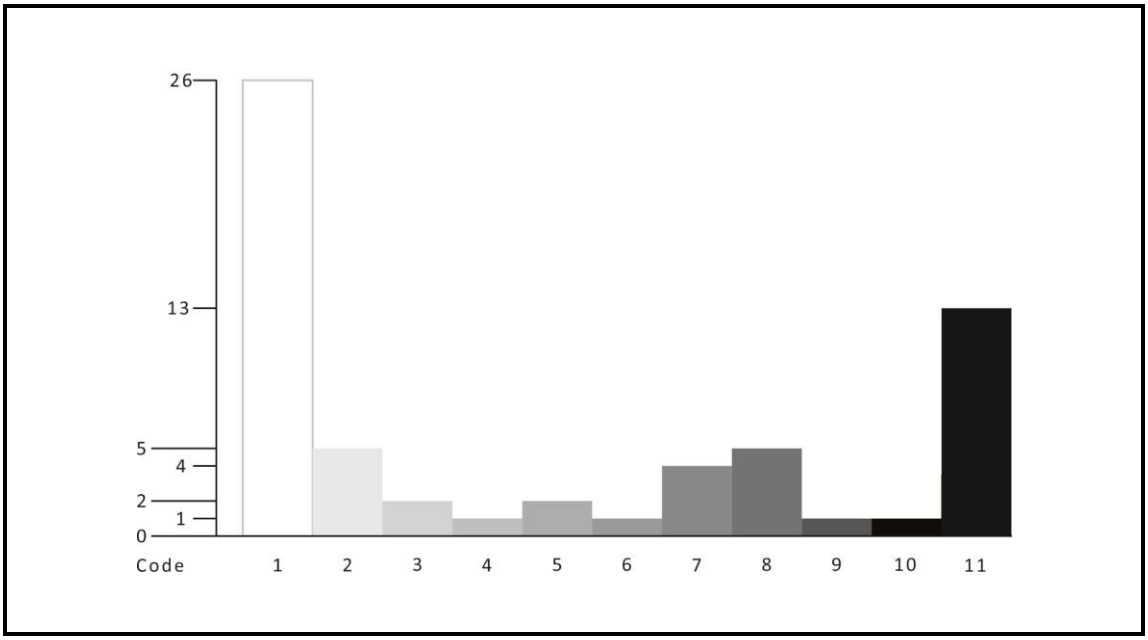


Figure 6.9 Subjective preferred of color-purity contrast (n=61)

- **Color-brightness contrast:** Color-brightness contrast is another professional term used in color science. It is the degree of contrast between light and dark colors. Brightness contrast is the most important factor in color composition. Color's levels and spatial relations rely mainly on the work of color brightness contrast. If only hue contrast is used without brightness contrast, it is difficult to identify pattern outlines and shapes. If only the purity contrast is used without brightness contrast, patterns are more difficult to recognize.

  Color-brightness contrast phenomenon occurs when two or more colors with a deferent degree of brightness are placed together. Brightness

contrast strength is related to human visual identification of an object. The assessment used 55 stimulants with contrast formed by two different degrees of brightness in shifting of gradient levels from strong to weak.

62 participants completed this section. The statistical results shows that the subjects' preference of color-brightness contrasts were 1 and 10 (Table 6.19). The general trend showed that strong contrast in black, white and light gray were preferred. The results visualization is demonstrated in Figure 6.10.

Table 6.19 Subjective preferred of color-brightness contact (n=62)

CBCC	1	3	7	8	10	15	44	48	Other
60-69	10	1	1	1	4	0	1	0	17
70-79	5	2	1	1	1	2	1	2	6
80+	2	1	1	0	0	0	0	0	2
Total (62)	**17**	**4**	**3**	**2**	**5**	**2**	**2**	**2**	25

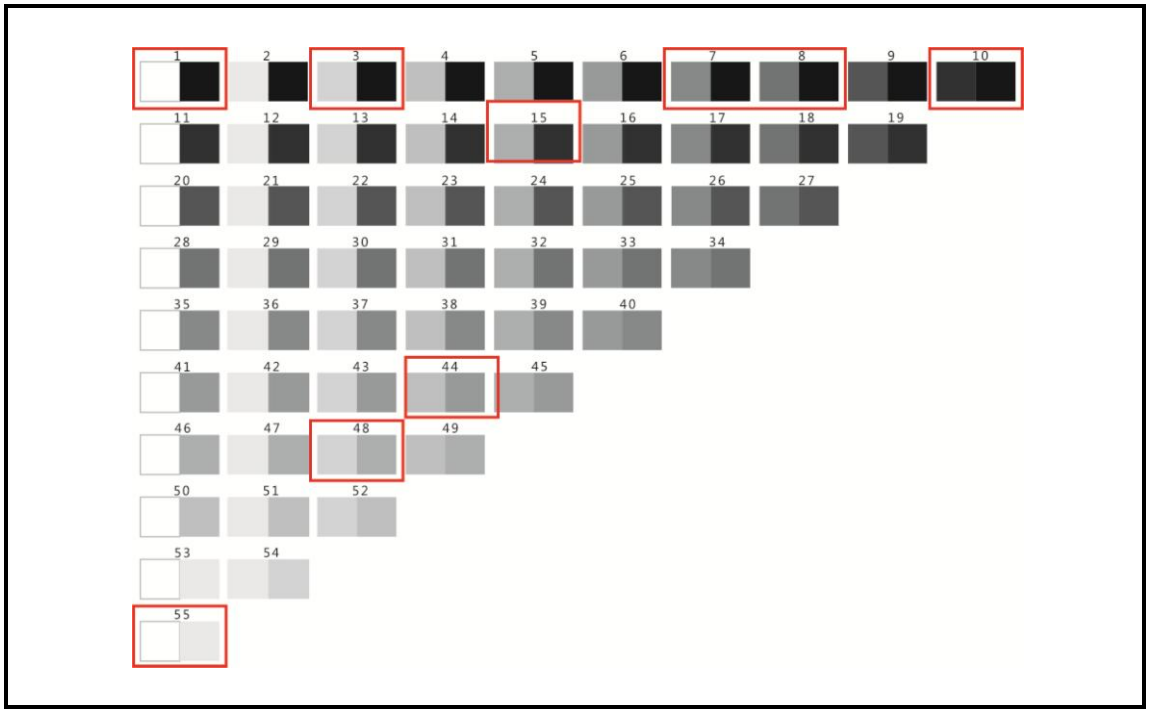


Figure 6.10 Subjective preferred of color-brightness contact (n=62)

■ Shape

Shape is the form of an object or its external boundary, outline, and external surface. From a psychological perspective, humans mentally break down images into simple geometric shapes, such as: square, circular, etc. Shape is very important for recognizing an objects appearance and features. Different shapes can bring different psychological feelings, for example, circular shapes elicit a feeling of fullness, and triangle elicits a feeling of stability, and so forth.

The assessment aimed to identify the subjects' preferred shape from 16 different shapes provided, ranging from less angular to more complex, small number of angles to multiple, regular to irregular, square to round and geometric to organic.

Table 6.20 Subjective preferred of shape (n=97)

ShaC	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
60-69	6	0	0	2	1	1	11	3	3	2	3	7	1	0	12	1
70-79	0	1	0	0	1	1	6	0	2	0	2	13	1	0	9	1
80+	2	0	0	0	0	0	1	1	0	0	0	2	0	0	0	1
Total (97)	**8**	1	0	2	2	2	**18**	**4**	**5**	2	**5**	**22**	2	0	**21**	3

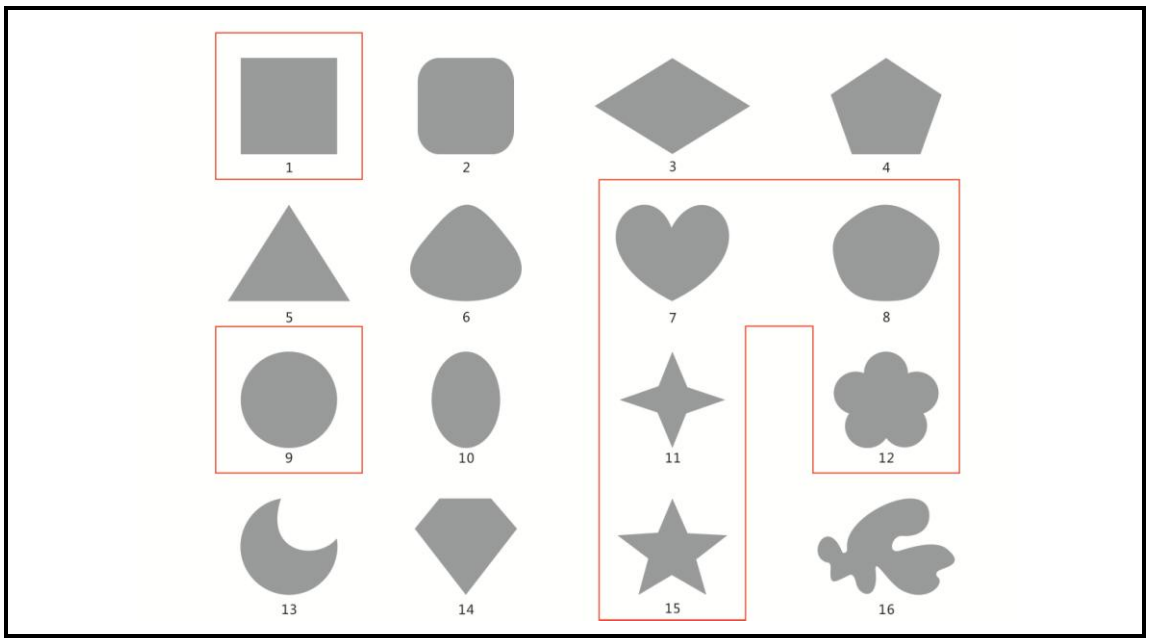


Figure 6.11 Subjective preferred of shape (n=97)

97 participants completed this section. The statistical results show that the subjects' preferred shapes 1, 7, 12 and 15 amongst others. The preferred shapes included: Square, heart, flower and pentagram (Table 6.20). The results show the overall trend of shape preference is related to representational features that easily arouse association to life experience or previous memory. The results visualization is demonstrated in Figure 6.11.

■ Size

Size is a relative concept abstracted from the process of comparing a larger to a smaller. It is the magnitude or dimensions of a thing, or how big something is.

The extent of size is highly relevant to the human's degree of visual reception. Due to the human capacity of receiving differences in size throughout different life stages, it is necessary to assess the common preference of size amongst the elderly.

Table 6.21 Subjective preferred of size (n=95)

SizC	1	2	3	4	5	6	7
60-69	4	13	11	8	9	1	4
70-79	6	6	6	3	5	6	6
80+	2	1	2	0	0	0	2
Total (95)	12	**20**	**19**	11	**14**	7	12

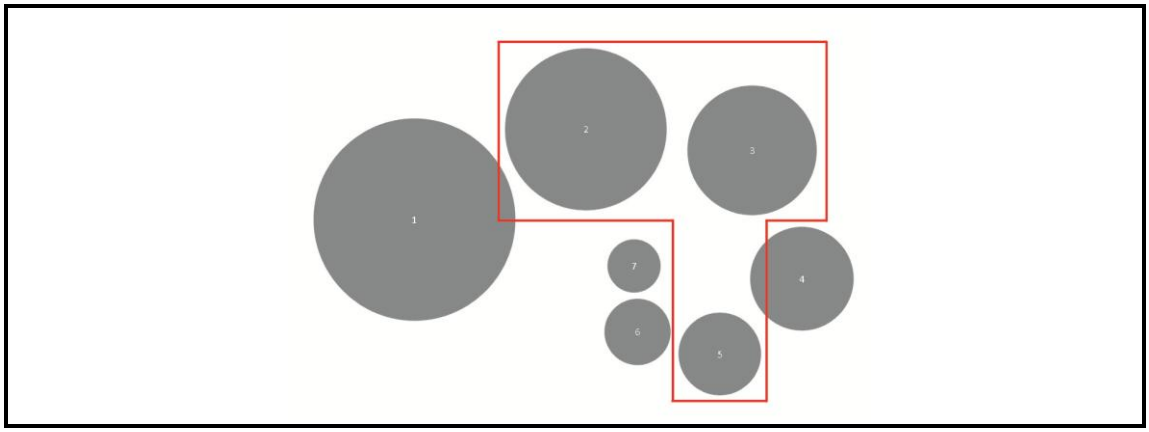


Figure 6.12 Subjective preferred of size (n=95)

95 participants completed this section. The statistical results show that the subjects' preferred sizes were 2, 3 and 5 with more selections from 7 different selections of shape with variation from larger to smaller (Table 6.21). The results show an overall trend that subjects more commonly prefer larger size. The results visualization is demonstrated in Figure 6.12.

■ Material and texture

Material and texture are two integrated properties of an article. Material is a broad term for the substance or mixture of substances that constitute a thing. Textures are the surface finish also known as surface texture.

Material and texture are related to sensitivity ease of use. This assessment aimed to find the special subjective preferences of textures and material.

Table 6.22 Subjective preferred of materials and textures (n=93)

MTC	A1	A2	A3	B1	B2	B3	C1	C2	C3	D1	D2	D3	E1	E2	E3	F1	F2	F3
60-69	0	4	7	2	1	3	2	18	6	0	5	1	1	0	1	0	0	0
70-79	0	3	5	0	1	4	2	6	2	0	1	2	2	2	1	0	0	0
80+	0	0	1	0	2	1	0	2	3	0	1	1	0	0	0	0	0	0
Total (93)	0	**7**	**13**	2	4	**8**	4	**26**	**11**	0	**7**	4	3	2	2	0	0	0

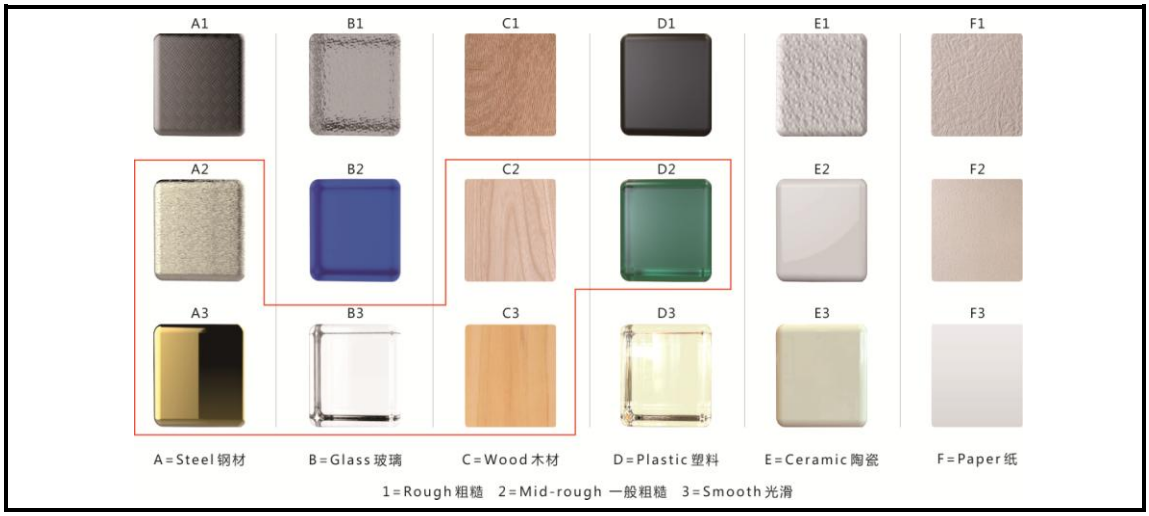


Figure 6.13 Subjective preferred of materials and textures (n=93)

93 participants completed this section. The statistical results show that the subjects' preferred materials and textures: A2, A3, B3, C2, C3 and D2 with other selections from 18 different stimulants of material: Steel, glass, wood, plastic, ceramic and paper. All stimulants were arranged in a three-step variation from rough to smooth (Table 6.22). The results show that the overall trend of preference of texture was neither rough nor fine, and they preferred steel, glass, wood, plastic, and other general manufacturing materials. The results visualization is demonstrated in Figure 6.13.

- **Pattern**

Pattern, as a means of product beautification, can strengthen the artistic features of the product. Most importantly, the pattern is related to the human's aesthetic and emotional arousal. Through pattern preference assessment, the aim was to find the subjects preferred pattern that left a generally good impression, as well as establish their aesthetic trend. This was key in their visual experience.

The six patterns used represent six styles: 1-inductive, 2-representational, 3-childish, 4-artistic, 5-abstract, 6-Chinese traditional.

74 participants completed this section. The statistical results show that the subjects' preferred pattern 2, the representational style, and pattern 6, the Chinese traditional style (Table 6.23). This indicates that the subjects most commonly preferred those patterns that embody representation and allow for easy identification of detail. The results visualization is demonstrated in Figure 6.14.

Table 6.23 Subjective preferred of pattern (n=74)

PC	1	2	3	4	5	6
60-69	5	17	6	4	2	6
70-79	2	10	2	1	2	10
80+	0	5	0	0	0	2
Total (74)	7	**32**	8	5	4	**18**

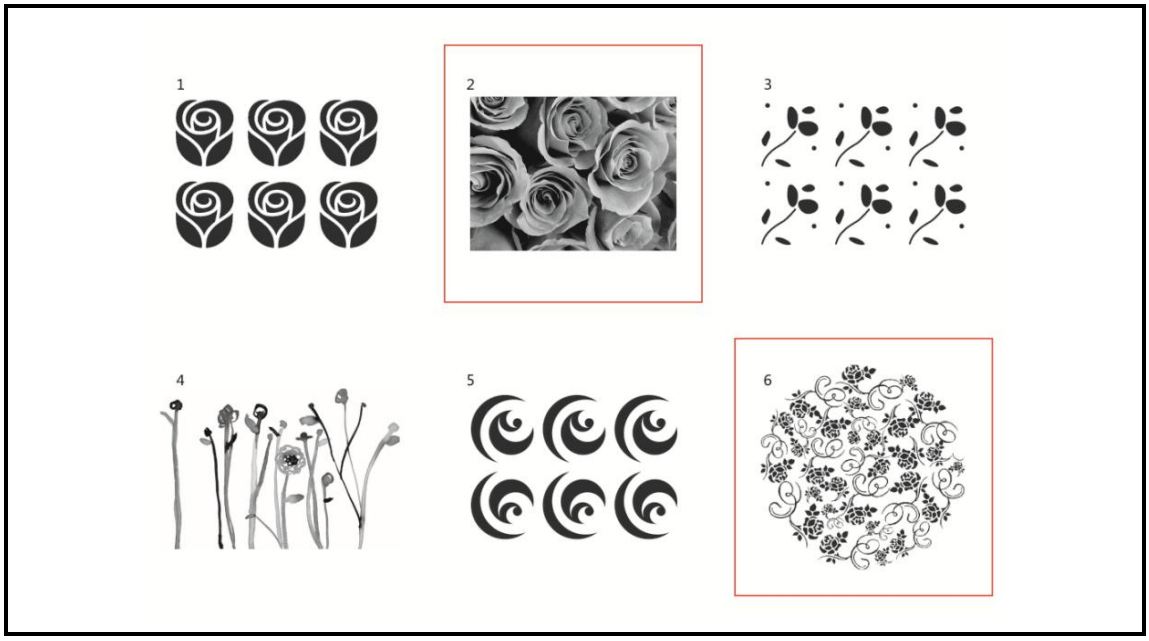


Figure 6.14 Subjective preferred of pattern (n=74)

■ Products design

Product design is a comprehensive reflection of the VE's basic factors in three-dimensional terms, and can identify the synthesized subjective preferences of a product via its design.

18 kettles were used as stimulus, and were selected based on the fact that it is an item closely related to the elderly; it is familiar and used daily. Additionally, the kettles have rich design style and are composed of a vast array of materials and textures; thus could act as a representative product for this assessment. The stimuli varied from traditional to modern, simple to complex, and included steel, glass,

plastic, ceramic, and steel mixed with plastic materials of different textures. 98 participants completed this section. The statistical results show that all but numbers 13 were selected. They also show that the subjects' preferred 2, 3, 7, 9 and 15 with higher frequency among the 18 products (Table 6.24).

The overall trend was that the subjects were not interested in modern or complex models, and they have a higher sensitivity to color. Moreover, with the traditional Chinese style, various materials and textures can be accepted. The results visualization is demonstrated in Figure 6.15.

Table 6.24 Subjective preferred of product design (n=98)

PDC	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
60-69	3	5	5	0	2	1	11	1	10	0	1	1	0	1	8	0	1	1
70-79	2	2	2	1	2	0	8	0	6	0	2	0	0	1	11	1	1	1
80+	0	1	2	1	0	0	0	0	0	1	0	0	0	0	2	0	0	0
Total	5	**8**	**9**	2	4	1	**19**	1	**16**	1	3	1	0	2	**21**	1	2	2

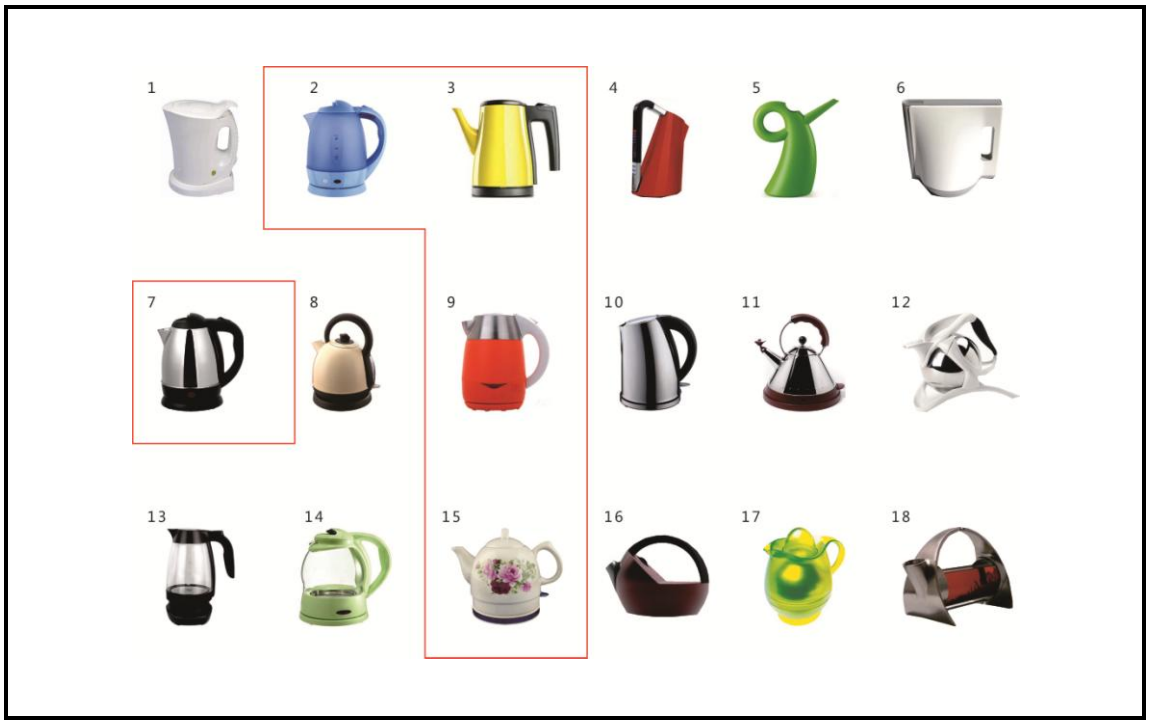


Figure 6.15 Subjective preferred of product design (n=98)

■ Layout of newspaper

Newspapers are an important part of media read by most Chinese elderly daily. It is also a comprehensive reflection of basic two-dentinal VE factors that can help to identify the synthesized subjective preferences via layout design.

This assessment aimed to identify the VE subjective preferences of newspaper layout through images and text. 4 types of newspaper stimulus were provided: 1-text centered, 2-text and image mixed half and half, 3-image more than text, and 4-irregular layout.

Table 6.25 Subjective preferred of layout of newspaper (n=88)

LNC	1	2	3	4
60-69	7	17	12	10
70-74	8	8	11	9
80+	0	1	3	2
Total	15	**26**	**26**	21

Figure 6.16 Subjective preferred of layout of newspaper (n=88)

88 participants completed this section. The statistical results show that numbers 2 and 3 were equally selected the most (Table 6.25). This indicates that most subjects prefer a moderate or slightly higher amount of images in the layout. Meanwhile, the high selection rate of layout 3 also indicates that an image heavy

modern style can still achieve preference. The results visualization is demonstrated in Figure 6.16.

- **Light spaces**

Light is an important factor in the human VE process. If there is no light, humans can not see anything. Additionally, for different ages and varying degrees of vision health, strong to weak lighting preference can vary with each individual. The light assessment aimed to understand the common preferences of light adaptability. This assessment was entirely dependent on subjective feelings. This section provided three options: warm light, cool light and natural light accompanied by a five-level scale: 1-weakest, 2-weak, 3-medium, 4-strong, 5-strongest.

84 participants completed this section. The statistical results show that the natural light was selected most often, and warm light more than cool (Table 6.26). The results indicate that most subjects prefer the natural light, and they hope the natural light is medium to the strongest.

Table 6.26 Subjective preferred of light spaces (n=84)

LSC	Warm light					Cool light					Natural light				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
60-69	0	1	1	3	1	0	0	0	0	0	0	5	17	11	8
70-79	0	1	1	1	0	0	1	0	0	0	1	1	11	10	4
80+	0	1	0	0	0	0		1	0	0	0	1	2	1	0
Total	0	3	2	4	1	0	1	1	0	0	1	7	30	22	12
	10					2					72				

6.5.1.5 Emotional assessment

The emotional assessment refers to subjects' emotional responses and feelings evoked by an object stimulated during the VE process. This assessment depended

entirely on description of personal experience based on the subject's previous VEs. The statistical results were based on the subjects' selections from prescribed options and corresponding scales. Through calculating the first selection of any one option, the preferred options were arranged according to selection occurrence. Moreover, due to the different understanding levels of the participants, some parts of the assessment could not be completed. No answer or wrong selections were excluded from the results to aid in objective statistical analyses.

(1) Pleasurable emotion as a benefit to human health

All subjects completed this part of the assessment. The statistical results shows that almost all subjects believe that pleasurable emotion can bring health benefits. This reflects the importance of this research (Table 6.27).

Table 6.27 Assessment of pleasurable emotion as a benefit to health (n=99)

Range of age	Yes	No	Don't know
60-69	52	2	1
70-79	35	1	3
80+	4	2	0
Total	91	5	3

(2) A good product should elicit positive emotion

92 participants completed this part of the assessment. The statistical results show that most subjects confirm that a good product should be able to evoke a positive emotion in the user (Table 6.28).

Table 6.28 Assessment of good product should elicit positive emotion (n=92)

Range of age	Yes	No	Don't know
64-69	52	1	0
70-79	33	0	0
80+	4	1	1
Total	89	2	1

(3) Products should meet the personal cognitive preferences that lead to pleasant emotion generation

64 participants completed this part of the assessment. The statistical results show that most subjects confirm that pleasurable emotion can be generated if the product meets their personal cognitive preferences. These results indicate that personal preferences, from a VE aspect, need further consideration (Table 6.29).

Table 6.29 Assessment: products should meet the personal cognitive preferences that lead to pleasant emotion generation (n=64)

Range of age	Yes	No	N/A
64-69	36	0	0
70-79	23	1	0
80+	2	2	0
Total	61	3	0

(4) Factors of a product that elicit pleasure

62 participants completed this part of the assessment. The statistical results show that most subjects confirm that functionality of a product is the most important factor in eliciting pleasure. Additionally, usability is the second most important factor. This shows that product appearance and concept, which are related to spiritual level needs, are at a relatively secondary position in the Chinese elderly consciousness (Table 6.30).

Table 6.30 Assessment of factors of a product that elicit pleasure (n=62)

Range of age	Function	Usability	Appearance	Concept
64-69	20	6	6	3
70-79	12	7	2	2
80+	2	1	1	0
Total	34	14	9	5

(5) Factors that elicit pleasure through product use

As a main assessment focus, this section includes six sub-sections: Function, usability, appearance, concept, color elicited emotion, and style elicited emotion. Through these six aspects, the assessment aimed to find the main factors that elicit pleasure or joy in the Chinese elderly.

■ Function

In this sub-section, 4 terms were provided based on the main features that were closely related to the stated functional requirements in a product: Helpful, simple, complex, and health care.

87 participants completed this part of the assessment. The statistical results show that most subjects confirm that the simple function of a product is of highest importance for eliciting a pleasurable mood, with helpful and health care following.

Table 6.31 Assessment on function as a factor that elicits pleasure through product use (n=87)

Range of age	Helpful	Simple	Complex	Health care
64-69	16	21	4	8
70-79	9	18	1	6
80+	1	0	1	2
Total	26	39	6	16

Thus, simple functionality should be the central focus in product design (Table 6.31).

■ Usability

In this sub-section, 7 terms were provided based on the main features which were closely related to the stated usability requirements in a product: High-tech, intelligent, easy to operate, easy to identify, conformity to the users' habits, harmless, and labor-saving.

97 participants completed this part of the assessment. The statistical results show that most subjects said easy to operate, labor-saving, harmless, and intelligent design were the most important aspects of usability. These terms are related to the operation, safety and convenience of a product, and although these selections are more universal factors than most people would select, they are indicative of the participants' decline in physical abilities (Table 6.32).

Table 6.32 Assessment on usability as a factor that elicits pleasure through product use (n=97)

Range of age	High-tech	Intelligent	Easy to operate	Easy to identify	Conformity with the user habits	Harmless	Labor-saving
64-69	4	5	19	3	0	9	11
70-79	1	5	14	3	4	5	7
80+	1	1	2	0	0	2	1
Total	6	11	35	6	4	16	19

■ Appearance

In this sub-section, 8 terms were provided based on the main features which were closely related to the stated appearance requirements in a product: Color, size, material and textures, style, pattern, light spaces, layout, and shape aspects.

84 participants completed this part of the assessment. The statistical results show that most subjects listed color, material and texture, size, and shape as the most important factors of appearance. Among them, the color occupies the absolute advantage. It strongly suggests that the color is the most important aspect in regards to the emotional experience and mood (Table 6.33).

Table 6.33 Assessment on appearance as a factor that elicits pleasure through product use (n=84)

Range of age	Color	Size	Material and textures	Style	Pattern	Light spaces	Layout	Shape
64-69	23	7	8	4	2	2	0	4
70-79	18	5	5	1	2	0	0	4
80+	3	0	0	0	0	0	0	1
Total	38	12	13	5	4	2	0	10

■ Concept

In this sub-section, 6 terms were provided based on the main features which were closely related to the stated concept requirements of a product: environmentally friendly, recycled, healthy, safe, pleasurable experience, and care.

86 participants completed this part of the assessment. The statistical results show that most subjects confirmed environmentally friendly, recycled, healthy and safe are the most important aspects of concept in design. From the results we can see Chinese elderly awareness of environmental protection is still relatively strong, while health and safety factors also hold strong emphasis (Table 6.34).

Table 6.34 Assessment on concept as a factor that elicits pleasure through product use (n=86)

Range of age	Environmentally Friendly	Recycled	Healthy	Safe	Pleasurable experience	Care
64-69	14	13	12	7	1	2
70-79	11	9	8	3	1	3
80+	1	0	1	1	1	1
Total	26	22	21	11	3	6

■ Preferred color aspect

In this sub-section, 6 terms were provided based on the main features which were closely related to the color aspects of a product: Hue, hue contrast, purity, purity contrast, brightness, and brightness contrast.

47 participants completed this part of the assessment. The statistical results show that most subjects preferred hue as the most important factor in eliciting emotion. As such, hue should be the key factor in design for the Chinese elderly (Table 6.35).

Table 6.35 Assessment on color as a factor that elicits pleasure through product use (n=47)

Range of age	Hue	Hue contrast	Purity	Purity contrast	Brightness	Brightness contrast
64-69	16	1	2	0	2	0
70-79	16	2	3	1	2	1
80+	0	1	0	0	0	0
Total	32	4	5	1	4	1

■ Preferred style

In this sub-section, 10 terms were provided based on the main features which were closely related to the stated style preferences of a product: Simple, complex, classical, modern, oriental, western, curved, straight, plain, and flamboyant.

52 participants completed this part of the assessment. The statistical results show that most subjects preferred styles that are simple, modern, classical, and oriental. The simple style was the most chosen style factor that influences the subjects' pleasurable emotion (Table 6.36).

Table 6.36 Assessment on style as a factor that elicits pleasure through product use (n=52)

Range of age	Simple	Complex	Classical	Modern	Oriental	Western	Curved	Straight	Plain	Flamboyant
64-69	16	0	1	7	3	0	0	0	1	0
70-79	16	0	1	2	2	0	0	1	1	0
80+	1	0	1	0	0	0	0	0	0	0
Total	35	0	5	9	5	0	0	1	2	0

(6) Main reason a product design gives a bad feeling.

In this section, 6 terms were provided based on the main features which were closely related to aspects of a product that evoke bad emotion: Unsafe, difficult to understand, inconvenient, difficult operation, poor appearance, and product is not suitable for the elderly.

78 participants completed this part of the assessment. The statistical results show that most subjects confirm that if a product is unsafe, it will evoke negative feelings. In addition, difficult operation was second, but appearance was not selected by any participants (Table 6.37).

Table 6.37 Assessment of main reason a product design gives a bad feeling (n=78)

Range of age	Unsafe	Difficult to understand	Inconvenient	Difficult operation	Poor appearance	Product is not suitable for the elderly
64-69	28	2	1	9	0	0
70-79	17	0	3	9	0	6
80+	2	0	1	0	0	0
Total	47	2	5	18	0	6

(7) Suggestions on improving pleasurable mood through product design

The suggestions given were collected from subjects' past experiences. After sorting: Easy to operate (56), safety (35), quality (12), beautiful (9), simple (6), large font (6), for elderly to use (6), health (4), advanced technology (3), good color (3), understandable (3), environmentally friendly (3), practical (2), low-cost (1), large

volume (1), moderate font (1), better shape (1), larger (1), effort saving (1), automatic (1), portable (1), affordable (1), and clear (1) were the suggestions listed.

6.5.2 Objective attraction

This assessment was conducted through a series of objective data collection and calculations from 44 invited subjects split into two groups. The assessment was based on an eye tracking device specially designed for the elderly and was consistent with the VPT-1's TB contents. Through data collection, statistical extraction, and analysis, results were identified on objective attraction and interest in VE factors. In the assessment, two groups, A and B, were tested separately in order to compare two sets of data and find rational verification as well as seeing the similarities and differences between the two groups.

