

Guidelines for Designing Non-Electric Kitchen Tools for Enhanced Pleasurability

by

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A thesis submitted to the Graduate Faculty of
Auburn University
in partial fulfillment of the
requirements for the Degree of
Master of Industrial Design

Auburn, Alabama
December 14, 2019

Keywords: Design guidelines, Pleasure, Five senses, Ergonomic factors, Materials

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Abstract

Today, meeting the spiritual solace has become the top priority of customer needs. The kitchen is always a happening place because it is the heart of the home. Kitchen tools have an important role in making the experience of cooking and eating pleasurable. Consumers can buy professional chef's tools or create and enjoy their own tool. As people have expectations for their kitchen tools, it is important to design pleasurable kitchen tools. This study will explore the most important elements that a pleasurable kitchen tool has and develop a process for designing kitchen tools that are pleasurable.

In the book 'Designing pleasurable products', Jordan states that "Pleasure with products comes from the relationship between a person and a product. Therefore, pleurability is not a property of a product but of interaction". This thesis is based on common emotional design principles. With consideration of emotional design elements of kitchen tools, three levels - visceral level, behavioral level and reflective level will be studied in this thesis. Safety, intelligence, compatibility, usability, hedonic and practical benefits associated with products will be researched in the study.

After studying physical and psychological pleasure feelings and ergonomics of kitchen tools, a process of designing pleasurable kitchen tools will be assigned in this study. A final design shown in this study will follow the guidelines to verify the feasibility of the design process.

Acknowledgments

I would like to express my gratitude to those who have been supportive of my educational career in Auburn University. First of all, I would like to thank my Chair Rich Britnell for his kindness and paternal support in the past three years, for his guidance and time management through the whole thesis writing process. Thanks also to Shuwen Tzeng and Christopher Arnold to always be available and willing to provide advice whenever requested.

Table of Contents

Abstract	ii
Acknowledgments.....	iii
List of Figures	viii
Chapter 1 Problem statement	1
1.1 Problem statement	2
1.2 Need for study	3
1.3 Objective of study	3
1.4 Scope and limits	4
1.5 Procedures and methodology	5
1.6 Anticipated outcomes	6
Chapter 2 Literature Review	7
2.1 Categories of non-electric kitchen tools	7
2.2 What is pleasure	15
2.2.1 Lewis’s classification of pleasure	15
2.2.2 Csikszentmihalyi’s flow	16
2.2.3 Tiger’s framework of four pleasure	16
2.3 Pleasurable products are a trend	20
2.4 Pleasurable emotion types	24

2.5 Conclusion	25
Chapter 3 Case Study of Pleasurable Non-Electric Kitchen Tools	27
3.1 Introduction	27
3.2 A case study: the oxo peeler	27
3.2.1 The history of the oxo peeler	27
3.2.2 Design factors of oxo peelers	28
3.3 A case study: Joseph Joseph color-coded board system	33
3.4 Design strategies of famous companies	34
3.5 Factors for leading pleasure to product design	39
3.6 Functionality	41
3.7 Human factors and ergonomics of non-electric kitchen tools	42
3.7.1 Ergonomics of the handle due to different operations	43
3.7.2 Shape of the handle	50
3.7.3 Conclusion	52
3.8 The aesthetics of pleasurable non-electric kitchen tools	42
3.8.1 The shape or form of product design	52
3.9 Colors of product design	55
3.9.1 Color psychology	55
3.9.2 Color trends for kitchen tool design	56
3.9.3 Color value of kitchen tools	56
3.10 Materials for product design	61
3.10.1 Basic requirements for materials	61
3.10.2 Metals for kitchen tool design	62

3.10.3	Plastics for kitchen tool design	66
3.10.4	Elastomers materials used in kitchen tool design	70
3.10.5	Natural materials used in kitchen tool design	72
3.10.6	Conclusion	74
3.11	The summary of case study	76
Chapter 4	Design recommendation checklists for non-electric kitchen tools	78
4.1	Introduction	78
4.2	Design recommendation checklist for cutting tools.....	78
4.3	Design recommendation checklist for squeezing tools	84
4.4	Design recommendation checklist for mixing tools	91
4.5	Conclusion	96
Chapter 5	Application of design guidelines	97
5.1	Introduction	97
5.2	Physio-pleasure.....	97
5.2.1	Handle ergonomics	97
5.2.2	Materials	98
5.2.3	Aesthetics	98
5.3	Psycho-pleasure	100
5.3.1	Usability (efficiency/effectiveness).....	100
5.4	Ideo-pleasure.....	101
5.4.1	Value/Personality.....	101
5.5	Socio-pleasure.....	102
5.5.1	Relationship/With others	102

5.6 Summary	103
Chapter 6 Conclusion and suggestions for future research	104
References	105

List of Figures

Figure 2.1 ZYLISS Lock N’ Lift can opener.....	17
Figure 2.2 The golden stainless steel three tier cake stand fruit plate	18
Figure 2.3 The OXO Good Grips 3-in-1 avocado slicer	19
Figure 2.4 The juicy salif citrus squeezer	20
Figure 2.5 Maslow’s hierarchy of needs	21
Figure 2.6 Level-type can opener design of 1885 by Robert Yeates	22
Figure 2.7 Bull-head lever-type can opener of 1865	22
Figure 2.8 Green can opener	23
Figure 3.1 Evolution of swivel peeler	27
Figure 3.2 Colorful OXO peelers.....	29
Figure 3.3 Handle of OXO peelers	29
Figure 3.4 People’s reviews about pleasurable feelings	32
Figure 3.5 Color-coded chopping board system	35
Figure 3.6 High performance of the color-coded board system	34
Figure 3.7 Wusthof cook’s knife	36
Figure 3.8 Kuhn Rikon chef’s knife and fruit knife	37
Figure 3.9 Sixteen main colors of Tovolo products	37
Figure 3.10 Wood handled vampire spatula	38

Figure 3.11 OXO Good Grips Y-peelers	41
Figure 3.12 Juicy salif lemon squeezer	42
Figure 3.13 Common hand position when using a handheld tool	44
Figure 3.14 Hand length and hand width	44
Figure 3.15 Anthropometric estimates for the hand	45
Figure 3.16 The average results of dimensions	46
Figure 3.17 A refers to hand length; B refers to hand breadth; C refers to grip breath inside width diameter; D refers to grip breath inside length diameter	47
Figure 3.18 Grip strength (G) as a function of the handle size (D). Vertical lines are 5 th -95 th percentile values in samples of 22 men and 22 women. The tool is a lever of the first class, the mechanical advantage = b/a. Hence, the effective cutting or crushing force = GB/A	48
Figure 3.19 The cylindrical handle showing the long axis A–A’ and the perpendicular axis B–B	49
Figure 3.20 The mechanics of the gripping and turning action, using a cylindrical handle	50
Figure 3.21 Force direction and handle shapes	51
Figure 3.22 Examples of geometric shapes	53
Figure 3.23 Examples of organic shapes	53
Figure 3.24 Handmade Wood Ladle Spoon, “Heart of Maya”	54
Figure 3.25 Modern American color associations (Birren, 1950)	55
Figure 3.26 <i>T-fal</i> , turquoise series	58
Figure 3.27 <i>KitchenAid</i> , Birds of Paradise	58
Figure 3.28 The example of red value	59
Figure 3.29 Knife sets made of high carbon steels	63

Figure 3.30 Lemon squeezer made of aluminum alloys	64
Figure 3.31 Knife sharpener	65
Figure 3.32 Zinc alloy kitchen squeeze tool	66
Figure 3.33 Silicone spatula set	72
Figure 3.34 Bamboo spoon set	73
Figure 3.35 Spoon set with wood handles	74
Figure 4.1 Design recommendation checklist for cutting tools	79
Figure 4.2 Design recommendation checklist for squeezing tools	85
Figure 4.3 Design recommendation checklist for mixing tools	91
Figure 5.1 Ergonomics details of the egg mixer	98
Figure 5.2 Aesthetics details of the egg mixer	99
Figure 5.3 Usability details of the egg mixer	101
Figure 5.4 Relationship details of the egg mixer	103

Chapter One

1.1 Problem Statement

The kitchen is the most important room at home because it is the center of our family's day-to-day living. According to recent surveys, total time in cooking and associated activities is more than one hour on average per day (Bureau of Labor Statistics, 2018). The kitchen is a bonding area that not only ties people's home together, but it also ties their loved ones together because their family and guests often gather in the kitchen to cook and eat together (Stietzel, 2013). Cooking has thus become a social activity because it increases relationships with family and friends. Kitchen tools are used when people are involved in cooking activities. These tools are mostly used in 1) cooking, storing and eating, 2) social activities and 3) managing lifestyles for oneself and one's family members (Johanson, Lundberg & Borel, 2011). It is obvious that kitchen tools affect people's everyday life in many ways. However, many of the kitchen tools in use (currently available on the market) only consider functionality and often ignore the user's feelings. Eddie Yoon, a researcher who focuses on human cooking behavior, has stated in his book *Superconsumers* that the proportion of people who hate cooking has risen to 45% (Eddie, 2017). Ronald Holden, a food writer who studied human cooking period has talked about the reason why people hate cooking. The problem is the unhappy cooking period that keeps

people away from the kitchen (Holden, 2017). As a result, people choose not to cook and prefer to go out to eat.

At the same time, related surveys show that there is more chance of a product being accepted if consumers perceived a product to be more pleasurable (Karkun & Chowdhury, 2017). People are less willing to accept less pleasurable products (Jordan, 1998) and are seeking kitchen tools that are a pleasure to use. Less pleasurable kitchen tools tend to keep people away from the kitchen because the tools do not enhance the pleasantness of cooking.

A Cambridge study found that people who cook up to five times a week were 47 percent more likely to still be alive after 10 years (Chen, Lee, Chang & Wahlqvist, 2012). This shows that cooking is healthy behavior. A study from University of Washington Health Sciences also suggests that people who cook at home more often, rather than eating out, often have a healthier life (University of Washington School of Public Health, 2017). These studies prove that people should cook at home to be healthier.

In order to encourage people to cook at home and add the pleasure of cooking, kitchen tools need to be designed to help make the cooking process pleasurable. A solution to this problem would be developing a design process to provide guidelines that focus on enhancing the pleasure of using kitchen tools for designers who work to develop them.

1.2 Need for Study

In Chapter Two, literature review, the author will first study the categories of non-electric kitchen tools. It is important to understand the categories of kitchen tools because different kitchen tools have different design factors to enhance pleasure.

After the categories of non-electric kitchen tools are studied, the author needs to understand what human pleasures are because the author needs to make a connection between human pleasures and design factors. In this part, former famous studies like Jordan's four pleasures will be mainly studied.

When the human pleasures are understood by the author, the author needs to study design strategies of famous companies to see how those pleasurable kitchen tools are made. During this section, case studies of famous non-electric kitchen tools need to be done to show the design details. The next thing that needs to be finished is that a connection between human pleasures and design details will be made to help make design checklists. After the connection is made, each design factor needs to have a deep description to relate it to human pleasures.

1.3 Objective of Study

The main objective of this study is to make design recommendations or checklist for designing non-electric kitchen tools.

The first step will be accomplished by studying existing surveys which focus on what are human pleasures. During this part, studies made by former researchers will be used to identify what are human pleasures.

The second step is to use several case studies to see how famous companies make pleasurable kitchen tools. In this section, the author will make a connection between design considerations, design factors, and human pleasure. The design factors that are related with the design considerations of those companies will have a deep description. By understanding each design factor, the author will make a connection between design considerations, design factors, and pleasures. The connections made in this step will help develop the design checklist in the next step.

According to the research result of the case studies, design checklists of each category of non-electric kitchen tools will be created. Non-electric kitchen tools mainly have three categories: cutting and slicing tools; gripping and squeezing tools; and mixing tools. Hence, the design checklist for each category is different.

The final step of the thesis will be the application of design checklists. A selected product will be studied to find the improvement points. The author will then follow the design factors in the design checklist to better improve the product.

1.4 Scopes and limits

In order to make a better understanding of kitchen tools, they will be made into three categories due to operations: cutting and slicing tools; gripping and squeezing tools; and mixing tools. Although there may be other categories, the function of these tools is more important than other elements. Hence, the categories used in this these will be cutting and slicing tools; gripping and squeezing tools; and mixing tools.

The research of the non-electric kitchen tools should avoid the cultural background

because culture is different for each country or different groups of people. Hence, the research of non-electric kitchen tools will focus on common products on the American market to avoid cultural differences.

During the research of design factors, the material consideration will mainly focus on the hardness, lightness, and food safety. Other properties do not show the same importance as these three properties so that they are not mentioned in the thesis. For the ergonomic factors, since the ergonomics of non-electric kitchen tools are more about the handle, the thesis will only study the handle ergonomics of kitchen tools.

1.5 Procedures and methodology

The following procedures are used in this thesis to make a guideline for designing a kitchen tool for enhanced pleasurability:

Step 1. Literature Review

The author will analyze other researchers' studies in this section. The studies are related with the categories of non-electric kitchen tools and human pleasures.

For categories of non-electric kitchen tools, the author will select several common kitchen tools on the market to make them into three categories due to operations.

For human pleasures, the author will mainly study what human pleasures are. In this section, famous research such as Jordan's four pleasures will be analyzed. Each research will have a deep description and an example will be made to better understand the research.

Step 2 Make a connection between guidelines and research findings

To make a connection between research findings, the author will first use several case studies to see how famous companies make pleasurable non-electric kitchen tools. When studying their design strategies, each design factor and design consideration will have a relationship. The next step is to connect the design consideration with human pleasures to see how human pleasures can be created during the design process.

Step 3 Develop a guideline

After making the connection between pleasure, design considerations, and human pleasures, the design checklist can be made according to different categories of non-electric kitchen tools.

Step 4 Apply the guideline

In the fourth step, the author will apply the guidelines by redesigning a kitchen tool.

Step 5 Conclusions and further discussion

After the application, the author will make a conclusion and have a further discussion of the design checklist.

1.6 Anticipated outcomes

The anticipated outcome of this study is a design checklist that will help designers and companies to design a pleasurable non-electric kitchen tool. With the development of guidelines, a kitchen tool redesigned by following the guidelines will also be shown in this study.




Chapter Two



Literature Review




2.1 Categories of non-electric kitchen tools





A non-electric kitchen tool is a hand-held, typically small tool that is designed for food-related functions. The author researched 34 common non-electric kitchen tools and made them into three categories due to operations.

The first category is the cutting and slicing tool. These tools are used to cut food that involve all kinds of knives and knife-related products in kitchen. Table 2.1 is a list of common cutting and slicing tools on the market.

Name	Purpose in food preparation	Image
Apple cutter	To cut apple and similar fruits easily while simultaneously removing the core and pips.	
Bread knife	To cut bread	
Butter curler	Used to produce decorative butter shapes.	

<p>Cake and pie server</p>	<p>To cut slices in pies or cakes, and then transfer to a plate or container</p>	
<p>Cheese cutter</p>	<p>Designed to cut soft, sticky cheeses (moist and oily).</p>	
<p>Cheese knife</p>	<p>Used to cut cheese.</p>	
<p>Cheese slicer</p>	<p>Used to cut semi-hard and hard cheeses. It produces thin, even slices.</p>	
<p>Chef's knife</p>	<p>Originally used to slice large cuts of beef, it is now the general utility knife for most Western cooks.</p>	
<p>Cleaver</p>	<p>Hacking through bone or slicing large vegetables (such as squash).</p>	

<p>Cutting board</p>	<p>A portable board on which food can be cut.</p>	
<p>Dough scraper</p>	<p>To shape or cut dough, and remove dough from a work surface</p>	
<p>Egg slicer</p>	<p>Slicing peeled, hard-boiled eggs quickly and evenly.</p>	
<p>Fillet knife</p>	<p>A long, narrow knife with a finely serrated blade, used to slice fine fillet cuts of fish or other meat.</p>	
<p>Herb chopper</p>	<p>Chops or minces raw herbs.</p>	

<p>Knife sharpener</p>	<p>Used to sharpen the kitchen knives.</p>	
<p>Lame</p>	<p>Used to slash the tops of bread loaves in artisan baking.</p>	
<p>Pastry blender</p>	<p>Cuts into pastry ingredients, such as flour and butter, for blending and mixing while they are in a bowl.</p>	
<p>Pastry wheel</p>	<p>Cuts straight or crimped lines through dough for pastry or pasta.</p>	





Peeler	Used to remove the outer layer of vegetables or fruits.	
Tomato knife	Used to slice through tomatoes.	

Table 2.1, Cutting and slicing tools on the market

The second category is the gripping and squeezing tool. These tools are used to grip and squeeze food that they usually have two power handles for users to hold. Table 2.2 is a list of common gripping and squeezing tools on the market.

Name	Purpose in food preparation	Image
Can opener	Used to open a can of food.	
Garlic press	Presses garlic cloves to create a puree, functioning like a specialized ricer.	











Nutcracker	To crack open the hard-outer shell of various nuts.	
Potato ricer	Presses very smooth vegetable mashes or purees, operates similar to a meat grinder/mincer.	
Tongs	For gripping and lifting. Usually used to move items on hot surfaces, such as barbecues, or to select small or grouped items, such as sugar cubes or salad portions.	

Table 2.2, Gripping and squeezing tools on the market

The third category is the mixing tool. Mixing tools are used to mix food that they usually have a long and straight handle for users to hold. Table 2.3 is a list of common mixing tools on the market.

Name	Purpose in food preparation	Image
Egg separator	A slotted spoon-like utensil used to separate the yolk of an egg from the egg white.	

Fish slice	Used for lifting or turning food during cooking	
Honey dipper	Drizzles honey.	
Ladle	A ladle is a type of serving spoon used for soup, stew, or other foods.	
Measuring spoon	Typically sold in a set that measures dry or wet ingredients in amounts from 1/4 teaspoon (1.25 ml) up to 1 tablespoon (15 ml). ^w	
Slotted spoon	A slotted spoon is a <u>spoon</u> implement used in <u>food preparation</u> .	
Spatula	Used to mix food.	




Spider	For removing hot food from a liquid or skimming foam off when making broths	
Whisk	To blend ingredients smooth, or to incorporate air into a mixture, in a process known as whisking or whipping	
Wooden spoon	For mixing and stirring during cooking and baking.	

Table 2.3, Common mixing tools on the market

The categories are based on kitchen tool operations, which can help the author easily learn about human ergonomics of non-electric kitchen tools. The study on human ergonomics will focus on each category of non-electric kitchen tools. However, according to different working environments, the kitchen tools can also be divided into two categories: tools for food preparation and tools for cooking. This will affect the study on material selection of non-electric kitchen tool. The author will mention it later in material selection part.

2.2 What is pleasure

Pleasure (mainly refers to pleasantness) is defined as “the condition of consciousness or sensation included by the enjoyment or anticipation of what is felt or viewed as good or desirable; enjoyment, delight, gratification” (Oxford English Dictionary, n.d.). To put it in a simpler way, it is an activity or feeling that makes you feel good.

2.2.1 Lewis’s classification of pleasure

Clarence Irving Lewis (1987), an American philosopher and the founder of conceptual pragmatism, classified pleasure as “need pleasures” and “pleasures of appreciation”. By Lewis’s classification, need pleasure is usually defined as the ability to transform people who are disappointed or unhappy to a state of satisfaction or pleasantness. For example, eating a meal allows a person to defeat hunger. It relates to satisfaction of mostly physiological needs, safety needs or need for belonging. On the other hand, pleasures of appreciation are defined as an accumulation from a person’s finding something pleasurable. For example, enjoying a cooking period makes people meet the satisfaction of the highest level of needs in pursuing pleasurable experience.

2.2.2 Csikszentmihalyi's flow

Pleasure from the self-actualization is well explained by "Flow", which is named in a study by Mihaly Csikszentmihalyi (1975). The study gives evidence that when people are fully involved in doing something, they can get deep enjoyment.

The result is later defined by Blythe and Hassenzahl (2003) as "a peak experience of total absorption in an activity" (p.91). The important point of the result is that pleasurable feelings derives from a process, such as the process of grinding coffee beans.

2.2.3 Tiger's Framework of Four Pleasure

Lionel Tiger (1992), a Canadian anthropologist, was renowned for his frameworks of pleasure. Design researchers who study the design of pleasurable products always quote his classification. Jordan further popularized the framework of pleasurable feelings in 1996. The model was developed to observe human experience and understand people. It can be used to help evaluate how pleasurable feelings can be applied to a product and enhance an existing product.

Designers need to provide users with a pleasant experience in order to connect with users and achieve people's enjoyment goals. This experience is divided into one of four categories - physical, social, psychological and ideology. This framework is often used to understand consumer needs to help designers design pleasurable products.

Physio-Pleasure

This is real contentment derived from sensory organs. Physio-pleasure is related to people's body reaction with a product (Jordan, 2003). It happens at the sensory level by touching, smelling, hearing and tasting something. Though it mostly corresponds to physiological needs in the pyramid of needs, it can also be related to the higher level in terms that sensory pleasure can be associated with esteem or self-actualization. Appreciating artworks is an example. An example provided by Amazon.com will help us better understand the physio-pleasure.



Figure 2.1, ZYLISS Lock N' Lift can opener, Amazon (2018)

Figure 2.1 is a can opener which is produced by Zyliss to sell at Amazon.com. With 4.1 stars out of 5 stars according to 6658 customer reviews online, the best seller product defeated many similar products. According to the consumers' feedback, this product has soft touch grip and handle which make users feel comfortable. In addition, the product also gives pleasure to consumers that they can open the can smoothly in

seconds. For consumers, avoiding failure of opening a can is a kind of success as it satisfies consumers by helping them finish one step of the whole cooking process.

Socio-pleasure

Socio-pleasure stems from relationships with other people or society. In general, products and services can effectively promote society and bring value to consumers to a certain extent. Social enjoyment often occurs in a variety of interactive situations in everyday life, such as people meeting up with their friends when they are in foreign countries or enjoying an excellent appointment in the coffee bar.

For example, the Golden Stainless Steel Three Tier Cake Stand Fruit Plate, which is often used at public events, can show social pleasure. According to 158 randomly selected customer reviews, customers give 4.4 stars out of 5 stars. Consumers can enjoy the events, such as a wedding, with guests by using this product. It gives a pleasurable talking environment which delivers social pleasure. The product also brings a sense of identity which makes the owner experience a feeling of pride.



Figure 2.2, the Golden Stainless Steel Three Tier Cake Stand Fruit Plate, Amazon (2018)

Psycho-Pleasure

Psycho-pleasure is related to people's mind and thoughts. It is created when people think about the situation, consciously and unconsciously (Jordan, 2003).

Psycho-pleasure has a lot to do with people's emotional and cognitive reactions, especially their reactions to products or services that they use (Hagel-Sorensen, 2006)

It is mentioned that psycho-pleasure is connected to a product's usability (Jordan, 2003). Good usability can bring positive or pleasurable feelings, while poor usability can avoid people from the product because of unpleasurable emotions.

For example, the OXO Good Grips 3-in-1 Avocado Slicer (Figure 2.3), with 4.5 stars out of 5 stars according to reviews, does a good job on creating psycho-pleasure.

The reviews on Amazon mention that the product is comfortable to use. The stainless-steel pitter allows consumers to remove pit with one quick twist. People also find some other unexpected features. They find that the knife on the slicer is more than sharp enough to cut an avocado in half quickly and easily, but not sharp enough to cut their skin. The safe use of this product is more than consumers expect. All of these lead to a certain sense of satisfaction, which creates psycho-pleasure feelings.



Figure 2.3, The OXO Good Grips 3-in-1 Avocado Slicer

Ideo-Pleasure

Ideological pleasure is connected to people's values, morality, and beliefs. Tiger (1992) stated that ideological pleasure comes from theoretical entities such as art. When it is related to a product, the ideological pleasure is more about aesthetics of product design (Jordan, 2006). That means the design may stand on its own such as reflecting a sense of protecting the environment. People may accept products that express their personal values. In terms of Maslow's Hierarchy of Needs, ideological pleasure tends to be higher up the scale and may be a form of self-actualization (Jordan, 2002).

The Juicy Salif Citrus Squeezer (Figure 2.4) is not just a kitchen tool but can also be an interesting decorative object for the kitchen. The shape is similar to an alien and meets some people's thought about outer space. This kind of aesthetic sensibility brings ideological pleasure.



Figure 2.4, The Juicy Salif Citrus Squeezer

2.3 Pleasurable products are a trend

Pleasure in psychology is considered one of the most critical and fundamental emotional requirements that make people continue his or her life. It has also a lot to do with the satisfaction of the needs of an individual. Maslow's hierarchy of needs (Figure 2.5) is linked to the psychology of pleasure because when a need is met, it drives people to experience the pleasure of satisfaction. It also makes people want more and better needs.



Figure 2.5, Maslow's Hierarchy of Needs, 1943

According to Figure 2.5, self-realization and respect are the highest, and love, security and physical needs are placed under both. Meeting these two highest demands gains a more profound sense of pleasure from their appreciation; others have pointed out the joy of meeting the requirements of life.

Maslow's hierarchy of needs reflects the evolution of a product. Here is the case.

The can opener was first designed in 1855 by Robert Yeates, a cutlery and surgical instrument maker in UK (Figure 2.6). The creation of the can opener helps people get food from the can. It helps people meet the bottom level: physiological needs.

However, its unprotected knife-like sickle was too dangerous for domestic use. Then in 1865, the bull-head lever-type can opener was produced (Figure 2.7). It moved the sickle part to the bottom of bull head, which protected hand use. At that time, it meets the safety level.

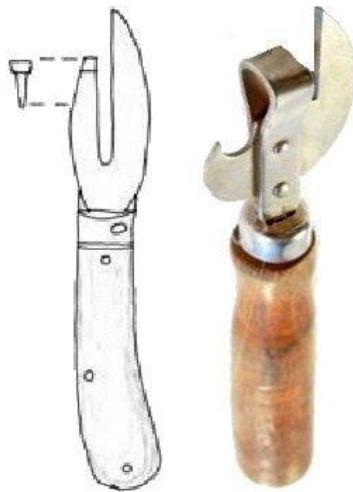


Figure 2.6, Lever-type can opener design of 1855 by Robert Yeates

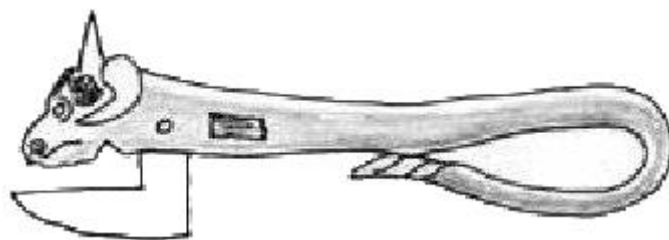


Figure 2.7, Bull-head lever-type can opener of 1865

In 1956, the electric can opener made by Walter Hess Bodle found immediate success on the market (Figure 2.8). The electric product can remove lids from more

than 20 cans per minute without risk of injury. It saved time and people could spend more time on other things. At the same time, more colors are used on can openers. For example, green colors are used to let people think of protecting the environment (Figure 2.9). The evolution of the can opener shows that products will gradually meet higher levels of Maslow's hierarchy of needs after creation. It also gives evidence that non-electric kitchen tools should be pleasurable because pleasurable feelings belong to a higher level of Maslow's hierarchy of needs.



Figure 2.8, Electric can opener by Walter Hess Bodle in 1956



Figure 2.9, Green can opener

The evolution of a product shows that products will gradually be designed to be pleasurable after creation. Besides this, other researchers also gave suggestions that people need pleasurable feelings. Early in 1989, a survey in America required

hundreds of participants to report on 32 emotional states (Frijda, Kuipers, Schure, 1989). Participants were asked to remember instances of experiencing these states and, for each experience, to fill out a questionnaire on appraisal dimensions and action readiness modes. Researchers found that in terms of behavioral impact, negative emotions stimulate individuals to withdraw from the object while positive emotions stimulate people to accept the object.

According to the result, it is obvious that the pleasurable or positive product has become a benchmark for consumers to make their purchase choices. Further studies gave evidence that pleasurable feelings stimulate product purchase intentions (Bitner, 1992; Pham, 1998), and contribute to creating usage comfort and decrease usage discomfort (Vink, 2005).

To design a pleasurable non-electric kitchen tool, designers should not only consider functionality, but also make an improvement on psychological level. It requires the author to have an in-depth understanding of pleasurable feelings or positive emotions.

2.4 Pleasurable emotion types

Pieter Desmet (2012) studied product pleasures and 25 positive emotion types were clustered from a list of 150 positive emotion words. In his study, the positive emotions are assembled by three steps: The first step is to get an extensive overview of emotion words from published emotion studies. Second, the database is cleaned up by removing non-related emotion words. Third, words of negative feelings are excluded.

Table 4 shows the result. These 25 positive emotions can be further organized into 9 categories: Enjoyment, Gratification, Empathy, Affection, Aspiration, Interest, Optimism, Assurance, and Animation. Similar emotion types are simplified by these nine categories, which helps better understand positive or pleasurable emotions.

Emotion type	Emotion words (drawn from the list in Appendix 2)
Admiration	Admiration, impressed, esteem
Amusement	Amused, entertained, gaiety, merry, playful, humorous, glee, funny, laughing, jolly
Anticipation	Anticipation, eager, expectant
Confidence	Confident, assurance, secure, trust
Courage	Courageous, brave, heartened
Desire	Desire, attracted, ardent, longing, craving, yearning, nostalgic
Dreaminess	Dreamy, contemplative, pensive
Enchantment	Enchanted, awe, charmed, moved, touched, enthrallment, wonder
Energized	Energetic, exuberant, zest, active, excited, stimulated
Euphoria	Euphoric, rapture, ecstasy, exaltation, thrilled, elated, high, exhilaration, exultation, jubilant, enraptured
Fascination	Fascinated, interest, curious, inquisitive, attentive, engrossed
Hope	Hope, optimistic, encouraged, wishful
Inspiration	Inspiration, enthusiasm, tempted, determined, challenged, zeal
Joy	Joy, bliss, overjoyed, pleasure, happy, good, delighted, wonderful, rejoice, smile, cheerful, enjoyment
Kindness	Kind, caring, friendly, tenderness, warm
Love	Love, romantic, infatuation, sentimental, fondness, in love, liking, affection, intimate
Lust	Lust, horny, passion, aroused, sensual, sexy
Pride	Pride, triumphant, self-satisfaction, smug
Relaxation	Relaxed, at peace, at ease, comfortable, peaceful, lighthearted, carefree, placid, serene, tranquil, easygoing, calm
Relief	Relief, reassured, gratitude, soothed, thankful
Respect	Respect, appreciating, approve
Satisfaction	Satisfaction, gratified, pleased, contentment, fulfilled, glad
Surprise	Surprise, amazement, astonished, startled, dazzled
Sympathy	Sympathy, compassion, empathy, pity, understanding, forgiving
Worship	Worship, adoration, devotion, reverence

Table 2.4, 25 positive emotion types by Pieter Desmet, 2012

These 25 positive emotions can occur when people have pleasurable products. The list of positive emotions can be used when making design recommendation checklists for non-electric kitchen tools.

2.5 Conclusion

In this chapter, three famous studies were learned to understand pleasure. We find

that people can get pleasure when they are involved in doing something; when they meet their needs; or have a good feeling from the environment or products. These findings are useful as many famous companies which produce non-electric kitchen tools follow them to improve their products. Hence, in Chapter Three, case studies of famous companies will be done to understand the design strategies. After knowing the design strategies, Jordan's four pleasures framework can be used to make design checklists in Chapter Four.

Chapter Three

Case Study of Pleasurable Non-Electric Kitchen Tools

3.1 Introduction

According to research in Chapter Two, Jordan's four pleasures that include physio-pleasure, psycho-pleasure, socio-pleasure, ideo-pleasure will occur when people have pleasurable feelings about products. Chapter Three will use a case study of the OXO peeler to find how the four pleasures are related to the product's features. The aim of the case study is to connect the design factors with four pleasures to help make the design guideline in Chapter Four.