The stimuli used for Eye Tracking (ET) were images displayed on a monitor without any associated text. Each test category was displayed for 5 seconds in order to collect data used in eye tracking metrics and calculate the raw gaze data that indicates regions of interest with a high fixation density. Because the participants with correspondingly different degrees had an array of visual disorders, some individual data could not be fully collected. However the overall amount of subject data met the assessments' statistical needs. The statistical results were separated into group A with 24 members and group B with 20 members, and further into three ranges of age: 60 to 69, 70 to 79, and 80 above, all without gender discrepancy.

Data generated from the eye tracking device were based on the calculation of the length of time of the subject took to respond and how long their attention to

stimulus was held. There were a variety of data generated that can be used for different purposes. In the analysis of the assessment, the statistical results utilized two data indicators extracted from the device: time to first fixation and observation length. They were selected because of their close relation to assessment's purpose of objectively identifying the participant's response to VE factors of attraction and interest.

6.5.2.1 Term descriptions

(1) ET: An abbreviation for eye tracking device. In the assessment, the Tobii X60 stand alone eye tracking unit was adopted for data collecting and testing the subjects' objective visual perception response as showed in Figure 6.17.

Figure 6.17 Simple of assessment in Tobii X60

(2) AOI: An abbreviation for attention of interest. In the assessment, all of stimuli are divided into deferent AOI as an independent AOI group.

(3) Time to first fixation - seconds: This metric measures how long it takes before a test participant fixates on an active AOI or AOI group for the first time[12]. In

[12] TobiiStudioUser's manual v.3.4.5 - en-US 9 Calculating eye tracking metrics and statistics 101, p 101

this assessment, the indicator means that the stimulus first attracted the subject's visual attention with the shortest time calculated.

(4) Observation length - seconds: This metric measures the duration of all visits within an active AOI (or AOI group)[13]. In this assessment, this indicator means that the stimulus piqued the subject's visual attention for a longer period of time.

(5) A: An abbreviation for Group A.

(6) B: An abbreviation for Group B.

(7) NA: An abbreviation for Not on AOI. This is the time a subject's eye tracks out of the stimuli range completely.

(8) Mean: Refers to the average value calculated. In this assessment, the data shows the average of the group.

(9) 1, 2, 3…n: Code of each stimulus.

6.5.2.2 Table descriptions

(1) Time to first fixation on stimulant: The data exported from Tobii Studio calculated automatically reflects the speed of which the subjects found the stimulus, the minimum numerical value represents the fastest time to a stimulus, therefore, the sequencing of numerical value adopted for a representative analysis is from smallest to largest. A few small values selected are highlighted in bold. The NA numerical value is just a reference and not use in analysis.

[13] Tobii Studio User's manual v.3.4.5 - en-US 9 Calculating eye tracking metrics and statistics 101, p.110

(2) Table of observation length- Participants vs AOIs: The data exported from Tobii Studio calculated automatically reflects the length of gaze on a stimulus by the subjects, the maximum numerical value represents the longest gaze, therefore, the sequencing of numerical value adopted for representative analysis is from largest to smallest. A few larger values selected are highlighted in bold. The NA numerical value is just a reference and not use in analysis. The examples of ET raw data of was presented in *appendix VI-I*.

6.5.2.3 Color-hue

This analysis was conducted to see which of 5 selected color hues were the fastest captured and longest focused on by participants.

Through the data comparison of the time which first fixation on a color hue stimulant occurred for both Group A and B, it is seen that most group A participants' were attracted to 1, 2, 3, 9 and 12, while the majority of group B participants' were attracted to 1, 2, 3, 6 and 11. Hues 1, 2, and 3 represent the common result between both group A and B.

Participants vs AOIs shows that 5, 7, 8, 10 and 11 were looked at longer by group A; while 2, 3, 5, 6 and 7 were looked at longer by group B. Hue 5 and 7 were consistently gazed at by both groups.

The comparative analysis based on the data of objective reflection shows:

Warm color series of color hue which range from 1 to 5 easily attract the elderly visual attention, but cannot keep participant's, in group A or B, interest for further observation.

On length of observation, which reflects the shifting of interest point, the cool color series take the most time to be observed after the first attraction. The time spent on each observed stimulus was scattered, indicating that any color can cause interest, and is different for each person.

Synthesis of the above data shows warm series color hues are most likely to first stimulate elderly vision, but the yellow and green are more likely to keep their interest (Table 6.38, and 6.39).

Table 6.38 Time to first fixation on stimulant of color hue

CHC	NA	1	2	3	4	5	6	7	8	9	10	11	12
A	0.447	**0.375**	**0.502**	**0.938**	1.401	1.109	1.702	2.019	1.557	**1.047**	1.379	1.248	**0.628**
B	0.776	**0.952**	**0.914**	**0.998**	1.706	1.522	**1.330**	2.092	1.490	1.394	1.678	**1.368**	1.617

Table 6.39 Observation length-Participants vs AOIs on stimulant of color hue

CHC	NA	1	2	3	4	5	6	7	8	9	10	11	12
A	0.000	0.010	0.118	0.089	0.051	**0.128**	0.104	**0.199**	**0.151**	0.125	**0.305**	**0.343**	0.037
B	0.000	0.142	**0.322**	**0.294**	0.182	**0.346**	**0.375**	**0.285**	0.164	0.252	0.176	0.191	0.139

6.5.2.4 Color-hue contrast

This analysis was conducted to see which of 7 selected color-hue contrasts were the fastest captured and longest focused on by participants via two tables format.

Through the data comparison of the time which first fixation on a color-hue contrast stimulant occurred for both Group A and B, it is seen that most group A

participants' were attracted to 1, 3, 6, 10, 11, 13 and 17, while the majority of group B participants' were attracted to 1, 3, 6, 8, 9, 11 and 12. Contrasts 1, 3, 6 and 11 represent the common result between both group A and B.

Participants vs AOIs analyses shows that 1, 2, 3, 8, 9, 10 and 14 were looked at longer by group A; while 1, 8, 9, 10, 11, 14 and 15 were looked at longer by group B. Contrast 1, 8, 9, 10 and 11 were consistently gazed at by both groups.

The comparative analysis based on the data of objective reflection shows:

5 composited color-hue contrasts consisting of red, orange, yellow, green, sky blue, blue and purple play the most important role in color-hue contrast. At the initial stage, the contrasts that quickly attracted attention were red-orange, yellow-green, blue-purple, and sky blue-purple. This reflects that more stimuli with soft contrast relationship between cool colors or a pairing of warm color contrast such red-orange attract first glance. However, following that, the elderly point of interest moved on to red-orange, orange-green, sky blue-yellow, blue-yellow, and green-blue, which reveals that more warm color-hue contrasts dominate attention keeping pairs (Table 6.40, and 6.41).

Table 6.40 Time to first fixation on stimulant of color hue contract

CHCC	NA	1	2	3	6	8	9	10	11	12	13	14	15	16	17	18	19	20
A	0.235	**1.275**	1.909	**0.810**	**0.354**	1.937	1.923	**0.855**	**0.012**	3.974	**1.419**	**1.393**	1.584	3.484	1.530	1.775	2.085	1.785
B	0.171	**0.868**	1.255	**0.297**	**0.679**	**1.197**	**0.716**	1.248	**0.828**	**1.074**	1.721	2.282	1.955	1.245	2.946	2.820	3.092	3.145

Table 6.41 Observation length-Participants vs AOIs on stimulant of color hue contract

CHCC	NA	1	2	3	4	6	8	9	10	11	12	13	14	15	16	17	18	19	20
A	0.000	**0.101**	**0.164**	**0.067**	0.048	0.006	**0.068**	**0.117**	**0.130**	0.037	0.001	0.056	**0.132**	0.017	0.020	0.041	0.020	0.015	0.037
B	0.000	**0.173**	0.054	0.055	0.015	0.070	**0.110**	**0.164**	**0.250**	**0.094**	0.019	0.065	**0.194**	**0.190**	0.027	0.092	0.081	0.062	0.048

6.5.2.5 Color-purity

This analysis was conducted to see which of the 5 selected color purities were the fastest captured and longest focused on by participants.

Through the data comparison of the time which first fixation on a color purity stimulant occurred for both Group A and B, it is seen that most group A participants' were attracted to 2, 3, 4, 7 and 8, while the majority of group B participants' were attracted to 1, 2, 4, 9 and 10. Purities 2, 4, and 9 represent the common result between both group A and B.

Participants vs AOIs analyses shows that 3, 5, 6, 7 and 9 were looked at longer by group A; while 2, 4, 5, 6 and 7 were looked at longer by group B. Purities 5, 6 and 7 were consistently gazed at by both groups.

The comparative analysis based on the data of objective reflection shows:

The highest purity of colors, such as 1, is not effective at first time attraction. Instead, those in the scale of moderately light and moderately dark are more effective. From the perspective of interest, moderately dark purity had a higher consistency of holding attention (Table 6.42, and 6.43).

Table 6.42 Time to first fixation on stimulant of color purity

CPC	NA	1	2	3	4	5	6	7	8	9	10
A	0.350	2.018	**0.746**	**0.194**	**0.798**	1.222	1.108	**0.736**	1.249	**0.428**	0.927
B	0.726	**1.064**	**0.708**	1.408	**1.171**	1.395	1.451	1.242	1.736	**0.832**	**0.586**

Table 6.43 Observation length-Participants vs AOIs on stimulant of color purity

CPC	NA	1	2	3	4	5	6	7	8	9	10
A	0.000	0.015	0.180	**0.243**	0.156	**0.303**	**0.189**	**0.201**	0.059	**0.213**	0.011
B	0.000	0.153	**0.247**	0.193	**0.386**	**0.583**	**0.230**	**0.302**	0.163	0.170	0.049

6.5.2.6 Color-purity contrast

This analysis was conducted to see which of 8 selected color-purity contrasts were the fastest captured and longest focused on by participants.

Through the data comparison of the time which first fixation on a color-purity contrast stimulant occurred for both Group A and B, it is seen that most group A participants' were attracted to 9, 14, 21, 24, 25, 26, 31, and 41, while the majority of group B participants' were attracted to 3, 14, 15, 17, 26, 30, 32, and 41. Contrasts 14, 25, 26 and 41 represent the common result between both group A and B.

Participants vs AOIs analyses shows that 3, 12, 14, 15, 21, 24, 37, and 52 were looked at longer by group A; while 14, 24, 25, 32, 33, 39, 41, and 42 were looked at longer by group B. Contrast 14 and 24 were consistently gazed at by both groups.

The comparative analysis based on the data of objective reflection shows:

The color-purity contrasts which attracted first time attention most effectively were in the range of moderate contrast. From the perspective of interest, moderate and medium contrast held attention the most effectively (Table 6.44 and 6.45).

Table 6.44 Time to first fixation on color purity contrast

CPCC	NA	3	4	9	12	14	15	16	17	21	24	25	26	30	31	32	33	34	36	37	39	41	44	48	52	55
A	0.227	1.534	3.871	**0.568**	1.700	**0.761**	1.763	3.751	3.857	**0.874**	**1.218**	**0.200**	**0.517**	3.001	**1.200**	1.540	2.609	1.266	2.217	1.697	2.826	**1.087**	2.474	1.768	1.684	1.370
B	0.482	**0.225**	2.064	1.608	3.955	**1.046**	**1.238**	1.502	**0.930**	2.948	1.671	1.466	**1.024**	**0.277**	1.675	**1.271**	1.547	3.803	3.018	1.892	1.655	**1.275**	1.751	2.183	3.482	3.535

Table 6.45 Observation length-Participants vs AOIs on color purity contrast

CPCC	NA	3	4	9	11	12	14	15	16	17	21	24	25	26	30	31	32	33	34	36	37	39	41	42	44	48	52	55
A	0.000	**0.044**	0.006	0.043	0.013	**0.062**	**0.104**	**0.049**	0.016	0.011	**0.069**	**0.144**	0.006	0.019	0.032	0.040	0.037	0.023	0.041	0.008	**0.048**	0.040	0.012	0.015	0.023	0.026	**0.069**	0.010
B	0.000	0.019	0.013	0.014	0.011	0.002	**0.083**	0.043	0.028	0.043	0.023	**0.083**	**0.093**	0.034	0.051	0.032	**0.381**	**0.142**	0.005	0.042	0.028	**0.056**	**0.114**	**0.054**	0.022	0.017	0.026	0.022

6.5.2.7 Color-brightness

This analysis was conducted to see which of 5 selected color brightnesses were the fastest captured and longest focused on by participants.

Through the data comparison of the time which first fixation on a color brightness stimulant occurred for both Group A and B, it is seen that most group A participants' were attracted to 3, 4, 5, 10 and 11, while the majority of group B participants' were attracted to 1, 3, 4, 8 and 9. Brightnesses 3 and 4 represent the common result between both group A and B.

Participants vs AOIs analyses shows that 4, 5, 8, 9 and 10 were looked at longer by group A; while 2, 3, 5, 6 and 7 were looked at longer by group B. Brightness 5 was the only item consistently gazed at by both groups.

The comparative analysis based on the data of objective reflection shows:

Table 6.46 Time to first fixation on stimulant of color brightness

CBC	NA	1	3	4	5	6	7	8	9	10	11
A	0.720	3.086	**0.070**	**0.627**	**0.746**	1.760	1.951	1.759	0.933	**0.427**	**0.384**
B	1.113	**0.800**	**1.049**	**0.691**	1.271	1.753	1.542	**0.670**	**0.519**	1.626	1.713

Table 6.47 Observation length-Participants vs AOIs of color brightness

CBC	NA	1	2	3	4	5	6	7	8	9	10	11
A	0.000	0.017	0.000	0.037	**0.199**	**0.504**	0.197	0.158	**0.255**	**0.243**	**0.207**	0.012
B	0.000	0.060	**0.258**	**0.290**	0.251	**0.352**	**0.439**	**0.269**	0.188	0.168	0.090	0.130

The color brightness that attracted the elderly attention most effectively were in the range of moderate partial light to darker that include from 3-5, and 8-11. From the perspective of interest, there was a wide range from 2 to 10, but in general,

moderate partial bright brightness was relatively more effective (Table 6.46, and 6.47).

6.5.2.8 Color-brightness contrast

This analysis was conducted to see which of 8 selected color-brightness contrasts were the fastest captured and longest focused on by participants.

Through the data comparison of the time which first fixation on a color-hue contrast stimulant occurred for both Group A and B, it is seen that most group A participants' were attracted to 7, 14, 23, 32, 38, 43, 45 and 48, while the majority of group B participants' were attracted to 2, 21, 30, 31, 32, 38, 43 and 52. Contrasts 1, 32, 43 and 50 represent the common result between both group A and B.

Participants vs AOIs analyses shows that 14, 15, 24, 25, 32, 38, 39, and 52 were looked at longer by group A; while 24, 31, 32, 33, 38, 39, 45, and 39 were looked at longer by group B. Contrasts 24, 32, 38 and 39 were consistently gazed at by both groups.

The comparative analysis based on the data of objective reflection shows:

Table 6.48 Time to first fixation on color brightness contrast

CBCC	NA	2	7	14	15	16	19	21	22	23	24	25	30	31	32	37	38	39	43	44	45	48	49	52
A	0.224	3.621	**1.028**	**1.023**	1.660	2.308	1.208	1.204	1.475	**0.688**	1.916	2.673	3.656	1.779	**0.291**	2.526	**0.512**	1.798	**0.295**	2.115	**0.394**	**0.427**	3.862	3.232
B	0.266	**0.881**	2.825	3.058	2.039	1.642	3.094	**1.525**	4.159	3.503	2.445	2.734	**0.911**	**1.332**	**0.553**	2.850	**1.594**	2.174	**1.205**	3.671	3.021	2.254	2.752	**1.582**

Table 6.49 Observation length-Participants vs AOIs on color brightness contrast

CBCC	NA	2	7	14	15	16	17	19	21	22	23	24	25	30	31	32	33	37	38	39	43	44	45	48	49	52
A	0.000	0.015	0.015	**0.135**	**0.055**	0.027	0.005	0.007	0.008	0.012	0.007	**0.107**	**0.042**	0.007	0.029	**0.071**	0.009	0.021	**0.039**	**0.046**	0.006	0.019	0.026	0.017	0.006	**0.050**
B	0.000	0.030	0.033	0.025	0.069	0.032	0.030	0.017	0.053	0.012	0.043	**0.119**	0.087	0.069	**0.242**	**0.288**	**0.096**	0.072	**0.107**	**0.103**	0.020	0.035	**0.090**	0.031	**0.089**	0.027

The color-brightness contrasts that attracted the elderly attention most effectively were in the range of weak moderate contrast as well as the strong contrast of black and white. From the perspective of interest, strong moderate contrasts were relatively more effective (Table 6.48, and 6.49).

6.5.2.9 Shapes

This analysis was conducted to see which of 6 selected shapes the fastest captured and longest were focused on by participants.

Through the data comparison of the time which first fixation on variously shaped stimulants occurred for both Group A and B, it is seen that most group A participants' were attracted to 2, 3, 7, 11, 12 and 16, while the majority of group B participants' were attracted to 2, 7, 8, 11, 12 and 15. Shapes 2, 7, 11 and 12 represent the common result between both group A and B.

Participants vs AOIs analyses shows that 3, 6, 7, 12, 15 and 16 were looked at longer by group A; while 6, 7, 10, 11, 12 and 16 were looked at longer by group B. Shape 6, 7, 12, and 16 were the item consistently gazed at by both groups.

The comparative analysis based on the data of objective reflection shows:

The shapes that attracted elderly attention most effectively were: Circular bead square, heart shape, four-cornered star and flower shape. This presents that soft and full shapes more easily attract elderly attention. From the perspective of interest, shapes like the circular bead triangle, heart shape, flower shape and complex shapes that elicit a feeling of exploration more easily capture interest (Table 6.50, and 6.51).

Table 6.50 Time to first fixation on stimulant of shape

ShaC	NA	1	2	3	5	6	7	8	9	10	11	12	14	15	16
A	0.150	2.595	**0.919**	**0.602**	2.066	1.306	**1.084**	2.114	1.284	1.780	**1.113**	**1.228**	2.560	1.944	**0.495**
B	0.228	2.735	**1.093**	1.170	3.035	1.665	**1.004**	**0.233**	1.399	1.445	**0.980**	**0.882**	2.794	**0.886**	1.680

Table 6.51 Observation length-Participants vs AOIs on stimulant of shape

ShaC	NA	1	2	3	5	6	7	8	9	10	11	12	14	15	16
A	0.000	0.051	0.078	**0.101**	0.043	**0.106**	**0.208**	0.017	0.019	0.070	0.075	**0.190**	0.015	**0.100**	**0.132**
B	0.000	0.015	0.019	0.015	0.012	**0.174**	**0.516**	0.020	0.046	**0.052**	**0.452**	**0.097**	0.034	0.051	**0.067**

6.5.2.10 Size

This analysis was conducted to see which of 3 selected sizes the fastest captured and longest were focused on by participants.

Through the data comparison of the time which first fixation on a patterned stimulant occurred for both Group A and B, it is seen that most group A participants' were attracted to 1, 2, and 6, while the majority of group B participants' were attracted to 1, 6, and 7. Sizes 1 and 6 represent the common result between both group A and B.

Participants vs AOIs analyses shows that 2, 3 and 6 were looked at longer by group A; while 1, 2, and 7 were looked at longer by group B. Only size 2 was consistently gazed at by both groups.

The comparative analysis based on the data of objective reflection shows:

Size is a relative concept in a virtual test. The sizes to attract elderly attention most effectively were on either extreme of the spectrum: For example, largest or

smallest size in comparison to others. From the perspective of interest, it shows that the elderly more easily fix their gaze on larger sizes (Table 6.52, and 6.53).

Table 6.52 Time to first fixation on stimulant of size

SizC	NA	1	2	3	4	6	7
A	0.634	**0.870**	**0.858**	1.535	1.309	**0.626**	1.388
B	0.170	**0.664**	0.993	0.950	1.426	**0.882**	**0.925**

Table 6.53 Observation length-Participants vs AOIs on stimulant of size

SizC	NA	1	2	3	4	6	7
A	0.000	0.194	**0.908**	**0.317**	0.169	**0.266**	0.091
B	0.000	**0.497**	**0.900**	0.222	0.119	0.056	**0.322**

6.5.2.11 Texture and material

This analysis was conducted to see which of 6 selected textures and materials were the fastest captured and longest focused on by participants.

The findings based on comparative analysis of statistical result of data, it shows the significant features as followings:

The textures and materials that most effectively attract elderly attention are steel, glass, wood, plastic and ceramic. Among them, glass and ceramic are most effective when presented with a smooth texture. From the perspective of interest, glass, wood, plastic, and ceramic held attention the best; with smooth glass, wood and plastic with rough and moderate texture being the most effective (Table 6.54, and 6.55).

Table 6.54 Time to first fixation on stimulant of material and texture

MTC	NA	A2	A3	B1	B2	B3	C1	C2	C3	D1	D2	D3	E2	E3	F3
A	0.309	3.766	1.922	**0.431**	1.762	**1.426**	1.760	**1.742**	1.953	**1.215**	2.082	2.188	**1.391**	**1.719**	3.307
B	0.226	**0.333**	**0.508**	2.162	1.625	**1.001**	2.143	1.809	2.643	2.242	**1.356**	2.466	2.520	**0.401**	**1.029**

Table 6.55 Observation length-Image vs AOIs on stimulant of material and texture

MTC	NA	A2	A3	B1	B2	B3	C1	C2	C3	D1	D2	D3	E1	E2	E3	F3
A	0.000	0.010	0.013	0.165	0.068	**0.207**	**0.214**	**0.325**	0.065	**0.153**	**0.149**	0.036	0.042	**0.138**	0.012	0.022
B	0.000	0.017	0.026	0.074	**0.113**	**0.410**	**0.132**	**0.254**	0.015	**0.106**	**0.387**	0.077	0.036	0.036	0.063	0.093

6.5.2.12 Pattern

This analysis was conducted to see which of 6 the selected patterns were the fastest captured and longest focused on by participants. The six patterns are: 1-inductive, 2-representational, 3-childish, 4-artistic, 5-abstract, 6-Chinese traditional.

Through the data comparison of the time which first fixation on a patterned stimulant occurred for both Group A and B, it is seen that most group A participants' were attracted to 2, 5, and 6, while the majority of group B participants' were attracted to 1, 2, and 5. Patterns 2 and 5 represent the common result between both group A and B.

Participants vs AOIs analyses shows that 2, 5, and 6 were looked at longer by group A; while 2, 5, and 6 were also looked at longer by group B. Patterns 2, 5, and 6 were consistently gazed at by both groups.

The comparative analysis based on the data of objective reflection shows:

Pattern 2, the representational style, is a pattern that can attract the elderly visual attention effectively, as well as keeping interest in both group A and B.

Pattern 5, the abstract style, can get subjects' attention because of significant shape contrast, and also keeping interest in both group A and B.

Pattern 6, the Chinese traditional style, although it not quickly attract the subjects' attention; its representational features with exquisite detail eventually arouse their interest and evoke further observation.

Synthesis of the above shows, representational patterns are most effective for attracting attention and keeping interest, because they are easy to identify and relatively understandable (Table 6.56, and 6.57).

Table 6.56 Time to first fixation on stimulant of pattern

PC1	NA	1	2	3	4	5	6
A	0.409	1.631	**0.702**	1.348	2.353	**0.998**	**0.766**
B	0.926	**1.009**	**0.701**	1.556	1.392	**1.222**	1.418

Table 6.57 Observation length-Participants vs AOIs on stimulant of pattern

PC1	NA	1	2	3	4	5	6
A	0.000	0.164	**0.521**	0.184	0.126	**0.688**	**0.460**
B	0.000	0.260	**1.042**	0.316	0.418	**0.587**	**0.497**

6.5.2.13 Product

This analysis was conducted to see which of the 6 selected products the fastest captured and longest were focused on by participants.

Through the data comparison of the time which first fixation on a product occurred for both Group A and B, it is seen that most group A participants' were attracted to 7, 9, 10, 11, 13 and 17, while the majority of group B participants' were attracted to 2, 3, 9, 12, 14 and 15. Products 9 represent the common result between both group A and B.

Participants vs AOIs analyses shows that 3, 8, 9, 10, 15 and 16 were looked at longer by group A; while 8, 9, 10, 11, 15 and 16 were looked at longer by group B. Products 8, 9, 10, 15 and 16 were consistently gazed at by both groups.

The comparative analysis based on the data of objective reflection shows:

The products to most effectively attract elderly attention were shiny with metallic finish and little innovation of shape. This reveals that familiar, traditional, and durable feelings grasp attention quickly. From the perspective of interest, traditional products with traditional auspicious pattern, as well as one with a very complicated shape and one with bright colors and material were most effective at warranting a longer gaze (Table 6.58, and 6.59).

Table 6.58 Time to first fixation on stimulant of product

G	PC2	2	3	4	5	7	8	9	10	11	12	13	14	15	16	17	18
A	0.212	3.617	1.744	1.574	2.401	**0.353**	1.503	**1.358**	**1.233**	**0.479**	2.622	**0.479**	2.035	1.725	1.409	**0.820**	1.477
B	0.585	**0.047**	**1.203**	1.878	1.913	2.604	1.650	**0.924**	1.436	1.304	**1.135**	3.696	**1.207**	**0.898**	1.772	1.526	2.491

Table 6.59 Observation length-Image vs AOIs on stimulant of product

G	PC2	2	3	4	5	7	8	9	10	11	12	13	14	15	16	17	18
A	0.000	0.027	**0.158**	0.045	0.039	0.083	**0.094**	**0.336**	**0.146**	0.072	0.003	0.015	0.028	**0.196**	**0.095**	0.081	0.066
B	0.000	0.048	0.164	0.126	0.092	0.086	**0.167**	**0.545**	**0.175**	**0.242**	0.074	0.014	0.102	**0.318**	**0.216**	0.078	0.018

6.5.2.14 Layout of newspaper

This analysis was conducted to see which layouts of newspaper selected were the fastest to capture attention and kept participant focus the longest.

Through the data comparison of the time which first fixation on a patterned stimulant occurred for both Group A and B, it is seen that most group A participants'

were attracted to 2 and 3, while the majority of group B participants' were attracted to 3 and 4. 3 represent the common result between both group A and B.

Participants vs AOIs analyses shows that 3 and 4 were looked at longer by group A; while 3 and 4 were also looked at longer by group B. Layouts 3 and 4 were consistently gazed at by both groups.

The comparative analysis based on the data of objective reflection shows:

The layout of newspaper that attracted the elderly attention most effectively had a relatively regular layout with more pictures. However, on the perspective of interest, the image heavy layout was more effective at holding interest (Table 6.60, and 6.61).

Table 6.60 Time to first fixation on stimulant of layout of newspaper

LNC	NA	1	2	3	4
A	0.922	1.189	**0.998**	**0.826**	1.018
B	2.000	2.585	1.118	**0.303**	**0.801**

Table 6.61 Observation length-Participants vs AOIs on stimulant of layout of newspaper

LNC	NA	1	2	3	4
A	0.000	0.201	0.576	**0.898**	**0.620**
B	0.000	0.158	0.930	**1.144**	**1.137**

6.6 Summary

This chapter focuses on measuring the Chinese elderly visual perception features through subjective and objective assessment approaches. The goal was to gather data and statistical results, with the eventual purpose of providing evidence in supporting the discussion and proposal of PVE in the next chapter.

Table 6.62 Results list of Chinese elderly visual perception features and its relevance in assessment

TVP-1 assessment	**NSU**	**VPT-2 assessment**	**NSU**
Importance of design for product use			
Most important factors of products			
The elderly product design needs to consider their unique needs based on age change			
Subjective visual preference features			
Easy finding factor in the perceptional processing of information			
Visual preference		**Objective attraction**	
Color	∇	Color	∇
Color-hue	∇	Color-hue	∇
Color-hue contrast	∇	Color-hue contrast	∇
Color-purity	∇	Color-purity	∇
Color-purity contrast	∇	Color-purity contrast	∇
Color-brightness	∇	Color-brightness	∇
Color-brightness contrast	∇	Color-brightness contrast	∇
Shape	∇	Shape	∇
Size	∇	Size	∇
Material and texture	∇	Material and texture	∇
Pattern	∇	Pattern	∇
Product design	∇	Product design	∇
Layout of newspaper	∇	Layout of newspaper	∇
Light spaces			
Emotional assessment			
Pleasurable emotion benefits human health			
Good product should elicit positive emotion			
Products that meet personal cognitive preferences lead to positive emotion generation			
Product factors affecting pleasurable mood			
Factors affecting pleasurable mood during product use			
Function			
Usability			
Appearance			
Concept			
Preferred color			
Preferred style			
Main reason product designs give bad feeling			
Suggestions on improving elderly mood via product design			

∇: Results used in next stage
NSU: Next Stage Use

Based on the investigations as well as analyses of statistical results and findings, details supplementary to the unclear and missing information gathered from the observation and interview stages were gained. It is shown below in table 6.62.

99 subjects participated in the VPT-1 assessment, and 44 of them voluntarily accepted the invitation to participate in the VPT-2 assessment. The number of subjects exceeded expectation, which was 50 subjects participating in VPT-1, and 40 participating in VPT-2. Thus, the sample size is large enough to be representative of the whole.

The general elderly features identified through the assessments were gradually made clear throughout this chapter and are reflected in three main aspects:

- Subjective preference features of visual perception;
- Subjective preference features of visual perception linked to positive emotion;
- Objective stimulus response features of visual perception.

The statistical results have achieved the requirements of this investigation producing scientific, objective, and credible results. Despite some of the assessment content not being able to be fully tested, the overall number of samples proved effective and convincing. Therefore, these results and findings, both subjective and objective, are fully qualified to act as the core indicator of first-hand rational information to be considered and used in supporting of the PVE factors discussed and proposed in the follow-up phase.

CHAPTER 7.

ANALYSIS AND DISCUSSION

7.1 Introduction

The purpose of this chapter is for further analysis of the relationship between the statistical results gained from the VPT-1 and VPT-2 assessments on visual preference and objective attraction, specifically for 12 items. Next, to find the common consistency features for supporting the proposal of Positive Visual Experience (PVE) factors in design for the Chinese elderly. Finally, to eventually discuss the final results of this investigation in context of PVE concept, PVE factors, and PVE processing model proposed for design for the Chinese elderly.

There are two parts of analysis in this chapter:

The first section, Consistency between Subjective and Objective Data Analysis, depends on the data gained from the VPT-2 assessment, and compares the observation time data against the subjective preferences in order to identify the relevancy and consistency amongst the 12 VE factors. An overlap of subjective and objective will better form a VE basis that indicates whether a factor is perceived to affect the VE on an object, and confirm whether that factor indeed sparked their interest.

The second section, PVE Factors, conglomerates the data from the eye tracking tests with subjective factors to identify consistent PVE factors that will elicit elderly response. The consistent PVE factor formulation is based on three indicators: Personal preference, reaction time to an object, and the length of time an object can hold attention. These formulate the PVE concept, PVE factors, and PVE process. The framework of analysis and discussion is showed in Figure 7.1.

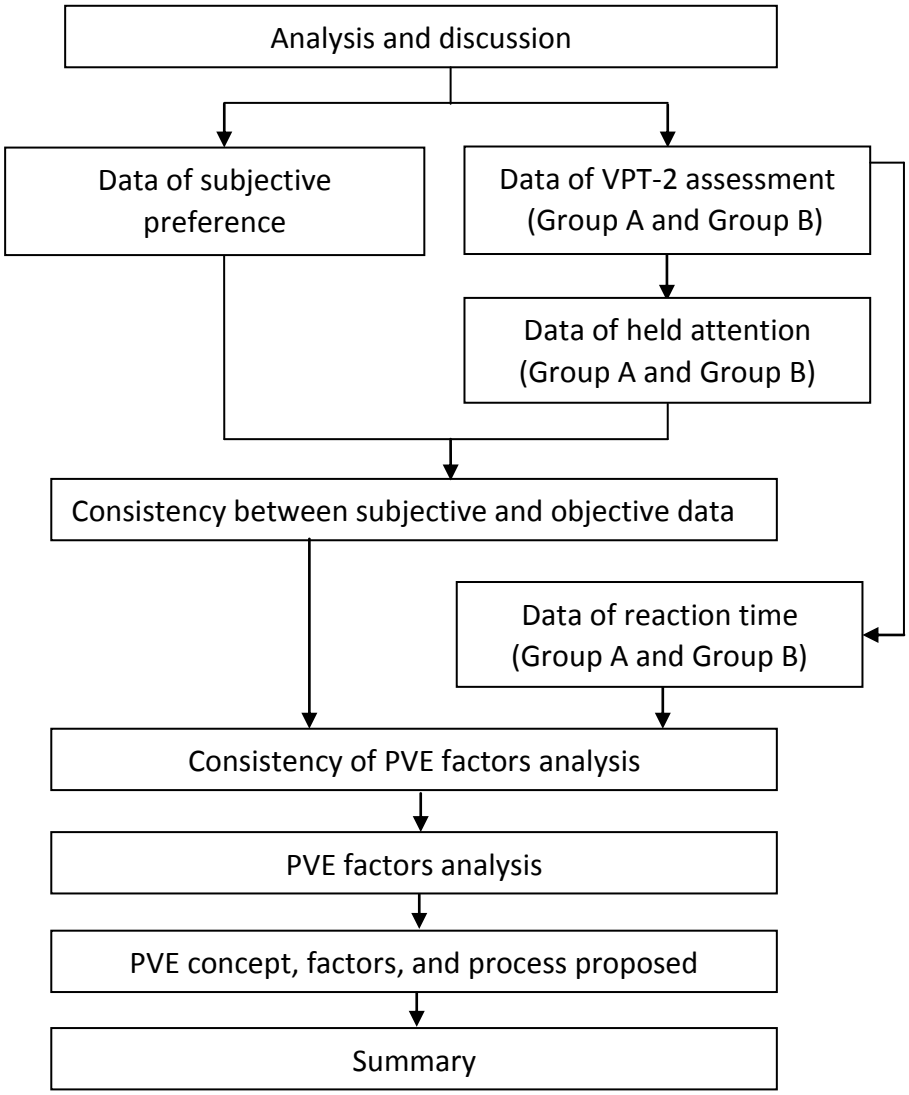


Figure 7.1 Framework of assessment

7.2 Consistency between subjective and objective data analyses

This section will analyze the consistency between subjective and objective data gathered throughout the research. Identified consistencies will indicate stated personal preferences that are in line with objective attraction.