3.2 A case study: the OXO peeler

3.2.1 The history of the OXO peeler



Figure 3.1, Evolution of Swivel Peeler

Figure 3.1 shows the evolution of Swivel Peeler from OXO. At the beginning, one founder named Sam Farber just wanted to make the product more comfortable for his wife to use. The company created everyday tools inspired by hands that need extra help and found that their customers will feel pleased or pleasurable when they improved the products on its shape and material. Taking the Swivel Peeler as an example, the shape of the ample handle is oval in cross-section, making it easy to grip, comfortable to hold and less likely to turn in the hand. The handle material that the product used is known as Santoprene, a processed rubber. The material is a dynamically vulcanized alloy consisting mostly of fully cured EPDM rubber particles encapsulated in polypropylene (PP) matrix. It has a long-term aging durability combined with dimensional stability and physical properties. The harmonization between parts is good so that human skins will feel comfortable. Besides this, its weight reduction and design flexibility help make Swivel Peeler a good product on the market.

3.2.2 Design Factors of OXO Peelers

Two design researchers studied the OXO peeler to find out what design factors can make it pleasurable (Cagan & Vogel, 2001). Based on their case study, the design factors include aesthetics, ergonomics, ease of manufacture, optimum use of materials, and value.

Aesthetics

Before the development of the OXO peelers, all-metal peelers usually do not have

multiple color choices. The OXO peelers successfully use colors to make it interesting in kitchen. Orange, green, red, and black are the four colors of the OXO peelers. The use of orange, green, and red can have a feeling of nature and powerful of the product so that users can have different pleasurable feelings by using it.



Figure 3.2, Colorful OXO Peelers

The shape of the OXO peeler prefers the organic shape. Although its handle part is made to be straight, curves are still used on the edge of the handle. The curves made the handle more comfortable for users to hold.



Figure 3.3, Handle of OXO Peelers

Ergonomics

The handle was press fit around a plastic core that extended out of the handle to form a protective curve over the blade and ended in a sharp point that can be used to remove potato eyes. In order to add great control, the overall handle used a straight shape because the force direction of using it is perpendicular to the handle.

Manufacture

The biggest question of the product development was the expensive price of using Santoprene to mold the handle. The OXO company first worked with Japanese manufacturers. However, it cost too much. The company finally invited a less-expensive manufacturing company in Taiwan to help mold the handle.

The OXO peelers only have three parts: the handle, the blade, and the guard of the blade. Each part is easily connected with each other. For users, if the blade can be changed themselves if it is no longer useful. The ease of manufacture of the peeler also makes it a pleasurable product.

Materials

In order to get a soft feeling of the handle, Santoprene was used to mold the handle surface. The product development team finally invited a less-expensive manufacturing company in Taiwan to save money. As for the food contact part, the plastic guard serves as the holder for the metal blade. To quickly cut food, the high-grade metal that is sharper and lasts longer is used to make the blade. Only the blade uses metals so that the company can save money on materials. Compared with all-metal versions, the improved OXO peeler is lighter to hold and can be used for a long time with high

quality. The use of Santoprene also improves users' feelings by making the handle soft and warm to touch.

Value

Compared with original all-metal peelers, the OXO peeler clearly represents that opportunities for added value were met. People will easily find the difference between original products and OXO peelers that OXO peelers are more comfortable and easier to use. They would also be willing to pay for the difference of aesthetics. The set factors were in place and consumers were ready to appreciate the useful, usable, and desirable features of the product.

These five design factors are the main points that designers need to consider during the process of design a pleasurable product. From the description of each factor, we can find the relationship between these factors and Jordan's four pleasures:

- Physio-pleasure is connected with the aesthetic factor, ergonomic factor, and the material factor. It is more about the appearance and product-making details.
- Psycho-pleasure is related with the manufacture factor. It is more about the functionality and usability of the product.
- Ideo-pleasure has relationship with value. To have ideo-pleasure from the product, the product should have different points compared with original products. For example, people will appreciate if the product is easier to use; the product is more interesting if it has multiple colors.
- Socio-pleasure is related to people's relationship with the product. To have socio-pleasure from the product, the function or appearance should make it a social

point. For example, the product is more colorful than original products so that people can show it to friends and then start talking about it.

During the design process, the four pleasures do not show the same importance. By researching consumers' reviews about the pleasurable OXO peeler, we can easily see the respective importance of each pleasure. 505 customer reviews from Amazon.com are used in the research. From consumers' reviews, "Super sharp", "Soft feelings", "Good ergonomics", "Durability", "Easy to hold", "Easy to use", "Bright colors", "Interesting", "Nice look" are nine points that are related with pleasure.

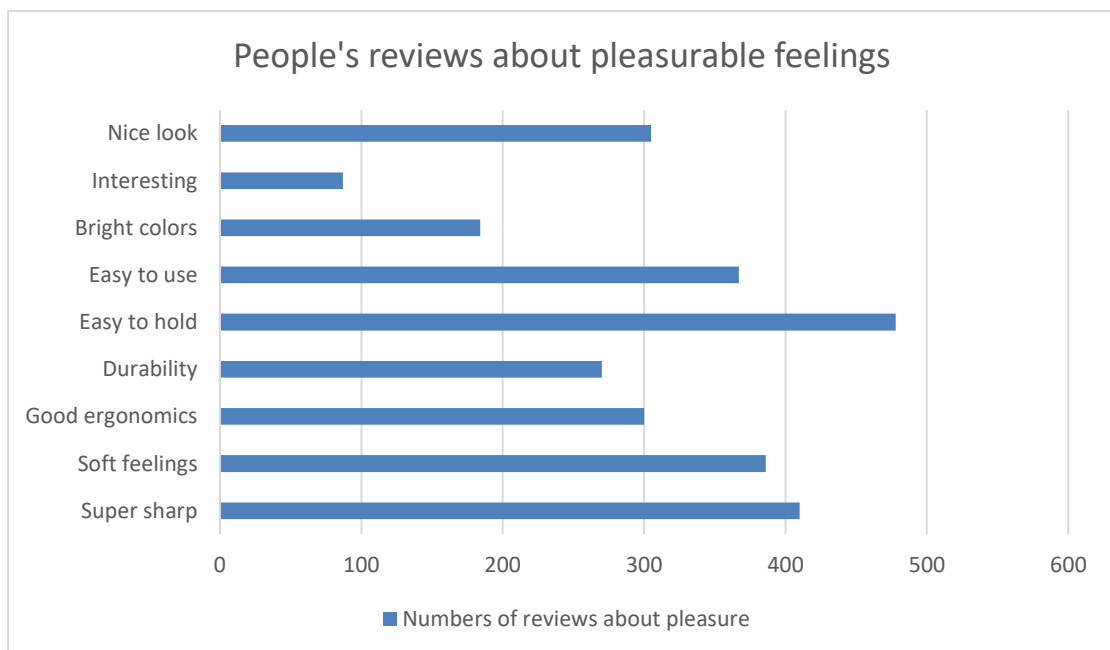


Figure 3.4, People's Reviews About Pleasurable Feelings

- Physio-pleasure: "Soft feelings" requires the material selection for the surface; "Good ergonomics" means that ergonomic factor must be considered; "Durability" means that we should consider the material properties; "Easy to hold" requires a good

shape; “Bright color” and “Nice look” are related with aesthetic factors.

- Psycho-pleasure: “Easy to use” and “Super sharp” means that the materials and shape of the product should meet the function point to get physio-pleasure.

- Socio-pleasure: these points do not have too much relationship with socio-pleasure.

- Ideo-pleasure: “Interesting” is related with the value factor.

3.3 A Case Study: Joseph Joseph Color-coded Board System

The second case is the color-coded chopping board system that is produced by Joseph Joseph (Figure 3.5). According to 1747 customer reviews on Amazon.com, more than 70% of consumers give the product a rating of 4.3 stars out of 5 stars. There are four main colors of this product and each color indicates a food: red is related to steak; yellow represents chicken; blue means fish; and green indicates vegetables and fruit. So, there is no risk of cross-contamination. The color use of this product allows users to select a suitable cutting board because the thickness of each board is different. It reduces the risk that the sharp knife will cut right through the board. The color use of this product not only prevents cross contamination, but also provides a safe working environment. Figure 3.6 shows the high performance of this product from 100 random reviews on Amazon.com.



Figure 3.5, Color-coded chopping board system

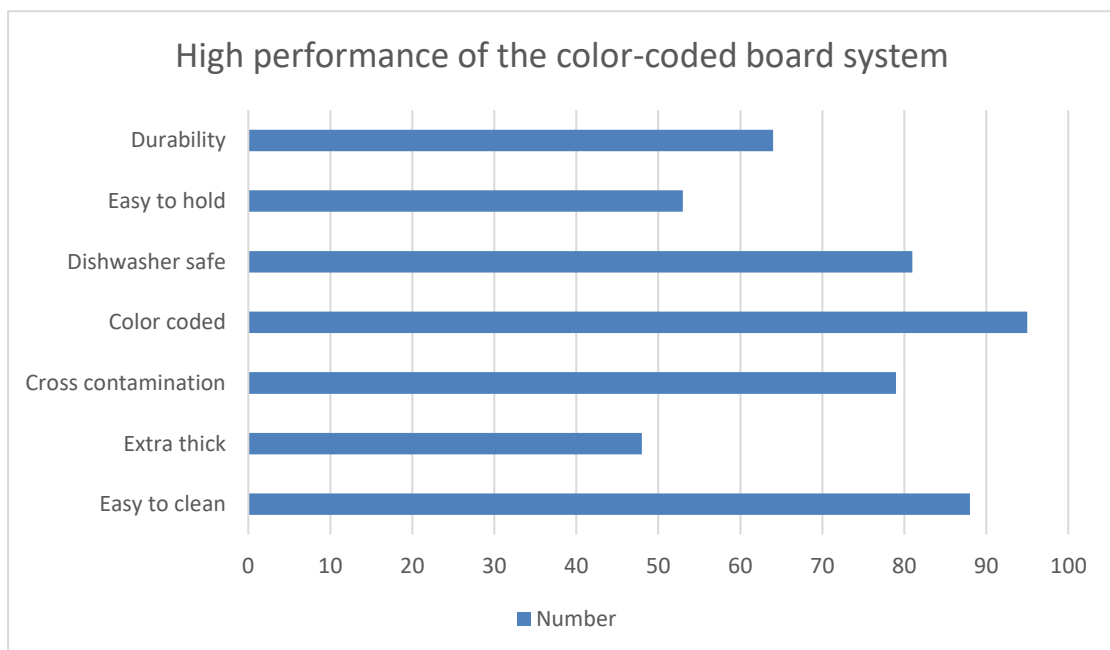


Figure 3.6, High performance of the color-coded board system

3.4 Design Strategies of Famous Companies

The two successful products above can help understand the design strategies of

those famous companies. The famous companies have already focused on making their products pleasurable.

For example, OXO Good Grips, a company which is famous for their cooking products, does a good job to make things better. The overall quality of all OXO products is the basis of the company's guiding principle. According to the company spokesperson Gretchen Holt's words (n.d.): "The goal of making products more usable forces us to first identify problems and inefficiencies of existing products." The company's design strategy emphasizes that a good kitchen tool should be not only comfortable, but also has a good performance.

Another famous company, which is named Joseph Joseph, is renowned for its kitchen toolsets. The company is good at using different colors to make their products pleasurable. Most products from Joseph Joseph have several colors, which include yellow, orange, green, purple, dark green, dark blue, red, and so on. The company aims to make the home kitchen more fashionable. The company believes that colors can make products more fashionable. People, especially young adults, are very willing to use products with different colors. There is one word in China, which is called Wanghong, which means it is prevalent online. Chinese people use this word to describe products from Joseph Joseph. The use of different colors makes their kitchen tools a big success on the market. The website of Joseph Joseph shows the company's design strategy: they want to design "smart" products. The company uses colors to add a new look for an old product to let people think about different things. Just as the example shows in Figure 3.5, each color used in their product is smart. It represents a

different food so that consumers can quickly know which one to use when preparing food.

The German company Wusthof is famous for their kitchen knives. As a company with more than 200 years' history, Wusthof believes that a pleasurable product should be functional.



Figure 3.7, Wusthof cook's knife

Figure 3.7 shows a classic cook's knife from Wusthof. The company gives the handle surface a small curvature to fit the palm of people's hands. The contoured handle is for a comfortable fit and has a more contemporary appearance.

Many companies have similar ideas to use colors to attract consumers, but Kuhn Rikon is cleverer that the company knows when to use a unique color. For different cutting tools, color selections are different. For example, Kuhn Rikon adds black color to a chef's knife, but green or yellow color to a fruit knife. Black represents a stable feeling while green or yellow color show more about nature.



Figure 3.8, Kuhn Rikon chef's knife and fruit knife

Tovolo is another company which makes pleasurable kitchen tools. Their products have in total of 16 colors for users to choose (Figure 3.9). And the company is good at giving users a funny feeling. Like the spatula in Figure 3.10, the surface of the mixing part is a vampire. Whether people are mixing, scraping, flipping, or turning, these whimsical tools make their everyday kitchen tasks fun and enjoyable. Tovolo also focuses on protecting the environment. Most of the handle parts of their products are made of wood. The material is natural to be recycled, and the price of the product is low. Most products have a low cost, which is less than \$20.



Figure 3.9, Sixteen main colors of Tovolo products



Figure 3.10, Wood handled vampire spatula

After understanding how these famous companies make their products more pleasurable, the author found that they improve the shape of the product to be more functional, use new materials to create a good feeling between hands and products, select different colors to make the kitchen tools fashionable, and put interesting images on the product surface to make it fun. Many other companies use the same approach, but only a few can be successful. To design a pleasurable non-electric kitchen tool, designers should first have an in-depth understanding of human ergonomics to make shape improvement. Second, they need to know the material properties to select a suitable material to make each part of the tool. Third, they need to understand how standard colors can affect people's feelings to choose appropriate colors.

If we make a connection between these design considerations and Jordan's four pleasures framework, we can have a relationship as below. Numbers 1 to 4 is used to represent the relative importance of each pleasure during the design process.

Design Consideration	Four Pleasures	Relative Importance
Ergonomics	Physio-pleasure	4
Aesthetics		
Materials		
Usability	Psycho-pleasure	3
Value	Ideo-pleasure	2
Human Relationship	Socio-pleasure	1

Table 3.1, Connection between design consideration and four pleasures; 4 means the most important

while 1 means the least important.

3.5 Factors for Leading Pleasure to Product Design

After understanding how famous companies make their non-electric kitchen tools pleasurable, several elements that affect consumers' pleasurable feelings can be summarized as below:

Cost: The level of pleasurable feeling could be enhanced if the product has a low price to purchase. The Tovolo company's products usually have a low price which is less than \$20. The low price of kitchen tools makes the product more competitive on the market.

Ergonomics: The product should be designed for human use. From the case study above, many successful products mention "easy to hold", "comfortable to use". It is

related to the size and shape of the kitchen tool.

Aesthetics: From the study of those famous companies, we can find that those successful products usually have multiple color choices. Color is one of the features of a product's appearance. Another factor of the aesthetics is the shape.

Safety: Safety could make consumers feel confident when using the product. From the case study above, Joseph Joseph uses different colors to represent different food, thus reducing the risk of selecting the wrong products. OXO improves the handle part of the peeler to make it safe to use.

Function: A pleasurable kitchen tool should function well. From the case study above, "super sharp", "easy to use" are always mentioned when consumers talk about the product's function. The German company Wusthof even thinks of the functionality as the basis of their design strategy.

Environment: Potential customers may be concerned about their environment and the damage by industrial production. From the case study, OXO tried many materials to select the most suitable material to make the peeler. Tovolo uses wood to make the handle for most of their products. When designing a product, it may be wise to ensure that the materials can be recycled or the product itself can be manufactured from a proportion of recycled material.

Company identity: The company identity may also be a benchmark for consumers to purchase the product. From the case study, more than 60 people highly recommended OXO products due to the company itself.

Quality: Quality means that the pleasurable kitchen tool should be created to last for

a long time. It requires selecting the right material to make the non-electric kitchen tool. From the case study, OXO uses a processed rubber to make the handle part but uses stainless steel to make the cutting part. And the material used for Joseph Joseph's cutting board is strong enough for different knives to cut food on it.

3.6 Functionality

Just as the conclusion above, a pleasurable product should first be functional. As a necessity in kitchen, the kitchen tool can help people do some difficult things for food preparation, such as opening a can of food and cutting the beef into small pieces. Obviously, functionality in a kitchen tool mainly refers to its practical function. The practical function primarily involves standards related to product performance, such as size, weight, ease of use, etc. An example of the OXO Good Grips Y-Peeler can help us better understand practical function of a product (Figure 3.11). The peeler has an easy-to-manuever y-shape tailor which is made for easy use. Sharp, rustproof, Japanese stainless-steel blades are built for precision, while ergonomic handles and compact design fit nicely in people's hand. The practical function of this product makes it popular on the market and becomes a big success.



Figure 3.11, OXO Good Grips Y-Peeler

However, in product design, functionality should include mental function (*Design Technology*, 2018). Mental function mainly focuses on people's emotional reactions or attachments to products. Taking Philippe Starck's Juicy Salif lemon squeezer in 1990 as an example, referring to Starck's words, his juicer does not care much about squeezing lemons but can be the beginning of a family conversation.



Figure 3.12, Juicy Salif Lemon Squeezer, Philippe Starck, 1990

The functionality involves the practical function and mental function. For a non-electric kitchen tool, it is obvious that practical function is more important than mental function because the kitchen tool is produced to help people prepare food. Very few people would hope their kitchen tools are hard to use. So, in this thesis, the author will limit the functionality to a product's practical function as it is the most important feature to make a kitchen tool easy to use.

3.7 Human Factors and Ergonomics of Non-Electric Kitchen Tools

Functionality of a pleasurable non-electric kitchen tool is mainly related to how

people use the tool. Since most of the non-electric kitchen tools have handles for people to hold, the handle is one of the most important parts we need to analyze. Due to the fact that most non-electric kitchen tools may have moving parts or a sharp edge, it can be dangerous for people to use a kitchen tool. For example, a survey which studied Emergency Department (ED) treatment among children and adults in the United States (US) from 1990 through 2008, found that there were 8,250,914 knife-related injuries during that ten years, averaging 1190 injuries per day (Smith, 2013). Among all the injuries, 900,812 were related to kitchen activities. Most of the injured did not have a safe and functional using way of their knives.

The results give us an advice that for a non-electric kitchen tool to be pleasurable, the kitchen tool, especially the handle part, should first be designed to be safe and functional to use.

3.7.1 Ergonomics of the Handle Due to Different Operations

In Chapter Two, the non-electric kitchen tools have three categories due to operations: cutting and slicing tools; gripping and squeezing tools; and mixing tools. Figure 3.13 shows a common position when people use a handheld tool. We can see that the handle length of the tool is related to the hand width (Figure 3.14).



Figure 3.13, Common hand position when using a handheld tool

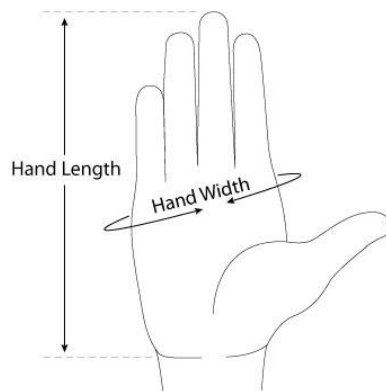


Figure 3.14, Hand Length and Hand width (Flybubble, 2016)

Researchers of Grid Publishing Inc in Columbus, OH, studied the handle length of basic kitchen tools and concluded that the minimum handle length for a comfortable product should range from 100 to 125 mm (Rachel & Stephan, 1986). Later in 1988, an English researcher named Vern Putz-Anderson found that most people's hand palm width is around 90mm (Vern, 1988). Another study analyzed the anthropometric data of adults aging from 19 to 65 and stated that the handle length should be longer than the palm breadth as people sometimes use their fingers to press the handle (Pheasant, 1996). Pheasant (1996) stated that the suitable handle length should be greater than the sum of hand breadth and thumb breadth. By checking the data, we can see that the

greatest sum of hand breadth and thumb breadth is:

$26 + 95 = 121$ mm. The result shows that the handle length should be greater than 121mm (Figure 3.15).

Dimension	Men				Women			
	5th %ile	50th %ile	95th %ile	SD	5th %ile	50th %ile	95th %ile	SD
1. Hand length	173	189	205	10	159	174	189	9
2. Palm length	98	107	116	6	89	97	105	5
3. Thumb length	44	51	58	4	40	47	53	4
4. Index finger length	64	72	79	5	60	67	74	4
5. Middle finger length	76	83	90	5	69	77	84	5
6. Ring finger length	65	72	80	4	59	66	73	4
7. Little finger length	48	55	63	4	43	50	57	4
8. Thumb breadth (IPJ) ^a	20	23	26	2	17	19	21	2
9. Thumb thickness (IPJ)	19	22	24	2	15	18	20	2
10. Index finger breadth (PIPJ) ^b	19	21	23	1	16	18	20	1
11. Index finger thickness (PIPJ)	17	19	21	1	14	16	18	1
12. Hand breadth (metacarpal)	78	87	95	5	69	76	83	4
13. Hand breadth (across thumb)	97	105	114	5	84	92	99	5
14. Hand breadth (minimum) ^c	71	81	91	6	63	71	79	5
15. Hand thickness (metacarpal)	27	33	38	3	24	28	33	3
16. Hand thickness (including thumb)	44	51	58	4	40	45	50	3
17. Maximum grip diameter ^d	45	52	59	4	43	48	53	3
18. Maximum spread	178	206	234	17	165	190	215	15
19. Maximum functional spread ^e	122	142	162	12	109	127	145	11
20. Minimum square access ^f	56	66	76	6	50	58	67	5

Notes:

^a IPJ is the interphalangeal joint, i.e. the articulations between the two segments of the thumb;

^b PIPJ is the proximal interphalangeal joint, i.e. the finger articulation nearest to the hand;

^c as for dimension 12, except that the palm is contracted to make it as narrow as possible;

^d measured by sliding the hand down a graduated cone until the thumb and middle fingers only just touch;

^e measured by gripping a flat wooden wedge with the tip end segments of the thumb and ring fingers;

^f the side of the smallest equal aperture through which the hand will pass.

Figure 3.15, Anthropometric estimates for the hand (all dimensions in mm), (Pheasant, 1996)

item		This study		Wang et al. (2002)
male	A hand length	187.9	(7.9)	183
	B hand breadth (four fingers)	83.6	(4.8)	86
	C grip breath inside width diameter	44.5	(5.3)	-
	D grip breath inside length diameter	35.6	(4.9)	-
female	A hand length	167.9	(6.6)	167
	B hand breadth (four fingers)	75.2	(6.2)	75
	C grip breath inside width diameter	32.2	(4.5)	-
	D grip breath inside length diameter	25.7	(5.0)	-
all	A hand length	177.9	(12.4)	175
	B hand breadth (four fingers)	79.4	(6.9)	80.5
	C grip breath inside width diameter	38.3	(7.9)	-
	D grip breath inside length diameter	30.7	(7.0)	-

Hand ergonomics of male and female (30 males and 30 females)

Figure 3.16, The average results of dimensions (unit: mm) (Chang-Yi & Deng, 2017)

The International Labor Office in Switzerland has stated that the grip handle of a product should consider the hand action when people use their hand to hold the handle (Fraser, 1980). D. Cochran and M. Riley (1986) studied the evaluation of knife handle guarding to show that a diameter of around 40 mm is suitable for both male and female to use when the handle is a cylindrical shape. John Wiley and his sons (2004) made another research study and found that the diameter of 30 to 40mm is the most suitable diameter for hands to hold or move the product. The data are outdated so that in 2017, researchers tested to see whether they still work (Chang-Yi & Deng, 2017).

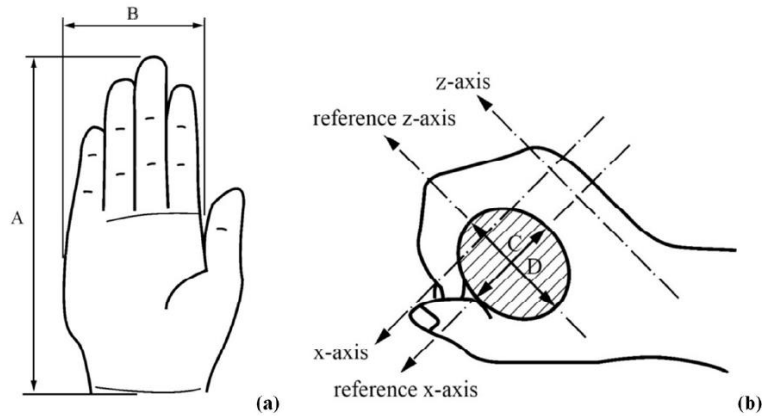


Figure 3.17, A refers to hand length; B refers to hand breadth; C refers to grip breadth inside width diameter; D refers to grip breadth inside length diameter. (Chang-Yi & Deng, 2017)

In Chang-Yi and Deng's study, 60 participants, 30 men and 30 women, were required to hold a handheld tool. The diameter of the comfortable handle which made users feel pleased was recorded. Figure 3.16 shows that the grip breadth inside diameter was 30.7 to 38.3mm (35.6 to 44.5mm for males and 25.7 to 32.2mm for females). It is because the hand length for males in the gripping is usually greater than females' hand length. The results are similar with John Wiley's findings in 2004 (suitable diameter: 30 to 40mm).

According to the data, we can make a conclusion: The handle diameter should be in a range of 25 to 45mm (considering different gender use).

However, according to the use of handheld tools, there are two main kinds of handheld tools: gripping and squeezing tools; gripping and turning tools (Pheasant, 1996). Gripping and squeezing tools such as the garlic press tools or kitchen tongs are usually equipped with two handles.

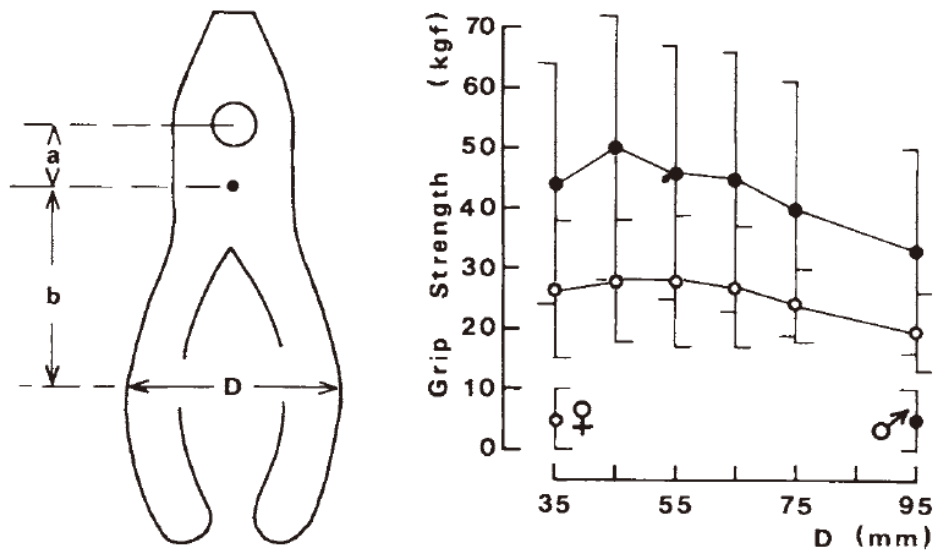


Figure 3.18, Grip strength (G) as a function of the handle size (D). Vertical lines are 5th-95th percentile values in samples of 22 men and 22 women. The tool is a lever of the first class, the mechanical advantage = b/a . Hence, the effective cutting or crushing force = GB/A . (Pheasant & Scriven, 1983)

Pheasant (1996) stated that the distance between the two handles of a gripping and squeezing tool determines the grip strength. As is shown in Figure 3.16, when the distance between the two handles of a squeezing tool is 45-55 mm, the grip strength shows the greatest power for both males and females (Pheasant, 1996).

For designing a gripping and turning tool, Pheasant used a cylindrical handle model as an example. He stated that when the handle is rotating about axis A-A', the power strength is determined by the hand-handle contact area. The available torque about axis A-A' (T) is related to the grip force (G), the friction coefficient (μ), and the cylinder diameter (D), hence, $T = \mu GD$

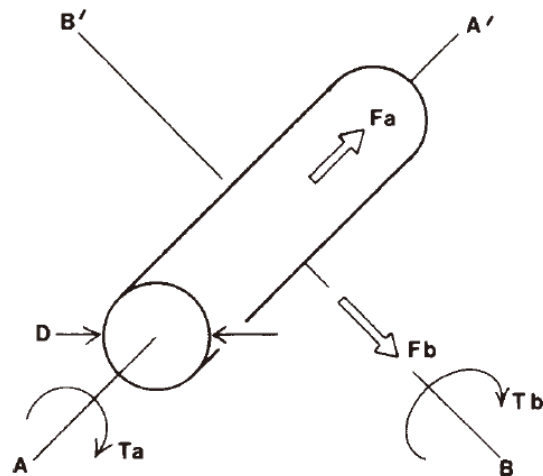


Figure 3.19, The cylindrical handle showing the long axis A–A' and the perpendicular axis B–B'

He also shows the relationship between thrust (F) and grip force (G) (Pheasant & O' Neill, 1975; Pheasant & Scriven, 1983) (Figure 3.20). According to the data, the torque (T) is the greatest when the handle diameter is 70mm; the shear (known as S , $S = T/D = \mu G$) and thrust (F) are greatest when the handle diameter is 30-50 mm. We know that the $F = \mu G$, shows that diameter only determines the grip force. Hence, we can see from the experiment that when diameter is 30 to 50 mm, the shear or thrust shows the greatest, which means it is the most comfortable diameter for people to add power. Therefore, when designing the handle of a kitchen gripping and turning tool, the handle diameter should be 30 to 50mm.

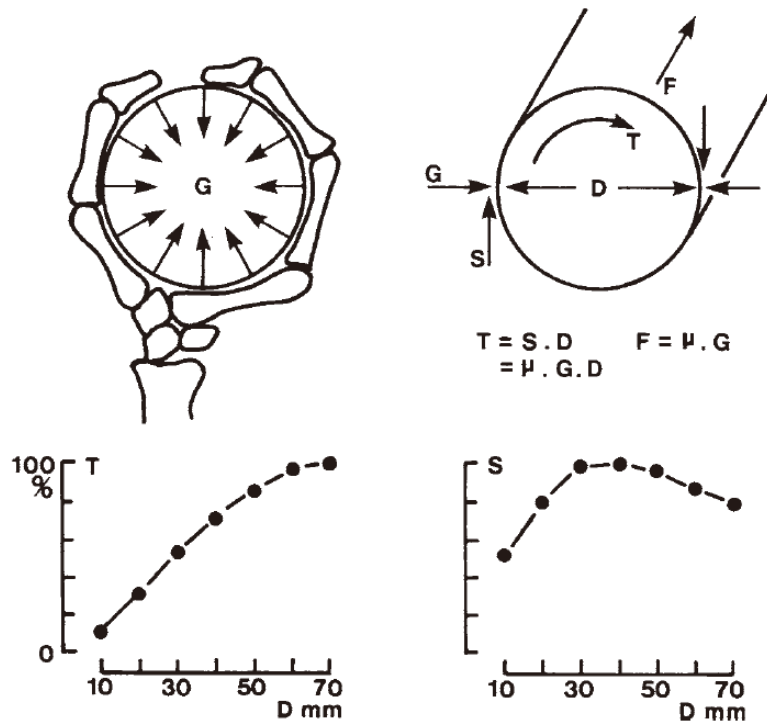


Figure 3.20, The mechanics of the gripping and turning action, using a cylindrical handle. (Pheasant,

1996)

3.7.2 Shape of the Handle

The latest hand tool ergonomics by Canadian Centre for Occupational Health and Safety (CCOHS) further made a handle shape guideline based on the wrist working behavior (CCOHS, 2019). Tools with bent or angled handles or tools with pistol-grips have benefit on wrist behavior when the force is exerted in a straight line (CCOHS, 2019). At the same time, the force direction has a similar direction with the straightened forearm and wrist, which can reduce the harm of wrist as we can reduce the wrist-bending time.