Through the fusion of the attention held test with the survey results, it has been revealed that, as opposed to personal preference not corresponding to reality, subjective visual perception preferences can match objective attraction to presented stimulus. This consistency factor is an ideal condition amongst Chinese elderly visual perception of external stimulus that is most likely to produce a positive mood. It is also an important verification of the original hypothesis that these factors are important components of the PVE.

The following statistical results present the compression of subjective and objective data collected from the VPT-1 and VPT-2 assessments in the last chapter. As an important method specially designed for this investigation, the purpose of this section is to further analyze the Chinese elderly subjects' consistency between subjective preferences and objective attraction data for providing overall consistency features common to the Chinese elderly demographic. The results will be key components in the discussion of PVE opened in the next section.

The data analyses adopted three main indicators of data sets to compare and achieve the needed outcomes.

- Integrated data of group A and B (IDAB) from VPT-2 assessment, eye tracking device's recorded data on Observation Length-Participants vs.

AOIs;

- Subjective preference data (SPD) from PVP-1 assessment TB;
- Consistency correlation data-1 (CCD-1) on the IABD and SPD.

7.2.1 Data analyses

(1) Data use

In order to ensure data adheres to statistic rationality, and is based on representative principles, the data was used in accordance to the following rules:

- All subjects' raw data are adapted into statistics, including those not recorded or statistics showing nil data. Nevertheless, those data reflect the objective in this study, so it has statistical significance and can be included in the statistical analysis;
- Two sets of statistical data; Observation Length-Participants vs. AOIs from group A and B recorded by Tobii X60 eye tracking device, were run through the Tobii Studio 1.5 software at this stage of the study;
- Because statistics are for IABD and SPD consistency data generating, if either or both of IABD and SPD are missing, the result will be eliminated, as calculation will produce false result;
- IDAB is a mean data of group A and group B, and can be used as an effective input despite missing one portion;
- For typical sample, data exceeding 50 percent underwent interpretation.

(2) Calculation method used

Due to the different representations in subjective and objective data, such as VPT-1 assessment calculative unit is a number notation and the VPT-2 assessment is a unit of time in seconds, in order to compare two sets of data and calculate one data unit output, the data utilized a common calculation method of Normalization with the Maximal Value (NMV) to convert the two types of data units into one unit for calculation. The specific calculation method is as follows:

- Set the maximum value of stimulus' data among each data set as a (100%) baseline;
- Use other values of stimulus' data is divided by the maximum value and calculated as a percentage value;
- Calculate using the percentage value.

For example: code 1 of OA's and 2 of OB's numerical value are highest, therefore, those can be set as 100 percent baseline and express in brackets (100%). The other, code 1 of OA with numerical value of 0.201 divided by code 2 of OA with 0.898, is 22 %, code 1 of OB with numerical value of 0.158 divided by code 2 of OB with 1.144, is 14 %. The calculative mean value of code 1 of OA and OB (MOAB) use OA's 22 plus OB's 14, and then divided by 2 to calculate out OA's 18.00 and OB's 100 (Table 7.1).

Table 7.1 Sample of percentage calculation

Code	1	2
OA	0.201 (22%)	0.898 (100%)
OB	0.158 (14%)	1.144 (100%)
MOAB	18.0	100.0

It is appropriate to note that a variation in elderly visual perceptional ability is normal. Therefore, the data reflects the normal and natural state of the Chinese elderly, especially in the eye tracking data recorded. Further statistical results are also based on the overall features analysis of the data shown without consideration and distinction of age or gender divide, allowing calculating the overall average data.

(3) Figure and table description

- **Table:** Includes 5 sets of data consisting of 3 sets of original data and 2 sets of data in each specific range with percentage conversion.
- **Figure:** Visualization of statistical analysis results.
- **Abbreviation:** In order to clearly display the statistical results in each table, specialized vocabularies were replaced by abbreviations. The details are as follows：

  - **S** = Subjective
  - **OA** = Objective group A
  - **OB** = Objective group B
  - **MOAB** = Mean of OA and OB
  - **C** = S (subjective) and MOAB of (objective of group A and B)
  - **1, 2, 3…n** = Code of each stimulus
  - **CHC** = Color-hue code
  - **CHCC** = Color-hue contrast code
  - **CPC** = Color-purity code
  - **CPCC** = Color-purity contrast code
  - **CBC** = Color-brightness code

- **CBCC** = Color-brightness contact code
- **ShaC** = Shape code
- **SiaC** = Size code
- **MTC** = Materials and textures code
- **PC** = Pattern code
- **PDC** = Product design code
- **LNC** = Layout of newspaper code

7.2.2 Analyses of consistency between subjective and objective data

(1) Color-hue

In general, the statistical results show that hues 1 and 9 were higher in personal preference, but 1 was preferred outright. In terms of objective attraction, 2, 3, 5, 6, 7, 9, 10 and 11 were relatively higher, with 11 the highest. From a consistency aspect, 1, 5, and 9 were higher, and 1 was the highest. Analyses of these features found that:

Table 7.2 Consistency between personal preference and objective attraction in color-hue

CHC	1	2	3	4	5	6	7	8	9	10	11	12
S	26 (100%)	3 (12%)	12 (46%)	2 (8%)	11 (42%)	6 (23%)	7 (27%)	1 (4%)	17 (65%)	2 (8%)	3 (12%)	6 (23%)
OA	0.010 (3%)	0.118 (34%)	0.089 (26%)	0.051 (15%)	0.128 (37%)	0.104 (30%)	0.199 (58%)	0.151 (44%)	0.125 (36%)	0.305 (89%)	0.343 (100%)	0.037 (11%)
OB	0.142 (38%)	0.322 (86%)	0.294 (78%)	0.182 (49%)	0.346 (92%)	0.375 (100%)	0.285 (76%)	0.164 (44%)	0.252 (67%)	0.176 (47%)	0.191 (51%)	0.139 (37%)
MOAB	20.5	60.0	52.0	32.0	64.5	65.0	67.0	44.0	51.5	68.0	75.5	24.0
C	**60.25**	36.00	49.00	20.00	**53.25**	44.00	47.00	24.00	**58.25**	38.00	43.75	23.50

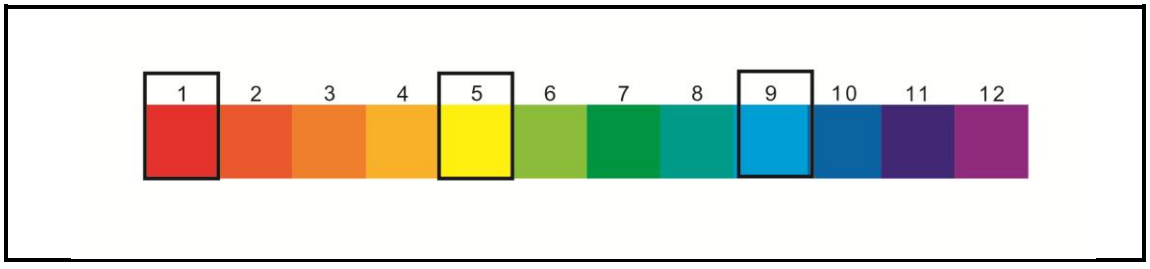


Figure 7.2 Consistency between personal preference and objective attraction in color-hue

The subjects' personal preference of color hue in visual perception had a wide array of results, but was most concentrated in red and sky blue. Warm colors elicit a sense of progress within Chinese traditional culture as well as good fortune and happiness. This shows that this result fits the Chinese elderly subjective preference and objective attraction condition. Sky blue was perceived as quiet, and its high consistency in terms of subjective and objective selection mean that it should be a very good color hue for the Chinese elderly.

As an aside, all color hues can attract the Chinese elderly attention without a large gap between them. This indicates that all color hues can have an attractive aspect (Table 7.2, and Figure 7.2).

(2) Color-hue contrast

Generally speaking, the statistical results show that color-hue contrasts 1, 7 and 9 were higher in personal preference, but 7 was preferred outright. In terms of objective attraction, 1, 2, 9, 10, 14 and 15 were relatively higher, with 10 and 15 the highest. From a consistency aspect, 1, 7, 9 and 10 were higher, with 1 being the highest. Analyses of these features found that:

The subjects' personal preference of color-hue contrast in visual perception had a wide array of results, but was most concentrated in red-orange, red-yellow, and yellow-cyan. These color-hue contrasts 1 and 9 are directly related to the color hue preferences listed above. It also shows that the more warm colors of red, orange and yellow are the most preferred components in contrasts. The objective attraction of color-hue contrast showed a wide distribution from 1 to 19. This indicates that many

color-hue contrasts can attract the attention of the Chinese elderly, but red- orange, orange-yellow, yellow-blue, yellow-cyan, green-blue and green-purple are the most effective, without including any dazzling special effects.

Table 7.3 Consistency between personal preference and objective attraction in color-hue contrast

CHCC	1	2	3	4	5	6	7	8	9	10	12	13	14	15	16	17	18	19
S	9 (69%)	2 (15%)	3 (23%)	2 (15%)	1 (8%)	1 (8%)	13 (100%)	3 (23%)	8 (62%)	5 (38%)	6 (46%)	5 (38%)	1 (8%)	1 (8%)	4 (31%)	1 (8%)	2 (15%)	3 (23%)
OA	0.101 (62%)	0.164 (100%)	0.067 (41%)	0.048 (30%)	0.000 (0%)	0.006 (4%)	0.000 (0%)	0.068 (42%)	0.117 (71%)	0.130 (79%)	0.001 (0.6%)	0.056 (34%)	0.132 (81%)	0.017 (10%)	0.020 (12%)	0.041 (25%)	0.020 (12%)	0.015 (9%)
OB	0.173 (69%)	0.054 (22%)	0.055 (22%)	0.015 (6%)	0.057 (23%)	0.070 (28%)	0.042 (17%)	0.110 (44%)	0.164 (66%)	0.250 (100%)	0.019 (8%)	0.065 (26%)	0.194 (71%)	0.190 (78%)	0.027 (11%)	0.092 (37%)	0.081 (32%)	0.062 (25%)
MOAB	65.5	61.0	31.5	18.0	11.5	16.0	8.5	43.0	68.5	89.5	4.3	30.0	76.0	89.0	11.5	31.0	22.0	17.0
C	**67.25**	38.00	27.25	16.50	9.75	12.00	**54.25**	33.00	**65.25**	**63.75**	5.15	34.00	42.00	48.50	21.25	19.50	18.50	20.00

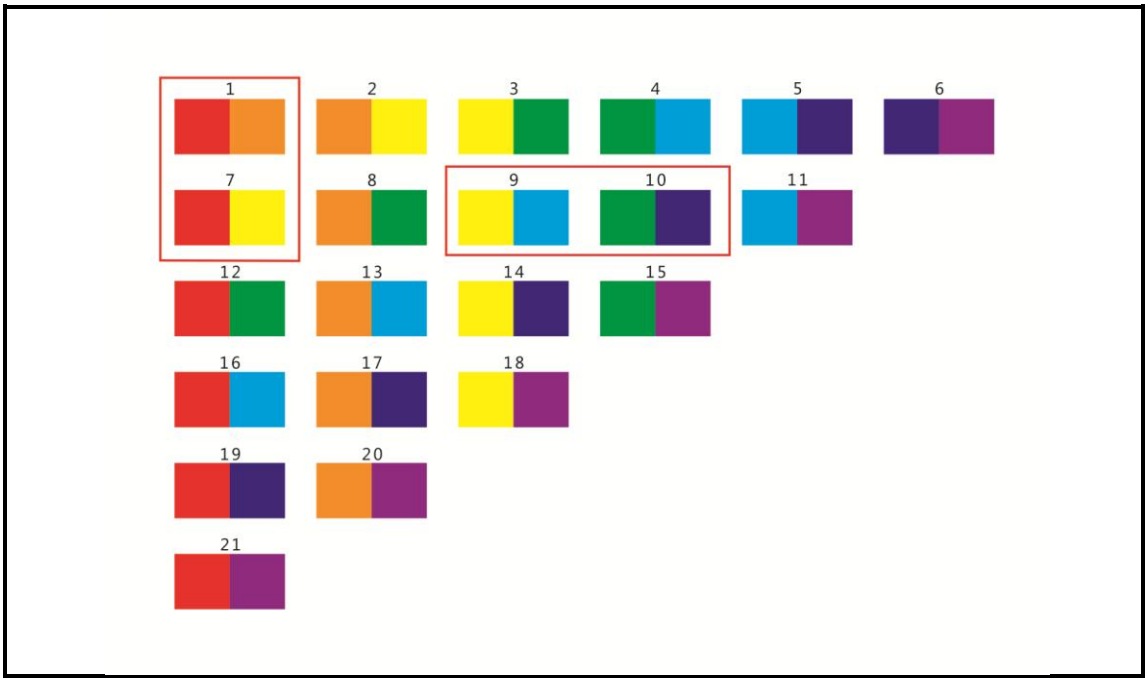


Figure 7.3 Consistency between personal preference and objective attraction in color-hue contrast

Moreover, the best contrasts with consistency between the three indicators were red-orange and yellow-sky blue, and as such need to be considered the more applicable for elderly design (Table 7.3, and Figure 7.3).

(3) Color-purity

Generally, the statistical results show that purity 1 was higher in personal preference outright. In terms of objective attraction, all numbers but 1, 8 and 10 were relatively high, with 5 the highest. From a consistency aspect, 1 was also the highest. Analyses of these features found that:

Subjects preferred the higher purity of color, while lower preferences of varying degrees did occur within a wide distribution. 2, 3, 4, 6, 7 and 9 color purities showed higher and similar attraction qualities, except with high purity elevated above than the rest. 1, 3 and 5 as such consistency were similar. A finding is contrary to expectations that although subjects preferred the high purity of the color, but it cannot continue to form their interest (Table 7.4, and Figure 7.4).

Table 7.4 Consistency between personal preference and objective attraction in color-purity

CPC	1	2	3	4	5	6	7	8	9	10
S	38 (100%)	8 (21%)	4 (11%)	5 (13%)	1 (3%)	4 (11%)	1 (3%)	1 (3%)	0 (0%)	7 (18%)
OA	0.015 (5%)	0.180 (59%)	0.243 (80%)	0.156 (52%)	0.303 (100%)	0.189 (62%)	0.201 (66%)	0.059 (20%)	0.213 (70%)	0.011 (4%)
OB	0.153 (26%)	0.247 (42%)	0.193 (33%)	0.386 (66%)	0.583 (100%)	0.230 (40%)	0.302 (52%)	0.163 (28%)	0.170 (29%)	0.049 (8%)
MOAB	15.5	50.5	56.5	59.0	100.0	51.0	59.0	24.0	49.5	6.0
C	**57.75**	35.75	**67.50**	36.00	**51.50**	31.00	31.00	13.50	24.75	12.00

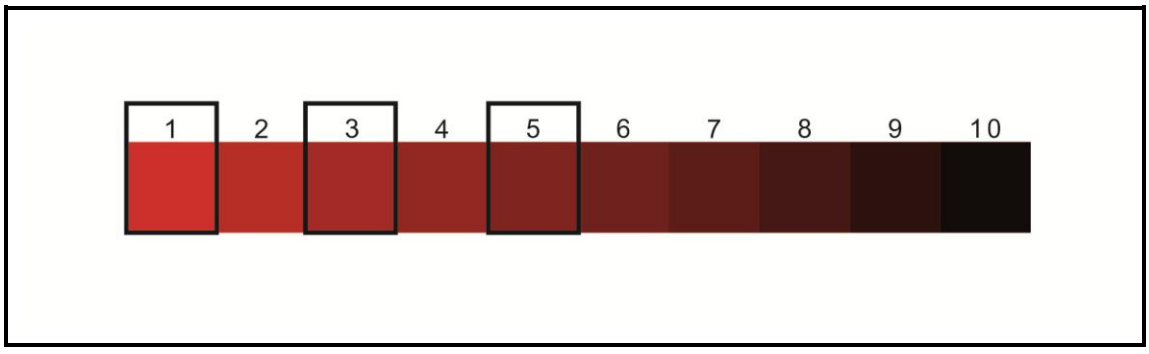


Figure 7.4 Consistency between personal preference and objective attraction in color-purity

(4) Color-purity contrast

The statistical results include just 14 samples, as there were 55 sets on the VPT-1 assessment TB and VPT-2, and the excessive stimulus caused decentralized visual response. As such, some data points are missing S or MOAB, and the consistency cannot be calculated. Therefore, the four sets listed in the data analysis can only be used as representative sets for this section.

Generally, the statistical results show that contrasts 3, 12, and 32 displayed the higher consistencies. 3 and 12 had high purity contrast, while 32 had high purities with weak contrast. Therefore, the contrasts with high purity range and weak contrast as well as high purity and strong contrast need to be considered the better color-purity contrast range for the Chinese elderly. The high purity and strong contrast sets showed high similarity in consistency (Table 7.5, and Figure 7.5).

Table 7.5 Consistency between personal preference and objective attraction in color-purity contrast

CPCC	3	4	9	11	12	25	26	30	31	32	33	36	42	55
S	4 (100%)	1 (25%)	3 (75%)	1 (25%)	2 (50%)	1 (25%)	2 (50%)	1 (25%)	1 (25%)	1 (25%)	1 (25%)	1 (25%)	1 (25%)	1 (25%)
OA	0.044 (71%)	0.006 (25%)	0.043 (10%)	0.013 (21%)	0.062 (100%)	0.006 (10%)	0.019 (31%)	0.032 (52%)	0.040 (65%)	0.037 (60%)	0.023 (37%)	0.008 (13%)	0.015 (24%)	0.010 (16%)
OB	0.019 (5%)	0.013 (3%)	0.014 (4%)	0.011 (3%)	0.002 (1%)	0.093 (24%)	0.034 (9%)	0.051 (13%)	0.032 (8%)	0.381 (100)	0.142 (37%)	0.042 (11%)	0.054 (14%)	0.022 (6%)
MOAB	38.0	14.0	7.0	12.0	50.5	17.0	20.0	32.5	36.5	80.0	37.0	12.0	19.0	11.0
M	**69.00**	19.50	41.00	18.50	**50.25**	21.00	35.00	28.75	30.75	**52.50**	31.00	18.50	22.00	18.00

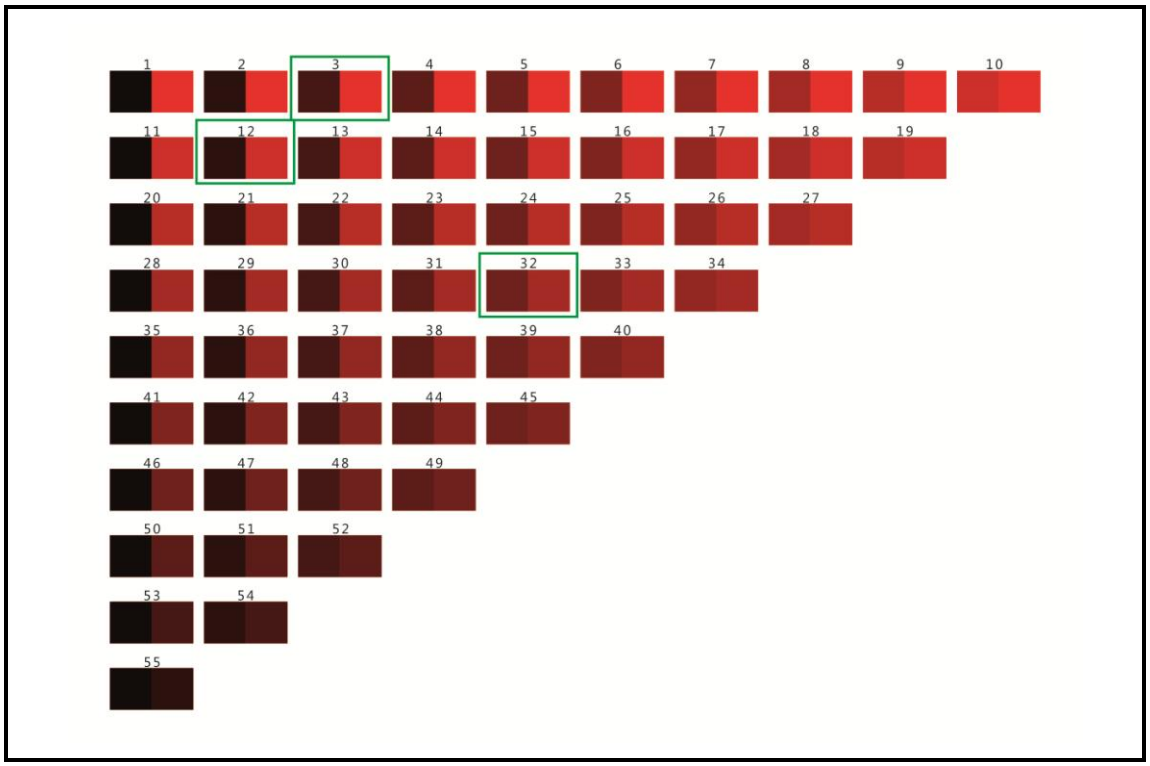


Figure 7.5 Consistency between personal preference and objective attraction in color-purity contrast

(5) Color-brightness

Generally, the statistical results show that brightness level 1 was preferred outright, with others receiving little or nor preference, besides black which was level 11. In terms of objective attraction, all showed attention grabbing ability, but 5 and 6 were higher. From a consistency aspect, 1 and 5 were higher. Analyses of these features found that: The color brightness levels that attracted the elderly's attention were mainly in the central range: 5 and 6. From the subjective preference perspective, however, the opposite trend was true: 1 and 11. The best consistency was mainly in the middle part of the distribution from 5 to 8, the moderate brightness range, as well as the two sides of the spectrum. This shows that aside

from the two extreme brightness levels, medium brightness can also be fitting for the elderly visual perception (Table 7.6, and Figure 7.6).

Table 7.6 Consistency between personal preference and objective attraction in color-brightness

CBC	1	2	3	4	5	6	7	8	9	10	11
S	26 (100%)	5 (19%)	2 (8%)	1 (4%)	2 (8%)	1 (4%)	4 (9%)	5 (19%)	1 (4%)	1 (4%)	13 (50%)
OA	0.017 (3%)	0.000 (0%)	0.037 (7%)	0.199 (40%)	0.504 (100%)	0.197 (39%)	0.158 (31%)	0.255 (51%)	0.243 (48%)	0.207 (41%)	0.012 (2%)
OB	0.060 (14%)	0.258 (59%)	0.290 (66%)	0.251 (57%)	0.352 (80%)	0.439 (100%)	0.269 (61%)	0.188 (43%)	0.168 (38%)	0.090 (21%)	0.130 (30%)
MOAB	8.5	29.5	36.5	48.5	90.0	69.5	46.0	47.0	43.0	31.0	16.0
M	**54.25**	24.25	22.25	26.25	**49.00**	36.75	27.50	33.00	23.50	17.50	33.00

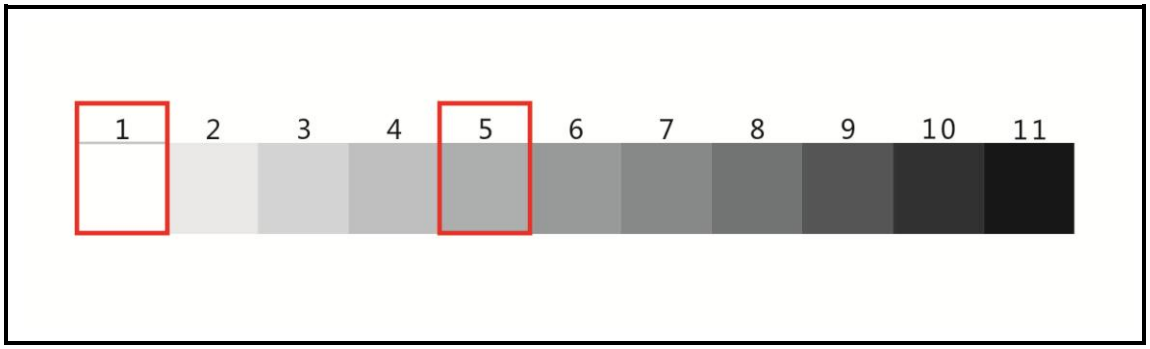


Figure 7.6 Consistency between personal preference and objective attraction in color-brightness

(6) Color-brightness contrast

The statistical results include just 15 samples, as there were 55 sets on the VPT-1 assessment TB and VPT-2, and the excessive stimulus caused decentralized visual response. As such, some data points are missing S or MOAB, and the consistency cannot be calculated. Therefore, the three sets listed in the data analysis can only be used as representative sets for this section. Due to the small amount of data, all were used for statistical analysis.

Generally, the statistical results show that contrasts 7, 15, 24 and 32 displayed the higher consistencies. 15, 24 and 32 had moderate brightness with high and

moderate contrast, while 7 had low brightness with weak contrast. Therefore, the contrasts with moderate brightness range and moderate or high contrast as well as low brightness and weak contrast need to be considered the better color-brightness contrast range for the Chinese elderly (Table 7.7, and Figure 7.7).

Table 7.7 Consistency between personal preference and objective attraction in color-brightness contact

CBCC	2	7	15	19	23	24	25	31	32	37	38	43	44	48	52
S	1 (33%)	3 (100%)	2 (67%)	1 (33%)	1 (33%)	1 (33%)	1 (33%)	1 (33%)	1 (33%)	1 (33%)	1 (33%)	1 (33%)	2 (67%)	2 (67%)	1 (67%)
OA	0.015 (14%)	0.015 (14%)	0.055 (51%)	0.007 (100%)	0.007 (7%)	0.107 (100%)	0.042 (39%)	0.029 (27%)	0.071 (66%)	0.021 (20%)	0.039 (37%)	0.006 (6%)	0.019 (18%)	0.017 (16%)	0.050 (47%)
OB	0.030 (10%)	0.033 (12%)	0.069 (24%)	0.017 (6%)	0.043 (15%)	0.119 (41%)	0.087 (30%)	0.242 (84%)	0.288 (100%)	0.072 (25%)	0.107 (37%)	0.020 (69%)	0.035 (12%)	0.031 (11%)	0.027 (9%)
MOAB	12.0	13.0	37.5	53.0	11.0	70.5	34.5	55.5	83.0.	22.5	37.0	37.5	15.0	13.5	28.0
M	22.50	**56.50**	**52.25**	43.00	22.00	**51.75**	33.75	44.25	**58.00**	27.75	35.00	35.25	41.00	40.25	47.50

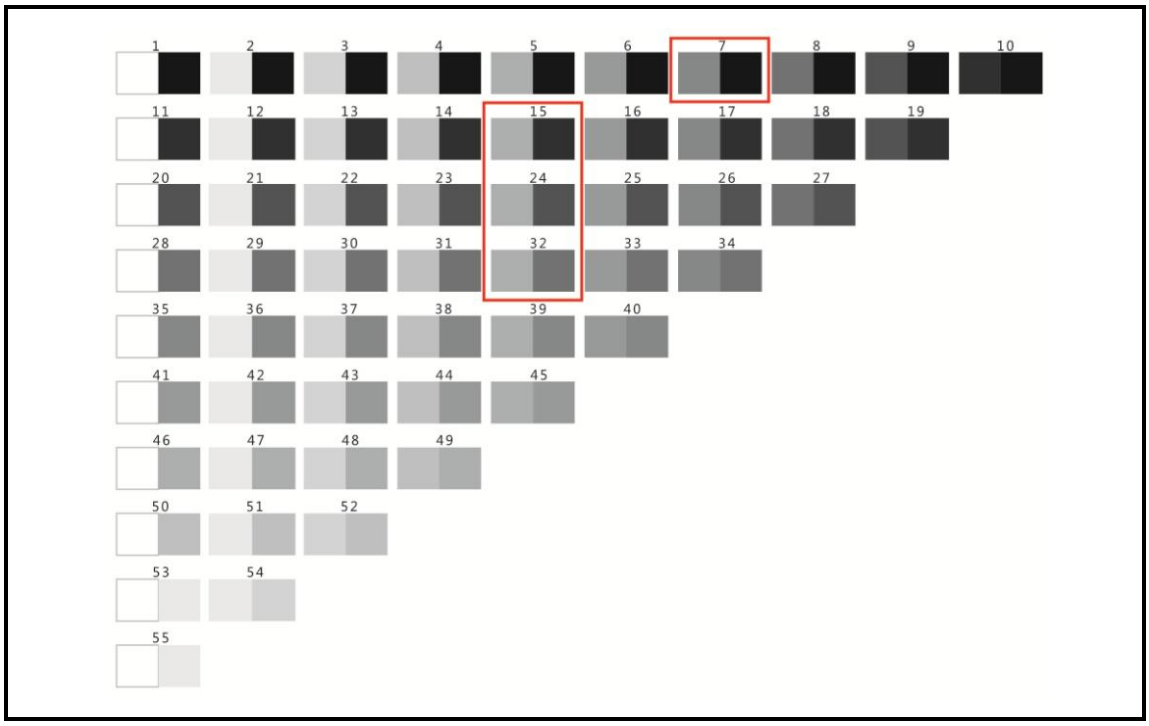


Figure 7.7 Consistency between personal preference and objective attraction in color-brightness contrast

(7) Shape

Generally, the statistical results show that shapes 7, 12 and 15 were higher in personal preference, but 12 was preferred outright. In terms of objective attraction, 7, 11 and 12 were relatively higher, with 7 the highest. From a consistency aspect, 7, 12 and 15 were higher, and 7 was the highest. Analyses of these features found that:

In general, the representational shapes i.e.: heart, flower and star are significantly more preferred. This indicates representational shapes are more easily identified and preferred by the Chinese elderly. In addition, the rounded triangle with the stocky, and complex shape with the exploratory feeling are easy to spark the elderly's interest.

The three shapes also had very high similarity in consistency. In addition, it is worth mentioning that the Heart shape had a strong consistency in line with elderly preference and interest (Table 7.8, and Figure 7.8).

Table 7.8 Consistency between personal preference and objective attraction in shape

ShaC	1	2	5	6	7	8	9	10	11	12	15	16
S	8 (36%)	1 (5%)	2 (9%)	2 (9%)	18 (82%)	4 (18%)	5 (23%)	2 (9%)	5 (23%)	22 (100%)	21 (95%)	3 (14%)
OA	0.051 (7%)	0.078 (38%)	0.043 (21%)	0.106 (51%)	0.208 (100%)	0.017 (8%)	0.019 (9%)	0.070 (34%)	0.075 (36%)	0.190 (91%)	0.100 (48%)	0.132 (63%)
OB	0.015 (3%)	0.019 (4%)	0.012 (2%)	0.174 (34%)	0.516 (100%)	0.020 (4%)	0.046 (9%)	0.052 (10%)	0.452 (88%)	0.097 (19%)	0.051 (10%)	0.067 (13%)
MOAB	5.0	21.0	11.5	42.5	100.0	6.0	9.0	22.0	62.0	55.0	29.0	38.0
M	20.50	13.00	10.25	25.75	**91.00**	12.00	16.00	15.50	42.50	**77.50**	**62.00**	26.00

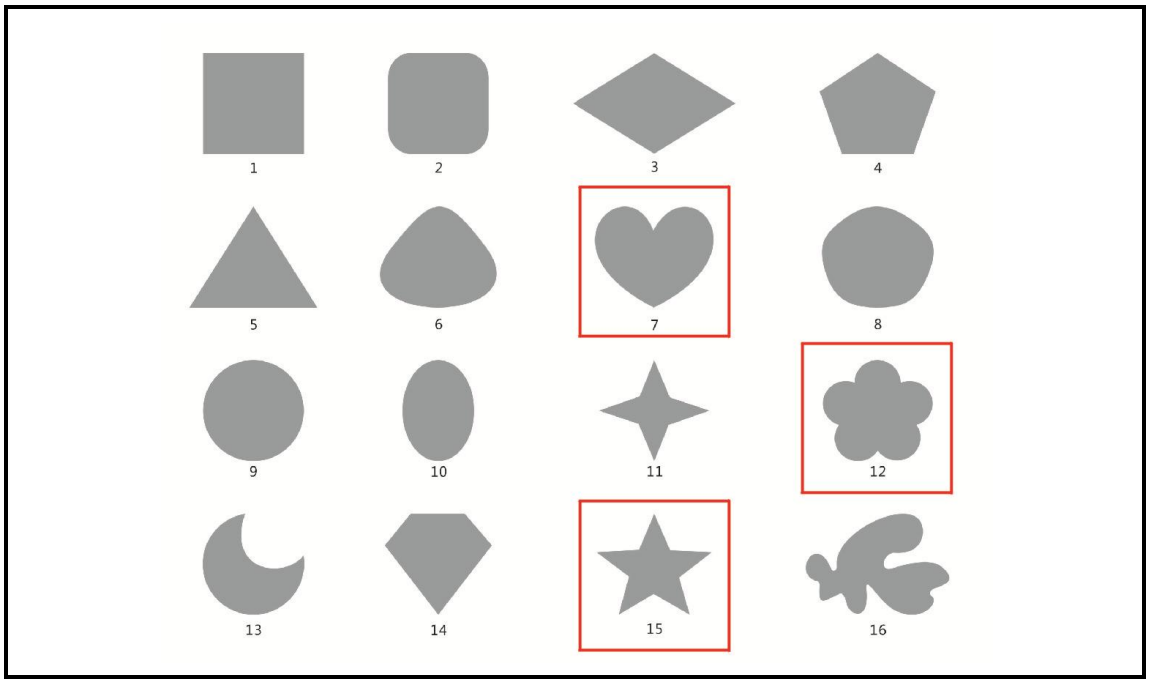


Figure 7.8 Consistency between personal preference and objective attraction in shape

(8) Size

Generally, the statistical results show that sizes 1, 3, and 5 were higher in personal preference, but all showed preferential selection. In terms of objective attraction, 1 was the highest, but similar results occurred. From a consistency aspect, 2 and 3 were higher, and 2 was the highest. Analyses of these features found that:

The relatively larger size is preferred by Chinese elderly as well as achieving objective attraction with higher consistency. Due to the decline in eyesight accompanying age change, the larger size should be beneficial to them. All sizes had a decent consistency, excluding the slightly lower 4 and 6. This indicates that reaction to size is relative, with different reactions based on different individual conditions (Table 7.9, and Figure 7.9).