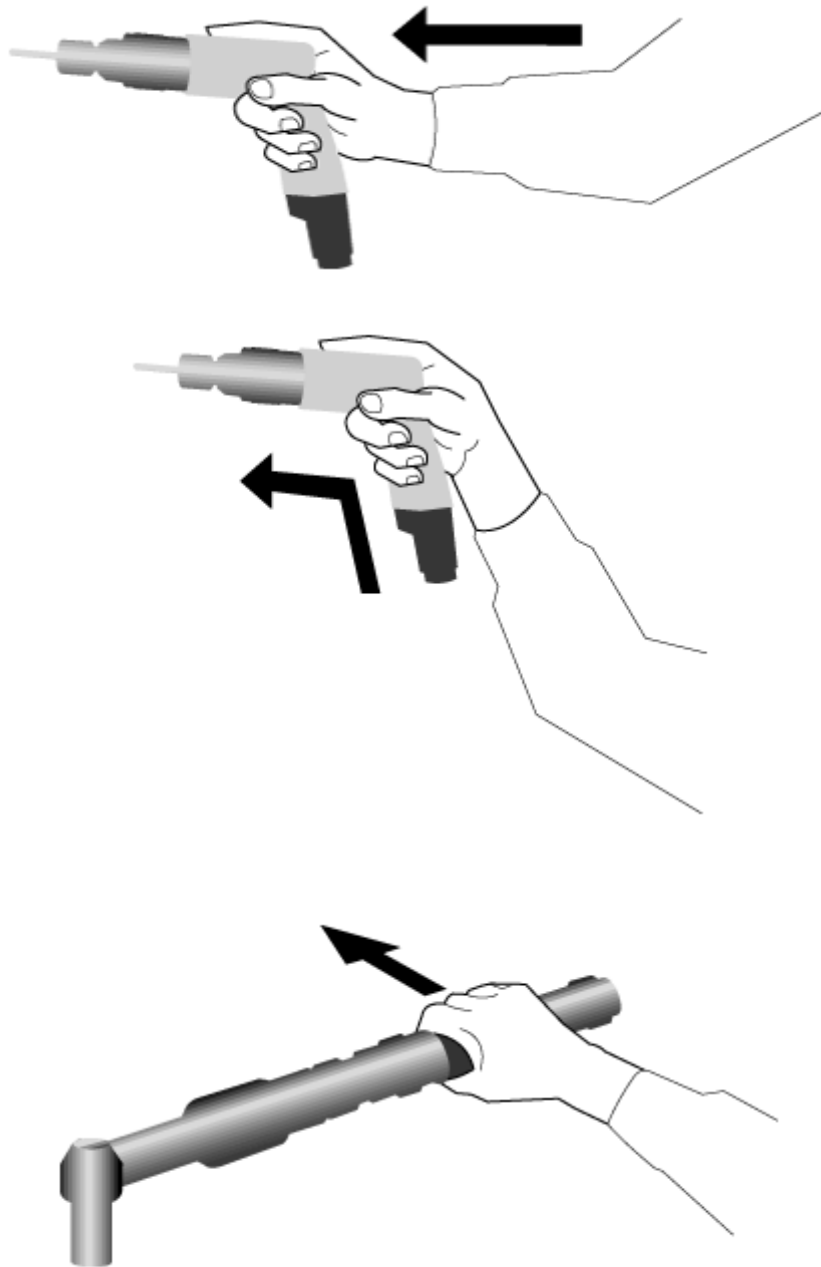


Figure 3.21, Force direction and handle shapes

However, when the force is exerted perpendicular to the straightened forearm and wrist, that means the force must be applied vertically, the handle shape of such tools is recommended to be straight (CCOHS, 2019).

3.7.3 Conclusion

In this part, we have understood that a pleasurable non-electric kitchen tool should be functional and safe. The common handle part of the kitchen tool is studied, and we can get common rules for designing a functional and safety handle:

- The length of the handle part should be larger than 121 mm.
- The diameter of common gripping tools should be from 25 to 45mm.
- The distance between two handles of a squeezing tool should be 45 to 55mm.
- The diameter of a turning tool should be 30 to 50mm.
- When the force direction of using the tool is parallel to the handle, the handle shape should be bent.
- When the force direction of using the tool is perpendicular to the handle, the handle shape should be straight.

3.8 The Aesthetics of Pleasurable Non-Electric Kitchen Tools

After understanding the functionality and human ergonomics of the non-electric kitchen tools, the next step is to study the aesthetics factor of the product. From the case study of famous companies and their products, we have found that the aesthetics factor is mainly related to the product's form and color.

3.8.1 The Shape or Form of Product Design

In common, the shape can be divided into two categories: geometric shapes and organic shapes. Geometric shapes are defined as shapes that have regular appearance

and are typically man-made using machines. Circles, triangles, rectangles, squares are common examples of geometric shapes (Figure 3.22).

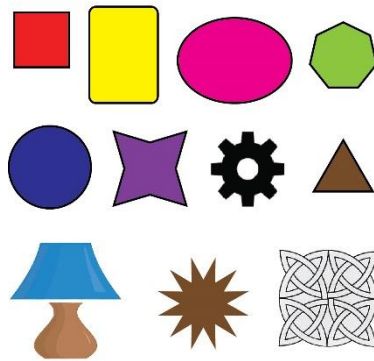


Figure 3.22, Examples of geometric shapes

Organic shapes are defined as shapes that are irregular in appearance. Most organic shapes tend to have a curvy flow to them. Examples of organic shapes are fruits, moon, sun, and other nature objects.



Figure 3.23, Examples of organic shapes

From the definition of geometric shapes and organic shapes, we can see that organic shapes usually have more beautiful curves. In product design, curves of the basic form can create the impression of aesthetics. According to a survey which

analyzed the impressions of different curves, the impressions can be divided into three categories: first is the divergent curve, which can give users a sharp impression; second is the neutral curve, which can bring a neutral impression; and the third is the convergent curve, which can give users a centripetal impression (Kanaya, Nakano, & Sato, 2007).



Figure 3.24, Handmade Wood Ladle Spoon, “Heart of Maya”

The product in Figure 3.24 is a handmade wood spoon which is named “Heart of Maya”. It has more than 10,000 fans on Pinterest.com. Organic shapes are used to make the product beautiful. Crowned with a heart, this ladle from Peten Wood Artisan Sculptors gives users a natural feeling. The example and study above both show that for designing a pleasurable non-electric kitchen tool, organic shapes should be considered first because the different curves of the organic shapes can give people different impressions, while geometric shapes do not have that function.

3.9 Colors of Product Design

As an important element of aesthetics, the color of the product is the first factor in the appearance of the product to stimulate people's attention. Different colors can have different effects on the user. In general, colors are mainly divided into three categories: warm, neutral, and cool. Warm color refers to the series composed of warm light, which usually includes red, orange and yellow. Some light gives people a warm feeling, usually called warm light. Cool color refers to some colors dominated by blue, including green and purple. The neutral colors are black, white and gray, which is suitable for any color system.

3.9.1 Color Psychology

Faber Birren (1950), an American researcher in the color industry, tried to find out what kind of association can be made by a particular color.

MODERN AMERICAN COLOR ASSOCIATIONS

Color	General appearance	Mental associations	Direct associations	Objective impressions	Subjective impressions
Red	Brilliant, intense, opaque, dry	Hot, fire, heat, blood	Danger, Christmas, Fourth of July, St. Valentine's, Mother's Day, flag	Passionate, exciting, fervid, active	Intensity, rage, rapacity, fierceness
Orange	Bright, luminous, glowing	Warm, metallic, autumnal	Halloween, Thanksgiving	Jovial, lively, energetic, forceful	Hilarity, exuberance, satiety
Yellow	Sunny, incandescent, radiant	Sunlight	Caution	Cheerful, inspiring, vital, celestial	High spirit, health
Green	Clear, moist	Cool, nature, water	Clear, St. Patrick's Day	Quieting, refreshing, peaceful, nascent	Ghastliness, disease, terror, guilt
Blue	Transparent, wet	Cold, sky, water, ice	Service, flag	Subduing, melancholy, contemplative, sober	Gloom, fearfulness, furtiveness
Purple	Deep, soft, atmospheric	Cool, mist, darkness, shadow	Mourning, Easter	Dignified, pompous, mournful, mystic	Loneliness, desperation
White	Spatial—light	Cool, snow	Cleanliness, Mother's Day, flag	Pure, clean, frank, youthful	Brightness of spirit, normality
Black	Spatial—darkness	Neutral, night, emptiness	Mourning	Funereal, ominous, deadly, depressing	Negation of spirit, death

Figure 3.25, Modern American color associations (Birren, 1950)

Psychological effects of warm colors: From Birren's study, we can find that warm colors often evoke happiness, optimism, and happy feelings. The symbolic color of warm colors is red. When we go to a KFC to have a meal, we will find that the environment is full of red color, which makes us feel warm and want to eat. Actually, Berman (2007) has stated that warm colors are suitable for design kitchen products because warm colors can make people feel hungry.

Psychological effects of cool colors: Cool colors (blue, green, and purple) are always seen as having effects on calming or relaxing people. However, it is also a symbol of sadness. For example, blue often comes to our mind when we listen to a sad song. In product design, blue has a positive effect that consumers could get a feeling of relaxation when they see blue and stores or restaurants always encourage consumers to buy more by making an environment with similar colors (Rider, 2009). Green is considered as a sign of health and environmental protection. It is a good choice for designing kitchen tools as it displays health and security. Purple with high saturation shows noble, spiritual, intuition, purity, inspiration, contemplation, solemnity, piety, mystery, and oppressive psychological feelings. With the introduction of Buddhism in the East, purple gradually became a symbol of nobleness and power. In kitchen tools design, purple is used by females as it can create a romantic atmosphere.

Psychological effects of neutral colors: Neutral colors involves gray, white, black, brown, and tan. In product design, neutral colors tend to be used as the background

colors because they can match many other colors most of time to create a visual pleasantness.

3.9.2 Color Trends for Kitchen Tool Design

Rider (2009) states that choosing suitable colors that will appear in the next few years affects supporting sales. Color trends seem to be important for designing kitchen tools as suitable colors could attract people to use the product. People will generate a pleasurable feeling if they like the kitchen tool.

The latest color trends in kitchen product design should be considered for choosing suitable colors for designing pleasurable kitchen tools. According to *Forbes* 2019 cookware trend report (2018), designers should continue to pump color into product design, which means the kitchen tools should be colorful. *Forbes* (2018) predicts in 2019, the anything-but-dark style will be very trendy. In fact, it is already happening. *Wayfair* has more than 1,000 listings on its online website named “colorful cookware”. *T-fal* also plans to expand its colorful cookware in 2019 to make the kitchen room own more bold colors. For example, its turquoise series is very successful in the market.



Figure 3.26, T-fal, turquoise series

Moreover, *KitchenAid* is expected to release new colorful kitchen tools and appliances following the big success of its *Pantone-friendly Birds of Paradise* series. “The color, a perfect mix of creamy coral and tropical salmon, is a dreamy summer shade that is definitely on trend” (*KitchenAid*, 2018).



Figure 3.27, KitchenAid, Birds of Paradise, 2018

Under the latest kitchen tool design trends, colorful kitchen tools would be more and more popular because colorful kitchen tools can bring consumers a natural feeling, thus making consumers feel pleasurable.

3.9.3 Color Value of Kitchen Tools

For most of the kitchen tools, designers will add white or black to a color to produce a high-value color or a low-value color that can give users different feelings. Adding white or black to a hue color is called color value. In general, no black, white or grey is added when the color is 100% pure. Figure 3.28 shows an example of the red value.

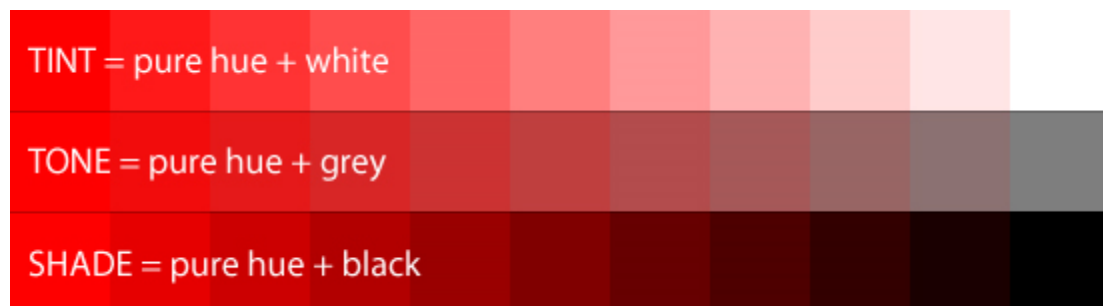


Figure 3.28, The example of red value

In the red value, from left to right, the level of the color purity decreased by 10% for each step, and ends when it turns into white, grey, and black. Adding white to a hue produces a high-value color, which is called tint. Adding black to a hue can product a low-value color, which is called shade. Normally, color tint and color shade can create two categories of positive emotions (Valdez & Mehrabian, 1994). First is

the feeling of dominance. For example, the cutting knives usually require giving users the feeling of dominance. Second is the direct pleasure feelings. For example, adding white to red until the tint range is around 60% can make the pink color that will have a romantic color. Patricia Valdez and Albert Mehrabian invited participants to test the relationship between color value and emotions in 1994. In their study, 76 color samples were selected for testing. 250 participants were required to rate a minimum of seven color samples for pleasure and dominance. In this way, pleasure and dominance reactions were assessed a total of 1,896 times. Table 3.2 shows the relationship between color brightness and positive emotions.

Positive Emotions Types	Color Brightness
Pleasure	Tint (hue is 100%)
Men & women	69%
Men only	61%
Women only	68%
Dominance	Shade (hue is 100%)
Men & women	76%
Men only	72%
Women only	73%

Table 3.2, Relationship between positive emotions and color brightness

In Table 3.2, the most suitable tint or shade percentages were listed for pleasure and dominance. The percentage range can be enlarged a little to make it suitable for all people. From the results, adding white to make a tint can generate pleasurable feelings like happiness, fun, and so on. The best range for the tint is from 60% to 70% as men and women all feel pleased. Adding black to make a shade can make people feel that they can dominate the product. The recommended range is from 70% to 80%.

3.10 Materials for Product Design

As is mentioned in the conclusion of factors that will lead to pleasure, we know that the right selection of material can make a pleasurable non-electric kitchen tool. For kitchen tools, metal materials and plastic materials are the most commonly used materials. Hence, metals and plastics will be studied to have a selection suggestion for different kitchen tools.

3.10.1 Basic Requirements for Materials

To ensure the safe use of material in kitchen tool design, the FDA (2003) has already made a list of requirements that designers need to follow. The requirements can be summarized as below:

- (a) The food-contact part of the kitchen tool may not impart odors, color or taste, nor contribute to the contamination of food.
- (b) Food-contact surfaces must be easily cleanable, smooth and free of breaks, open seams, cracks, chips, pits, and similar imperfections.
- (c) Cast iron may be used as a food-contact surface only if the surface is heated.
- (d) Single-service articles must be made from clean, sanitary and safe materials.
- (e) The plastic, rubber, and rubber-like materials should be of sufficient weight and thickness to permit cleaning and sanitizing by normal dishwashing methods.
- (f) The plastic, rubber, and rubber-like materials must be resistant under normal conditions of use to scratching, scoring and decomposition.
- (g) Hard maple or other nonabsorbent material can be used for cutting boards and

cutting blocks.

- (h) Wood should be used for single service articles, such as the chopsticks or the spatula.
- (i) All the material used in kitchen tools should be antibacterial and nontoxic.
- (j) The materials used in kitchen tools should function properly for intended purposes and perform properly.
- (k) Materials should be safe. It must be stable even under high temperature heat.