Table 7.9 Consistency between personal preference and objective attraction in size

SizC	1	2	3	4	5	6	7
S	12 (60%)	20 (100%)	19 (95%)	11 (55%)	14 (70%)	7 (35%)	12 (60%)
OA	0.194 (21%)	0.908 (100%)	0.317 (35%)	0.169 (19%)	0.181 (20%)	0.266 (29%)	0.091 (10%)
OB	0.497 (55%)	0.900 (100%)	0.222(25%)	0.119 (13%)	0.000 (0%)	0.056 (6%)	0.322 (36%)
MOAB	38.0	100.0	30.0	16.0	10.0	17.5	23.0
M	49.00	**100.00**	**62.50**	35.50	40.00	26.25	41.50

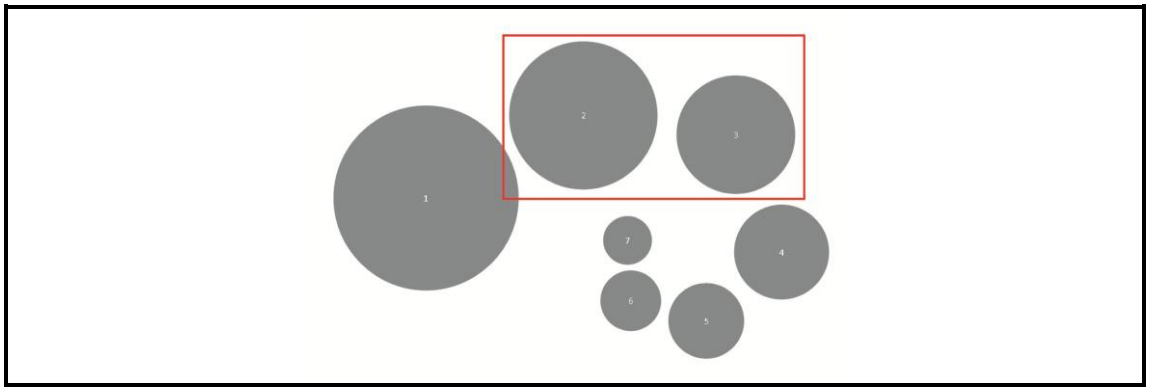


Figure 7.9 Consistency between personal preference and objective attraction in size

(9) Material and texture

The statistical results show that A3 and C2 were higher in personal preference, but C2 was preferred outright. In terms of objective attraction, B3, C2 and D3 were relatively higher, with B3 the highest. From a consistency aspect, C2 was the highest. Analyses of these features found that:

Overall, the subjects favored a variety of materials in differing degrees of consistency with objective attraction. The smooth glass and mid-rough textures displayed the higher consistencies. However, the best consistency was wood with a mid-rough texture. This shows that the only material that is closely related to nature is the most welcome by the elderly. Moreover, mid-rough textures, which are conducive to the formation of a soft visual perception and have good tactile impression, are preferred. This should be consistent with the elderly visual perception feature (Table 7.10, and Figure 7.10).

Table 7.10 Consistency between personal preference and objective attraction in material and textures

MTC	A2	A3	B1	B2	B3	C1	C2	C3	D2	D3	E1	E2	E3
S	7 (27%)	13 (50%)	2 (8%)	4 (15%)	8 (31%)	4 (15%)	26 (100%)	11 (42%)	7 (27%)	4 (15%)	3 (12%)	2 (8%)	2 (8%)
OA	0.010 (3%)	0.013 (4%)	0.165 (51%)	0.068 (21%)	0.207 (64%)	0.214 (66%)	0.325 (100%)	0.0652 (20%)	0.153 (47%)	0.149 (46%)	0.036 (11%)	0.042 (13%)	0.138 (42%)
OB	0.017 (4%)	0.026 (6%)	0.074 (18%)	0.113 (28%)	0.410 (100%)	0.132 (32%)	0.254 (62%)	0.015 (4%)	0.106 (26%)	0.387 (94%)	0.077 (19%)	0.036 (9%)	0.036 (9%)
MOAB	3.5	5.5	34.5	24.5	82.5	49.5	81.5	12.5	36.5	70.5	15.5	11.5	25.5
M	15.25	27.50	21.25	19.75	56.50	32.00	90.50	27.00	31.75	42.50	13.50	9.50	16.75

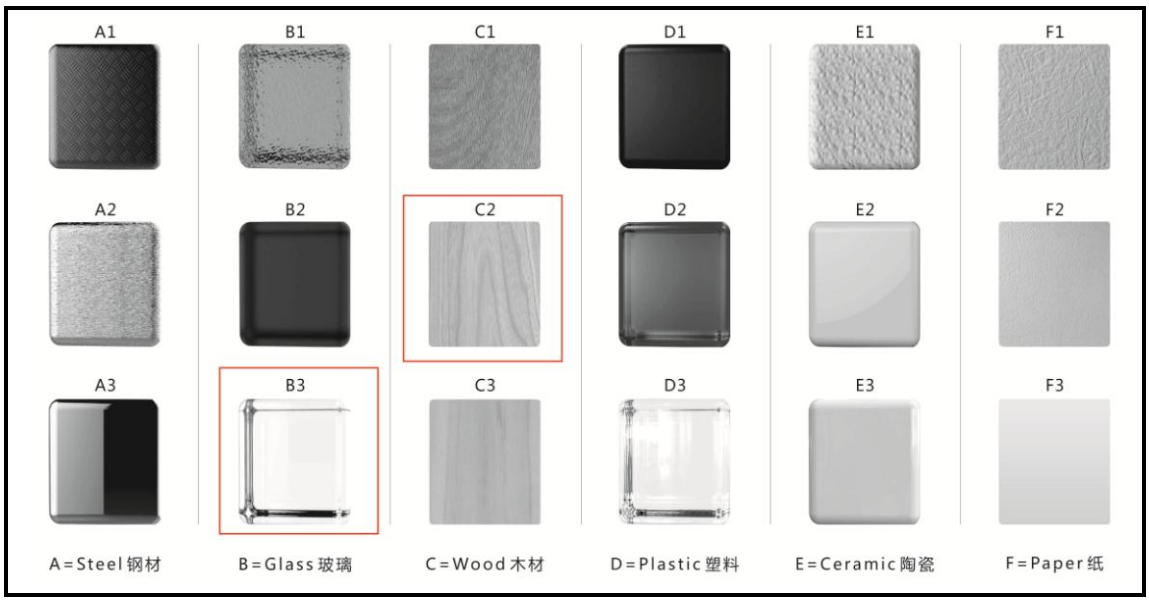


Figure 7.10 Consistency between personal preference and objective attraction in material and textures

(10) Pattern

Patterns 2 and 6 were higher in personal preference, but 2 was preferred outright. In terms of objective attraction, all patterns could attract attention but 2 was the highest, closely followed by 5. From a consistency aspect, discrepancy was quite high, with 2 having the distinct advantage and 6 showing more preference with higher consistency. Analyses of these features found that:

Concrete patterns, that is, easily identifiable detailed patterns, have a higher degree of consistency between personal preferences and objective attraction. Additionally, Chinese traditional patterns have the similar features. Although the others have certain appealing qualities, the results showed that there are styles the subject would prefer (Table 7.11, and Figure 7.11).

Table 7.11 Consistency between personal preference and objective attraction in pattern

PC	1	2	3	4	5	6
S	7(22%)	32(100%)	8(25%)	5(16%)	4(13%)	18(56%)
OA	0.164(24%)	0.521(76%)	0.184(27%)	0.126(18%)	0.688(100%)	0.460(67%)
OB	0.260(25%)	1.042(100%)	0.316(30%)	0.418(40%)	0.587(56%)	0.497(48%)
MOAB	24.5	88.0	28.5	29.0	78.0	57.5
C	23.25	**94.00**	26.75	22.50	45.50	**56.75**

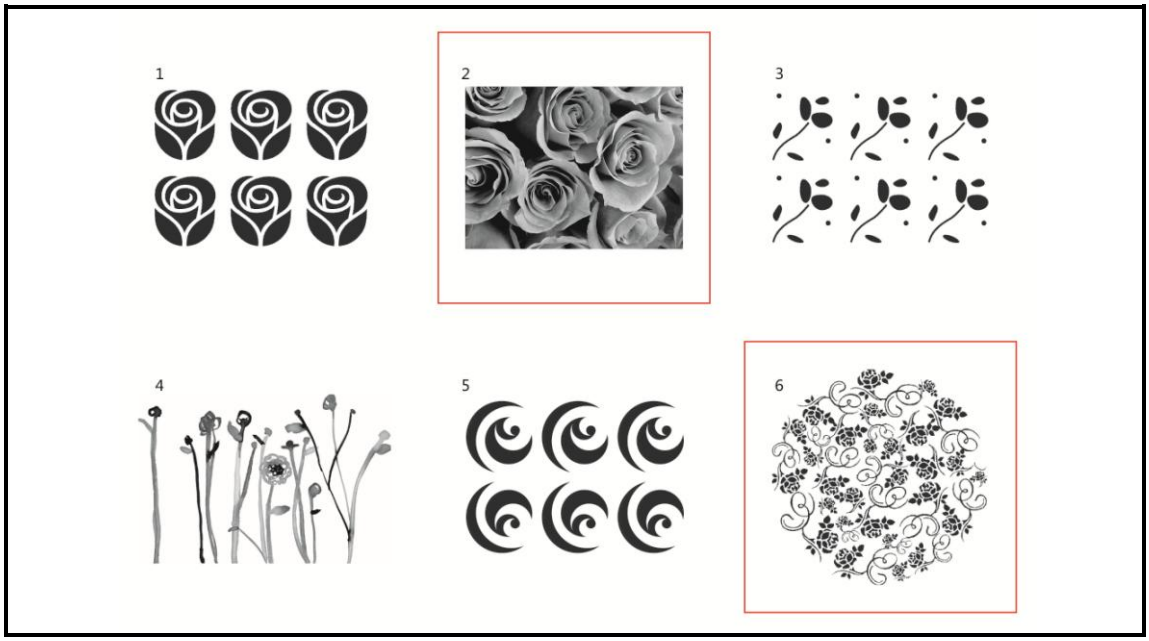


Figure 7.11 Consistency between personal preference and objective attraction in pattern

(11) Product design

The statistical results show that product designs 7, 9 and 15 were higher in personal preference, but 15 was preferred outright. In terms of objective attraction, 8 and 15 were relatively higher, with 15 the highest. From a consistency aspect, 7, 8,

9 and 15 were higher, and 15 was again the highest. Analyses of these features found that:

As a whole, the subjects' personal preferences have significant differences from visual perception, but kettles with basic styling are still more popular. The elderly do not seem to care about excessive innovation in kettle design, and can accommodate a variety of materials, but it is better to have a relatively embellished color or contrast formed by the material itself. Moreover, the basic shape and familiar, traditional style and durable feeling can arouse a nostalgic emotion and elicit their preference. The Chinese traditional style showed the most consistency in terms of similarity between subjective and objective (Table 7.12, and Figure 7.12).

Table 7.12 Consistency between personal preference and objective attraction in product

PDC	2	3	4	5	6	7	8	9	10	11	12	14	15	16	17	18
S	8 (38%)	9 (43%)	2 (10%)	4 (19%)	1 (5%)	19 (90%)	1 (5%)	16 (76%)	1 (5%)	3 (14%)	1 (5%)	2 (10%)	21 (100%)	1 (5%)	2 (10%)	2 (10%)
OA	0.027 (8%)	0.158 (47%)	0.045 (13%)	0.039 (12%)	0.083 (25%)	0.094 (28%)	0.336 (100%)	0.146 (43%)	0.072 (21%)	0.003 (1%)	0.015 (5%)	0.028 (8%)	0.196 (58%)	0.095 (28%)	0.081 (24%)	0.066 (20%)
OB	0.048 (15%)	0.164 (30%)	0.126 (23%)	0.092 (17%)	0.086 (16%)	0.167 (31%)	0.545 (100%)	0.175 (32%)	0.242 (44%)	0.074 (14%)	0.014 (3%)	0.102 (19%)	0.318 (58%)	0.216 (40%)	0.078 (14%)	0.018 (3%)
MOAB	11.5	38.5	18.0	14.5	20.5	29.5	100.0	37.5	32.5	7.5	4.0	13.5	58.0	34.0	19.0	11.5
M	24.75	40.75	14.00	16.75	12.75	**59.75**	**52.50**	**56.75**	18.75	10.75	4.50	11.75	**79.00**	19.50	14.50	10.75

Figure 7.12 Consistency between personal preference and objective attraction in product

(12) Layout of newspaper

Generally, the statistical results show that layouts 2, 3, and 4 all showed similar consistency, but 1 was highest outright. In terms of objective attraction, 4 was relatively higher than the rest. From a preference aspect, 2 and 3 received equal selection as the highest. Analyses of these features found that:

The layout of newspaper with text and images matched moderately as well as with a slightly image heavy layout was preferred by most subjects. However, the dynamic and unconventional layout of newspapers can attract the elderly's attention easily. Meanwhile, due to increased images and combination of unique visual effects, such layouts can allow for higher consistency (Table 7.13, and Figure 7.13).

Table 7.13 Consistency between personal preference and objective attraction in layout of newspaper

LNC	1	2	3	4
S	15 (58%)	26 (100%)	26 (100%)	21 (81%)
OA	0.201 (22%)	0.576 (64%)	0.898 (100%)	0.620 (69%)
OB	0.158 (14%)	0.930 (81%)	1.144 (100%)	1.137 (99%)
MOAB	18.0	72.5	100.0	84.0
C	38.00	**86.25**	**100.00**	82.50

Figure 7.13 Consistency between personal preference and objective attraction in layout of newspaper

7. 3 Positive Visual Experience (PVE) Factors

In this section, the optimal VE factors for the Chinese elderly will be further discussed. In fact, the optimal VE composition is associated with a number of factors. In the VE process, many factors mutually effect and impact one another, and can produce different results between a good VE and a bad VE. This research focuses on the good factors of the VE. These factors, integrated together, will be beneficial to the VE. Based on these factors, the production of a VE is proposed creating a Positive Visual Experience (PVE).

PVE factors include four indicators:

- **Subjective preference factors**

Personal preference factors in visual perception are an important component in PVE. They can meet the needs of the elderly on a physical and psychological level, which are the subjective visual and emotional requirements, and as such need to be given a high priority. In the VE process, if specific personal preference factors are not easily found, it is a visual stimulus to the elderly that their preferred factors are not present, causing them to passively accept a product without a pleasurable mood or feeling and possibly generating a tied feeling. This makes it impossible for them to have a better VE. This experience also is a passive experience.

- **Easier finding factors**

Easier finding factors are an important component in the PVE from an objective perspective. Quickly attracting the elderly visual attention in the first instantce, and

then triggering their interest is a factor of concern. Despite the experience throughout the process, if personal preference factors are not easily found, a PVE feeling is not attainable and the experience feels unilateral. If there is an element that I like, but it is not present, it is difficult to feel a pleasurable emotion. This experience is a passive experience.

- **Easier attracting factors**

Easier attracting factors are also an important component in PVE from an objective perspective. They can hold the elderly's attention for a sustained period of time, allowing a trigger of potential positive feeling matched with their preferences. The stimulus that most likely attracted the attention of the individual is also the factor that keeps them interested. In the process of experience, the stimuli that are focused on for the longest period of time continue to generate a larger interest. If the stimulus factors presented are not attractive, these factors do not have the possibility of triggering furthered interest. This experience is also a passive experience.

- **Consistency factor**

Consistency factor is an important indicator that integrates subjective preference factors, easier finding factors, and easier attracting factors.

This indicator does not tend towards any one factor, but is the average of three indicators listed above. It is a comprehensive and general PVE factor that is most likely to form a pleasant feeling.

In this section, the Chinese elderly PVE factors will be identified. As the first time to fixation data is important for identifying which stimuli can quickly attract the eye, it will be used as the connecting VE factor between the integrated statistics, consistency between subjective and objective identified in the last section, and the PVE factors specially catered for the Chinese elderly's subjective visual preference, objective attention, quick stimuli reaction and positive emotion.

To achieve this purpose, the following statistical results are based on the Factor Analysis Approach. In order to provide average data with consistency between both aspects, the adapted data are the statistical results of consistency between the subjects' subjective preferred factors and the objective factors discovered in the last section, as well as the time to first fixation found in the VPT-2 assessment. The analyzed result will be the final PVE factors proposed through this investigation.

The data analyses adopted two main data sets to compare and achieve the desired results:

- Integrated data of group A and B (IABD) from PVP-2 assessment and eye tracking device's recorded data in time to first fixation;
- Consistency correlation data-2 (CCD-2) on the IABD and CCD-1.

7.3.1 Data analyses

(1) Data use

In order to ensure data adheres to statistic rationality, and is based on representative principles, the data was used in accordance to the following rules:

- Because statistics are for C and MOABT consistency data generating, if either or both of C and MOABT are missing, the result will be eliminated, as calculation will produce a false result;
- Two sets of statistics data, Time to First Fixation from group A and B recorded by Tobii X60 eye tracking device, were run through the Tobii Studio 1.5 software at this stage of the study;
- PVE is a mean data of C and MOABT;
- For typical sample and interpretation, just the higher value of data in the leading position of a set of data bases the average in specific circumstances.

(2) Calculation method

Due to the different representations of calculative units, in order to compare two sets of data and calculate one data unit output, the data utilized a common calculation method of Normalization with the Maximal Value (NMV). Because less time of stimulus found just reflects its strong attractiveness, therefore, the final calculative value needs to convert minimum value into negative percentage units for maximum value.

The specific calculation method is as follows:

- Set the maximum value of stimulus' data among each set data as a (100%) baseline;
- Use other values of stimulus' data divided by the maximum value and calculate percentage value;
- Convert each percentage value into negative percentage.

For example: code 1 of OAT's and 2 of OBT's numerical value are highest, therefore, those can be set as 100 percent baseline and expressed in brackets (100%). The other, code 2 of OAT with numerical value of 0.998 divided by 1 of OAT with 1.189, is 84 %, the code 2 of OBT with numerical value of 1.118 divided by 1 of OBT with 2.258, is 43 %. The calculative mean value of code 1 of OAT and OBT (MOABT) use OAT's 100 plus OBT's 100, and then divided by 2 to calculate out 100. The calculative code 2 of MOABT is used OAT's 84 plus OBT's 43, and then divided by 2 to calculate out 63.5. The final negative percentage of code 1 of MOABT calculated use 100 minus 100 to 0, and code 2 of MOABT calculated use 100 minus 63.5 to 36.5 (Table 7.14).

Table 7.14 Sample of percentage and negative percentage calculation

Code	1	2
OAT	1.189 (100%)	0.998 (84%)
OBT	2.585 (100%)	1.118 (43%)
MOABT	100.0 (0.0)	63.5 (36.5)

It is appropriate to note that a variation in elderly visual perceptional ability is normal. Therefore, the data reflects the normal and natural state of the Chinese elderly, especially in the eye tracking data recorded. Further statistical results are also based on the overall analysis of the data shown without consideration and distinction of age or gender divide, allowing calculation of the overall average data.

(3) Figure and Table description

- **Table:** Includes 5 sets of data with percentage conversion, and one with negative percentage conversion.
- **Figure:** Visualization of statistical analysis results.
- **Abbreviation:** In order to clearly display the statistical results in each table,

specialized vocabularies were replaced by abbreviations. The details are as follows：

- **OAT** = Objective of group A in time to first fixation
- **OBT** = Objective of group B in time to first fixation
- **MOABT** = Mean value of OAT and OBT
- **C** = S (subjective) and MOAB of (objective of group A and B)
- **PVE** = Positive visual experience factors based on the consistency of MOABT and C
- **CHC** = Color-hue code
- **CHCC** = Color-hue contrast code
- **CPC** = Color-purity code
- **CPCC** = Color-purity contrast code
- **CBC** = Color-brightness code
- **CBCC** = Color-brightness contact code
- **ShaC** = Shape code
- **SiaC** = Size code
- **MTC** = Materials and textures code
- **PC** = Pattern code
- **PDC** = Product design code
- **LNC** = Layout of newspaper code

7.3.2 Analyses of PVE consistency between first time to fixation and consistency between subjective and objective data

(1) Color-hue

The statistical results show that the code numbers 1, 2 and 3 are the most important PVE factors in color hue with higher PVE consistency. The final results show that the warm color series is in a dominant position. Warm colors elicit a sense of progress, and in Chinese traditional culture they represent good fortune and happiness. These colors fit the Chinese elderly subjective preference and objective attraction condition (Table 7.15, and Figure 7.14).

Table 7.15 PVE factors in color-hue

CHC	1	2	3	4	5	6	7	8	9	10	11	12
OAT	0.375 (19%)	0.502 (25%)	0.938 (47%)	1.401 (69%)	1.109 (55%)	1.702 (84%)	2.019 (100%)	1.557 (77%)	1.047 (52%)	1.379 (68%)	1.248 (62%)	0.628 (31%)
OBT	0.952 (46%)	0.914 (44%)	0.998 (48%)	1.706 (82%)	1.522 (73%)	1.330 (64%)	2.092 (100%)	1.490 (71%)	1.394 (67%)	1.678 (80%)	1.368 (65%)	1.617 (77%)
MOABT	32.5 (67.5)	34.5 (65.5)	47.5 (52.5)	75.5 (24.5)	64.0 (36.0)	74.0 (36.0)	100.0 (0.0)	74.0 (36.0)	59.5 (40.5)	74.0 (36.0)	63.5 (36.5)	54.0 (46.0)
C	60.25	36.00	49.00	20.00	53.25	44.00	47.00	24.00	58.25	38.00	43.75	23.50
PVE	**63.88**	**50.75**	**50.75**	22.25	44.63	40.00	23.50	30.00	49.38	37.00	40.13	34.75

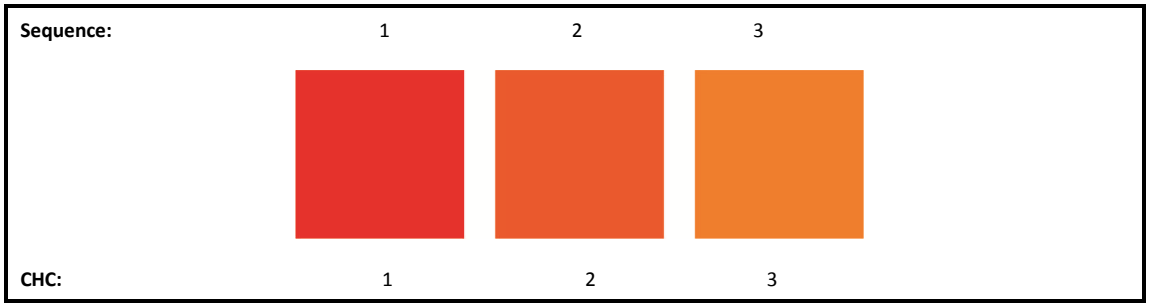


Figure 7.14 PVE factors in color-hue

(2) Color-hue contrast

The statistical results show that the code numbers 7, 1, 13, 9, 3, 10 and 4 are the most important PVE factors in color-hue contrast with higher PVE consistency.

The final results show that contrasts including colors from the warm color series as well as those with blue were in a dominant position. This was similar to their favorite color hue. Overall, color hue contrast presents a softer trend. This shows that there were no strong opposite color contrast preferred. Therefore, using the highest intensity hue contrast is not suitable for the elderly. The group of color-hue contrast identified for PVE would be the better option to consider when designing for the elderly (Table 7.16, and Figure 7.15).

Table 7.16 PVE factors in color-hue contrast

CHCC	1	2	3	6	8	9	10	12	13	14	15	16	17	18	19
OAT	1.275 (32%)	1.909 (48%)	0.810 (20%)	0.354 (9%)	1.937 (49%)	1.923 (48%)	0.855 (22%)	3.974 (100%)	1.419 (36%)	1.393 (35%)	1.584 (40%)	3.484 (88%)	1.530 (39%)	1.775 (45%)	2.085 (53%)
OBT	0.868 (28%)	1.255 (41%)	0.297 (10%)	0.679 (22%)	1.197 (39%)	0.716 (23%)	1.248 (40%)	1.074 (35%)	1.721 (56%)	2.282 (74%)	1.955 (63%)	1.245 (40%)	2.946 (95%)	2.820 (91%)	3.092 (100%)
MOABT	30.0 (70.0)	44.5 (55.5)	15.0 (85.0)	15.5 (84.5)	44.0 (56.0)	35.5 (64.5)	31.0 (69.0)	67.5 (32.5)	46.0 (54.0)	54.5 (45.5)	51.5 (48.5)	64.0 (36.0)	67.0 (33.0)	68.0 (32.0)	76.5 (23.5)
C	67.25	38.00	27.25	12.00	33.00	65.25	63.75	5.15	34.00	42.00	48.50	21.25	19.50	18.50	20.00
PVE	**68.62**	46.75	**56.13**	48.25	44.50	**64.88**	**66.38**	18.83	44.00	43.75	48.50	28.63	26.25	25.25	21.75

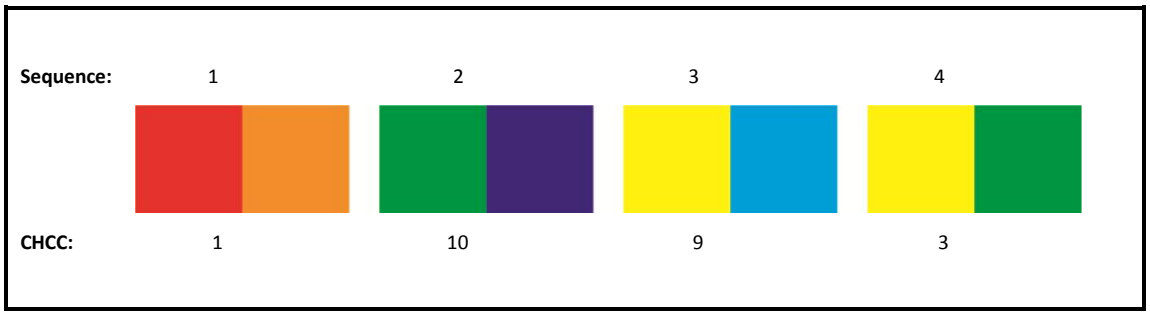


Figure 7.15 PVE factors in color-hue contrast

(3) Color-purity

The statistical results show that the code numbers 3 are the most important PVE factors in color purity with higher PVE consistency. The final result shows that color purity in the middle-upper range were in a dominant position. The results were different from what was first imagined. Instead, more moderate and softer purities are more suitable to their visual perception (Table 7.17, and Figure 7.16).

Table 7.17 PVE factors in color-purity

CPC	1	2	3	4	5	6	7	8	10
OAT	2.018 (100%)	0.746 (40%)	0.194 (10%)	0.798 (40%)	1.222 (61%)	1.108 (55%)	0.736 (37%)	1.249 (62%)	0.428 (21%)
OBT	1.064 (61%)	0.708 (41%)	1.408 (81%)	1.171 (68%)	1.395 (80%)	1.451 (84%)	1.242 (72%)	1.736 (100%)	0.832 (48%)
MOABT	80.5 (19.5)	40.5 (59.5)	45.5 (54.5)	54.0 (46.0)	70.5 (29.5)	69.5 (30.5)	54.5 (45.5)	81.0 (19.0)	34.5 (65.5)
C	57.75	35.75	67.50	36.00	51.50	31.00	31.00	13.50	24.75
PVE	38.63	47.63	**61.00**	41.00	40.50	30.75	38.25	16.25	45.13

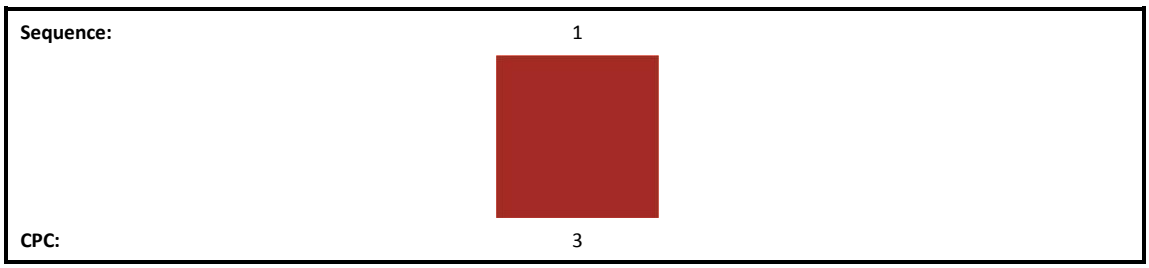


Figure 7.16 Bar chart of PVE factors in color-purity

(4) Color-purity contrast

The statistical results show that the code numbers 3, 9, 25, 26 and 32 are the most important PVE factors in color-purity contrast with higher PVE consistency. The final results show that contrasts located in the range of 9 and 26, with high purity with weak contrast, and 25 and 32, with moderate purity with moderate contrast, and contrast 3, with high purity with strong contrast, were most suitable. These features reveal that the color purity contrasts in a PVE are in the high purity zone, but with the strong to medium intensity levels for the Chinese elderly (Table 7.18, and Figure 7.17).

Table 7.18 PVE factors in color-purity contrast

CPCC	3	4	9	12	25	26	30	31	32	33	36	55
OAT	1.534 (40%)	3.871 (100%)	0.568 (15%)	1.700 (44%)	0.200 (5%)	0.517 (13%)	3.001 (78%)	1.200 (31%)	1.540 (40%)	2.609 (67%)	2.217 (57%)	1.370 (35%)
OBT	0.225 (6%)	2.064 (52%)	1.608 (41%)	3.955 (100%)	1.466 (37%)	1.024 (26%)	0.277 (7%)	1.675 (42%)	1.271 (32%)	1.547 (39%)	3.018 (76%)	3.535 (89%)
MOABT	23.0 (77.0)	76.0 (24.0)	28.0 (72.0)	72.0 (28.0)	21.0 (79.0)	19.5 (80.5)	42.5 (57.5)	36.5 (63.5)	36.0 (64.0)	53.0 (47.0)	66.5 (33.5)	62.0 (38.0)
C	69.00	19.50	41.00	50.25	21.00	35.00	28.75	30.75	52.50	31.00	18.50	18.00
PVE	**73.00**	21.75	**56.50**	39.13	**50.00**	**57.75**	43.13	47.13	**58.25**	39.00	26.00	28.00

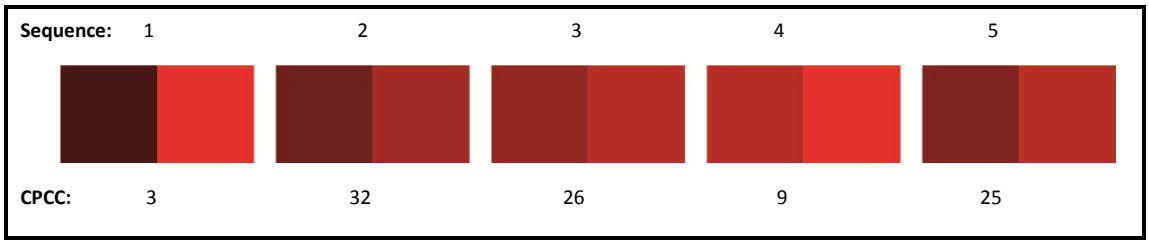


Figure 7.17 PVE factors in color-purity contrast

(4) Color-brightness

The statistical results show that the code numbers 3, 4, 5 and 9 are the most important PVE factors in color brightness with higher PVE consistency. The final results show that brightness levels located in the middle-upper range were most suitable overall. Therefore, it can be confirmed that the elderly prefer bright but not dazzling. However, partial light with soft, comfortable, and moderate brightness are more suitable for their visual perception (Table 7.19, and Figure 7.18).

Table 7.19 PVE factors in color-brightness

CBC	1	3	4	5	6	7	8	9	10	11
OAT	3.086 (100%)	0.070 (2%)	0.627 (20%)	0.746 (24%)	1.760 (57%)	1.951 (63%)	1.759 (60%)	0.933 (30%)	0.427 (14%)	0.384 (12%)
OBT	0.800 (46%)	1.049 (60%)	0.691 (39%)	1.271 (73%)	1.753 (100%)	1.542 (88%)	0.670 (38%)	0.519 (30%)	1.626 (93%)	1.713 (98%)
MOABT	73.0 (27.0)	31.0 (69.0)	29.5 (70.5)	48.5 (51.5)	78.5 (21.5)	75.5 (24.5)	49.0 (51.0)	30.0 (70.0)	53.5 (46.5)	55.0 (45.0)
C	54.25	22.25	26.25	49.00	36.75	27.50	33.00	23.50	17.50	33.00
PVE	40.63	**45.63**	**48.38**	**50.25**	29.13	26.00	42.00	**46.75**	32.00	39.00

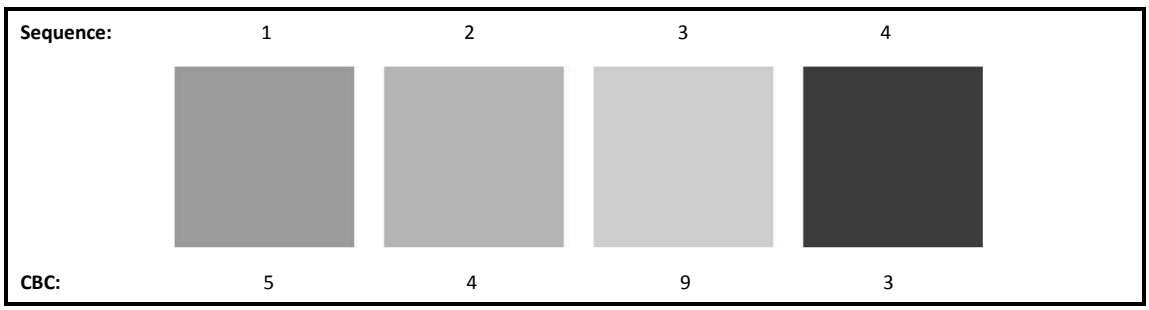


Figure 7.18 PVE factors in color-brightness

(6) Color-brightness contrast

The statistical results show that the code numbers 7, 31, 32, 38, 43 and 48 are the most important PVE factors in color-brightness contrast with higher PVE consistency. 7 is located in the dark-brightness range with strong contrast, number 43 and 48 are located in the light-brightness range with weak contrast, and number 31, 32 and 38 are located in the moderate-brightness range with moderate contrast. Therefore, the moderate-brightness range with moderate to strong and weak contrast can be considered the most suitable color-brightness contrast range based on the findings.