3.10.2 Metals for Kitchen Tool Design

In Chapter Two, the non-electric kitchen tools can be divided into three categories: cutting and slicing tools; gripping and squeezing tools; and mixing tools. For the former two kinds of tools, they usually have the food-related part which requires the material to have a good hardness because the food-related part is used to cut or squeeze food.

For most of these two kinds of tools, the cutting or squeezing part is usually made of metals because metals usually have a good hardness. According to Ashby and Johnson (2002), metals can be divided into nine categories: carbon steels; stainless steels; low alloy steels; aluminum alloys; magnesium alloys; titanium alloys; nickel alloys; copper alloys; and zinc alloys.

Carbon steels

Carbon steels are alloys of iron with carbon. For kitchen tools, high carbon steels (0.5-1.6% carbon) are used for cutting tools or knives. High carbon steels achieve a

great hardness. According to the Vickers hardness test, the high carbon steels have a hardness range of 120-650 HV that is greater than most of other metals (Ashby & Johnson, 2002). However, more carbon is not recommended to be added into cast iron (1.6%-4%) because material properties will be less good than steel (Ashby, Johnson, 2002). Common high-carbon steels have the designations 1080 and 1095.



Figure 3.29, Knife sets made of high carbon steels

Stainless steels

Stainless steels are alloys of iron with four or five elements such as chromium and nickel. Compared with carbon steels, stainless steels have less performance on hardness, but still have a range of 130-600 HV. For kitchen tool design, stainless steels are typically used in food-processing tools such as the lemon squeezer and can opener.

Low alloy steels

Compared with carbon steels and stainless steels, low alloy steels are heat treatable.

With a similar hardness as carbon steels and stainless steels, low alloy steels are usually used to make the ball bearings or connecting rods of the kitchen tools.

Aluminum alloys

Aluminum alloys are strong and have a hardness range of 20-150 HV. However, compared with other steels, aluminum alloys are lighter. In kitchen tool design, aluminum alloys are suitable for those tools that need both strength and lightweight. Aluminum alloys are always recommended when making the gripping and squeezing tools.



Figure 3.30, Lemon squeezer made of aluminum alloys

Magnesium alloys

Magnesium alloys have a similar hardness with aluminum alloys. However, magnesium alloys will corrode badly in salty water and acids, so magnesium alloys are usually not recommended to be used in kitchen tool design.

Titanium alloys

Titanium alloys have a hardness range of 60-380 HV. However, titanium alloys are expensive (more than 10 times of the price of aluminum). As a result, titanium alloys are usually to be used in the small but the hardest part of the kitchen tool. It is usually used as the sharpening part of the kitchen knife sharpener.



Figure 3.31, Knife sharpener

Nickel alloys

Nickel alloys have a good hardness of 75-600 HV. Pure nickel has good electrical conductivity, thermal conductivity, and strength and corrosion resistance. In general, the principal uses of nickel are an alloying element in stainless steels and superalloys. Most of the cutting knives have nickel in the knife part.

Copper alloys

Copper started to be widely used in kitchen tools since Victorian times. Copper and

its alloy are easy to cast, to roll to sheet, and to shape in other ways. The hardness of copper materials is 44-180 HV. However, nowadays, copper materials are not recommended in kitchen tool design. When preparing salty food, iodine present in salt quickly reacts with copper, which releases more copper particles. Hence, non-electric kitchen tools should prevent selecting copper materials.

Zinc alloys

Zinc alloys have a hardness range of 30-160 HV. Most zinc is used in galvanizing steel to improve corrosion resistance. Zinc die-casting alloys are strong enough for most consumer products. In kitchen tool design, zinc alloys can survive exposure to acids, and it is easy to shape. The material is widely used to make all kinds of kitchen squeeze tool.



Figure 3.32, Zinc alloy kitchen squeeze tool

3.10.3 Plastics for Kitchen Tool Design

Compared with cutting and slicing tools, gripping tools and mixing tools should consider more about the handle. People usually need to move their hands when using gripping and mixing tools, so the materials used in these two kinds of tools should have a light weight. Besides this, the materials used in the handle part should have a good toughness for consumers to hold easily. In kitchen tool design, plastic materials are always used to make the handle. Table 3.2 shows the technical attributes of common plastic materials.

Material	Density, Mg/m³	Toughness, MPa.m^{1/2}	Service Temperature, C	Vickers Hardness, HV	FDA Approved & Food Safe
PE	0.92~1.4	0.4~5.16	-40~100	0.4~5.16	Yes
PP	0.89~0.92	3~4.5	-40~120	6~11	Yes
PS	1.04~1.05	0.7~1.1	-18~100	9~16	No
ABS	1.01~1.21	1.2~4.2	-18~90	6~15	Yes
PA	1~1.42	0.58~8.03	-80~120	6~28	No
PMMA	1.16~1.22	0.7~1.6	-50~100	16~21	Yes
PC	1.14~1.21	2.1~4.602	-40~120	17~22	Yes
POM	1.39~1.43	1.71~4.2	-30~110	14~24	No
PTFE	2.14~2.2	5~7	-270~250	59~65	No
PEEK	1.3-1.32	2.73~4.30	-30~250	25~28	No

PVC	1.3-1.58	1.46~5.12	-20~70	10~15	Yes
PU	1.02-1.25	0.2~4.97	-55~100	16~22	No
PET	1.19-1.81	1.05~9.16	-20~160	11~40	Yes

Table 3.2, Technical attributes of common plastic materials

Weight

From Table 3.2, we can see the density information of common plastic materials. All these plastic materials have a low density that is around 1.00 Mg/m^3 . Compared with the density of metal materials, plastic materials are so light that they can be the suitable materials to make a light handle. Table 7 gives a heavy or light feeling of these FDA approved & food safe plastics. We can see that PE, PP, and ABS are lightweight so that they are highly recommended to use to make the handle of kitchen tools.

Material	Heavy or light
PE	Light
PP	Light
ABS	Light
PMMA	Heavy
PC	Heavy
PVC	Heavy
PET	Heavy

Table 3.3, Weight features relative to plastic materials

Temperature and texture

Table 3.2 also gives the information of plastic materials' working temperature. For all the FDA approved and food safe plastic materials, PE, PP, PC, and PET materials have a better working environment that is greater than 100 C. These four materials are highly recommended when the non-electric kitchen tools will be used in high temperature.

Besides this, Ashby and Johnson also analyzed smooth or tough feelings these plastic materials. Table 8 shows people's reaction of these FDA approved and food safe plastic materials.

Material	Warm to cool, 0~10	Soft to hard, 0~10	Smooth or tough
PE	4~5	5~7	Tough
PP	4~4	6~7	Tough
ABS	4~5	6~7	Tough
PMMA	4~5	7~7	Smooth
PC	4~5	7~7	Tough
PVC	4~5	7~7	Smooth
PET	4~5	6~7	Smooth

Table 3.4, People's reaction of FDA approved & food safe plastic materials

From Table 3.4, we can see that at room temperature, these FDA-approved and food safe plastic materials have a similar reaction from consumers. Consumers have a same feeling that score 4 to 5 to these materials' warm feelings. PE, PP, ABS, and PC are reacted to have a tough feeling for consumers. Since PE, PP, ABS also have light weight, these three plastic materials are highly recommended to make the handle of kitchen tools.

3.10.4 Elastomers Materials Used in Kitchen Tool Design

In kitchen tool design, many tool handles utilize rubber (usually synthetic such as TPU) as overmolded coating for better comfort and waterproof. Materials that involve rubber and rubber-like materials are called elastomers. According to the description from Ashby and Johnson (2003), elastomers mainly have the following categories:

Natural Rubber

Natural rubber is the most widely used of all elastomers in that more than 50% of products will use this material. Natural rubber is an excellent and cheap elastomer which has large stretch capacity. Its service temperature is -50 C to 115 C. However, natural rubber has poor resistance on oil. Hence, natural rubber is not recommended for food-related products such as kitchen tools.

Styrene-Butadiene Elastomers (SBS)

SBS have similar properties like natural rubber. The material has poor resistance on strength, thus often requiring reinforcement. Its main use is to make tires. In kitchen tool design, SBS are usually not recommended.

Butyl Rubbers (NR)

Butyl rubbers are synthetics that resemble natural rubber in properties. Butyl rubbers have good resistance to tearing, flexing, and abrasion. The material is widely used for electrical applications because it has low dielectric constant and loss. In kitchen tool design, NR are not recommended.

Isoprene

Isoprene is synthetic natural rubber. Isoprene has low hysteresis and high tear resistance. Its main use is the same as butyl rubbers.

Acrylate elastomers

Acrylate elastomers are made from butyl or ethyl acetate. The material has good oil resistance but low strength and tear resistance. In general, acrylate elastomers are used to make automobile transmission seals. The material is not recommended to make food-related products.

Ethylene-Vinyl-Acetate Elastomers (EVA)

EVA is available in pastel or deep hues. The material is FDA-approved for direct food contact. The toughness and flexibility of EVA are good even at low temperatures. The material can be processed by most normal thermoplastic processes such as rotational molding and injection molding. In kitchen tool design, EVA is usually used to make food packaging such as milk containers.

Thermoplastic Polyurethane (TPU)

TPU is any of a class of polyurethane plastics with many properties. Technically, TPU are thermoplastic elastomers. On the market, TPU is widely used because it has

high abrasion resistance, low-temperature performance, high shear strength, high elasticity, and good oil resistance. In kitchen tool design, TPU is the FDA-approved material. It is usually used to cover tool handles for better comfort and to make them waterproof.

Silicones

Silicones are high-performance and high cost materials. Silicones have poor strength and can be used over a range of temperature (-100~300 C). The materials have excellent chemical stability and an unusual combination of properties. In kitchen tool design, silicones are widely used because they are chemically inert and do not absorb water. The material is always used to make the spatula. Companies always use silicones to make the whole spatula or make the food contact part that is connected with a wood handle.



Figure 3.33, Silicone spatula set

3.10.5 Natural materials used in kitchen tool design

In kitchen tool design, natural materials are also recommended to make the kitchen

tool. In kitchen tool design, the most common materials can involve bamboo and wood.

Bamboo

Bamboo is nature's gift to designers. Bamboo's hard surface and ease of working makes it the most versatile of materials. It has similar properties as wood but is faster growing that it can be harvested after a year. In kitchen tool design, bamboo is always used to make the spoon set.



Figure 3.34, Bamboo spoon set

Wood

Wood has been used to make products for a long time. Early at round 700 BC, the Greeks start to use wood to make kitchen tools. Wood offers a remarkable combination of properties. It is light, strong and tough. Wood is cheap and renewable. It is easily machined, carved, joined, and it can be molded to complex shapes. In kitchen tool design, wood is a common material that it is always used to make the handle of kitchen tools or the cutting board.



Figure 3.35, Spoon set with wood handles

3.10.6 Conclusion

Material use in kitchen tool design needs to be considered well before designers make the product. For different kitchen tools, material selection principles are different. For cutting and slicing tools, and gripping and squeezing tools, the most important property that designers need to consider is the hardness of the materials because consumers need to put a great power on these tools to prepare food. In this case, metal materials are recommended. An introduction of nine main metals in Chapter Three can help develop the material guidelines in Chapter Four later.

For mixing tools, since people need to hold the handle to move the tool, the weight and texture of the material should be focused more. In kitchen tool design, plastic materials are usually lighter than metal materials that plastics are usually used to make the handle of mixing tools. After learning about the properties of those FDA approved & food safe materials, PE, PP, and ABS are highly recommended to be used for mixing tools. These three plastics have lightweight and are tough enough for users

to easily hold.

Another conclusion can be got here is that when the working environment is at high temperature (for kitchen tools, it usually happens when the tools are used around the fire), PE, PP, PC, and PET materials are highly recommended. For non-electric kitchen tools, most of them work at room temperature. Mixing tools, especially the spatula and spoon will need to work at high temperatures. Considering the material properties for mixing tools, the plastic should be light and tough enough to hold. Hence, PE and PP materials will be highly recommended when the tool needs to work at high temperatures.

Elastomers are always used to cover tool handles for better comfort and to make them waterproof. In this case, silicones, EVA, and TPU are recommended for kitchen tool design because these materials are FDA approved and have good material properties.

The following table is a summary description of materials for Chapter Two. It includes the type of kitchen tool and the required material attributes. It also gives examples for recommended materials.

The type of tool	The required material attributes	Recommended materials
Cutting and slicing tool	Hardness; Food safe;	High carbon steel for high hardness; high carbon steel chef's knife

Gripping and squeezing tool	Hardness; Food safe;	High carbon steel for high hardness; high carbon steel lemon squeezer
Mixing tool (room temperature)	Lightweight; Texture; Food safe	PE, PP, ABS for tool handle design; wooden handle
Mixing tool (high temperature)	Food safe; Lightweight; Service temperature	PE, PP for tools such as spatula; wooden spoon; wooden spatula
Tool handle overmolded part	Food safe; Toughness; Strength; Elasticity	EVA, TPU, Silicones for overmolding; TPU for great elasticity

Table 3.5, Material Recommendations for Each Category of Kitchen Tools

3.11 The summary of case study

The visceral/reflective/behavioral elements can be used to summarize the design strategies of famous companies that produce pleasurable kitchen tools. Jordan's four pleasure framework can be related to the three parts. Physio-pleasure which derives from sensory organs belongs to the visceral part. Psycho-pleasure which involves usability can be related to the behavioral part. Ideo-pleasure and socio-pleasure that are connected to people's values and relationships belong to the reflective part.

Visceral

- The visceral part of the model is aesthetics oriented.
- It means the kitchen tool can attract users by its aesthetics (Van, 2012).

- It involves aesthetic properties of the kitchen tools (i.e. look, sound, smell, touch, and taste).

Reflective

- The reflective part of the model is personality oriented.
- It evokes personal memory focusing on the message, culture, and the meaning of a product or its use.

Behavioral

- The behavior part of the model is function oriented.
- It focuses on use and understanding. This considers how people will use a kitchen tool, focusing on functionality.

For most of the kitchen tools on the market, the designers have already focused on physio-pleasure and psycho-pleasure. According to research in Chapter Three, common rules of ergonomics, materials, aesthetics, and functions are studied to design kitchen tools. These are the basic and necessary rules that designers need to follow to design a pleasurable kitchen because physio-pleasure and psycho-pleasure can be generated from them. In the next chapter, a checklist will be given first to show how designers can use the rules in Chapter Three to make sure their kitchen tools can generate physio/psycho-pleasure. Then the 25 positive emotions that were studied in Chapter Two will help make a summary of what kind of value or emotion can people get from each category of kitchen tools.

Chapter Four

Design Recommendation Checklists for Non-electric Kitchen Tools

4.1 Introduction

After studying the design factors that can lead to pleasurable kitchen tools, design recommendation checklists are made to help designers make kitchen tools for enhanced pleasurability. Based on the categories of kitchen tools, the design recommendation checklists will have three types: design recommendation checklist for cutting tools; design recommendation checklist for squeezing tools; and design recommendation checklist for mixing tools. Each checklist will list the design factors and related rules/recommendations for four pleasures. Designers can check these rules/recommendations when making pleasurable kitchen tools.

4.2 Design recommendation checklist for cutting tools

Figure 4.1 shows the design recommendation checklist for cutting tools. Designers can use the checklist when designing cutting tools or related products.