Additionally, the statistical results show that the code number 32 is important PVE factors in color-brightness contrast with higher PVE consistency. The features reveal that the PVE of color-brightness contrast in the moderate-brightness zone can have a moderate contrast. In short, the too strong of a brightness contrast is not suitable for the Chinese elderly, but an appropriate degree of contrast needs to be maintained in order to allow for proper recognition (Table 7.20, and Figure 7.19).

Table 7.20 PVE factors in color-brightness contact

CBCC	2	7	15	19	23	24	25	31	32	37	38	43	44	48	52
OAT	3.621 (100%)	1.028 (28%)	1.660 (64%)	1.208 (33%)	0.688 (19%)	1.916 (53%)	2.673 (74%)	1.779 (49%)	0.291 (8%)	2.526 (70%)	0.512 (14%)	0.295 (8%)	2.115 (58%)	0.427 (12%)	3.232 (89%)
OBT	0.881 (24%)	2.825 (78%)	2.039 (56%)	3.094 (84%)	3.503 (95%)	2.445 (67%)	2.734 (75%)	1.332 (36%)	0.553 (15%)	2.850 (78%)	1.594 (43%)	1.205 (33%)	3.671 (100%)	2.254 (61%)	1.582 (43%)
MOABT	62.0 (38.0)	53.0 (47.0)	60.0 (40.0)	58.5 (41.5)	57.0 (43.0)	60.0 (40.0)	74.5 (25.5)	42.5 (57.5)	11.5 (88.5)	74.0 (26.0)	28.5 (71.5)	20.5 (79.5)	79.0 (21.0)	36.5 (63.5)	66.0 (34.0)
C	22.50	56.50	52.25	43.00	22.00	51.75	33.75	44.25	58.00	27.75	35.00	35.25	41.00	40.25	47.50
PVE	30.25	**51.75**	46.13	42.25	32.50	45.88	29.63	**50.86**	**73.25**	26.88	**53.25**	**57.38**	31.00	**51.88**	40.75

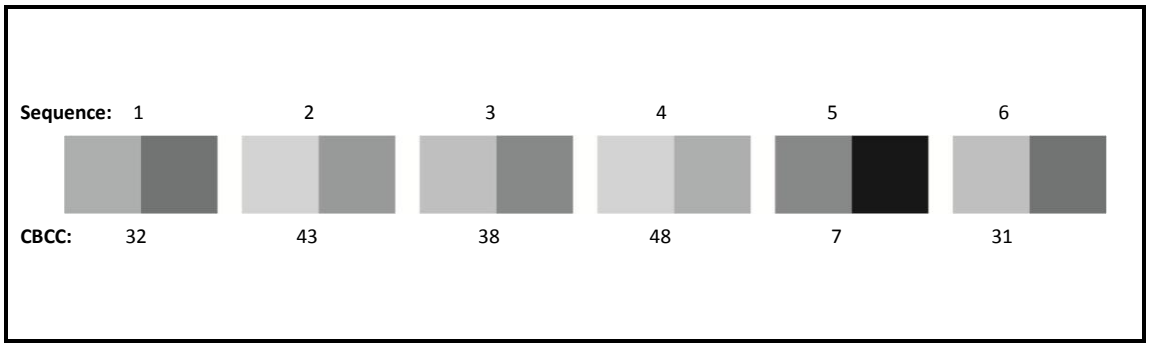


Figure 7.19 PVE factors in color-brightness contrast

(7) Shape

The statistical results that the code numbers 7 and 12 are the most important PVE shapes with higher PVE consistency. The final results show that representational shapes, i.e. heart or flower, are significantly more preferred by the subjects. This indicates that representational shapes are more easily identified and preferred by the Chinese elderly. Moreover, representational shapes can stimulate their imagination and evoke memory of past events. Besides, both shapes are considered symbols of good things, and as such are able to produce pleasant emotions for them. Therefore, the representational shape is a PVE factor which needs to be considered in design for Chinese elderly products (Table 7.21, and Figure 7.20).

Table 7.21 PVE factors in shape

ShaC	1	2	5	7	8	9	10	11	12	15	16
OAT	2.595 (100%)	0.919 (35%)	0.602 (23%)	2.066 (80%)	1.306 (50%)	1.084 (42%)	2.114 (82%)	1.284 (50%)	1.780 69%)	1.113 (43%)	1.228 (47%)
OBT	2.735 (90%)	1.093 (36%)	1.170 (39%)	3.035 (100%)	1.665 (55%)	1.004 (33%)	0.233 (8%)	1.399 (46%)	1.445 (48%)	0.980 (32%)	0.882 (29%)
MOABT	95.0 (5.0)	35.5 (64.5)	31.0 (69.0)	90.0 (10.0)	52.5 (47.5)	37.5 (62.5)	45.0 (55.0)	48.0 (52.0)	58.5 (41.5)	37.5 (62.5)	38.0 (62.0)
C	20.50	13.00	10.25	91.00	12.00	16.00	15.50	42.50	77.50	62.00	26.00
PVE	12.75	38.75	39.63	**50.50**	29.75	39.25	35.25	47.25	**59.50**	**62.25**	44.00

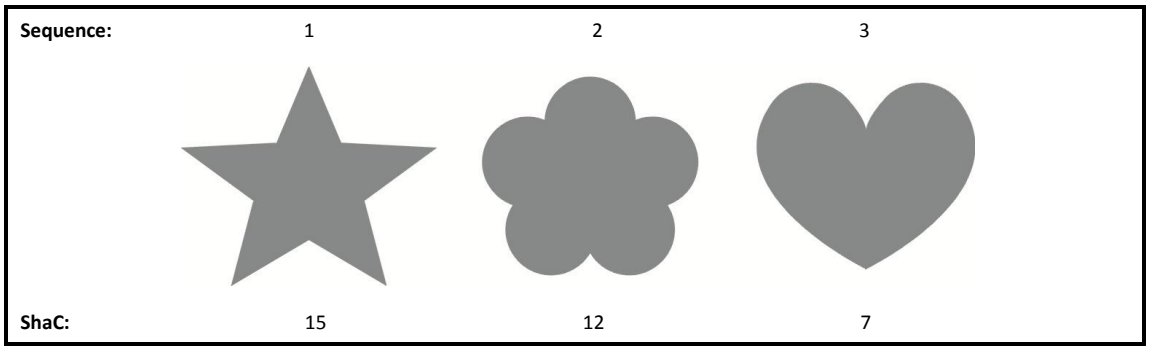


Figure 7.20 PVE factors in shape

(8) Size

The statistical results show that the code numbers 2 is the most important PVE sizes with higher PVE consistency, but that relative size and its contrast to other items affects the perception of an item. In general, however, larger sizes were most suitable for the elderly, but they do not require sizes that are overly sized. Additionally, slightly smaller sizes did show some importance. Therefore, it indicates that size in the PVE can vary for different individuals, but the overall trend is that a larger size is better (Table 7.22, and Figure 7.21).

Table 7.22 PVE factors in size

SizC	1	2	3	4	6	7
OAT	0.870 (57%)	0.858 (56%)	1.535 (100%)	1.309 (85%)	0.626 (41%)	1.388 (90%)
OBT	0.664 (47%)	0.993 (70%)	0.950 (67%)	1.426 (100%)	0.882 (62%)	0.925 (65%)
MOABT	52.0 (48.0)	63.0 (37.0)	83.5 (16.5)	92.5 (7.5)	51.5 (48.5)	69.0 (31.0)
C	49.00	100.00	62.50	35.50	26.25	41.50
PVE	**48.50**	**68.50**	39.50	21.50	37.38	36.25

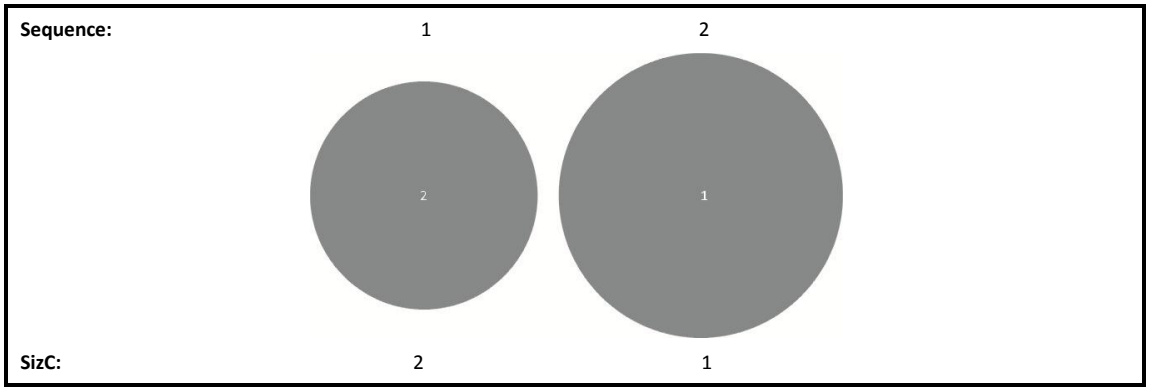


Figure 7.21 Bar chart of PVE factors in size

(9) Material and texture

The statistical results show that the code numbers B3 and C2 are the most important PVE material and texture combinations with higher PVE consistency. The final results show that wood was the best PVE element amongst materials because of its close relation to nature and higher applicability by the Chinese elderly. Glass materials are also commonly used in their daily life. These two materials can be considered to elicit more positive emotion. Additionally, the mid-rough surface, which offers a relatively neutral feel, can evoke two sides of tactile feeling, both strong and delicate, and allow for more easy manipulation. Rough texture is more easily perceived, especially amongst hard materials (Table 7.23, and Figure 7.22).

Table 7.23 PVE factors in material and textures

MTC	A2	A3	B1	B2	B3	C1	C2	C3	D2	D3	E2	E3
OAT	3.766 (100%)	1.922 (51%)	0.431 (11%)	1.762 (47%)	1.426 (38%)	1.760 (47%)	1.742 (46%)	1.953 (52%)	2.082 (55%)	2.188 (58%)	1.391 (37%)	1.719 (46%)
OBT	0.333 (13%)	0.508 (19%)	2.162 (82%)	1.625 (61%)	1.001 (38%)	2.143 (81%)	1.809 (68%)	2.643 (100%)	1.356 (51%)	2.466 (38%)	2.520 (95%)	0.401 (15%)
MOABT	56.5 (43.5)	35.0 (65.0)	46.5 (53.5)	54.0 (46.0)	38.0 (62.0)	64.0 (36.0)	57.0 (43.0)	76.0 (24.0)	53.0 (47.0)	48.0 (52.0)	66.0 (34.0)	30.5 (69.5)
C	15.25	27.50	21.25	19.75	56.50	32.00	90.50	27.00	31.75	42.50	9.50	16.75
PVE	29.38	46.25	37.38	32.88	**59.25**	34.00	**66.75**	25.50	39.38	47.25	21.75	43.13

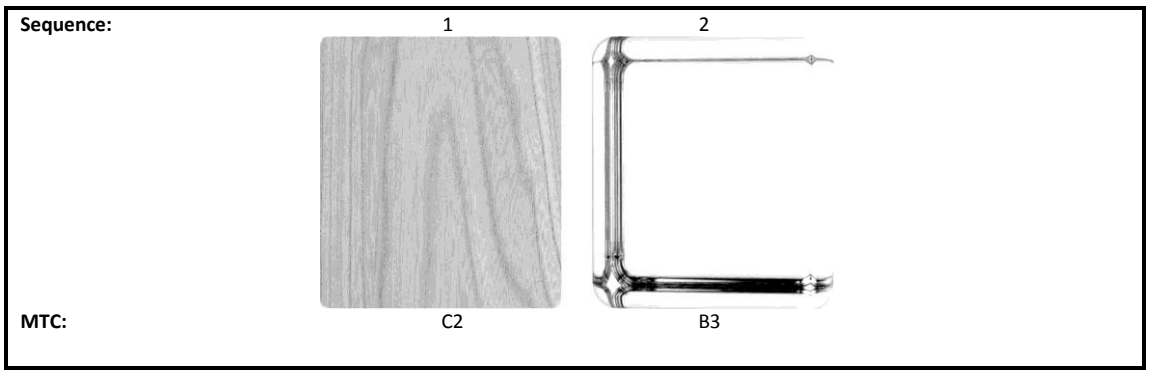


Figure 7.22 PVE factors in material and textures

(10) Pattern

The statistical results show that the code numbers 2, 6 and 5 are the most important PVE patterns with higher PVE consistency. The final results show that concrete patterns with details and lined features that are easy to identify were most suitable. Chinese traditional patterns have those concrete features. On the contrary, more abstract patterns are not suitable PVE elements. Therefore, in design, patterns with the concrete features are conducive to the elderly VE, and easily evoke a desire for exploring and elicit emotional memories (Table 7.24, and Figure 7.23).

Table 7.24 PVE factors in pattern

PC	1	2	3	4	5	6
OAT	1.631 (69%)	0.702 (30%)	1.348 (57%)	2.353 (100%)	0.998 (42%)	0.766 (33%)
OBT	1.009 (65%)	0.701 (45%)	1.556 (100%)	1.392 (89%)	1.222 (79%)	1.418 (91%)
MOABT	67.0 (33.0)	37.5 (62.5)	78.5 (21.5)	94.5 (5.5)	60.5 (39.5)	62.0 (38.0)
C	23.25	94.00	26.75	22.50	45.50	56.75
PVE	28.13	**78.25**	24.13	14.00	**42.50**	**47.38**

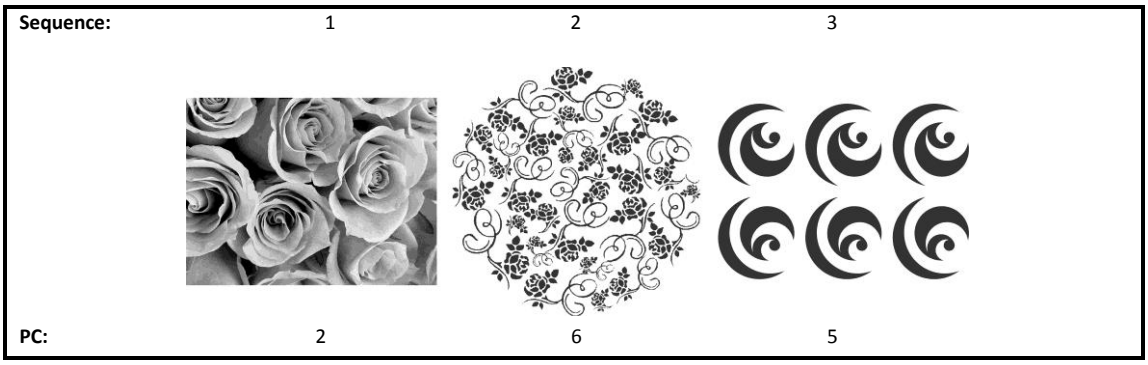


Figure 7.23 PVE factors in pattern

(11) Product design

The statistical results show that the code numbers 3, 7, 8, 9 and 15 are the most important PVE examples of product design with higher PVE consistency. The final results show that the kettles with the basic styling were most suitable. Familiar, traditional, and durable feeling styles are more fitting for the Chinese elderly. They

do not care for excessive and modern innovation. They can accommodate a variety of materials, but still mostly prefer ceramic, plastic and metal-based. The relatively colorful or kettle with a Chinese traditional pattern can arouse their nostalgic emotion (Table 7.25, and Figure 7.24).

Table 7.25 PVE factors in product

PDC	2	3	4	5	7	8	9	10	11	12	14	15	16	17	18
OAT	3.617 (100%)	1.744 (48%)	1.574 (44%)	2.401 (66%)	0.353 (10%)	1.503 (42%)	1.358 (38%)	1.233 (34%)	0.479 (13%)	2.622 (72%)	0.479 (13%)	2.035 (56%)	1.725 (48%)	1.409 (39%)	0.820 (23%)
OBT	0.047 (1%)	1.203 (33%)	1.878 (51%)	1.913 (52%)	2.604 (70%)	1.650 (45%)	0.924 (25%)	1.436 (39%)	1.304 (35%)	1.135 (31%)	3.696 (100%)	1.207 (33%)	0.898 (24%)	1.772 (48%)	1.526 (41%)
MOABT	50.5 (49.5)	40.5 (59.5)	47.5 (52.5)	59.0 (41.0)	40.0 (60.0)	43.5 (56.5)	31.5 (68.5)	36.5 (63.5)	24.0 (76.0)	51.5 (48.5)	56.5 (43.5)	44.5 (55.5)	36.0 (64.0)	43.5 (56.5)	32.0 (68.0)
C	24.75	40.75	14.00	16.75	59.75	52.50	56.75	18.75	10.75	4.50	11.75	79.00	19.50	14.50	10.75
PVE	37.13	**50.13**	33.25	28.88	**59.88**	**54.50**	**62.63**	41.13	43.38	26.50	27.63	**67.25**	41.75	35.50	39.38

Figure 7.24 PVE factors in product

(12) Layout of newspaper

The statistical results show that the code numbers 2, 3 and 4 are the most important PVE sample layouts with higher PVE consistency. The final results show that the layouts of newspaper that matched text and images moderately or was slightly image heavy were most suitable. Comparatively, the text-based or unconventional layout can easily be seen as rigid or too dynamic, causing confusion. The PVE layout features listed are more conducive to the mental needs of the elderly in their pursuit of moderate and stable feelings (Table 7.26, and Figure 7.25).

Table 7.26 PVE factors in layout of newspaper

LNC	1	2	3	4
OAT	1.189 (100%)	0.998 (84%)	0.826 (70%)	1.018 (86%)
OBT	2.585 (100%)	1.118 (43%)	0.303 (12%)	0.801 (31%)
MOABT	100.0 (0.0)	63.5 (36.5)	41.0 (59.0)	58.5 (41.5)
C	38.00	86.25	100.00	83.00
PVE	19.00	**61.38**	**79.50**	**62.25**

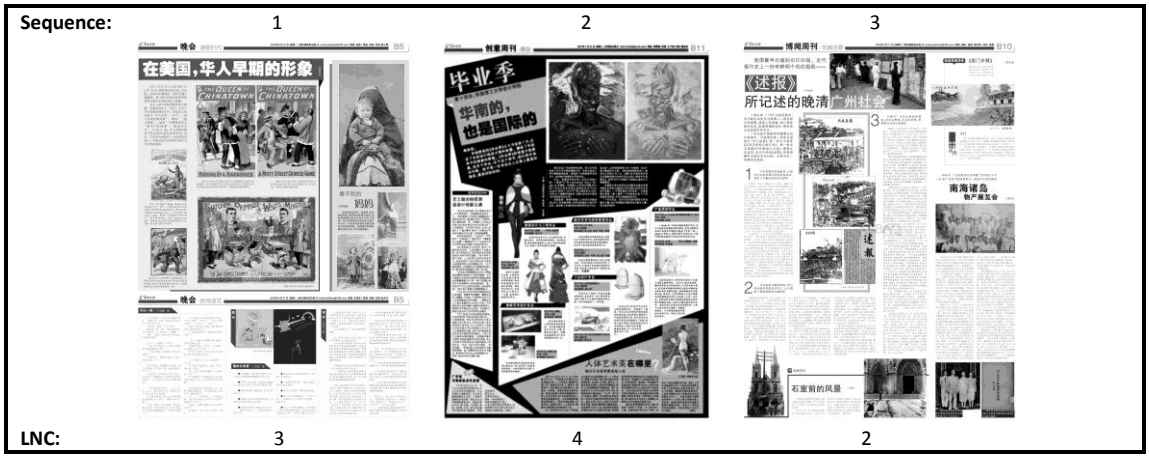


Figure 7.25 PVE factors in layout of newspaper

7.3.3 Purpose of proposed PVE factors

PVE, as an integrated concept, focused on the combination of many favorable factors in the VE process. The concept of PVE for the elderly that is proposed is founded on the principle that the elderly VE can elicit positive emotion through objective and subjective conditions that are based on the consistency between their personal subjective preferences, objective attraction, and objects that gain the fastest response (Men 2011). Based on this requirement for a PVE, the relevant PVE factors for elderly Chinese have been further identified via investigation for design consideration.

Based on the purpose of PVE, with the investigative results of PVE factors in design for elderly Chinese, the PVE concepts have gradually become clear. In order to put forth PVE concepts with factors that can be valuable in design for the special

needs of elderly Chinese, accurate descriptions of standard PVE concepts need to be proposed.

(1) Concept of PVE proposed

PVE, the Positive Visual Experience, can be defined as the best visual experience state when people are in an interactive condition with a product or surroundings. The experience includes feelings, composed of an integrated consistency between subjective preference and objective attraction, which eventually generate a pleasurable emotion. PVE is formed depending on a series of objective effects from visual stimuli presented in color, shape, size, texture, pattern and light, and a comprehensive matching between these factors with attention grabbing and observation length as well as the viewer's preferred factors subjective to culture, experience, habit, and so forth. These multiple positive elements, integrated together, will promote a positive and pleasurable effect throughout the VE activities of the process (Men 2016). If they are not met, it can lead to a Negative Visual Experience (NVE) (Figure 7.26).

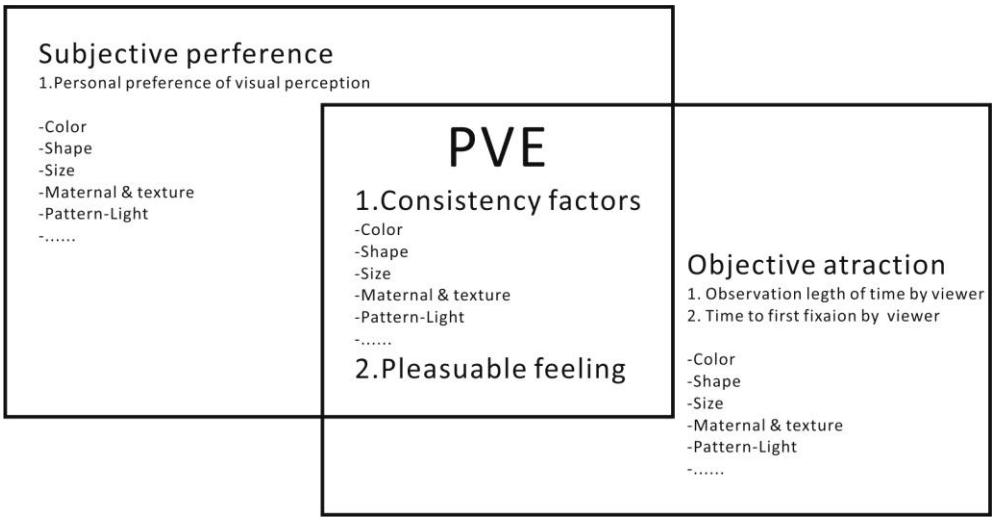
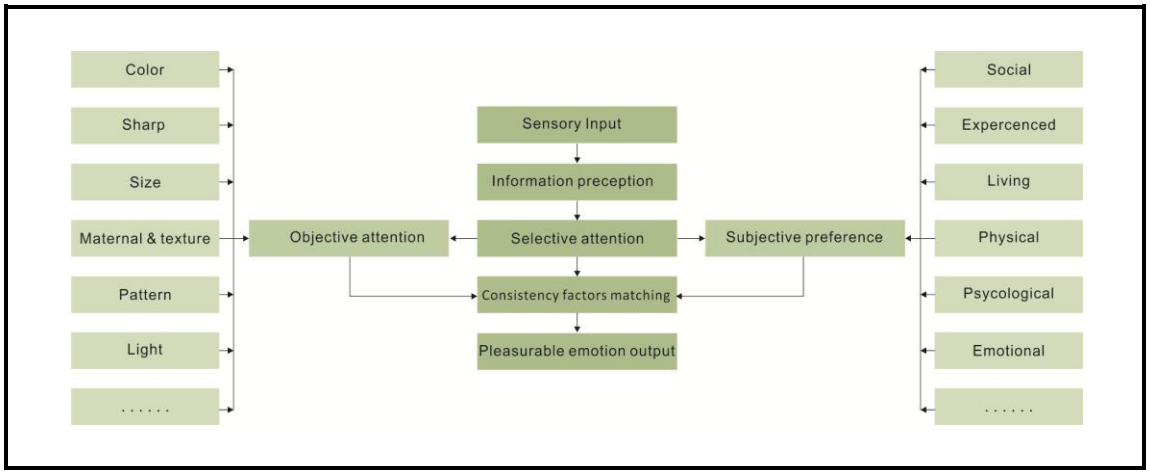


Figure 7.26 Model of PVE factors formation proposed

(2) PVE process proposed

PVE factors are achieved through a process. In the PVE process for elderly, their VE behavior is in a natural state. Objective information perception, the blending of personal subjective preferences, as well as produced pleasant emotions, are happening spontaneously. Therefore, for the designer, creating a PVE includes consideration for the special circumstances of the elderly, analysis of their features from a subjective and objective aspect in order to provide them with better VE factors, and completion of a better VE process that includes satisfaction and pleasant emotion in the unconscious. This is a positive process. The elderly will happily be dragged along. The opposite of this is a VE process that leads to a NVE. The PVE process framework is shown in Figure 7.27.



7.27 Framework of PVE process proposed

7.4 Summary

This chapter is focused on the analyses of consistency between data from the VPT-1 and VPT-2 assessments for the eventual identification of PVE factors. Closely following the purpose and objectives specific to this research, the analyses adapted a comprising approach to discover consistency amongst a range of VE factors including: subjective personal preference, subjects' response time and observation length. Next, PVE factors dependent on the consistency of these three aspects were illustrated. Lastly, PVE concepts and the PVE process model were proposed.

As anticipated, the analysis in this chapter achieved results as follows:

- Through the analyses of consistency between subjective and objective data and interpretation amongst color-hue, color-hue contrast, color purity, color-purity contrast, color-brightness, color-brightness contrast, shape, size, material and texture, pattern, product design, and layout of newspaper, it was found that personal preferences of elderly Chinese are in line with objective attraction;
- The optimal VE factors for elderly Chinese, coined as Positive Visual Experience (PVE) factors, are presented and discussed via the statistics and analysis of the three data indicators combined;
- The PVE concept is further discussed and proposed;
- PVE process framework is clarified.

The general features of VE and the PVE factors for elderly Chinese reflected in the data have satisfied the requirements of the investigation in this chapter. The

overall results and analyzed findings fully supporting the conclusion, and form the core of the next chapter.

CHAPTER 8.

CONCLUSION AND RECOMMENDATIONS

This research conducted an investigation into the elderly's visual experience features, relating them to design via a set of methods that explored their subjective and objective visual experience behaviors and factors. The aim was to discover the factors that specifically demonstrate the physiological and psychological characteristics associated with age, visual perception characteristics, and subjective and objective factors related to pleasure.

This research was underpinned by two main disciplines：Ergonomics and cognitive psychology． Mainly based on their theoretic sources and basic approaches, many studies were referenced throughout the process of investigation. Moreover, in the field of design, a variety of design concepts and practices with new methods developed in recent years provided different insights and a wealth of information. They include: Experience Design, User-Centered Design, Universal Design, Emotional Design, and so forth. These design concepts and methods represent the future trend of design, and are to a certain extent, the support and enrichment of this study. However, the methodology and focus of this study was not limited to these disciplines and domains, but also includes areas such as Elderly Psychology, Environmental Psychology, Developmental Psychology, and so forth. While they are less intricately related, they also provided additional support with relevant knowledge. Therefore, this study is a fusion of knowledge. On these bases, the research framework and methods for investigation were constructed.

This main research method was to find the positive visual experience factors for elderly individuals. This, in essence, was a combination of methods used to substantiate the PVE theory hypothesized. By searching the arguments around this

hypothesis, the relevant theoretical basis for supporting the PVE concept was found and research approaches proposed. There is ample evidence to show that human-environment-object (Environmental psychology perspective) has experiential factors closely related to two aspects of human visual experience; subjective and objective. Subjectivity was reflected through the elderly's visual characteristics. This includes decline in physical ability, visual preferences, and desire; along with accumulation of culture and conditions of pleasant mood production. The collection of this subjective information required new assessment methods to be constructed. Visual attention measurements, on the other hand, relied on various stimulus factors to measure a series of physiological and psychological reactions including attraction, attention, interest, and emotional reaction. These were acquired through a series of device centered tests designed for the collection and processing of objective data. In this research, the VPT-1 assessment was developed with specially formulated contents for subjective information collection, and the VPT-2 assessment was developed with specially formulated contents in electronic format for objective data collection with a testing device. The Eye Tracker (ET) is one of the best options for testing and calculating natural reaction time and the length of attention on an item. The research adopted a statistical consistency method between subjective preference and objective attraction. This depends on the subjects' TB preference selection via VPT-1 assessment, and objective data collection of VPT-2 assessment via eye-tracking device and its stimulation observation length and time to fist fixation automatically calculated by the software. Finally, through the comparison of the subjective information and objective data, points of consistency became the basis for the elderly Positive Visual Experience. The development of testing contents was

done through continuous optimization in order to form enhanced assessments that best fit the elderly cognitive features. Positive Visual Experience concepts as well as exploration methods are the main contributions in this study. They can be used to define Visual Experience features for different target groups, which can be put into product design and development for creating Positive Visual Experiences. The results of the study have universal applicability with obvious significance.

A total of 191 people participated in this study throughout the different survey stages including: Participant and expert interviews, VPT-1 assessment, VPT-2 assessment, and observation. As a research, although the number of participants and subjects in the study do not limit the theory, consideration of the validity and representation of the selected participants and subjects in this study was based on a random or natural sample basis.

Moreover, this research put forward unique ideas on Positive Visual Experience concepts and their collection methods. The methodological feasibility was verified by its continual improvement throughout development and into the final format. Visual Experience is a holistic consideration that connects multiple aspects of physiology, psychology, cognition, and emotion. This research formed distinguishable characteristics setting it apart from other similar studies in the field of design for the elderly. The most obvious difference was the variety of theories, concepts, and methods used that were based on respective theoretical frameworks in previous visual experience research. This kind of holistic research, which integrates a variety of knowledge bases and reference methods, has not yet been seen in other research theories. The combination of physical and psychological aspects while seeking the

Positive Visual Experience design elements is a rare and unique approach to finding and identifying more specific issues. This research, through the development and validation of the methodology, provides more specific outcomes.

In terms of information and data collection, except the conventional methods of observation and interviews (participants and experts), the assessment methods were specially tailored research methods with distinctive features. Their development and role play a decisive factor throughout the study and the final outcome of the investigation. Because the information and data related to the elderly visual experience was necessarily obtained from subjective and objective aspects, therefore, this assessment integrated two approaches to achieve this purpose. They include the VPT-1 assessment with BT (manual basis) offering subjective appraisal and VPT-2 assessment using the Eye Tracker device (computer aid) for objective testing. These two groups of information and data respectively represent the elderly subjective visual preference characteristics and objective reaction characteristics. While these two groups of statistics represent different factors of visual experience, they may reflect the mismatch phenomenon between subjective desire and actual reaction within real surroundings. Based on these issues and theoretical discussion on improved visual experience state and condition, the new concepts of Positive Visual Experience were proposed. As the core of this research, it provides a reflection for Visual Experience that goes beyond function and usability, with the aim of pursuing pleasurable design.

This thesis, from a new perspective, widely discussed the possibility of a PVE. It also, through method development, further identified some different considerations

on the elderly VE based on statistical results of PVE factors. This reflection is embodied when the elderly VE is fully aligned with the PVE factors. Aside from the experienced feeling brought on by function and usability in design and product development, whether the design ignores the elderly VE needs is based on the designer's personal understanding. Even designer's subjective understanding can cause adverse reactions in the VE. This thesis defines elderly PVE factors and presents how to create a PVE for elderly individuals. On the one hand, these PVE findings can be used in product development as a design reference for the improvement of elderly VE quality, hopefully avoiding NVE. On the other hand, PVE concepts and the methods proposed can be extended for a wider range of use.

Overall, this thesis embodies the characteristics of qualitative and quantitative analysis, offering data calculated support as an important aspect of scientific verification. Its objective data was automatically computer generated. "User research" with data supported statistical results can show the inherent laws of the elderly VE characteristics. The positive and negative experience factors produced by design can also be verified. This goes to show that the application of scientific research could further assist the study of rationality and veritable result outputs.

The aim and objectives of this research was to present a thesis that could highlight the whole explorative journey around the elderly PVE and finally achieve the goal of original contribution in the following main aspects:

- **Theoretical and methodological basis:** The thesis successfully found the theoretical and methodological basis in pleasurable mood generation when visual representation is in line with the personal cognitive preference in VE from

previous literature, interviews, and observation.

- **Consistency factors:** The thesis found the factors of consistency existing between personal subjective preferences and objective reaction, and examined the common elderly VE features in relation to physiological and psychological effects, specifically reflected in vision, perception, and emotion. These results proposed will contribute to the further understanding of the elderly needs and experiences, and provide valuable reference for improving pleasurable and satisfactory reaction in the elderly VE.
- **PVE concepts:** PVE concepts were proposed so design can consider the target group's VE factors and bring them a pleasant experience. These concepts state that PVE is the overall reaction between humans, environments, and objects. It connects the common physiological and psychological features with the stimulus from the external surroundings and object itself. It looks at physiological reaction, as well as emotional arousal on a psychological level. The resulting PVE factors identified in this thesis can be used as design concepts enabling different target groups to experience their wanted, needed, and observed factors that elicit pleasurable mood during the VE process.
- **VPT assessments and TB development：** Development of VPT assessments for collecting subjective preference information and objective attraction data further determines the PVE. They find pleasurable factors based on their generic cognitive needs and preferences in product design. Consistency factors were the key aspects that aim to achieve PVE identification. The concept extracts the elderly subjective preference and objective attraction factors in the VE that occur in a consistent state, showing an accord between their visual

preference features and the external appearance of the design or environment presented. Under the premise of this consistency, it is possible to produce a pleasurable mood and reaction.

Framework of PVE process: A framework of PVE formation was proposed for optimal understanding of this concept. The objective perception information, blended subjective preferences, and pleasant emotion production, were all observed in a spontaneous state. Therefore, the designer gains critical PVE characteristics, allowing them to analyze their features from a subjective and objective standpoint in order to provide better VE factors. This allows them to create a VE process that elicits satisfaction and pleasant emotions in the unconscious. This is a positive process that the elderly should welcome with open arms.

This research is to explored and adopted feasible methods to discover the consistency between subjective desire and objective environmental reactions for providing the optimal pleasurable VE conditions for elderly individuals through results produced. These theoretical and methodological research results on PVE can offer guidance, with the approaches developed, and be used in more extensive. It can be used for specific product design study and practices for different target groups across different regions, types, and for groups with significant cognitive differences, such as children or those with significant visual impairment. Simultaneously, it is also able to provide a conceptual and methodological reference for a wider range of user experience research.

Pleasurable product designs are more likely to produce happiness and joy during the user experience. It breaks through over consideration of function and usability in product design, and raises product design to a pleasurable emotion level. PVE will improve the relationship between the human and the physical environment. Future design trends will be more concerned with human emotions as well as emotional reactions. PVE concepts and use of its methods in design will be conducive for improving VE quality and eliciting pleasurable feeling for the elderly. Because this research is focused on elderly Chinese, its results and specific defining PVE factors are not necessarily suitable for other elderly of other regions. PVE research and the adoption of its methods also need continual development and discussion based on more regions and target groups for its future improvement.

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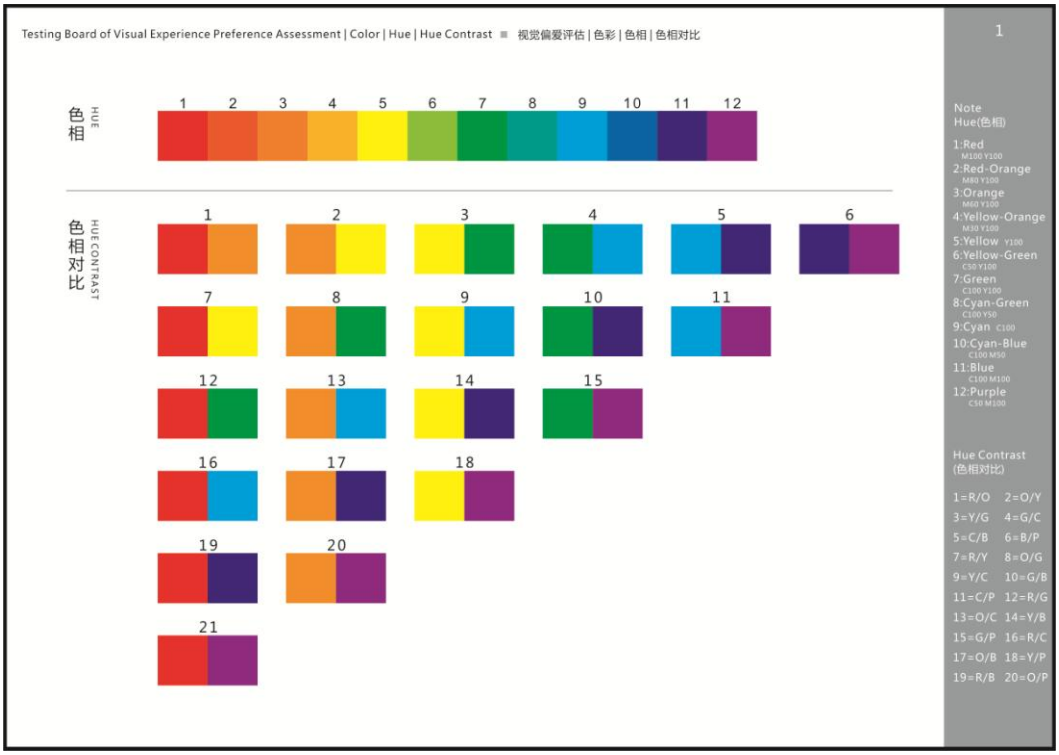
APPENDICES

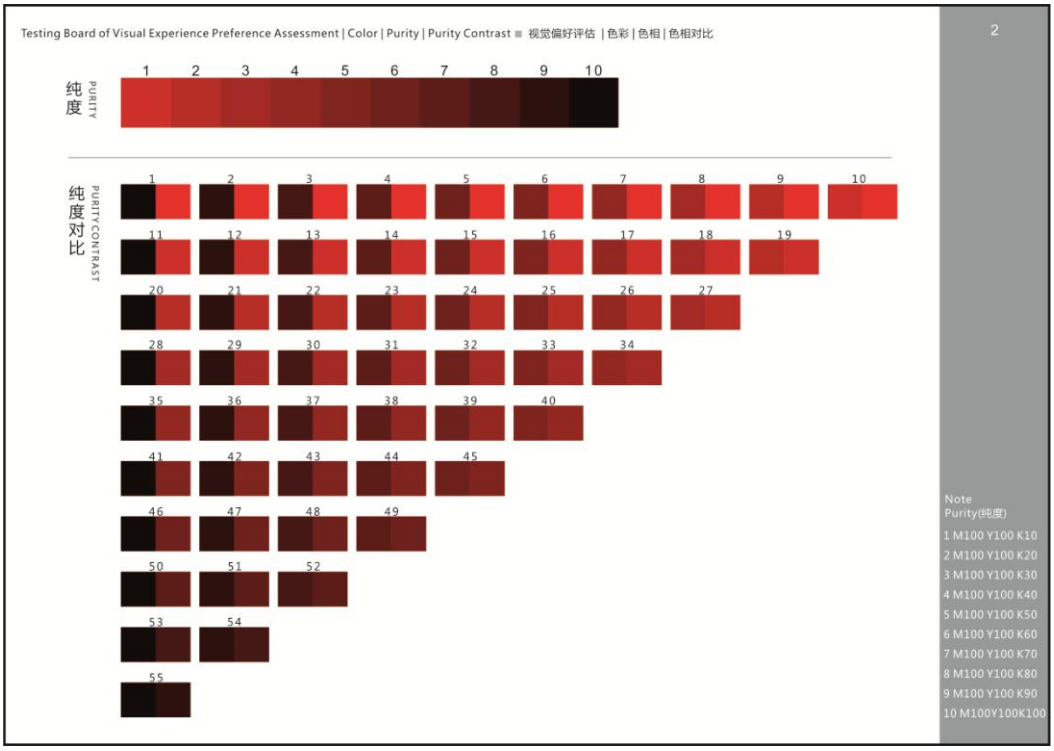
APPENDIX. III - I. Testing Board of Visual Experience and Preference Assessment for the Chinese elderly (Standard size: 420 mm x 297 mm)

Cover

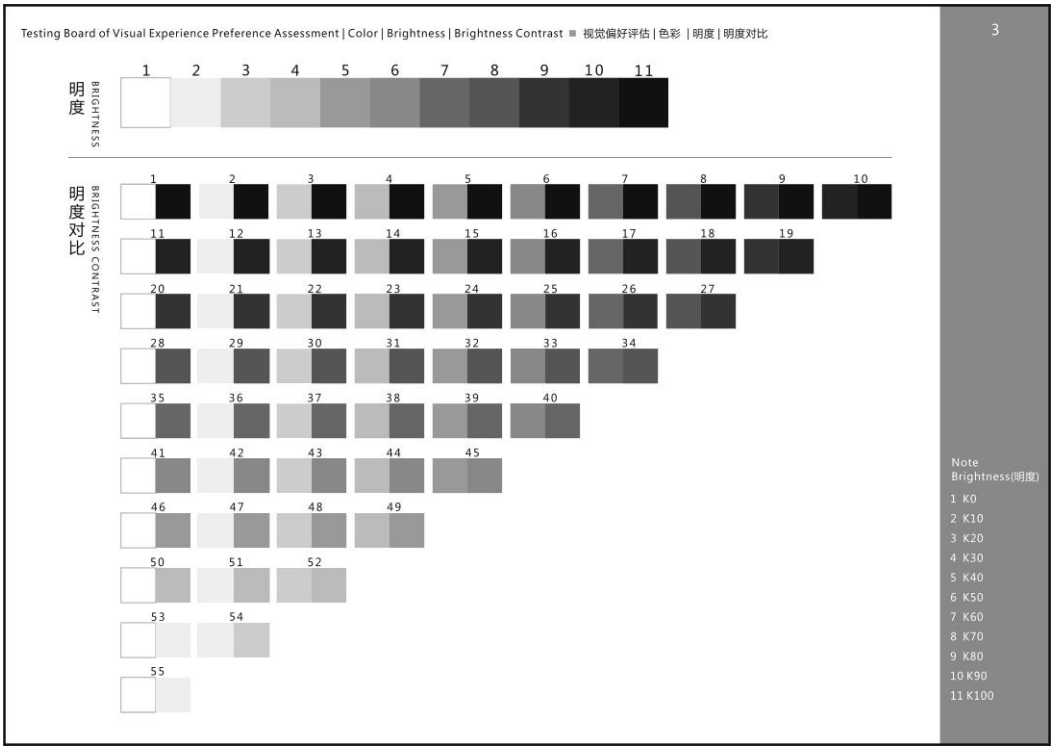
Color (Hue / Hue Contrast)



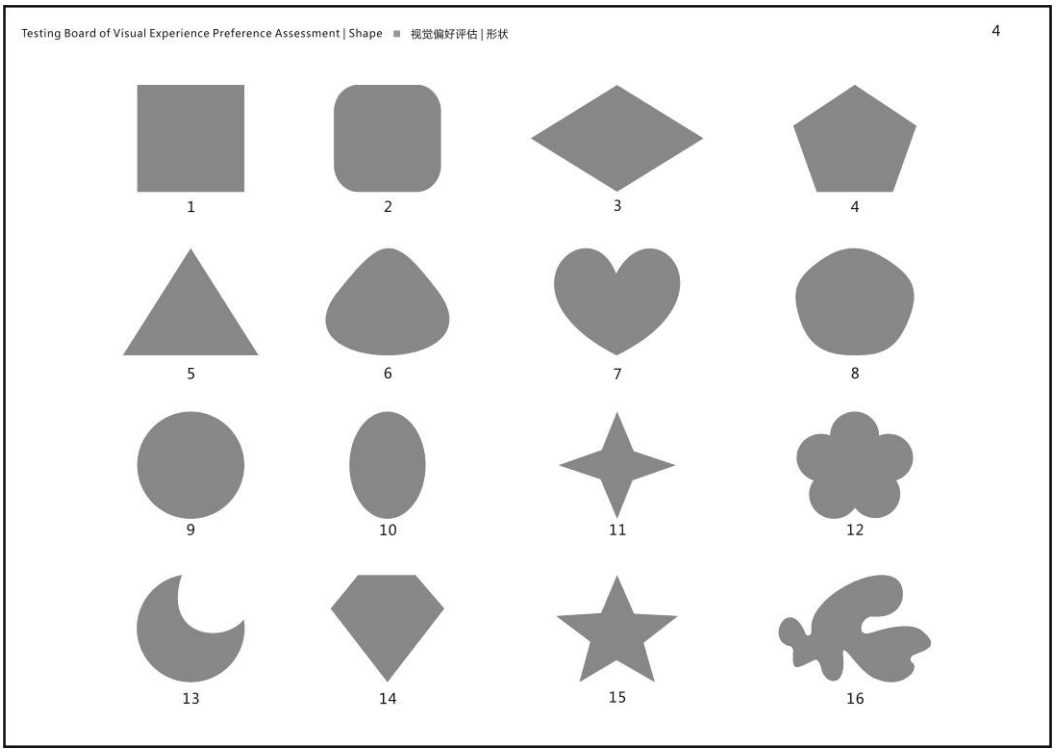
Color (Purity / Purity Contrast)



Color (Brightness / Brightness Contrast)



Shape


Testing Board of Visual Experience Preference Assessment | Shape ■ 视觉偏好评估 | 形状
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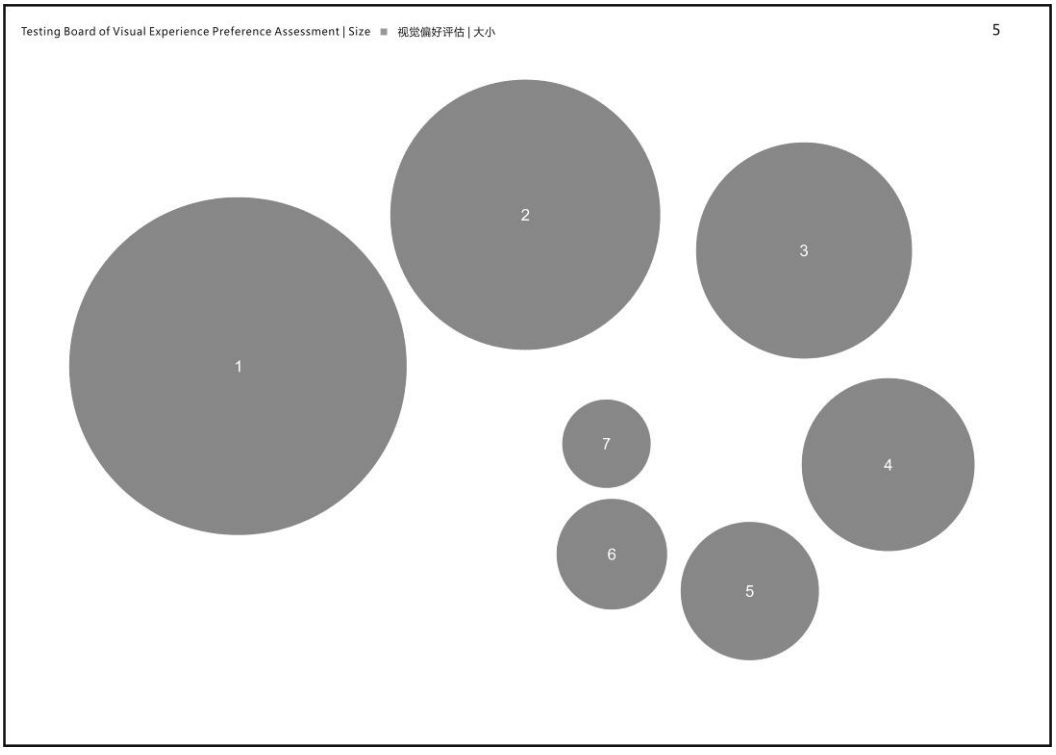
Size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Product

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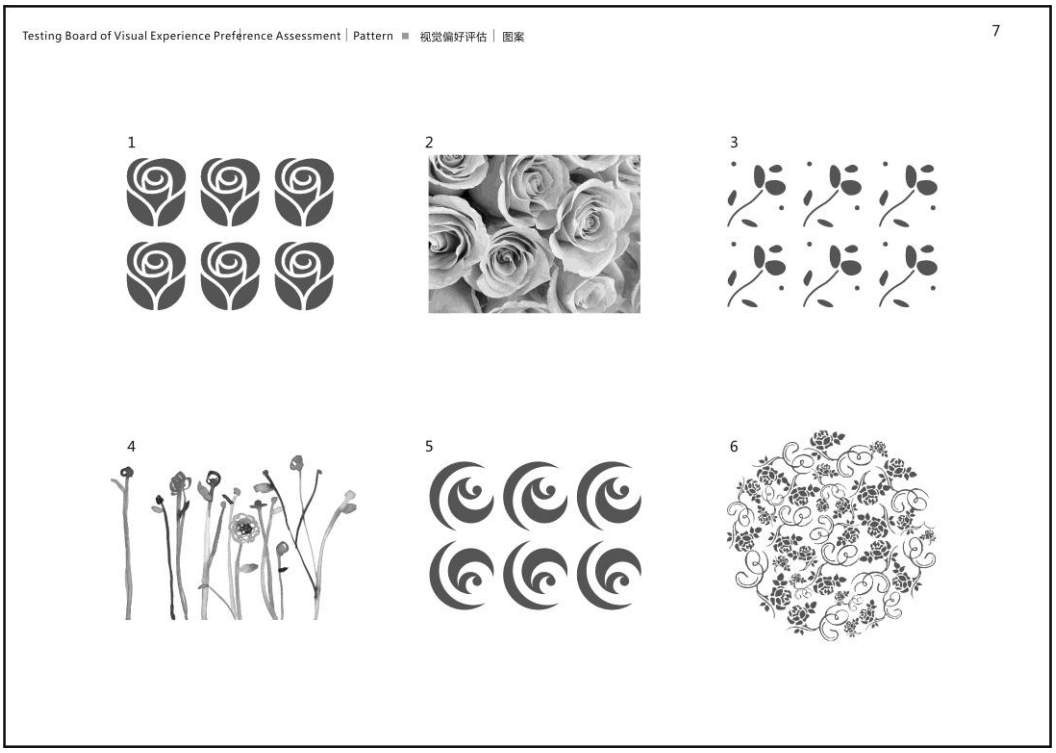
Pattern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APPENDIX. V - I. Research Participant Information and Consent Form for Experts Interview

An Investigation into the User-Centred Visual Experience Design and Emotional Reflection for the Elderly

Research Participant Information and Consent Form

Principal Investigator: Delai Men (email: P09004054@myemail.dmu.ac.uk)

My name is Delai Men and I am a current PhD research student at De Montfort University in Leicester (UK) and I am current working towards a PhD's degree in User Centred Design and Innovation. The current project is to discover the elderly positive visual experience behaviour and factor with pleasant emotions in product use in order to improve the satisfaction of design for healthy concern.

DESCRIPTION OF THE RESEARCH

You are invited to participate in a research study about visual experience design and emotional reflection for the elderly to discover the positive visual experience factor with pleasurable emotions in product use.

The participants for this survey should ideally have an interest in unique needs of product in appearance or functionality and usability related to enjoyment.

The research being conducted is aimed to find out in depth information regarding emotional reflection, cognitive behaviour feature and their needs for the products. This is broken down further into the elderly cognition changes and feature with age changing associated with clarify factor of positive visual experience - and how these aspects affect their pleasurable emotions in product use.

This study will include 60 years old above people who either enable to use product in daily life or have an interest in product improvement for their needs with two target group spread 60-69 and 70 above. Those invited will generally be gathered from Chinese participants and Chinese specialised areas experts.

This survey will be completed mainly via the questionnaire with interview and eye tracking device.

WHAT WILL MY PARTICIPATION INVOLVE?

If you decide to participate in this research you will be asked to If you decide to participate in this research you will be asked to complete a survey comprising of several different sections referring to the research topic.

You will be asked to complete 1 survey with questionnaire and interviews and will be asked to complete 1 test with device. Your participation will last approximately 20 minutes.

ARE THERE ANY RISKS TO ME?

The research is a simple survey to be completed by the participant and will contain no risks, the participant also has the option to opt out at any time freely.

HOW WILL MY CONFIDENTIALITY BE PROTECTED?

While there will probably be publications as a result of this study, your name will not be used. Only group characteristics will be published.

If you participate in this study, we would like to be able to quote you directly without using your name. If you agree to allow us to quote you in publications, please initial the statement at the bottom of this form.

All records and results from this study will be securely held for the researchers eyes only and will be disposed once the research stage of the study has been completed.

All text documents you saw will be shown in Chinese and English.

WHOM SHOULD I CONTACT IF I HAVE QUESTIONS?

You may ask any questions about the research at any time. If you have questions about the research you should contact the Principal Investigator Delai Men at P09004054@myemail.dmu.ac.uk.

Your participation is completely voluntary. If you decide not to participate or to withdraw from the study you are free to do so at any time.

Your signature indicates that you have read this consent form, had an opportunity to ask any questions about your participation in this research and voluntarily consent to participate. You will receive a copy of this form for your records.

Name of Participant (please print):_____

_____ _____

Signature Date

I give my permission to be quoted directly in publications without using my name.

APPENDIX. V - II. Result of Experts Interview

Exp. Q1： Design issues				
Question (Q)	**Exp.1**	**Exp.2**	**Exp.3**	**Exp.4**
Exp. Q1-1: Consideration on care for the elderly in design	– The elderly are not as sensitive to color as younger people. therefore, the usage of color needs to be studied. – Most people agree that the elderly's phone keyboard needs to be larger, but the degree of which it needs to be increased should be identified in depth. This can't be subjectively assumed and needs further research.	– Of all our daily use items, in general, needs of the eldery are excluded. – Preception, controling, and operation of product are not same across all different age phases of the elderly. – Currently, most elderly live alone during their final years. – Different products needs need to be considered for different periods of the adult life. – A big issue we face for elderly getting from the bed to the street. – No enterprises willing to design and manufacture products for the elderly in china.	– Barrier-free design, the universal design and inclusive design all need work. – Design for the elderly, is design for the society. – We need to return to the specific needs of the elderly when considering design for our society.	– Memory decline is quite serious, so decreasing the amount of things they need to remember is a plus. Additionally, the elderly have a harder time accepting and learning new ideas. – Use common language opposed to academic language to express ideas, otherwise it may hinder their ability to accept.
Exp. Q1-2: Difference of cognitive feature between 60-69 and 70+	– The people who age from 60 to 69's life experience is rich. They have the vitality of middle age, and might think that the products for the elderly are irrelevant to them. – There are changes among the elderly who age from 61 to 69, but the change is not especially large. They still have some vigor and vitality preserved. – For the elderly who are aged 70 and above, the change is larger, they feel obvious strain. If they encounter change, following up is needed. – After the age of 70, require the larger font, larger keys, and hope to be able to use their smart phone without taking off their glasses.	– People who age from 60 to 69's life style is not obviously different from middle-aged people. – Age 70 and above have limb health decrease, and obvious decrease in activity level and control capacity. However, they retain some aspects of self-care. – 80 and above might need to be nursed. Generally, they have lost self-care ability.	– 60 to 69's is called younger elderly. In fact, from biologically speaking, they have yet to experience big declines in ability. Psychologically, this is a transitional period. Therefore, design should consider the transitions for this phase, such as cognition and life-style. They are much different from those above 70. – People who age 70 and over experience serious cognitive and psychological decline. Based on this, design should take more extreme measures into consideration.	– Ages 80 years are known as high elderly. The closer to this age the lower their education level, and their ability to accept new things as well. – The high elderly are experiencing more drastic levels of declined ability.
Exp. Q1-3: Possibility of improvement for the elderly product deign	– Standardization and integration of health monitoring devices without medical apparatus and devices appearance such as blood pressure monitors, allowing the elderly to check their health anytime	– The main entry point is macro guidance from the government, particularly in China, policy needs to be intensified. – Products provided to the elderly are usually the worst. This is	– Aside from declining technical or universal skills, research should be done on design. Put forward some theoretical model of research methods. There may be two aspects: One is how to research the	– Larger typeface is essential. – The elderly need simplification, this is a core concept, and anything else can be built on this. – Safety

	anywhere. – Fully-automatic commodes – The bathroom floor requires skid resistance. The most important thing is to avoid them falling in toilet, a lot of the elderly emergencies occur while taking a bath. – The elderly cell phone needs to be improved: color, keys, screen, anti-slip etc.	counterproductive to design ideology. – Governmental policy can form guided effect to the entire market, providing business opportunities seen by enterprises, only then will these enterprises design for the elderly. – Hearing and touch aspects both need to undergo revamping. – Considering new materials for floors and walls that provide good self-cleaning function. – The elderly supermarket, clothing, food etc. can be developed, providing an experience catered to the elderly	different needs among different people in a different context. This kind of research is relatively lacking. Secondly, instituting actual change. – Now, research on aging is still mostly in the theoretical research level. The real transformation, from design to production, hasn't reached the levels it needs.	– Health – Stability – Affordability
Exp. Q1-4: Practical Application	– Elderly monitoring device. Something that can simply tell the body's state. Doesn't have to be too medically technical. – As an example, an automatic toilet; elderly find it difficult to twist and pull paper etc. If there could be some assistance that would help. – One of the biggest needs for the elderly is simply standing up. – Anti-slip surfaces are pretty poor, need to work on slip proofing restrooms. – losing glasses is an issue – Mobile phones need larger buttons, increased volume, and brighter colors. Easier access to emergency and commonly used numbers. Larger screens, standardized buttons and tactile indicators.	– Why would we design stove hoods or cupboard for the elderly? If there isn't a market, or profit available, even if we have a good heart, without subsidies, there really isn't a point. – The hand's ability to experience fine quality is in steady decline. – Ultimately, the only real functions needed for an elderly person's phone with be a few buttons, one for son, one for daughter, and one for hospital; just remember if you have an issue which one to hit.	– Ford focus car, was designed for the elderly, at least at the outtake. The Design team was an integration of Alzheimer's experts, behavioral scientist, and materials scientists that formed an interdisciplinary team, and made a suit that mimicked younger elderly's gradual process and decreased motor skills such as strenuous arm bending and blurred vision. In fact, these let the designer experience user lifestyle from the user's point of view, and from this standpoint, design the car. It became the annual best-selling car in Europe, favorite amongst the elderly is even used by young people, who also feel it was easier to use afterwards. Later the car became the representative of the model of universal design.	– Some elderly would like a 'blind' watch which **t**ells time audibly when a button is pressed. – Create a series of games and exercises that test and expand the elderly person's ability to practice cognitive memory, and transfer these skills to daily life, i.e. remembering which bus to take, and where to get off.

■ Findings:

Exp. Q1-1: Consideration on care for the elderly in design:

Thirteen opinions related to this issue were extracted from this portion of the interview. Although the experts' expressions are slightly varied based on

their individual point of view, their opinions demonstrate common features:

- Memory decline is quite serious, so decreasing the amount of things they need to remember is a plus. Additionally, the elderly have a harder time accepting and learning new ideas. (Exp.4). Therefore, different products needs need to be considered for different periods of the adult life (Exp.2).
- It can be conducted from many aspects of concepts in product design, e.g.: barrier-free design, the universal design and inclusive design all need work (Exp.3).
- Peception, controling, and operation of product are not same across all different age phases of the elderly (Exp.2).
- The elderly are not as sensitive to color as younger people. therefore, the usage of color needs to be studied (Exp.1).

Exp. Q1-2: Difference of cognitive feature between 60-69 and 70+:

Eleven opinions related to this issue were extracted from this portion of the interview. Through basic interpretation, the insights generally reflected:

- The people who age from 60 to 69's life experience is rich. They have the vitality of middle age (Exp.1). From biologically speaking, they have yet to experience big declines in ability. Psychologically, this is a transitional period (Exp.3).
- Age 70 and above have limb health decrease, and obvious decrease in activity level and control capacity. However, they retain some aspects of self-care (Exp.2). They feel obvious strain (Exp.1), and over experience serious cognitive and psychological decline (Exp.3). require the larger font, larger keys, and hope to be able to use their smart phone without taking off their glasses (Exp.1).
- Ages 80 years are known as high elderly. The closer to this age the lower their education level, and their ability to accept new things as well (Exp.4),

and 80 and above might need to be nursed. Generally, they have lost self-care ability (Exp.2).

Exp. Q1-3: Possibility of improvement for the elderly product design:

Nineteen opinions related to this issue were extracted from this portion of the interview, the common features include:

- The main entry point is macro guidance from the government, particularly in China (Exp.2). At the present stage. Products provided to the elderly are usually the worst (Exp.2).
- How to research the different needs among different people in a different context and instituting actual change (Exp.3).
- Hearing and touch aspects both need to undergo revamping (Exp.2), larger typeface is essential (Exp.4), and the elderly need simplification, this is a core concept, and anything else can be built on this (Exp.4, Exp.1).
- Safety, healthy, stable, affordability also needs to be improved (Exp.4).
- Considering new materials for floors and walls that provide good self-cleaning function (Exp.2).
- The elderly supermarket, clothing, food etc. can be developed, providing an experience catered to the elderly (Exp.2).
- From a psychological perspective, health products, such as blood pressure monitor, without too complex of a medical apparatus feeling would be preferred (Exp.1).
- Fully-automatic commodes (Exp.1).
- The elderly cell phone needs to be improved: color, keys, screen, anti-slip etc. (Exp.1).

Exp. Q1-4: Cases interpretation：

Twelve opinions related to this issue were extracted from this portion of the interview, the common features include:

- The hand's ability to experience fine quality is in steady decline (Exp.2).
- Elderly monitoring device. Something that can simply tell the body's state. Doesn't have to be too medically technical (Exp.1).
- An automatic toilet; elderly find it difficult to twist and pull paper etc. If there could be some assistance that would help. (Exp.1).
- Anti-slip surfaces are pretty poor, need to work on slip proofing restrooms (Exp.1).
- Mobile phones need larger buttons, increased volume, and brighter colors. Easier access to emergency and commonly used numbers. Larger screens, standardized buttons and tactile indicators (Exp.1). Ultimately, the only real functions needed for an elderly person's phone with be a few buttons, one for son, one for daughter, and one for hospital; just remember if you have an issue which one to hit. (Exp.2).
- Ford focus car, was designed for the elderly, at least at the outtake. The Design team was an integration of Alzheimer's experts, behavioral scientist, and materials scientists that formed an interdisciplinary team, and made a suit that mimicked younger elderly's gradual process and decreased motor skills such as strenuous arm bending and blurred vision. In fact, these let the designer experience user lifestyle from the user's point of view, and from this standpoint, design the car. It became the annual best-selling car in Europe, favorite amongst the elderly is even used by young people, who also feel it was easier to use afterwards. Later the car became the representative of the model of universal design (Exp.3).

Exp. Q2：Cognitive issues				
Question (Q)	**Exp.1**	**Exp.2**	**Exp.3**	**Exp.4**
Exp. Q2-1: Cognitive error with age changing	– Complicated task and functions easily upset the user. – The elderly don't have to many cognitive requirements. Technology should be very practical, and the product more and more simple. Do not transfer the high-tech function to the user, but instead the designer should use programming to make the product simpler, e.g. bullet mineral water. – Vision decreases with age, and as such measures should be taken to help i.e. larger font, bolder colors, etc. – Preferably material is matte which prevents slipping. Additionally, surface irregularity can stimulate elderly tactility.	– Due to memory problems of the elderly, behavioral symptoms begin to appear, such as the elderly suddenly forget why they went to the kitchen, etc. – When using mobile phones, key stroke accuracy is an issue.	– In fact, cognitive ability is in decline, but their experience is on the rise. The model we built was to explore how we can maximize the reference to the elderly's experience in design. We want to use their previous experience to maximize their ability to use an item. – Due to the decline of cognitive skill, some may not able to immediately accept not things. If designer can make good use of the current technology and combine it with traditional experience, I think it might help the elderly more in this aspect of the aging process.	No specific answers.
Exp. Q2-2: Cognitive Characteristics with age change	– Tactile decline. – Vision sensitivity to color decline. – Decreased interest in intellectually complex things.	– Tactile decline. – Vision sensitivity to color decline. – Some elderly tend to wear more colorful clothing. – The elderly had a common behavioral phenomenon, which is to reject aging and long for their youth. – Decrease in cognitive reactionary skills.	– From a behavioral science perspective, behavior, including utility, is tied to environment. If this environment changes, behavior will change with it.	– Slowed reaction. Decreased memory. Abstract thinking declines, along with ability to learn new things. – Spatial ability decline is particularly severe.
Exp. Q2-3: Possibility of improvement approaches for the elderly cognition	– Simple operation, usability. – Strong color contrast. – Clearly distinct tactile buttons for ease of use. – Slip resistance – Don't necessarily need gaudy and showy, gray tone contrast with bright colors is better. – Larger font that be seen without wearing glasses.	– Mobile phone thicker, rounded corners, without smooth surfaces; tactilely recognizable. – Color contrast and saturation needs to be increased for improved visibility. – The volume control elements need to be centralized for ease of grasping, manipulation, and visual identification.	– Create new experience for the elderly by calling on their old experiences. – User experiment based design can create a new type of user. Some of these experiments can be crated, some a continuation of what is already existent.	– Try to avoid eliciting abstract thought. – Avoid complexity.
■ **Findings:**				

Exp. Q2-1: Cognitive error with age changing:

The answers from the experts are not accurately or positively related to the core question required. Regardless, eleven opinions were extracted from this portion of the interview. There is a common opinion that elderly cognitive memory is in decline. The opinions expressed demonstrate that the experts interviewed are not clear on the concept of cognitive error. It also shows that more research and discovery needs to be done on a conceptual level. However, in spite of this, these opinions are beneficial to the research:

- Complicated task and functions easily upset the user. (Exp.1).
- Due to memory problems of the elderly, behavioral symptoms begin to appear, such as the elderly suddenly forget why they went to the kitchen, etc. (Exp.2).
- Cognitive ability is in decline, but their experience is on the rise. Design can maximize their previous experiences to maximize their ability to use an item. (Exp.3).
- Good use of the current technology and combine it with traditional experience, might help the elderly more in this aspect of the aging process. (Exp.3).
- When using mobile phones, key stroke accuracy is an issue. (Exp.2).
- The elderly don't have too many cognitive requirements. Technology should be very practical, and the product more and more simple (Exp.1).
- Vision decreases with age, and as such measures should be taken to help i.e. larger font, bolder colors, etc. (Exp.1).

- Preferably material is matte which prevents slipping. Additionally, surface irregularity can stimulate elderly tactility (Exp.1).

Exp. Q2-2: Cognitive feature with age changing：

Thirteen opinions related to this issue were extracted from this portion of the interview. While opinions varied, there were similar views on tactile decline, sensitivity decline, and slowed reaction. The general features are as follows:

- From a behavioral science perspective, behavior, including utility, is tied to environment. If this environment changes, behavior will change with it (Exp.3).
- In many aspects, the elderly perceptive ability is decline, i.e.: memory (Exp.4), tactile (Exp.1), thinking reaction capacity (Exp.2) and slower reaction (E4), visual sensitivity to color (Exp.1), abstract thinking declines, along with ability to learn new things and spatial ability decline is particularly severe (Exp.4).
- Decreased interest in intellectually complex things (Exp.1).
- Some elderly tend to wear more colorful clothing (Exp.2).

Exp. Q2-3: Possibility of improving approaches for the elderly cognition：

Five opinions related to this issue were extracted from this portion of the interview. While opinions varied, there were similar views on avoiding complexity, strong color contrast, and traditional experience extension. The general features are as follows:

- Strong color contrast (Exp.1), and color contrast and saturation needs to be increased for improved visibility (Exp.2). Don’t necessarily need gaudy

and showy, gray tone contrast with bright colors is better (Exp.1). Mobile phone thicker, rounded corners, without smooth surfaces; tactilely recognizable (Exp.2).

- Larger font that be seen without wearing glasses (Exp.1).
- Avoiding complexity (Exp.4). Simple operation, usability (Exp.1). Clearly distinct tactile buttons for ease of use (Exp.1). The volume control elements need to be centralized for ease of grasping, manipulation, and visual identification (Exp.2).
- Creating new experience for the elderly by calling on their old experiences. Some of these experiences can be created, some a continuation of what is already existent (Exp.3).
- Try to avoid eliciting abstract thought (Exp.4).