Design Recommendation Checklist for Cutting Tools

Four Pleasures	Design Considerations	Design Factors	Design Rules/Recommendation	Y/N/NA
Physio-pleasure	Ergonomics	Handle Length	Handle length: > 121 mm	
		Handle Diameter	Handle diameter: 25~45 mm	
		Handle Shape	Straight shape	
	Materials	Hardness	1. High-carbon steels for making the cutting part if cutting bones or steak. 2. Common stainless steels for making the cutting part if cutting fruit or vegetables. 3. Suggest using nickel alloys for making the sharpening part of the knife sharpener.	
		Food Safe	1. Safe plastics include PE, PP, ABS, PMMA, PC, PVC that can be used to make the handle. 2. Other common materials include ceramics, bamboo, wood are recommended to make the handle. 3. Suggest using carbon steels, stainless steels, or nickel alloys to make the food contact part.	
	Aesthetics	Color	1. The food contact part should be the color of the material. 2. Colors for knives should have a confident feeling or can calm down users. Neutral colors, such as black, are usually used as the color of the handle. 3. Adding black to the color hue (which is called shade). When the range is from 70% to 80% (color hue is 100%), people can feel that they can control or dominate the cutting tool.	
Shape		1. Organic shape is preferred. 2. The cutting and slicing part should be made into thin and sharp shape. 3. The edges of the handle part are preferred to be made into curves.		
Psycho-pleasure	Usability (Efficiency/Effectiveness)	Shape	1. The cutting and slicing part should be made into thin and sharp shape.	
		Tool Hardness	1. Materials for cutting parts should have a good hardness. 2. Suggest using high-carbon steels if cutting food like bones or steak. 3. Suggest using common stainless steels if cutting fruit or vegetables. 4. The hardest and expensive nickel alloys is recommended if making the sharpening part.	
		Tool Weight	Materials that have heavy weight are recommended to make the cutting or sharpening part. Metals are usually heavy and they are suggested to make the cutting or sharpening part.	
		Main Function	1. Materials for cutting or sharpening parts should have a good hardness. 2. The cutting part should be made thin and sharp for easy out.	
Ideo-pleasure	Value/Personality	Confidence (confident, assurance, secure, trust)	1. People are usually very careful to use cutting tools. Designers should let users feel confident when using the tool. 2. The cutting or sharpening tools should not hurt users themselves. Ergonomics for the handle should follow the rules: Handle length is larger than 121 mm; Handle diameter is from 25 to 45mm; Handle shape is preferred to be straight to have the greatest power. 3. The tools need to be safe to use. It needs to follow the rules: Safe plastics include PE, PP, ABS, PMMA, PC, PVC that can be used to make the handle; Other common materials include ceramics, bamboo, wood are recommended to make the handle; Suggest using carbon steels, stainless steels, or nickel alloys to make the food contact part. 4. The tools need to be easy to work. Materials for cutting and sharpening should follow the rules: High-carbon steels for making the cutting part if cutting bones or steak; Common stainless steels for making the cutting part if cutting fruit or vegetables; Suggest using nickel alloys for making the sharpening part of the knife sharpener. 5. Suggest using TPU, EVA, silicone to overmold the handle surface; Suggest using patterns that are made of repeated and dense lines to increase a rough feeling of the surface.	
		Satisfaction (gratified, pleased, contentment, glad, fulfilled)	1. Materials for cutting and sharpening should work easily: High-carbon steels for making the cutting part if cutting bones or steak; Common stainless steels for making the cutting part if cutting fruit or vegetables; Suggest using nickel alloys for making the sharpening part of the knife sharpener. 2. The handle should be comfortable for using; Suggest using TPU, EVA, silicone to overmold the handle surface; Suggest using patterns that are made of repeated and dense lines to increase a rough feeling of the surface. 3. The handle size should fit human ergonomics: Handle length is larger than 121 mm; Handle diameter is from 25 to 45mm; Handle shape is preferred to be straight to have the greatest power.	
Socio-pleasure	Relationship/With Others	Professional (show talent)	The cutting tools can be professional to use. Users can use the professional knives to show their cooking talent in front of others. This requires designers to follow these rules: 1. The cutting tool should have good ergonomics: Handle length is larger than 121 mm; Handle diameter is from 25 to 45 mm; Straight handle 2. The cutting tool should be safe to use; Suggest using TPU, EVA, silicone to overmold the handle surface; Suggest using patterns that are made of repeated and dense lines to increase a rough feeling of the surface; Safe plastics include PE, PP, ABS, PMMA, PC, PVC that can be used to make the handle; Other common materials include ceramics, bamboo, wood are recommended to make the handle; 3. The cutting tool should work well: The cutting part should be made thin and sharp for easy out; Suggest using carbon steels, stainless steels, or nickel alloys to make the food contact part.	

Figure 4.1, Design recommendation checklist for cutting tools

Physio-pleasure: Ergonomics

In order to have good physio-pleasure, cutting tools and related products should have good ergonomics. From research in Chapter Three, ergonomics for cutting tools mainly focus on the handle. Rules for handle design should be followed as below: the

handle length should be larger than 121 mm; the handle diameter should be from 25 to 45 mm; the handle shape is preferred to be straight.

Physio-pleasure: Materials

Physio-pleasure requires that the materials for cutting tools and related products should pay attention to food safety and hardness.

- The materials for cutting tools should have a good hardness. Based on research in Chapter Three, metals are always used to make the cutting or sharpening part.

High-carbon steels are recommended if cutting bones or steak; common stainless steels are recommended if cutting fruit or vegetables; nickel alloys are suggested if making the sharpening part.

- All materials for making the tool should be food safe. Based on research in Chapter Three, food safe materials for cutting tools involve plastics, natural materials, and metals. For cutting tools, safe plastics that include PE, PP, ABS, PMMA, PC, PVC can be used to make the tool handle; natural materials like wood, bamboo, ceramics can be used to make the handle; carbon steels, stainless steels, or nickel alloys should be used to make the food contact part.

Physio-pleasure: Aesthetics

Physio-pleasure requires that the cutting tools should have good aesthetics. For cutting tools and related products, rules for aesthetics mainly focus on the color and shape. Based on research in Chapter Three, the food contact part of the kitchen tool should be the color of materials. Hence, the color of the cutting or sharpening part of the cutting tool should be the color of its material (usually this is the metal color). The

handle color should give users confidence to use it. From research in Chapter Three, adding black to color hue (which is called shade) can create a feeling of dominance. When the color shade is in the range from 70% to 80% (color hue is 100%), the color can make people feel that they can control or dominate the cutting tool. Besides this, research in Chapter Three also suggests that the handle of the cutting tool should be made straight for the greatest power. To ensure that the cutting tool can cut food easily, the cutting and slicing part should be made thin and sharp.

Psycho-pleasure: Usability (Efficiency/Effectiveness)

From research in Chapter Two, psycho-pleasure always comes from good usability. It requires that the tool should have both good efficiency and effectiveness. For cutting tools and related products, shape, tool hardness, tool weight, main function, and safe use will affect usability.

- To make sure the cutting tool can cut food easily, the cutting or slicing part should be made into a thin and sharp shape.
- Materials for cutting parts should have a good hardness. High-carbon steels are recommended if cutting bones or steak. Common stainless steels are suitable if cutting fruit or vegetables. For the sharpening tool, the hardest sharpening part should use nickel alloys in production.
- Normally, the cutting tool and related products require a heavy weight. Metals are usually heavier than other materials and they are suggested to make the tool.
- To ensure the effectiveness of the cutting tool, cutting or sharpening parts should have good hardness. Designers should follow the material rules.

Especially the cutting part should be made thin and sharp for easy cutting.

- Good usability requires the cutting tool should be safe to use. In general, ergonomics and handle texture should be focused on. Handle length should be larger than 121 mm; handle diameter can be from 25 to 45 mm; a straight handle is preferred. Patterns that are made of repeated and dense lines can be used to increase roughness of the handle surface. TPU, EVA, and silicone are highly recommended to overmold the handle surface.

Ideo-pleasure: Value/Personality

From research in Chapter Two, ideo-pleasure is usually caused by personal values or personality. According to study of 25 positive emotions in Chapter Two and case studies in Chapter Three, confidence and satisfaction are the two major values for cutting tools that can create ideo-pleasure.

- Confidence involves the confident feeling, assurance, security, and trust. To create confidence for users, rules should be followed as below:
 1. The cutting or sharpening tools should not hurt users themselves. Hence, good ergonomics require that handle length should be larger than 121 mm; handle diameter is from 25 to 45 mm; handle shape prefers to be straight.
 2. Tools should be food safe to use. Hence, food safe plastics that include PE, PP, ABS, PMMA, PC, PVC can be used to make the handle. Other common materials like ceramics, bamboo, and wood are often used to make the handle. Carbon steels, stainless steel, and nickel alloys are food safe metals that can be used to make the cutting or sharpening part.

3. The tools need to be easy to work with. Materials for cutting and sharpening should follow these rules: High-carbon steels for making the cutting part if cutting bones or steak; common stainless steels for making the cutting part if cutting fruit or vegetables; nickel alloys for making the sharpening part of the knife sharpener.
 4. TPU, EVA, silicone should be used to overmold the handle surface; patterns that are made of repeated and dense lines to increase a rough feeling of the surface.
- Satisfaction (gratified, pleased, contentment, glad, fulfilled) also requires that designers should follow the rules as below:
 1. The cutting or sharpening tool should work easily. Based on research in Chapter Three, high-carbon steels are suggested for cutting hard food like bones and steak; common stainless steels are suitable for cutting food like fruit and vegetables; nickel alloys are suggested for making the sharpening part of the tool.
 2. The handle of the cutting tool should be comfortable and safe for holding. Based on research in Chapter Three, TPU, EVA, and silicone are always used to overmold the handle surface. Patterns are also recommended to be added because repeated and dense lines can increase a rough feeling of the surface.
 3. The size of the handle should fit human ergonomics. According to research in Chapter Three, handle length should be larger than 121 mm; handle

diameter should be from 25 to 45 mm; a straight handle shape is preferred for the greatest power.

Socio-pleasure: Relationship/With Others

Based on research in Chapter Two and case studies in Chapter Three, the cutting tool and related products can be made professional. Users can use the professional tool to show their talent in front of others, which can improve relationships between each other.

- The cutting tools can be professional to use. This requires designers to follow these rules:
 1. The tool should have good human ergonomics. According to research in Chapter Three, handle length should be larger than 121 mm; handle diameter should be from 25 to 45 mm; a straight handle shape is preferred for the greatest power.
 2. The tool should be food safe to use: TPU, EVA, silicone to overmold the handle surface; patterns that are made of repeated and dense lines to increase a rough feeling of the surface; food safe plastics include PE, PP, ABS, PMMA, PC, PVC that can be used to make the handle; other common materials including ceramics, bamboo, wood are recommended to make the handle.
 3. The cutting tool should work well: The cutting part should be made thin and sharp for easy cutting; carbon steels, stainless steels, or nickel alloys to make the food contact part.

4.3 Design recommendation checklist for squeezing tools

Design Recommendation Checklist for Squeezing Tools

Four Pleasures	Design Considerations	Design Factors	Design Rules/Recommendation	Y/N/NA
Physio-pleasure	Ergonomics	Handle Length	Handle length: > 121 mm	
		Handle Diameter	Handle diameter: 25~45 mm	
		Handle Shape	Straight and cylindrical shape	
		Distance Between Two Handles When Working	Distance range: 45~55 mm	
	Materials	Hardness	1. Squeezing tools are used to squeeze fruit into juice or food into small pieces. They do not need the squeezing part to be very hard. 2. Aluminum alloys and zinc alloys are hard enough to squeeze food. They are suggested to make the tool.	
		Lightness	1. The materials for squeezing tools should have a suitable weight for long-time holding. 2. Lightweight materials like aluminum alloys and zinc alloys are recommended to make the tool. 3. Light-weight plastics include PE, PP, ABS can be used to make the handle. 4. Natural light-weight materials include wood and bamboo are suggested.	
Food Safe		1. Safe plastics include PE, PP, ABS, that can be used to make the handle. 2. Other common materials include ceramics, bamboo, and wood. 3. Aluminum alloys and zinc alloys are food safe to make the squeezing part.		
Aesthetics	Color	1. The food contact part should be the color of the material. 2. Squeezing tools are less dangerous to use compared with cutting tools, but still needs to be careful to use. For the handle part, adding black to the color (which is called shade). When the range is from 70% to 80%, people can feel that they can control or dominated the squeezing tool. 3. For other parts, adding white to the color hue (which is called tint). When the tint range is from 60% to 70% (color hue is 100%), people can feel pleased.		
	Shape	1. The handle shape is suggested to made into straight and cylindrical to have the greatest power.		
Psycho-pleasure	Usability (Efficiency/Effectiveness)	Handle Texture	1. The handle surface should have a good roughness to hold easily and safely. 2. Suggest using TPU, EVA, silicone to overmold the handle surface or using patterns to increase a rough feeling. 3. Natural materials like wood and bamboo usually have a good roughness	
		Tool Hardness	1. Squeezing tools do not need the same hardness as the cutting and sharpening tools. 2. Aluminum alloys and zinc alloys are enough to squeeze food.	
		Tool Weight	1. Squeezing tools should have a light weight for long-time use. 2. Aluminum alloys and zinc alloys are recommended light-weight materials that also have good hardness. 3. Handle materials can select light plastics such as PE, PP, ABS, or natural materials like wood and bamboo.	
		Safe use (ergonomics)	1. Squeezing tools also need to be careful to use 2. The handle length should be larger than 121 mm; Handle diameter should be from 25 to 45 mm; Handle shape is suggested to be straight and cylindrical; If working, the distance between two power handles should be from 45 to 55 mm for the greatest power.	
		Main Function	1. The main function is squeezing food. 2. Squeezing tools do not need the same hardness as the cutting and sharpening tools. 3. Aluminum alloys and zinc alloys are enough to squeeze food.	
Ideo-pleasure	Value/Personality	Confidence (confident, assurance, secure, trust)	1. People are usually careful to use squeezing tools. Designers should let users feel confident when using the tool. 2. The squeezing tools should not hurt users themselves. Ergonomics for the handle should follow the rules: Handle length is larger than 121 mm; Handle diameter is from 25 to 45mm; Handle shape is preferred to be straight and cylindrical to have the greatest power; Distance between two handles when working should be from 45 to 55 mm. 3. The tools need to be easy to work. Aluminum alloys and zinc alloys which have both light weight and good hardness are highly recommended. Other light materials include PE, PP, ABS, wood, ceramics, and bamboo. 4. Safe plastics that include PE, PP, ABS can be used to make the handle; Other common materials include ceramics, bamboo, wood are recommended to make the handle; Suggest using aluminum alloys and zinc alloys to make the squeezing part. 5. Suggest using TPU, EVA, silicone to overmold the handle surface; Suggest using patterns that are made of repeated and dense lines to increase a rough feeling of the surface.	
		Joy (happy, cheerful)	Compared with cutting tools, squeezing tools are not very dangerous to use and can be designed to be fun. Designers can add white to the color hue to make a color tint. When the range is from 60% to 70% (color hue is 100%), the color tint can let people feel pleased.	
		Satisfaction (gratified, pleased, contentment, glad, fulfilled)	1. Materials for squeezing tools should work easily: Aluminum alloys and zinc alloys are recommended to be used to make the squeezing part. 2. The handle should be comfortable for using; Suggest using TPU, EVA, silicone to overmold the handle surface; Suggest using patterns that are made of repeated and dense lines to increase a rough feeling of the surface. 3. The handle size should fit human ergonomics: Handle length is larger than 121 mm; Handle diameter is from 25 to 45mm; Handle shape is preferred to be straight and cylindrical to have the greatest power; Distance between two handles when working should be from 45 to 55 mm. 4. The tools should have a light weight for long-time use. Light materials are recommended which include aluminum alloys, zinc alloys, PE, PP, ABS, wood, and bamboo.	
Socio-pleasure	Relationship/With Others	Amusement (playful, funny)	Squeezing tools can be designed to be playful and funny. For example, designers can choose unique style like the as the basis for the squeezing tool. Making the style of the squeezing tool interesting will lead to other family joining in the kitchen to work with the users. Hence, the relationship between them can be increased.	

Figure 4.2, Design recommendation checklist for squeezing tools

Figure 4.2 is the design recommendation checklist for squeezing tools. Designers

should follow the rules or recommendations in it to design pleasurable squeezing tools.

Physio-pleasure: Ergonomics

In order to have good physio-pleasure, squeezing tools should have good ergonomics. From research in Chapter Three, ergonomics for squeezing tools mainly focus on the handle. Rules for handle design should be followed as below: the handle length should be larger than 121 mm; the handle diameter should be from 25 to 45 mm; straight and cylindrical shape is preferred for the greatest power. Since most squeezing tools have two power handles, designers should ensure that the distance between two handles when working is from 45 to 55 mm.

Physio-pleasure: Materials

Physio-pleasure requires that the materials for squeezing tools should pay attention to hardness, lightness, and food safe.