Exp. Q3：Emotional issues				
Question (Q)	**Exp.1**	**Exp.2**	**Exp.3**	**Exp.4**
Exp. Q3-1: Emotional factor effected by product to the elderly	– Create products shapes that are more reserved and easily manipulated, link products for elderly in the past. – Texture. – Color. – No need for complex procedures, one step functions are best. – Independent operation.	– The elderly don't like pure black and white. Form a visual perspective, color contrast and purity should take elderly needs into consideration. – Simple and easy to use.	– If red color brings pleasurable feelings, it's because people have an affinity towards red; this is related to his or her previous life experience, and whole cultural background. (Supported by theory of Jordan).	– The elderly focus on the affordability. – Simple, easy to use.
Exp. Q3-2: Relationship between pleasurable emotional and visual experience	– Affinity for the design in shape. – Easy on the eyes. – Tacitly easily understood. – Color doesn't need to be too extreme, as it appears tacky. The elderly also don't want to seem tacky. – Design philosophy driven design. – Instrumentally test elderly eye movement and reading habits to design better products. – Positive visual experience and based on user-centered concept.	– The elderly generally want simplicity. The simpler the better is present in elderly mentality. – Simplify complex products for elderly users. – They prefer the bright and vigorous colors, as opposed to calm color. From this perspective, they can accept red, yellow, orange, green, or gray with any of the above colors; in comparison, they don't like blue, black, and grey.	– Life experiences help him to communicate with the product, and actually interact with the product. How can you help them use the product easily, efficiently and correctly. Personally I think if the elderly are drawing on past similar experience, it will be easier to bring pleasure. – First of all, you need to overcome exhaustion, if the body can remain relaxed, then other comprehensive experiences will be richer.	– For training exercises, we don't choose negative things. We select neutral and positive things, such as pictures or materials with someone's image. Research has shown that the elderly are more sensitive to images of other elderly people as well as pictures showing affection.

■ **Findings:**

Exp. Q3-1: Emotional factor effected by product to the elderly:

Ten opinions related to this issue were extracted from this portion of the interview. While opinions varied, there were similar views on color preference with cultural background, simplicity, and ease of use. The general features are as follows:

– Simple and easy to use (Exp.4, Exp.2). One step functions are best without complex procedures (Exp.1). Independent operation (Exp.1).

– The elderly focus on the affordability (Exp.4).

- Products shapes that are more reserved and easily manipulated, link products for elderly in the past. (Exp.1).
- Texture and color (Exp.1).
- If red color brings pleasurable feelings, it's because people have an affinity towards red; this is related to his or her previous life experience, and whole cultural background (Exp.3). However, The elderly don't like pure black and white. Form a visual perspective, color contrast and purity should take elderly needs into consideration. (Exp.2).

Exp. Q3-2: Relationship between pleasurable emotion and VE：

Thirteen opinions related to this issue were extracted from this portion of the interview, the common features include:

- If the elderly are drawing on past similar experience, it will be easier to bring pleasure (Exp.3).
- If the body can remain relaxed, then other comprehensive experiences will be richer (Exp.3).
- The elderly are more sensitive to images of other elderly people as well as pictures showing affection (Exp.4).
- Tacitly easily understood (Exp.1).
- Instrumentally test elderly eye movement and reading habits to design better products (Exp.1).
- The elderly prefer the bright and vigorous colors, as opposed to calm color. From this perspective, they can accept red, yellow, orange, green, or gray with any of the above colors; in comparison, they don't like blue, black, and grey (E2) and too extreme (Exp.1).
- Affinity for the design in shape (Exp.1).

- Simplify complex products for elderly users (Exp.2).
- Positive visual experience and based on user-centered concept (Exp.1).

Exp. Q4：VE issues				
Question (Q)	**Exp.1**	**Exp.2**	**Exp.3**	**Exp.4**
Exp. Q4-1: Relationship between pleasurable emotion and visual experience	– Currently, a product is manufactured, including packaging, to be just that thing. The manufactured product was not designed based on a thought. Instead there is a product first design philosophy. Instead, thought should drive design, which leads to thought and on to design, and so forth, to complete a cycle. Right now, design is a big issue.	– The existing TV channels are too numerous, in fact so numerous, channels cannot be accessed, because they don't even know how to adjust the remote control. – Keys on mobile phones have too little tactile association. – 3. Words on food packaging are too small.	– The elderly need to have a similar experience as with a product in use. If it is a new product, that they never used before, such as a new cooking device, (not oven or microwave) but can create a delicious meal, for young people, we can make a completely new product, but for the elderly, we need to consider their past utility experiences before designing. For westerners, oven is more common, so they can use past oven experience to create a new product with similar user interface over new technology.	– The elderly market is still small and forward-looking. Certainly, there aren't a lot of people are not willing to do this work and the experts are even less.
Exp. Q4-2: Thought about PVE	– Now the information we receive is passively negative, for instance, the advertisements we seen on the street are annoying. It gives us the feeling that the designer is not consciousness of us and is going for hard sale or designer centered design.	– Two TV controllers would be better. One is for the elderly use, and another one is for their children. This one, used by their children, can assist the elderly to set the volume, light, and contrast ratio of TV. After that, it will be packed up. – the phone designed for the elderly is better in three or four key press functionality.	– Combine past life experience and current science and technology. – Product appearance would be better if closely related to the products frequently used in the past. – We need to have a better integration between design research ideology and design practice, otherwise all this research is pointless if not put into practice.	– Slowly begin to **develop some training and measuring tools.** Do some projects and gradually join the basic research and the research of **application of practical psychology**. – Help elderly to participate in group studies. Let them take some helth products to see if we can't help them improve cognition and memory.
Exp. Q4-3: Suggestion for PVE research based on professional knowledge	– Attention processes we design are subjective, and they can only experience within the process we provide. However, if we conduct elderly observation, we can consider how to conform to the elderly physiological characteristics throughout the design process. – Recording their information, don't force sell and force buy for them.	– Follow the day in the life of an elderly person and record their experiences. By experiencing and observing, we can start to understand their difficulties. Some are as they say, some are even contradictory to what they express. – Need a lot of data collecting to understand elderly color preferences.	– Based on the research of design practice, results can re-feed the design for aged persons. – Design practice itself should return to support pure theoretical design research.	– Evaluation of elderly cognition and training is needed, and some training tools can be developed into products.
Exp. Q4-4: Needs related to pleasurable factor：	– Functionality. – Enjoyment. – Usability.	– Both narrow and lager spaces are not suitable the elderly. For the elderly, their precision declines in narrow space. For instance, they can easily bump into things. However, in a larger space, their ability to distinguish direction and control where to	– Traditional symbols. – Traditional characters. – Traditional colors and contexts.	– Materials used for training tools have to meet the elderly individual's preference. – For instance, Heath and vitality

		go can be affected. – Bright lights.		

■ **Findings:**

Exp. Q4-1: Existing VE issues on visual and product communication：

Seven opinions related to this issue were extracted from this portion of the interview, the common features include:

- The elderly need to have a similar experience as with a product in use. If it is a new product, that they never used before, such as a new cooking device, (not oven or microwave) but can create a delicious meal, for young people, we can make a completely new product, but for the elderly, we need to consider their past utility experiences before designing. For westerners, oven is more common, so they can use past oven experience to create a new product with similar user interface over new technology (Exp.3).
- The existing TV channels are too numerous, in fact so numerous, channels cannot be accessed, because they don't even know how to adjust the remote control (Exp.2).
- Keys on mobile phones have too little tactile association (Exp.2).
- Words on food packaging are too small (Exp.2).

Exp. Q4-2: Thought about PVE：

Eight opinions related to this issue were extracted from this portion of the interview. While their views were varied, the common features include:

- Now the information we receive is passively negative. Designer is not consciousness of us and is going for hard sale or designer centered design

(Exp.1).

- Developing some training and measuring tools. Do some projects and gradually join the basic research to the psychological research of practical application (Exp.4).
- Helping elderly to participate in group studies. Let them take some health products to see if we can't help them improve cognition and memory (Exp.4).
- Combining past life experience and current science and technology. Product appearance would be better if closely related to the products frequently used in the past (Exp.3).
- Two TV controllers would be better. One is for the elderly use, and another one is for their children. This one, used by their children, can assist the elderly to set the volume, light, and contrast ratio of TV. After that, it will be packed up. The phone designed for the elderly is better in three or four key press functionality (Exp.2).

Exp. Q4-3: Suggestion for PVE research based on professional knowledge：

Six opinions were collected from the expert's suggestion on PVE research. The opinions, while expressing diversity, show general features listed below:

- The attention processes we design are subjective and can only experienced within the process we provide. However, if we conduct observation recording their features in the process, we can consider how to conform to the elderly physiological characteristics throughout the design process. (Exp.1).

- Following the day in the life of an elderly person and record their experiences. By experiencing and observing, we can start to understand their difficulties. Some are as they say, some are even contradictory to what they express (Exp.2).
- Need a lot of data collecting to understand elderly color preferences (Exp.2).
- Based on the research of design practice, results can re-feed the design for aged persons. Design practice itself should return to support pure theoretical design research. (Exp.3).
- Evaluation of elderly cognition and training is needed, and some training tools can be developed into products (Exp.4).

Exp. Q4-4: Needs related to pleasurable factor：

Ten opinions related to this issue were extracted from this portion of the interview. While their views were varied, the common features include:

- Functionality, usability, enjoyment (Exp.1).
- Traditional symbol, traditional characters, and traditional colors and contexts (E3) and bright lights (Exp.2)
- Materials used for training tools have to meet the elderly individual's preference (Exp.4).
- Health and vitality (Exp.4).
- Both narrow and lager spaces are not suitable the elderly. For the elderly, their precision declines in narrow space. For instance, they can easily bump into things. However, in a larger space, their ability to distinguish direction and control where to go can be affected. (Exp.2).

APPENDIX. V - III. VPT-1 and VPT2 Assessment for the Chinese Elderly Visual Experience Design with the Consent Form

Dear participant:

I would appreciate your to complete this research questionnaire for discover the elderly positive visual experience behavior and factor associated with pleasant emotions in product use in order to improve the satisfaction of design for healthy concern.

If you are invited and decide to participate in this research you will be asked to complete 1 survey with questionnaire and testing. The research is a simple survey without risks and at last approximately 30 minutes.

The project is conducted by PhD research student Delai MEN from De Montfort University in Leicester (UK). All records and results from this study will be securely held by the researchers only and will be disposed once the research stage of the study has been completed. While there will probably be publications as a result of this study, your name will not be used. We also would like to be able to quote you directly without using your name. If you agree to allow us to quote you in publications, please initial the statement at the bottom of this form.

If you have any questions about the research you should contact the principal investigator at any time at P09004054@myemail.dmu.ac.uk.

Your participation is completely voluntary. Your signature indicates that you have read this consent form and has the option to opt out or to withdraw from the study at any time freely. You will receive a copy of this form for your records.

Thanks for your cooperation, if you agree the survey please sign your name below.

Yours faithfully,

Delai MEN

Participant signature: _____ Date: _____

(I give my permission to be quoted directly in publications without using my name)

Participant signature: _____

SECTION A: Demographics

1. Age： _____ **2. Gender：** ☐Male ☐Female **3. Nationality：** ☐China ☐ Other: _____

4. Region： ☐East ☐South ☐Centre ☐North ☐Northwest ☐Southwest ☐ Northeast

5. Level of education： ☐None ☐Primary school ☐Middle school ☐High school ☐Vocational high school ☐Polytechnic school ☐Senior college ☐BA/BS ☐ MA/MS/MPhil ☐PhD

6. Visual difficulties: (Including: Wearing contact lenses, wearing lens glasses, color blindness, hypochromatopsia etc.) ☐Yes ☐No ☐Partial. If you have, please fill in: _____

Section B: Product Customer Satisfaction

7. Favorite products

No.	Four products most important in your daily life	The superiority of the product	Use frequency	Use length of time
1		☐Very poor ☐Poor ☐ General ☐Good ☐Very good	☐Every day ☐Once a week ☐More than once a week ☐Once a month ☐More than once a month ☐ Irregularly	
2		☐Very poor ☐Poor ☐ General ☐Good ☐Very good	☐Every day ☐Once a week ☐More than once a week ☐Once a month ☐More than once a month ☐ Irregularly	
3		☐Very poor ☐Poor ☐ General ☐Good ☐Very good	☐Every day ☐Once a week ☐More than once a week ☐Once a month ☐More than once a month ☐ Irregularly	
4		☐Very poor ☐Poor ☐ General ☐Good ☐Very good	☐Every day ☐Once a week ☐More than once a week ☐Once a month ☐More than once a month ☐ Irregularly	

8. Evaluation of the above products

Content	Most satisfied product (Please tick in box)	Most dissatisfied product (Please tick in box)
Brand and model (If have)		
Function	☐Very poor ☐Poor ☐General ☐Good ☐Very good	☐Very poor ☐Poor ☐General ☐Good ☐Very good
Usability	☐Very poor ☐Poor ☐General ☐Good ☐Very good	☐Very poor ☐Poor ☐General ☐Good ☐Very good
Appearance	☐Very poor ☐Poor ☐General ☐Good	☐Very poor ☐Poor ☐General ☐Good

	☐Very good	☐Very good
Evoked Emotion	☐☐Very poor ☐Poor ☐General ☐ Good ☐Very good	☐☐Very poor ☐Poor ☐General ☐ Good ☐Very good
Safety	☐Very poor ☐Poor ☐General ☐Good ☐Very good	☐Very poor ☐Poor ☐General ☐Good ☐Very good
Like those products design?	☐Dislike very much；☐Dislike moderately；☐Like moderately ☐Like moderately ☐ Like very much	☐Dislike very much； ☐Dislike moderately； ☐Like moderately ☐Like moderately ☐Like very much
Problems encountering using these products?	☐Have not ☐Have If yes, please fill out the specific reason:	☐Have not ☐Have If yes, please fill out the specific reason:

9. Do you think design is very important for product using?

☐Not at all ☐Unimportance ☐General ☐Important ☐Very important

10. Which factor of products do you think is most importance? (Fill in the numbers in order of importance: 1. Very important…… 6.Not at all)

_____Function_____Usability； _____Appearance____ Evoked emotion _____ Safety

11. Do you think design need to consider their features and unique needs?

☐Yes ☐No ☐Don't know

SECTION C: Cognition Feature

12. In the process of receiving visual information, which factor do you think is most likely to be found? (Fill in the numbers in order of importance: 1. Very important…… 6. Not at all)

_____Color _____Shape _____Size _____Material and texture

_____Pattern _____Light

13. Cognitive preference (According to the number of the test board)

Contents		Easy finding	Easy to ignore	Personal favorite	Degree of personal preference
Color	Hue				☐Like slightly ☐Like ☐Like very much ☐Like extremely
	Hue contrast				☐Like slightly ☐Like ☐Like very much ☐Like extremely
	Purity				☐Like slightly ☐Like ☐Like very much ☐Like extremely
	Purity contrast				☐Like slightly ☐Like ☐Like very much ☐Like extremely
	Brightness				☐Like slightly ☐Like

					☐Like very much ☐Like extremely
	Brightness contrast				☐Like slightly ☐Like ☐Like very much ☐Like extremely
Shape					☐Like slightly ☐Like ☐Like very much ☐Like extremely
Size					☐Like slightly ☐Like ☐Like very much ☐Like extremely
Material and texture					☐Like slightly ☐Like ☐Like very much ☐Like extremely
Pattern					☐Like slightly ☐Like ☐Like very much ☐Like extremely
Product					☐Like slightly ☐Like ☐Like very much ☐Like extremely
Newspaper layout					☐Like slightly ☐Like ☐Like very much ☐Like extremely
Light space (Please select one of them and its degree)				☐Warm	☐Weakest light ☐Weaker light ☐Moderate ☐Stonger ☐ Stongest
				☐Cool	☐Weakest light ☐Weaker light ☐Moderate ☐Stonger ☐ Stongest
				☐Natural	☐Weakest light ☐Weaker light ☐Moderate ☐Stonger ☐ Stongest

SECTION D: Emotional Reflection

14. Do you think pleasurable emotion can benefit health?
☐Yes ☐No ☐ Don't know

15. Do you have a pleasurable emotion when the visual presentation of a product is in line with your cognitive preference?
☐Yes ☐No ☐Don't know

16. When product's visual presentation is in accordance with your cognitive preferences, if you will generate pleasurable mood? ☐Yes ☐No ☐Don't know

17. Which factors will affect your pleasurable mood when you see or use a product?
(Fill in the numbers in order of importance: 1. Very important……6.Not at all)
___Functionally___Usability___Appearance___Concept

18. Choosing 3 factors that can affect your mood in the following. (Fill in the numbers in order of importance: 1. Very important……6.Not at all)

Functionally	Usability	Appearance	Concept
___Helpful ___Simple ___Complex ___Health care	___High-tech ___Intelligence ___Easy to operate ___Easy to identify ___In conformity with the user habits ___Harmless ___Labor-saving	___Color ___Shape ___Sizes ___Material and texture ___Style ___Pattern ___Light spaces	___Environmentally friendly ___Recycled ___Healthy ___Safe ___Pleasurable experience ___Care

If "Favorite color “or " Favorite style” are selected, please re-select 3 options in them (Fill in the numbers in order of importance: 1. Very important……6. Not at all)

Favorite color	Favorite style
___Hue ___Hue contrast ___Purity ___Purity ___Contrast ___Brightness ___Brightness contrast	___Simple ___Complex ___Classical ___Modern ___Oriental___Western ___Curved ___Straight ___Plain ___Flamboyant

19． What is the main reason that the product design cannot to bring pleasure? Please select at least 3 of the most important, (Fill in the numbers in order of importance: 1. Very important, 6. Not at all)

_____Unsafe _____Difficult to understand information _____Inconvenient _____Difficult operation _____Poor appearance _____Product is not suitable for the elderly____Other, for instance：_____

20． Do you think of how to design products for the elderly to enhance their pleasurable mood?_____

Thank you for taking the time to complete this assessment

APPENDIX. V - IV. Result of Participants Interview

P. Q1: Awareness					
Question (Q)	**P. Q1-1: Have you noticed the issue about product design for the elderly?**	**P. Q1-2: What is your favorite product most use in your daily life?**	**P. Q1-3: How do you think the product which you favorite can bring joyful feeling to you whilst you use it?**	**P. Q1-4: How do you like the product design? Why?**	**P. Q1-5: How do you think a good product design should consider the elderly unique needs based on their experience and cognitive changing?**
P.1	Yes	TV	Pleasure	Like, because it is convenience, safe, and beautiful	Of course
		Air-conditioning	Pleasure	Like, because it is convenience, safe, and beautiful	
		Washing machine	Pleasure	Like, because it is convenience, safe, and beautiful	
P.2	Yes	TV	Happy	Like, because it is easy to use	Of course, need
		Washing machine	Happy	Like, because it is easy to use	
P.3	Yes	Mobile phone	Well	More convenience with easy to carry, the operation is OK	A good product should be suitable for the elderly
P.4	Yes	Mobile phone	Pleasure	I do not like the design, although the font is big, but it cannot send a message in handwritten way	Should be
P.5	Yes	TV	Like with larger screen, rich color good sharpness, and easy to use	For the elderly, simple is first, intuitive. Second, the screen, font aspects are very important. sometimes too small font cannot be seen	Of course, need
P.6	Yes	Mobile phone	Happy with understanding the outside things every day via mobile phone	Like, because it is simple and easy to operate	As long as safe and easy to operate. Young people must fully like completed function, so the difference is there
		TV	Happy with understanding the outside things every day via TV	Like, because it is simple and easy to operate	
		Air-conditioning	N/A	Like, because it is simple and easy to operate	
P.7	Yes	Computer	Pleasure	Easy to operate, wide vision, all-inclusive	Yes, it should be this way
P.8	Yes	Electric fan	Joyful	Like, because it is easy to use, comfortable blowing, cool	Of course, according to the elderly
P.9	No	Bicycle	Happy	Like, no requirements to these, but practical is OK	Do not need
		Mobile phone	Happy	Like, no requirements to these, but practical is OK	
		Telephone	Happy	Like, no requirements to these, but practical is OK	
P.10	No	Mobile phone	Pleasure	Like	Of course, need
		TV	Pleasure	Like	
P.11	No	Mobile phone	Pleasure	Like, because of convenience	Do not need
P.12	No	Electric bicycle	Pleasure	Like, because of convenience	Necessary
		Mobile phone	Pleasure	Like, because of convenience	
		TV	Pleasure	Like, because of convenience	
P.13	Yes	TV	Pleasure	Like, very durable, because never had quality problems	Do not need
P.14	No	Mahjong machine	Pleasure	Like, because the design is very reasonable now, and very happy when mahjong	Of course, need

				playing	
		TV	Pleasure	Like, because the design is very reasonable now	
P.15	No	Automatic washing machine	Pleasure	Like	Of course, need
		TV	Pleasure	Like, because there are a lot of TV channels to watch, vast program options	
P.16	No	Mobile phone	Pleasure	Like, because the phone's color looks good, as well as very convenient to contact others	Do not need
P.17	No	Massager	Pleasure	Like, because leg very comfortable after product use, working easier, and helpful to the body	Of course, need
P.18	N/A	Range hood	Pleasure	N/A	For example, cosmetics, the elderly items are not the same as little kids
P.19	N/A	Blood pressure monitor	Pleasure	N/A	This should be nothing. The elderly needs certainly are simpler. Needn't to remember a lot of things
P.20	N/A	N/A	Cheerful	Design is good looking, for instance, pot cover is red, but the circle is black	N/A
P.21	N/A	N/A	Cheerful	N/A	N/A
P.22	N/A	Microwave oven	Happy, fast and convenient	N/A	Need to consider the elderly needs, especially the elderly actions are a little slower
			Satisfied, fast and convenient		
Summary	17 participants answered the questions: 9 yes, 8 no, and 5 omitted It shows that most the elderly notice that product design needs to consider their requirements	20 participants answered positively and listed 14 types of products. 2 participants omitted. The mentioned products are TV (9), Mobile phone(8), Washing machine (3), Air-conditioning (2), Computer(1), Electric fan (1), Bicycle(1), Telephone(1), Electric bicycle(1), Mahjong machine(1), Massager(1),Range hood(1), Blood pressure monitor(1), and Microwave oven(1). The top three products respectively are TV, mobile phone, and washing machine. This reflects their main product	All of participants answered in regards to the 32 products mentioned with 33 words of positive emotion in terms of joyful feeling, i.e.: pleasure (20), happy (8), joyful (1), well (1), cheerful (2), like (1), and satisfied (1). Only 1 answer is N/A (1) The reasons for satisfaction are quick and conveniently use of microwave oven, larger screen TV with rich color and good sharpness, and easy to use. Additionally, TV and mobile phone can let them easily understand the world around them and can generate the	25 answers are favorable, 4 impartial, just explaining the cause, but these answers still express favorable meaning. Only 1 answer is unfavorable. 2 participants do not answer The responses corresponding to the 32 mentioned products': convenience (9), easy to operate (8), simple (4), beautiful (4), practical (3), design reasonable (2), comfortable (2), and safe (2). Easy to carry, intuitive, durable, quality, vast program options, good looking color, working easier, helpful all were mentioned once For the purpose of further classifying, these expressional terms are placed in Jordan's customs need-hierarchy theory in terms of functionally, usability, and pleasurable, all words answered can be placed in the following three clusters: **Pleasurable:** beautiful (4), good-looking color **Usability:** convenience (9), easy to operate (8), simple (4), comfortable (2), safe (2), design reasonable (2), working easier, easy to carry, quality, intuitive, durable **Functionally:** practical (3), helpful, vast program	Most participants (17) positively answered the question**.** 11 of which said 'of course' directly, and 6 answered indirectly, but their opinions fully support the meaning of need within their explanation i.e. a good product should be suitable for the elderly, safe and easy to operate, the elderly needs are not same as little kids, The elderly needs are certainly simpler, needn't to remember a lot of things, and the need to consider the elderly needs, especially that the elderly actions are a little slower 4 answered do not need to consider, and 2 answers are N/A.

		needs are entertainment, communications and home appliances. The selected products confirm common properties of product which commonly associated with Chinese elderly life and are in accordance with research expectations	pleasurable feeling This indicates that the vast majority of emotional words related to participants' experience of products, which they commonly used, was positive	From the amount of words in each cluster, the usability cluster was most described which shows that product's usability is still the largest expressed need for Chinese elderly individuals. Pursuit of pleasure, it is not in the core of their life at present Moreover, the favorable reasons contain a variety of aspects such as safety, quality, etc. Therefore, as the most important aspects, they are separated into five clusters according to the correlation with the participants' preference; these are detailed in the interpretation below	the participants who answered without needs are living in north part of China It may reflect that the impression that you should not care so much about yourself

P. Q2: Design issues				
Question (Q)	**P. Q2-1: When you use one of your daily life dependent product, experienced comfort and discomfort, safe or unsafe, easy or difficult to use these and other problems?**	**P. Q2-2: What do you think the lack of consideration of product design for the elderly caring?**	**P. Q2-3: If not met, you think how to improve the use and demand for older products?**	**P. Q2-4: Could you describe an experience previously about product in use with good or bad feel?**
P.1	Encountered. There is always noise inside TV. I felt it was unsafe	Sometimes lack	Yes, design requires it to be more generous, simpler, safer and easy to use. Because of the Chinese elderly are numerous	Yes, my table fan broke within a half year. Became noisy after short running time. Bad quality with unknown brand
P.2	Encountered	Lack	Ease of use for the elderly	Yes, the washing machine, sometimes, its speed of washing clothes is uneven, some clothes, such as scarves will be twisted or torn
P.3	Encountered	Lack	The product, which is suitable for the elderly, needs to be researched more in the future, mainly mobile phones. Clear display, convenience, safety, and easy to send information with hand writing	Ah, I use the old-fashioned phone, NOKIA, whether now or in the past. I think it is more convenient, nice performance, and easy to carry
P.4	Since I use the phone, I still feel this is comfortable and safe	Lack	The mobile phones, which the elderly use, the screen and font need to be a little bit bigger, particularly include hand-writing function. The computer could also include hand-writing function.	The question is answered above
P.5	Encountered	Some fashionable products, and some of the latest products now will take this into consideration	For TV, the button of the remote control is small and with English as well, so my eyes cannot to see and my hands cannot adjust the channel. Sometimes, I try to press the buttons or see something on it incorrectly	There are good experience, for instance, from a bigger, good resolution TV, that can be hung on the wall
P.6	Encountered, I'll call to consult	Font for the elderly should be large and clear, because the elderly eyesight is not good. Younger people just consider function	I have not encountered	None
P.7	Encountered	Lack, many products lack this	Design should properly consider education level on tech or intelligent design, especially as the society steps into the era of intelligent	A new motorcycle was found to have quality problem after I had only ridden it a few times, and I had to return for another one over and over, even though the manufacturer was responsible for the change within the warranty period
P.8	Encountered, if something is bad will get it fixed	Of course, some lack	I do not know	Refrigerator keeps food good and fresh
P.9	Never encountered	Lack	N/A	Yes, previous bicycle is more durable than the new one, and the previous one's structure I was familiar with. It's uncomfortable to ride the current one.
P.10	Never encountered	No lack	The elderly eyesight is poor, so font needs to be bigger, in order to see something clearly.	None
P.11	Encountered	No lack	Good quality and safety.	Sometimes the cell phone is difficult to use with difficult operation

P.12	Never encountered	Lack	Yes, the elderly products need to be designed more, and the household goods which are in daily used need to be designed with more convenience in mind.	None
P.13	Encountered	Lack, the product doesn't allow the elderly to better understand functions and usage	Designed products need a little bit more simplicity, not too fancy. The function needn't be too complicated	Mahjong table often has small problems that effect playing and ruin the mood
P.14	Never encountered	No lack	Need more convenience, for example, if the electric bicycle can be designed as solar powered, it won't encounter the case of needing to pedal when it has lost power on halfway. The elderly cannot handle unexpected, so sudden events need to be considered in design.	None. My background was pretty rough, so I am very satisfied the current appliances
P.15	Never encountered	No lack, very satisfied with modern products	The current products can change for the better. They can be developed into certain specialized products for the elderly to bring more enjoyment, service, and special care to them	None
P.16	Never encountered	No lack	The current product has been very good, and needn't to change.	None
P.17	Never encountered	No lack, No requirements for product	Designed products need a little bit more simplicity, and the keys needn't be too complicated	I do not know how to use a water heater, so, the erector took a long time to teach me
P.18	Encountered	N/A	N/A	Our family used to use an electric cooker with non-stick function, but it failed gradually. Later, we changed for a new and better one that cost one thousand RMB. The rice is very fragrant, but the time spent is longer than the old one. Same rice cooked, but with different results
P.19	Unable to turn on with many times unsuccessful attempts, however, when we were waiting, it suddenly caught fire. It was so scary. I said to my son that if the item is dangerous, it is the best to use electric instead. But the electric version does not seem as fast as gas	N/A	N/A	N/A
P.20	I feel unsafe using gas	N/A	N/A	I worked as a tailor before. The sewing machine I bought needed to be tread by foot and cause fatigue. Now it is electric. Because of my presbyopia problem, I hope that it will be better with auto-threading function
P.21	I don't know what the problem was	N/A	N/A	N/A
P.22	Yes, I cannot leave the product which used every day are microwave oven	Lack	One is a remote control that should be made with consideration to the elderly cognition. Another is	Microwave oven is good with easy use and operation. I can see inside, and can stop immediately if there are some problems.

	and refrigerator		TV with rapid electric appliance update; stuff such as VCD and DVD which was bought only ten years ago, are no longer in use	
Summary	13 participants answered that they encountered problems before directly, and 8 participants answered that they don't encounter problems directly. Some of the answers are detailed reasons i.e.: unsafe (2 P.s), not running (1 P.), noise (1 P.) This shows that most of the participants encounter product problems during their daily life experience, with the main aspects being safety and usability related.	6 participants answered that they are lacking directly 1 of them indicated that the product doesn't allow them to better understand functions and usage 3 expressed sometimes or some products lack 3 answered lacking indirectly with suggestions, 1 of them consider that large, clear font for the elderly eyesight should be better, and that fashionable products now and some latest of the products will take this into consideration 6 answered not lacking, 1 is very satisfied with the modern products, and 1 has no requirements for products 4 answers are omitted Over half the participants think product design for the elderly lack consideration. This shows that caring for the elderly in product design still needs to improve	Considering the questions of improving the usage and demand for the elderly products, more suggested answers from participants are proposed. 14 answers were definite. 8 answers are without suggestions, 5 of them omitted, 2 stated not knowing clearly, and not encountered, 1 answered that current products are very good and don't need change This inducted the 3 categories in terms of usability, cognitive/understanding, and functionality. From the result, it also shows that usability is most important and cognition is above functionality. The experienced importance should focus on usability and cognition **Usability:** Simpler (4) without too fancy and function Ease to use / send (3) Safer (3) Convenient (3) in household goods which in daily used or solar powered electric bicycle in case to prevent the elderly accidents Larger press button (2) for TV remote Larger font (2) Larger screen Clear display Chinese typeface **Cognitive and understanding:** Generous Consider the elderly cognition for a remote control Appropriate consideration of education level of the elderly on high-tech or intelligent products Develop certain specialized products for the elderly enjoyment, service, and special care **Functionality:**	Positive feeling with 5 answers and bad feeling with 9 answers, mainly focusing on usability, functionality and perceptive experience as follows: Good feeling is 5, bad feeling is 9, and most involved in quality problems **In function aspects:** – Refrigerator keeps food fresh – Electric cooker with non-stick function **In usability aspect:** – The old-fashioned phone, NOKIA, is more convenient, nice performance, and easy to carry – Microwave oven is good with easy use and operation. I can see into inside things, and can stop immediately if there is some problems occurrence **In perception aspects:** – Bigger, good resolution TV can be hung on the wall **In function aspects:** – Table fan with bad quality has broken within a half year – Washing machine, sometimes, its speed of washing clothes is uneven, some clothes, such as scarves will be twisted into tore lousy – A new motorcycle often is wrong with quality problem **In usability aspects:** – Sewing machine is difficult to thread a needle – Cell phones which the elderly used, the screen and font are small without the hand writing, as well as computer. – Cell phone sometimes is difficult to use with difficult operation **In perceptive experience aspects:** – Water heater without know to operation – Current bike bicycle is uncomfortable to ride – Mahjong machine is often appearing small problems and effect playing mood 6 answered is none, and 2 did not answer

			Hand writing for cell phones (2) as well as computer Good quality	In general, bad feeling is more than good feeling within each aspect. This shows that the function, usability, and perceptive experience have equal importance. The usability aspects involved identification of size such as button size, font etc. The perceptive experience aspects involved factors such as eliciting a positive mood, comfortable, and easily identifying the objective.

P. Q3: Cognitive issues						
Question (Q)	**P. Q3-1: Do you think it is important that your emotion is affected by visual presentation of product?**	**P. Q3-2: If yes, please describe the most important factor such as color, shape and texture etc.?**	**P. Q3-3: Did you often occur the cognitive error along with age increasing before?**	**P. Q3-4: If yes, would you please tell me an experience on it?**	**P. Q3-5: Which kind of product design are your best preferred from these water pot? Why?**	**P. Q3-6: Could you describe the felling in detail what if you have pleasurable emotion when your see or use it?**
P.1	Yes	All are issues with bad material	Yes	Unremembered	No 7, because commonly used in the home	I will be very happy
P.2	Yes	Colors effect my mood	Yes	Not clear	No 7, simple, especially the kettle, it is simple and convenient for elderly use	Happy
P.3	Yes	I think it is OK, this will affect my mood	Yes	Yes, sometimes I go to get something, but will soon forget what I went to take after walking around the room	No 7, I feel it's much safer because the kettle and the pedestal are separated. The power supply at the bottom and the kettle on top and can be moved	Yes, I will feel this product is good if I see others use it
P.4	Yes indeed, like computer, if its' running speed is fast, the mood will be good	Font, functional design	None	Not felt	No 7, I think the elderly require some auxiliary facility, such as handrail, the size is very convenience	Yes, the electric kettle can boil water very fast when you have guests visit your home
P.5	Very important	I think the first and most important is color, second is the font size. I hope the volume is also higher. The remote control adjustment is convenient. In short, the TV with rich color and high resolution are desirable	Yes	On color, due to my limited ability to see color, it is sometimes adjusted by my children in order to look better and make me more comfortable. Otherwise, the remote-control unit with small font is difficult to see	N/A	Watching TV is my most important daily activity. Watching TV is also the most enjoyable activity for the elderly, and one of the most important tools which is associated with people's mood
P.6	Yes	It is the product's quality problems, like TV, if sharpness is good and image is not clear it can make me agitated	Yes, there are a lot of things I do not know how to use with age increase. Radically missing the	None	No. 9, Because red does not belong to the terrorist color, it is more conspicuous and easy to find it, just for this reason	Yes, very pleased

			consideration to the elderly			
P.7	Visual mood affected by sanitation	For a purchased product, in general, the colors and materials will be selected based on personal preferences, but sometimes the function cannot be used due to unclear instruction	Have this experience sometimes	N/A	No 15, unique with chinaware and electric appliance separated into two parts, upper and lower. The other part is stainless steel. It integrates various materials into one product	I mostly liked its design which integrated variety of materials, and plants and flowers patterns on the top of kettle
P.8	It may affect, ugly = uncomfortable	Nice color can affect mood	Yes, often	I cannot say too much at a time, for one example, I often grab my cell phone as a remote control when I need to use the remote control	No 9, color and good-looking appearance	Happy
P.9	Yes	Shape is the most important, followed by color	None	None	No 7, The shape is best, ordinary and generous	Yes
P.10	Important	Color	None	None	No 9, because color and good-looking appearance, so, it looks comfortable	I will be very happy
P.11	Yes	Material	None	None	No 15, because it is simple and neat not fancy, so, it looks pleasing to the eye	I will be very happy
P.12	Yes	Material is first, shape is second	Yes	Don't know how to say it	No 7, looks quite practical	Yes
P.13	Yes	Color	Yes	Don't know how to say it	No 9, because the color is red, shape easy to identify without complication	I will be very happy
P.14	Important	Shape. I am not really concerned though	None	None	No 9, because the bright in color	Will be very cheerful
P.15	Yes	Color	Yes	Mistake other things as their own, or mix up controllers for TV A/C etc. I am often forgetful as well	No 15, because it's quality looks good	Will be very cheerful
P.16	Not Important	Color	None	None	No 9, because the good-looking decorative design, simple and neat color, quietly elegant, and simple style	Will be very cheerful
P.17	Important	Color	Yes	Misidentifying household items	No 7, because it is good-looking, practical, and simple	Will be very cheerful
P.18	Of course	N/A	Knowledge that was learned in childhood cannot be forgotten. Current memory	N/A	N/A	N/A

			ability is declining			
P.19	For example, we will be very happy when we wear white clothes and use a red fan	N/A	Sure, it is certainly not the same as with young people. young people want to do anything	N/A.	N/A	N/A
P.20	N/A	N/A	Absolutely not, the text can be recited easily as when I was young, but, at present, I am old	N/A	N/A	N/A
P.21	N/A	N/A	N/A	N/A	N/A	N/A
P.22	Can affect	Sometimes it color, and sometimes it is material. The material problem is lower than color	Never met. Maybe referring to the TV, Sometimes, I don't know which buttons need to be pressed	I do not know why, but the TV is broken accidentally when I had touched it, and the TV quality is so poor now	N/A	Happy
Summary	18 answered important. The explanations of which related in the visual presentation: – Color, for example, they will be very happy when they wear white clothes and use a red fan – Good looking, such as ugliness may bring uncomfortable feeling Participants also claim other reason which influence they emotion from usability and environment	The most important factors from participants are: – Colors (11), such as rich color TV – Material (5) – Shape (3) – Font (2). Such as a bit larger – Volume, higher, – Clarity (3), such as sharpness in TV with clear image 1 participant just reply ok with ambiguous meaning, but thinks the color, shape and texture will affect mood. 4 participants didn't answer. Some	15 participants answered that they experience cognitive error 2 of which stress that they are sometimes or often occurring 6 participants answered they do not experience this, with 1 participant answering that they didn't encounter this kinds of case In general, cognitive error is a serious issue that the elderly encounter in their daily life. Therefore, it needs to be met with	7 participants gave negative aspects of their experience i.e.: – Faulty identification (3) – Often forgetting something (2) – Product broken – Small font is difficult to see Positive aspects of their experience: – Appropriate color 15 participants cannot answer the questions with the reasons as followings in: – None (6) – N/A (4) – Unknown how to say it (2) – Unremembered – Not clear – No felt The question answers show that most participants don't care about their	According the selected order, the kettle which are preferred by the participants with reasons are as follows: No. 7 (7) – Commonly used – Simple (2) and convenient for the elderly use – Safer with separated kettle and the pedestal, and can be easily moved – Convenient for the elderly with larger size handle – Shape is best, ordinary and generous – Looking quite practical (2) – Good-looking The reason focuses on simple (2), practical (2), commonly used, convenience, safety, shape, and good-looking No. 9 (6) – Red color (2), more conspicuous for easy to find – Good looking color (2), so, it looks comfortable – Bright in color – Shape easy to identify – Good-looking decorative design, simple and neat color, quietly elegant, and simple style	18 answers were positive which related to the term happy: Pleasure (5) Very happy (4) Very cheerful (4) Happy (3) Very pleased (1) Easy to use (1) Greatest fun (1) N/A(4 The result shows that the elderly will experience pleasurable emotion if they see or use their preferred product

	aspects, for instance: – Computer with fast running speed, the mood will be good – Sanitation will affect visual mood 1 answered that it may affect, uncomfortable reason caused by ugly present 1 answered not important 2 N/A This confirms emotion is strongly affected by the visual presentation of a product	answers exceeded the range of required answer including: convenience, functional design, clear instruction, and quality problem. These answers will are also useful and can be considered as a reference in the next stage These replies indicate that factors such as: color, material, shape, font, etc. are very impactful on elderly emotion and mood	care in product design The main explanations on the question provided in detail are: – Memory ability is in decline (2). – The elderly's ability is certainly not same as with young people – Bad identification such as not knowing which buttons need to be pressed – Many things the elderly do not to know how to use	experiences or are unclear on how to express the concepts. It also indicated that design needs to improve to satisfy the elderly requirements of experienced feeling Experience barriers include: – Identification difficult (3) with lacking consideration of the elderly eyesight decline, for example, small font and inappropriate color – Memory decline (2). It is an important factor which influences the elderly experience and use of the product. Therefore, designing the remind function in is very important – Usability. It is always an important factor that is related to product use and mood effect	The reason focuses on color, shape, decoration, and simple style requirements No. 15 (3) – Unique with several integrated materials into one product – Simple and neat not fancy, so, it looks pleasing to the eye – Quality looks good The reason focuses on materials, simplicity, and quality aspects 6 participants did not answer Based on the 3 products and preference reasons, it shows that the 3 products showed differences in the emphasis: – No 7 (7), simple (2), practical (2), common use, convenience, safe, shape, and good-looking. It shows usability and the product's appearance were key elements – No. 9 (6), color, shape decoration, and simple style. It shows only product's appearance was key element – No 15, materials, simplicity, and quality. It stresses the basic function and the product's basic appearance A synthesis of the above shows that the product's appearance most easily affected the elderly when picking their favorite	

P. Q4: Emotional issue			
Question (Q)	**P. Q4-1: Do you think a pleasurable mood will be benefit for the elderly health?**	**P. Q4-2: What kind of product do you think can make you pleasant?**	**P. Q4-3: What condition of product in use can keep you pleasurable mood?**
P.1	Yes, of course, good mood benefits good health. People can keep healthy state, but if the mood is not good, everything is empty	TV, watching television	Comfortable from air conditioning blowing
P.2	Yes	Electric pressure cooker, Cooking convenience	Easy to use
P.3	Yes	All kinds of appliances are same that require safety, convenient and pro-environment, mainly safety and healthy	Convenient, safety, easy and simple to operate, that's all
P.4	Can promote the elderly health. More pleasant mood, more fulfilling life, more longevity	Electronic products	Simple, good use
P.5	Yes, very much, look at some variety programs, or young people show, dramas, etc. after viewed, sometimes very happy with laughing, sometimes sad with tears following the plot	Commonly used products i.e.: TV, computer, refrigerator, air condition, cooking kit, cell phones etc	Safety. The shape needs to fit functional needs. For instance, the electric cooker is good for use in cooking, and the pressure-cooker for cooking soup is very convenient. All of them are good and can make life more convenient for us.
P.6	Yes	Electrical appliances, so I chose three kinds products above with my favorites as well as indispensable	I think from the quality perspective, the product's quality should pass inspection when it comes from the factory. The supervision should be strictly controlled, to prohibit the fake and inferior products from entering into the market
P.7	Yes	Electrical appliances, computers, TV sets can make me happy	Normal running
P.8	Yes	Electrical products	Convenient use
P.9	Yes	Nothing in particular	Not broken
P.10	Yes	Good quality	Convenience to me
P.11	Yes	Electric bicycle	Safety
P.12	Yes, sure	Watching TV	Very simple product without flashiness and easy to identify at a glance
P.13	Yes	Mahjong machine	Running normally without small trouble
P.14	Yes, there is a great relationship that the mood affects the body's health	Electric vehicles	Product without error
P.15	Yes, laughter is the best medicine, happiness is good for health	TV, it can bring much more television programs	None
P.16	Yes	TV, entertainment programs	When the product benefits health, adds body comfort
P.17	Yes	Radio	When let me to hear the drama
P.18	Of course, my favorite is the little radio. When I work at home or am washing clothes, I will turn it on and listens to songs, and then I will feel very happy while the music plays	N/A	None
P.19	N/A	N/A	None
P.20	N/A	N/A	None
P.21	Sometimes, I will be ok when I listen to music when I am in a bad mood	N/A	None
P.22	Of course, if mood is good, seems the body feels better; if the mood	Sofa, when watching TV, I can lay down to watch if I am in house	Feel better when using

	is bad, people often get sick	alone sometimes	
Summary	Except 2 participants who did not answer the question, all of the remaining participants, show a positive correlation between mood and health. The answers are very rich with lots of reasons given. These reasons can strongly underpin the meaning of this research Amongst those that agree, 12 participants answered yes directly, and others are with different stated reasons are as follows: – Sure – Good mood benefits good health. People can keep healthy state, but if the mood is not good, everything is empty – Promote the elderly health. More pleasant mood, more fulfilling life, more longevity – Very happy with strong emotion after viewed variety programs – Sometimes, my bad mood will be ok when I listen to music. – If mood is good, seems the body feels better. If the mood is bad, people get sick soon – There is a great relationship between the mood and the body's health. – Laughter is the best medicine, happiness is good for health. – Listening to music while doing chores makes me happy. According to the responses, the concept of pleasurable mood benefitting health gained the common agreement from the participants. However, due to lacking research, it need to digger and identify their emotional reaction and the relationship between the elderly pleasurable emotion and its inducement	– TV (7) – Electrical appliances (4) – Electric bicycle (2) – Computers (2) – Mobile phone (2) – Air condition (2) – Electric pressure cooker – Refrigerator – Radio – Mahjong machine – Cooking kit, – Sofa 4 participants with N/A, 1 participant is not sure, 1 participant gave an irrelevant answer: good quality. Most products that selected were electrical appliances or products. They mainly cover entertainment, living, traveling, communication, cooking etc. Thus, it can be seen that the elderly are becoming more and more closely associated to electrical items in their daily lives. It obviously shows that the usability of products needs to be reconsidered in order to satisfy the elderly living requirements and their good mood/health moving forward. In addition, TV, as the most important entertainment article for daily use, is favorable with a mixture of visual and auditory diversified programs. It is also an important window for understanding their outside world. For new technology development, the products with simple manipulation are most suitable to the elderly's perception and understanding; and should be the first consideration in design for the elderly. Therefore, easy to grasp and easy to use will be equally important	The answers are separated into four aspects mentioned which affect the participants' pleasurable mood: Vision, feeling, usability, and quality. The detail interpretation with reasons as follows: **Vision related:** – Easy to identify at a glance – Very simple without flashiness, – Shape. **Feeling related:** – Convenient (3) – Comfortable from air conditioning blowing – Good use – Health Benefit, comfort – Hearing dramas – Product use **Usability related:** – Safety (3) – Simple(2) to operate – Easy to operate – Easy to use **Quality related:** – Function needs – Normal running – Good quality – Running without broken – Running without error – Normally running without small trouble 5 participants answered N/A The results reveal that the mood can be affected by a variety of aspects. Based on the visual related aspect "easy to identify at a glance" indicated that required appearance of product should mach the perceptive features with different factors such as color, shape, texture and surface to arouse their attention with clear identification. Additionally, simple, is another elderly preference commonly stated. Simplicity can reduce the load of perception and allow for quick identification of the object allowing easier manipulation

P. Q5: VE issue			
Question (Q)	**P. Q5-1: Do you have any good or bad experience on pleasurable emotion, and visual feeling when product in use?**	**P. Q5-2: Which daily used product with visual comfort or discomfort?**	**P. Q5-3: Did you encounter the problem occurred of receiving information from environment or product such as instruction book and warn sign etc?**
P.1	Yes	The elderly will be happy when they watch a better program of TV in line with elderly mentality	Encountered, I bought a electric cooker without understanding the usage, and it was hard to use
P.2	Yes	Confused	Yes
P.3	No	None	None
P.4	Yes	Computer that I want to use, can make me bad mood due to the difficult spelling that comes with old age. It will be better if it can write directly	Yes
P.5	Such as computers, there are a lot of contents and information in internet. but it will make me anxious caused by slower speed after a long time running, and small fonts etc.	My computer screen is small, but the LCD which I used many years displayed very well without harming the eyes and gave a good feeling. The all-in-one computer I hold, easily causes my eyes to be tired after long time of viewing, feels to bright	Yes, there is a small window will tell you OK or Cancel. It is very good, but it does not seem that it is displayed each time. I hope I could receive reminding in each step.
P.6	Never encountered before, because the product I have chosen is my favorite	None	Yes
P.7	Not found so far	Acceptable without finding	Yes, some times
P.8	Yes	None	Yes
P.9	Yes	New bicycle looks more uncomfortable then the old-fashioned	Encountered, too professionally written instructions
P.10	No	None	Never met before, usually the instructions book is tossed, I just ask directly during the purchasing.
P.11	No	Good-looking	Never met before, I probably can understand the meaning, and satisfy the requirements
P.12	Yes, bad-looking things need to be thrown away immediately	Pay no attention	Encountered. I often do not understand the instructions book, because of the difficulty words, and a lot of English in many cases
P.13	No	Good-looking	Encountered. Due to the reason that I do not recognize a lot of words, so the descriptive information is difficult to understand
P.14	No	Not found, current designs are good-looking	Encountered. Some instructions books are too much trouble without image
P.15	No	Good-looking	Encountered. I cannot read the English on a medicine I bought
P.16	No	Good-looking	Never met before, all instructions can be understood
P.17	No	Good-looking	Often encountered. I cannot understand instructions due to the reason that I cannot recognize the words
P.18	No	N/A	Some symbol show prohibition with red cross on it. As well as with an exclamation point
P.19	No	N/A	N/A
P.20	No	N/A	N/A
P.21	No	N/A	N/A
P.22	No	A bad mood can be generated when watching a TV program	In instructions nowadays I cannot understand the symbols, and the contents

			are too long winded
Summary	7 participants answered yes but just 2 of them provided reasons: – Anxious caused by slower speed after a long time running, and small fonts etc – Bad-looking things need to be thrown away immediately 15 participants stated they have not experienced this, 2 of them gave the reasons: – Not found temporarily – Never has been encountered before, because the product I chose is my favorite The results show that the most participants said they do not encounter this kind of experience. This reflects that the elderly in general, can ignore the feeling in their daily life toward the products that lack care for their emotional and visual feeling	Based on the reply from participants, the answer separated into two sides related to visual comfort and discomfort as follows: **Visual comfort related:** – Good-looking (5) – Happy when watching a better program of TV in line with elderly mentality (1) – Computer with the LCD display is very good without harming the eyes (1). **Visual discomfort related:** – Difficulty to use the computer, hopes for handwriting function (1) – New bicycle looks uncomfortable (1) – A bad mood can be generated when watching TV program (1). – Computer display is too bright, eye fatigue (1). 4 participants are N/A 4 participants are none, indicating current designs are good or acceptable, 2 participants answers are unfound, indicating current designs are good or acceptable, 1 Acceptable. 1 participant did not pay attention to the issue, 1 participant feels the question was confusing. The replies of the question on visual comfort and discomfort of daily use products were extracted and used as beneficial indicators for this research: – Good-looking is related to the issue of **comprehensive appearance effect on viewer's mood and feeling** – Lower visual stimulation and eye fatigue reflect the **receptivity relationship between object and the elderly** – New bicycle looking more uncomfortable than the old-fashioned is related to their **nostalgic psychology**	15 participants answer yes and express that they have encountered this situation with many detailed reasons. **One had positive suggestion:** – Ok or cancel options, hoping to be reminded in each step of computer use **Some answered indefinitely without stated reasons:** – Some times – Some symbols are – Misunderstand symbol meaning **The negative answers include:** – Misunderstanding the usage – English reading limitation – Troubled instructions book without image – Too professionally written, roundabout – Misunderstood instructions book with unrecognized Chinese or English – Descriptive information is difficult to understand with strange words 4 participants answered no encounter with the reasons: – Never met before, read lass, ask more – Probably can understand the meaning for satisfying the requirements – Understand all instructions contents 3 participants did not answer The results reveal that the most participants have encountered issues with receiving information, mainly focusing on informational understanding, words unrecognized, images, complicated writing. The answers mostly indicate instructional reminders, and show that the elderly have lowered imaginative ability of understanding. However, the information from their answer is very useful to understand their limitations on product information and instructions. A few participants think they never encounter the situation because they never read the instructions book, or because of understanding the meaning and contents included

		– Difficulty to use the computer and hopes of handwriting function are **usability factors** – A bad mood can be generated when watching TV program, is related to the **artistic expression that can affect the audience's emotion** All of these 5 aspects are later discussed in the contents of this thesis	

P. Q6: Needs issue		
Question (Q)	**P. Q6-1: Do you think what the elderly needs should be considerate in product design for them?**	**P. Q6-2: Do you have any idea about designing such product, in which with pleasurable elements?**
P.1	With age, the elderly need to be considered via design in: safety, convenience, pleasant appearance, energy saving and fitting the elderly style.	No, old people do not want to do this
P.2	The elderly cannot see clearly, particularly English words which are easy to misunderstand unclear words with small size	I do not want to because I don't know how to do this
P.3	Due to elderly having poor eyesight and slowed speed of visual recognition, larger font is required. Besides, there are needs of safety and health products, but they must to be understood easily and useable	I wish, but I don't know how to do this, such as my cell phone, I often sent message and must often type, So, I want to make handwriting one.
P.4	Color, appearance and in particular function	I do not have this ability because I don't know how to do this
P.5	Safety is first of course, easy to use, convenient and most straightforward is the best. Larger font to ensure it can be seen, and to know which keys to press, and operate. It is better to have less buttons to press or buttons with a little silly function like auto focus camera.	Many elderly people use radio, so for an example, when we go climbing for exercise, it can hang around the waist, or be strapped to the arm. They can also download something from the computer, or have real-time radio function. I hope to integrate sound, image, and functionality
P.6	Sharpness, safety, and operation should be relatively easy due to the reason that the elderly lack the know how compared to young people	Without this idea, because of advancing age
P.7	Easy to learn, easy to understand, and easy to operate	None
P.8	Older people find it difficult to lift heavy things, and unclear vision	None
P.9	Straightforward, understandable, and safety guaranteed	Yes, after all, the elderly is not the same as young people, So, it should bring joy to the elderly
P.10	Easy operation is first. Secure is second	None
P.11	Better quality required	Yes
P.12	Simple, generous, and simple operation	Yes, manufactured products should make people happy. People do not purchase the product which makes them unhappy
P.13	The elderly have poor eyesight, So larger font, uncomplicated operation are needed	Yes
P.14	Easy understanding and larger font	There is the idea that elderly are a growing demographic. As such there should be more living utensil for the elderly manufactured; that can bring them more pleasure and joy.
P.15	Taking into account the elderly age and the end of life coming, it is their time for enjoyment, so there should be some more products which bring enjoyment to the elderly; invented and created	Yes
P.16	Not aware of any	None
P.17	Many products cannot be operated by the elderly, therefore, require 'simple is better' via design	None
P.18	N/A	N/A
P.19	N/A	N/A
P.20	N/A	N/A
P.21	N/A	N/A
P.22	It is easy to eat enough, because of the large bowl with enough noodle for the people who live in Guangzhou	N/A
Summary	17 participants think the elderly needs should be considered in product design for them. The key words in order shows the reasons are: **Usability related:**	**8 participants have an idea on designing a product and proposal:** – There is the idea that elderly are a growing demographic. As such there should be more living utensil for the elderly manufactured; that can bring them more pleasure and joy – It should bring joy to the elderly more

	– Simple or easy to operation (9) – Safe(7) – Energy saving (2) – Convenient (2) – Easy to learn – Easy to use – Healthy – Usability – Defined amount for the elderly – Light **Perception and emotion related:** – Larger font (5) for the elderly easy to read – Easy understanding (5) – Clearness (2) – Generous – Pleasant appearance – Fitting the elderly style – Clear fonts – More products which bring enjoyment to the elderly should be invented and created – Chinese text – Color – Appearance **Function related:** – Function for the elderly – Quality better – Growing with age, the elderly need to be considered via design 1 participant answered they are not aware of the issue 1 participant did not answer the question Synthesis of the above shows: Simple, convenient, visual identity, and safety are the main considerations for the elderly needs. Therefore, it is obviously embodied in two aspects: usability and perception; which further affect the elderly VE and their mood.	– Manufactured products should make people happy. People do not purchase the product which makes them unhappy – Want to make handwriting function one cell phone – Many elderly people use radio, so for an example, when we go climbing for exercise, it can hang around the waist, or be strapped to the arm. They can also download something from the computer, or have real-time radio function. I hope to integrate sound, image, and functionality **9 participants have no ideas for products with the main reasons being:** – Unwilling to think about it due to old age – Lacking knowledge (3) – Lacking this ability 5 participants answered N/A The results indicated that most of the elderly had no ideas on the issue, had misunderstanding, and were unwilling, or unknowing and incapable in design. A few participants answered with proposals, but had ambiguous meaning. Most hunger for happy mood brought by a product, but the suggestions just stay on the level of ease of use. This shows that the elderly need items design to meet these specified needs

APPENDIX. V - V. Application form to Gain Approval for Activities Involving Human Research

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APPLICATION FORM TO GAIN APPROVAL FOR ACTIVITIES INVOLVING HUMAN RESEARCH

Notice to Staff and Students

If your research involves using human tissue or fluid samples please **DO NOT** use this application form. Please approach the Research and Commercial Office, Faculty of Health and Life Sciences, 2.25L Hawthorn Building, Phone: 7891 / 7777 for the correct application form if you are using human tissue.

The University requires that approval is obtained by members of staff of the University and by students of the University who wish to engage in the type of research detailed below. Please use this form for an application if your research involves:

1. Gathering information from or/and about individual human beings (and organisations) through:
   - interviewing
   - surveying
   - questionnaires
   - observation of human behaviour
   - modifying/disturbing human behaviour
   - interfering in normal physiological and/or psychological processes
2. Using archived data in which individuals are identifiable.
3. Researching into activities which involves direct observation of or contact with those who are or who might reasonably be supposed to be engaged in or have engaged in criminal activities or activities which are related to criminal activity
4. Research which involves a risk of physical or psychological injury to the researcher or any other person involved in the research
5. Supporting innovation that might impact on human behaviour e.g. Behavioural Studies

[It should be noted that in regard to research into illegal activities there are no exclusions or blanket permissions and the University Insurance cover may not apply if the research activity has not been cleared by the University or, in certain cases with delegated authority, the appropriate Faculty Committee.]

Guidance and support will be given by your supervisor (for student research), your line manager or an appropriate designated officer/ Faculty Research Office. Queries arising out of this should be directed to:

FAILURE TO GAIN FREC APPROVAL FOR YOUR RESEARCH MEANS THAT YOUR PROJECT MAY BE FAILED OR THAT YOU ARE SUBJECT TO DISCIPLINARY ACTION.

DE MONTFORT UNIVERSITY

APPLICATION FORM FOR RESEARCH ACTIVITY REQUIRING HUMAN RESEARCH ETHICS CONSIDERATION OR APPROVAL

Staff/Student Name	**Programme (if relevant)**
Delai Men	User Centred Design and Innovation

Title of Research Project

An Investigation into the User-Centred Visual Experience Design and Emotional Reflection for the Elderly

Brief description of proposed activity and its objectives:

1. Collection of information about the elderly emotional reflection of visual experience on product through: observation, questionnaire, interview with experts, testing
2. Information collected from Chinese participants (via the questionnaire with interview, testing in surveys)
3. Collection of information about design issues for the elderly from Chinese experts through: Interview

Ethical issues identified:	**How these will be addressed:**
Disclosing the full details of research to participants	Attached project proposal, consent form and written information about the research for each participant
Allowing voluntary participation and freedom for withdrawal	Consent form detailing participant involvement, their freedom to withdraw or take part in the study
Signed consent by participant	Signed consent form with date required by every participant
Written description of involvement	All records keep in confidential filing system and to be seen only by myself for the period of primary research only
Appropriate records being kept confidential	Electronic records to be password protected with only a single copy available
Keeping records secure and with secure disposal	All physical records to be disposed via shredding, all electronic records to be wiped and destroyed after use
Language description of involvement	Clear Chinese and English interpretation to be used at all times with no localization of speech

To which ethical codes of conduct have you referred? These are specific to each Faculty and if you have a query please ask your supervisor or Faculty REC for advice.

http://www.dmu.ac.uk/research/humanities/ethics.jsp
http://www.dmu.ac.uk/research/graduate-school//code-of-practice/cop2005/P4_Ethics.jsp

How have concerns regarding the safety of the researcher and/or the research subject been addressed if applicable?

Checklist for applicant:

Has the research proposal identified any of the following research procedures?

1. Gathering information from or/and about human beings through: Interviewing, Surveying, Questionnaires, Observation of human behaviour
2. Using archived data in which individuals are identifiable
3. Researching into illegal activities, activities at the margins of the law or activities that have a risk of personal injury
4. Supporting innovation that might impact on human behaviour e.g. Behavioural Studies

The following should be considered. Please tick yes as relevant:

☑ Providing participants with full details of the objectives of the research
☑ Providing information appropriate for those whose first language is not English
☑ Voluntary participation with informed consent
☑ Written description of involvement
☑ Freedom to withdraw
☑ Keeping appropriate records
☑ Signed acknowledgement and understanding by participants
☑ Relevant codes of conduct/guidelines

Are there other/additional factors that could/will give rise to ethical concerns? E.g. Communication difficulties

The subject focus on the elderly group of China, so the language for communication with Chinese participant need to be conducted in Chinese and precise English translation, and all of text documents related to their also be shown in bilingual

List of accompanying documentation to support the application:

(1) A copy of the research proposal
(2) The details of arrangements for participation of human subjects (including recruitment, consent and confidentiality procedures and documentation as appropriate)
(3) A copy of all the documentation provided to the volunteer to ensure the clarity of information provided

(4) Copies of appropriate other ethical committee permissions (internal or external) or supporting documentation
(5) If appropriate: a list of proprietary drugs or commercial drugs to be used in the proposed investigation including formulation, dosage and route of administration and known adverse side effects
(6) A statement of your competence to carry out this research as a student or a brief one page curriculum vitae for each applicant, including recent publications (staff only)
(7) Other documentation as advised necessary:

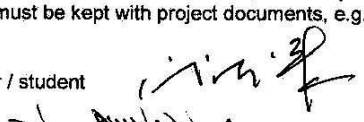
There are normally four possible outcomes from reviewing the activity against the procedures in place:

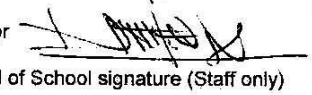
1. no ethical issues
2. minor ethical issues which have been addressed and concerns resolved
3. major ethical issues which have been addressed and concerns resolved
4. ethical issues that have not been resolved/addressed

Provisional approval could be given at the discretion of the Research Ethics Committee.

Authorisation is dependent on Faculty. Please refer to your faculty guidelines for details on how outcomes are reached:

- The reviewer advises the PMB/SAB/REC of those activities in the first three outcomes.
- Activities in the fourth outcome are submitted to the Faculty REC for resolution
- The approved form must be kept with project documents, e.g. be included as an appendix in the report.

Signature of researcher / student  Date 02-02-2012

Signature of supervisor  Date 25-01-2012

Line Manager or Head of School signature (Staff only) Date

This form complies with the DMU policy statement on Human Research Ethics, a full copy of which can be found in the General Regulations and Procedures Affecting Students.

A separate form is required for each project.

ADVANCE APPROVAL OF RESEARCH ACTIVITY INVOLVING HUMAN RESEARCH ETHICS

1 Respondents' co-operation in a research project is entirely voluntary at all stages. They must not be misled when being asked for co-operation.

2 Respondents' anonymity must be strictly preserved. If the Respondent on request from the Researcher has given permission for data to be passed on in a form which allows that Respondent to be identified personally:

(a) the Respondent must first have been told to whom the information would be supplied and the purpose for which it will be used, and also

(b) the Researcher must ensure that the information will not be used for any non-research purpose and that the recipient of the information has agreed to conform to the requirements of any relevant Code of Practice.

3 The Researcher must take all reasonable precautions to ensure that Respondents are in no way directly harmed or adversely affected as a result of their participation in a research project.

4 The Researcher must take special care when interviewing children and young people. The Faculty REC will give advice on gaining consent for studies involving children or young people.

5 Respondents must be told (normally at the beginning of the interview) if observation techniques or recording equipment are used, except where these are used in a public place. If a respondent so wishes, the record or relevant section of it must be destroyed or deleted. Respondents' anonymity must not be infringed by the use of such methods.

6 Respondents must be enabled to check without difficulty the identity and bona fides of the Researcher.

APPENDIX. VI - I. Examples of Raw Data of ET

Table 6.44 Time to first fixation on color purity contrast

G	NA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55
A	0.227	3.268		1.534	3.871	1.105	0.352			**0.568**		2.802	1.700		**0.761**	1.763	3.751	3.857				**0.874**		2.085	**1.218**	**0.200**	**0.517**			1.762	3.001	**1.200**	1.540	2.609	1.266		2.217	1.697		2.826		**1.087**	0.000		2.474			1.322	1.768				1.684		0.166	1.370
B	0.482			**0.225**	2.064			1.241		1.608		0.000	3.955		**1.046**	**1.238**	1.502	**0.930**	1.025	0.000		2.948	1.466		1.671	1.466	**1.024**		2.638		**0.277**	1.675	**1.271**	1.547	3.803		3.018	1.892	2.189	1.655	0.801	**1.275**	3.092	1.400	1.751	1.201	0.534		2.183	1.651	3.708	2.764	3.482			3.535

Table 6.45 Observation length-Participants vs AOIs on color purity contrast

G	NA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55
A	0.000	0.008	0.000	**0.044**	0.006	0.108	0.009	0.000	0.000	0.043	0.000	0.013	**0.062**	0.000	**0.104**	**0.049**	0.016	0.011	0.000	0.000	0.000	**0.069**	0.000	0.043	**0.144**	0.006	0.019	0.000	0.000	0.018	0.032	0.040	0.037	0.023	0.041	0.000	0.008	**0.048**	0.000	0.040	0.000	0.012	0.015	0.000	0.023	0.000	0.000	0.033	0.026	0.000	0.000	0.000	**0.069**	0.000	0.017	0.010
B	0.000	0.000	0.000	0.019	0.013	0.000	0.000	0.018	0.000	0.014	0.000	0.011	0.002	0.000	**0.083**	0.043	0.028	0.043	0.006	0.001	0.000	0.023	0.047	0.000	**0.083**	**0.093**	0.034	0.000	0.029	0.000	0.051	0.032	**0.381**	**0.142**	0.005	0.000	0.042	0.028	0.091	**0.056**	0.020	**0.114**	**0.054**	0.072	0.022	0.022	0.018	0.000	0.017	0.032	0.014	0.026	0.026	0.000	0.000	0.022

Table 6.48 Time to first fixation on color brightness contrast

G	NA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55
A	0.224		3.621		0.250	1.664	0.761	**1.028**	0.864	0.994					**1.023**	1.660	2.308	0.000		1.208		1.204	1.475	**0.688**	1.916	2.673		1.774			3.656	1.779	**0.291**	0.000		0.268		2.526	**0.512**	1.798			**0.295**	2.115	**0.394**	3.212	2.018	**0.427**	3.862			3.232				
B	0.266	0.625	**0.881**					2.825			0.257		1.952	2.343	3.058	2.039	1.642	3.286	2.577	3.094	0.897	**1.525**	4.159	3.503	2.445	2.734	1.345			0.466	**0.911**	**1.332**	**0.553**	2.216				2.850	**1.594**	2.174	0.390		4.654	**1.205**	3.671	3.021			2.254	2.752	1.341	2.138	**1.582**		1.008	

Table 6.49 Observation length-Participants vs AOIs on color brightness contrast

G	NA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55
Mean	0.000	0.000	0.015	0.000	0.025	0.009	0.063	0.015	0.016	0.019	0.000	0.000	0.000	0.000	0.000	**0.135**	**0.055**	0.027	0.005	0.000	0.007	0.000	0.008	0.012	0.007	**0.107**	**0.042**	0.000	0.005	0.000	0.000	0.007	0.029	**0.071**	0.009	0.000	0.016	0.000	0.021	**0.039**	**0.046**	0.000	0.000	0.000	0.006	0.019	0.026	0.009	0.020	0.017	0.006	0.000	0.000	**0.050**	0.000	0.000	0.000
Mean	0.000	0.017	0.030	0.000	0.000	0.000	0.000	0.033	0.000	0.000	0.032	0.000	0.087	0.052	0.025	0.069	0.032	0.030	0.012	0.017	0.005	0.053	0.012	0.043	**0.119**	0.087	0.052	0.000	0.000	0.032	0.069	**0.242**	**0.288**	**0.096**	0.000	0.000	0.000	0.072	**0.107**	**0.103**	0.078	0.000	0.033	0.020	0.035	**0.090**	0.000	0.000	0.031	**0.089**	0.014	0.006	0.027	0.000	0.017	0.000

APPENDIX. VIII - I. Examples of Images Recording of Investigation