- Compared with cutting tools, squeezing tools are often used to squeeze fruit into juice or vegetables into small pieces. Materials for squeezing tools do not need to be very hard. Based on research in Chapter Three, aluminum alloys and zinc alloys are hard enough to squeeze food. They are highly suggested to make the squeezing part of the tool.
- The materials for squeezing tools should have a suitable weight for long-time holding. Light metal materials like aluminum and zinc alloys are recommended to make the tool. Light plastics that include PE, PP, ABS can be used to make the handle. Wood and bamboo are natural light materials that can be used to

make the handle.

- All materials for making the tool should be food safe. Based on research in Chapter Three. Food safe materials for squeezing tools involve plastics, natural materials, and metals. For squeezing tools, safe plastics that include PE, PP, ABS can be used to make the tool handle; other materials like wood, bamboo, ceramics can be used to make the handle; aluminum alloys and zinc alloys to make the squeezing part.

Physio-pleasure: Aesthetics

Physio-pleasure requires that the squeezing tools should have good aesthetics. Rules for aesthetics mainly focus on the color and shape. Based on research in Chapter Three, the food contact part of the kitchen tool should be the color of materials. Hence, the color of the squeezing part of the squeezing tool should be the color of its material (usually the metal color). Squeezing tools are less dangerous to use compared with cutting tools, but still needs care in use. For the handle part, add black to the color (which is called shade). When the range is from 70% to 80%, people can feel that they can control or dominated the squeezing tool. For other parts, add white to the color hue (which is called tint). When the tint range is from 60% to 70% (color hue is 100%), people can feel pleased. Besides this, the handle shape is suggested to be made straight and cylindrical to have the greatest power.

Psycho-pleasure: Usability (Efficiency/Effectiveness)

From research in Chapter Two, psycho-pleasure always comes from good usability. It requires that the tool should have both good efficiency and effectiveness. For

squeezing tools, handle texture, tool hardness, tool weight, main function, and safe use will affect usability.

- The handle surface should have a good roughness to hold easily and safely. TPU, EVA, silicone should be used to overmold the handle surface or patterns to increase a rough feeling. Natural materials like wood and bamboo usually have a good roughness.
- Squeezing tools do not need the same hardness as the cutting and sharpening tools. Aluminum alloys and zinc alloys are recommended to make the squeezing part because they are hard enough to squeeze food like fruit and vegetables.
- Squeezing tools should have a light weight for long-time use. Aluminum alloys and zinc alloys are recommended light-weight materials that also have good hardness. Handle materials can be of light plastics such as PE, PP, ABS, or natural materials like wood and bamboo.
- Squeezing tools also need care in use. The handle length should be larger than 121 mm; Handle diameter should be from 25 to 45 mm; Handle shape is suggested to be straight and cylindrical; If working, the distance between two power handles should be from 45 to 55 mm for the greatest power.
- The main function is squeezing food. Squeezing tools do not need the same hardness as the cutting and sharpening tools. Aluminum alloys and zinc alloys are enough to squeeze food.

Ideo-pleasure: Value/Personality

From research in Chapter Two, ideo-pleasure is usually caused by personal values or personality. According to a study of 25 positive emotions in Chapter Two and case studies in Chapter Three, confidence, joy and satisfaction are the three main values for squeezing tools that can create ideo-pleasure.

- Confidence involves the confident feeling, assurance, secure, and trust. To create confidence for users, rules should be followed as below:
 1. The squeezing tools should not hurt users themselves. Ergonomics for the handle should follow the rules: handle length is larger than 121 mm; handle diameter is from 25 to 45mm; handle shape is preferred to be straight and cylindrical to have the greatest power; distance between two handles when working should be from 45 to 55 mm.
 2. Tools should be food safe to use. Hence, food safe plastics that include PE, PP, ABS can be used to make the handle. Other common materials like ceramics, bamboo, and wood are often used to make the handle. Aluminum alloys and zinc alloys are suggested to make the squeezing part.
 3. The tools need to be easy to work. Aluminum alloys and zinc alloys are light and hard enough to make the squeezing part. Other light materials include PE, PP, ABS, wood, ceramics, and bamboo
 4. TPU, EVA, and silicone are suggested to overmold the handle surface; so are patterns that are made of repeated and dense lines to increase a rough feeling of the surface.

- Joy is a happy or cheerful feeling. Compared with cutting tools, squeezing tools are not very dangerous to use and can be designed to be fun. Based on research in Chapter Three, designers can add white to the color hue to make a color tint. When the range is from 60% to 70% (color hue is 100%), the color tint can let people feel pleased.
- Satisfaction (gratified, pleased, contentment, glad, fulfilled) requires that designers should follow the rules as below:
 1. Materials for squeezing tools should work easily: Aluminum alloys and zinc alloys are recommended to be used to make the squeezing part.
 2. The handle should be comfortable for using: TPU, EVA, silicone to overmold the handle surface; patterns that are made of repeated and dense lines to increase a rough feeling of the surface.
 3. The handle size should fit human ergonomics: Handle length should be larger than 121 mm; Handle diameter is from 25 to 45mm; Handle shape is preferred to be straight and cylindrical to have the greatest power; Distance between two handles when working should be from 45 to 55 mm.
 4. The tools should have a light weight for long-time use. Light materials are recommended, which include aluminum alloys, zinc alloys, PE, PP, ABS, wood, and bamboo.

Socio-pleasure: Relationship/With Others

Squeezing tools can be designed to be playful and fun. For example, designers can choose unique style like the eggplant as the basis for the squeezing tool. Making the

style of the squeezing tool interesting will lead to other family joining in the kitchen to work with the users. Hence, the relationship between them can be increased.

4.4 Design recommendation checklist for mixing tools

Design Recommendation Checklist for Mixing Tools

Four Pleasures	Design Considerations	Design Factors	Design Rules/Recommendation	Y/N/NA
Physio-pleasure	Ergonomics	Handle Length	Handle length: > 121 mm	
		Handle Diameter	Handle diameter: 25~45 mm	
		Handle Shape	Straight and cylindrical shape	
	Materials	Lightness	1. Mixing tools need to be held by hand for a long time to mix food. The material weight should be light. 2. PE, PP, and ABS are suggested light plastics that can be used to make the tool. 3. Wood, bamboo are two natural materials with light weight to be used to make the mixing tool. 4. Metals usually have a heavy weight and they are not recommended to make the mixing tool.	
		Temperature	1. For mixing tools, the materials should focus on the working temperature. 2. If the working temperature is high, for example, the spatula that is used to mix food in hot soup, in this case the material should have a good heat resistance. PE, PP are common suitable plastic to make the tool. 3. If the working temperature is common, such as the room temperature at around 23 °C, PE, PP, and ABS are suitable plastics. 4. Natural materials like wood and bamboo have better heat resistance and they can be used to make the tool for both high and common temperature.	
		Food Safe	1. Safe plastics include PE, PP, ABS, that can be used to make the tool. 2. Other common materials include ceramics, bamboo, and wood.	
Aesthetics	Color	1. The mixing part should be the color of the material 2. Adding white to the color hue (which is called tint). When the tint range is from 60% to 70% (color hue is 100%), people can feel pleased.		
	Shape	1. The handle shape is suggested to be straight and cylindrical. 2. The mixing part does not have detailed rules. It can be any style only if the tool can mix food.		
Psycho-pleasure	Usability (Efficiency/Effectiveness)	Handle Texture	1. The handle surface should have a good roughness to hold easily and safely. 2. Suggest using TPU, EVA, silicone to overmold the handle surface or using patterns to increase a rough feeling. 3. Natural materials like wood and bamboo usually have a good roughness	
		Material Heat Resistance	Considering the working temperature of mixing tools, designers should follow the rules: When the mixing tool is used at a high temperature such as mixing food in hot soup, PE and PP are suitable plastics; ABS is suitable when the tool is only used at room temperature at around 23 °C.	
		Tool Weight	1. Mixing tools are recommended to be light for easy mixing food. 2. Light materials such as PE, PP, ABS, wood, bamboo are suggested to make the tool.	
		Safe use (ergonomics)	Mixing tools are usually safe to use. The handle length is suggested to be larger than 121 mm; Handle diameter is from 25 to 45 mm; Cylindrical and straight handle is preferred.	
		Main Function	1. The main function is mixing food. 2. Food safe and light materials such as PE, PP, ABS, wood, bamboo are recommended.	
Ideo-pleasure	Value/Personality	Confidence (confident, assurance, secure, trust)	1. Food safe materials like PE, PP, ABS, wood, and bamboo are common materials to make mixing tools. These materials have light weight and can let people use the mixing tools easily. 2. To make sure the safe use, the handle length is suggested to be larger than 121 mm; handle diameter is from 25 to 45 mm; cylindrical and straight handle is preferred. 3. To make sure the safe use, when the working temperature is high, ABS can not be selected as the tool materials.	
		Satisfaction (gratified, pleased, contentment, glad, fulfilled)	1. The handle should be comfortable for using: Suggest using TPU, EVA, silicone to overmold the handle surface; Suggest using patterns that are made of repeated and dense lines to increase a rough feeling of the surface. 2. The handle size should fit human ergonomics: Handle length is larger than 121 mm; Handle diameter is from 25 to 45 mm; Handle shape is preferred to be straight and cylindrical to have the greatest power; 3. The tools should have a light weight for long-time use. Light materials are recommended which include aluminum alloys, zinc alloys, PE, PP, ABS, wood, and bamboo.	
Socio-pleasure	Relationship/With Others	Amusement (playful, funny) Joy (happy, good, enjoyment)	Mixing tools are safer to use compared with other two kinds of tools. Mixing tools can be designed to be funny. 1. For example, cartoon characters can be used to add patterns on the mixing tools. Users will feel interesting when they see the characters 2. The style of related food can be used as the basis for the tool. For example, styles like eggplant, corn, and banana are always to be used as the style of the tool handle.	
		Relaxation (at peace, comfortable, calm)	Mixing food can be a relaxation. People can chat when they mix food. Designers need to create a communication for the mixing tool. 1. Good product quality always create communication between people. Designers should follow the material selection rules and ergonomics rules to ensure the tool quality. 2. Cool colors always calm down people and they can start a communication. Designers can use cool colors as the main color of the tool. For example, blue and its related colors can calm down people; blue and its related colors always create a natural environment.	

Figure 4.3, Design recommendation checklist for mixing tools

Figure 4.3 is the design recommendation checklist for mixing tools. Designers

should follow the rules or recommendations to design pleasurable mixing tools.

Physio-pleasure: Ergonomics

In order to have good physio-pleasure, mixing tools should have good ergonomics. From research in Chapter Three, ergonomics for squeezing tools mainly focus on the handle. Rules for handle design should be followed as below: the handle length should be larger than 121 mm; the handle diameter should be from 25 to 45 mm; straight and cylindrical shape is preferred for the greatest power.

Physio-pleasure: Materials

Physio-pleasure requires that the materials for mixing tools should pay attention to lightness, temperature, and food safety.

- Mixing tools need to be hold by hand for a long time to mix food. The material weight should be light. PE, PP, and ABS are suggested light plastics that can be used to make the tool. Wood, bamboo are two natural materials with light weight that can be used to make the mixing tool. Metals usually have a heavy weight and they are not recommended to make the mixing tool.
- For mixing tools, the materials should focus on the working temperature. If the working temperature is high, for example, the spatula that is used to mix food in hot soup, in this case the material should have a good heat resistance. PE, PP are common suitable plastic to make the tool. If the working temperature is common, such as the room temperature at around 23 °C, PE, PP, and ABS are suitable plastics. Natural materials like wood and bamboo have better heat resistance and they can be used to make the tool for both high and common

temperature.

- All materials for making the tool should be food safe. Based on research in Chapter Three, food safe plastics include PE, PP, ABS. Other common materials include ceramics, bamboo, and wood.

Physio-pleasure: Aesthetics

Physio-pleasure requires that the mixing tools should have good aesthetics. Rules for aesthetics mainly focus on the color and shape. Based on research in Chapter Three, the food contact part of the kitchen tool should be the color of materials. Hence, the color of the mixing part of the mixing tool should be the color of its material.

Mixing tools are the safest to use compared with other tools. Based on research in Chapter Three, designers can add white to the color hue (which is called tint). When the tint range is from 60% to 70% (color hue is 100%), people can feel pleased.

Besides this, the handle shape is suggested to made straight and cylindrical to have the greatest power. The mixing part does not have detailed rules. It can be any style as long as the tool can mix food.

Psycho-pleasure: Usability (Efficiency/Effectiveness)

From research in Chapter Two, psycho-pleasure always comes from good usability. It requires that the tool should have both good efficiency and effectiveness. For mixing tools, handle texture, material heat resistance, tool weight, main function, and safe use will affect usability.

- The handle surface should have a good roughness to hold easily and safely. TPU, EVA, silicone are suggested to overmold the handle surface or using

patterns to increase a rough feeling. Natural materials like wood and bamboo usually have a good roughness.

- Considering the working temperature of mixing tools, designers should follow these rules: When the mixing tool is used at a high temperature such as mixing food in hot soup, PE and PP are suitable plastics; ABS is suitable when the tool is only used at room temperature at around 23 °C.
- Mixing tools are recommended to be light for easy mixing of food. Light materials such as PE, PP, ABS, wood, bamboo are suggested to make the tool.
- Mixing tools are usually safe to use. The handle length is suggested to be larger than 121 mm; Handle diameter is from 25 to 45 mm; Cylindrical and straight handle is preferred.
- The main function is mixing food. Food safe and light materials such as PE, PP, ABS, wood, bamboo are recommended.

Ideo-pleasure: Value/Personality

From research in Chapter Two, ideo-pleasure is usually caused by personal values or personality. According to study of 25 positive emotions in Chapter Two and case studies in Chapter Three, confidence and satisfaction are the two main values for mixing tools that can create ideo-pleasure.

- Confidence involves the confident feeling, assurance, secure, and trust. To create confidence for users, rules should be followed as below:
 1. Food safe materials like PE, PP, ABS, wood, and bamboo are common materials to make mixing tools. These materials have light weight and can let

people use the mixing tools easily.

2. To make sure of the safe use, the handle length is suggested to be larger than 121 mm; handle diameter is from 25 to 45 mm; cylindrical and straight handle is preferred.

3. To make sure of the safe use, when the working temperature is high, ABS should not be selected as the tool material.

- Satisfaction (gratified, pleased, contentment, glad, fulfilled) requires that designers should follow the rules as below:

1. Materials for squeezing tools should work easily: Aluminum alloys and zinc alloys are recommended to be used to make the mixing part.

2. The handle should be comfortable for using: TPU, EVA, silicone to overmold the handle surface; patterns that are made of repeated and dense lines to increase a rough feeling of the surface.

3. The handle size should fit human ergonomics: Handle length is larger than 121 mm; Handle diameter is from 25 to 45 mm; Handle shape is preferred to be straight and cylindrical to have the greatest power.

4. The tools should have a light weight for long-time use. Light materials are recommended which include aluminum alloys, zinc alloys, PE, PP, ABS, wood, and bamboo.

Socio-pleasure: Relationship/With Others

Based on research in Chapter Two and case studies in Chapter Three, amusement and relaxation are two elements that designers can check to make socio-pleasure for

the mixing tools

- Mixing tools are safer to use compared with other two kinds of tools. Mixing tools can be designed to be fun. For example, cartoon characters can be used to add patterns on the mixing tools. Users will feel interested when they see the characters. Styles of related food can be used as the basis for the tool. For example, styles like eggplant, corn, and banana can be used as the style of the tool handle.
- Mixing food can be a relaxation. People can chat when they mix food. Designers need to create a communication for the mixing tool. Good product quality always creates communication between people. Designers should follow the material selection rules and ergonomics rules to ensure the tool quality. Cool colors always calm down people and they can start a communication. Designers can use cool colors as the main color of the tool. For example, blue and its related colors can calm down people; blue and its related colors always create a natural environment.

4.5 Conclusion

The design recommendation checklists in Chapter Four can be applied to kitchen tool design. These checklists are specific about each design factor that can create related pleasure. The next chapter will design a related kitchen tool by using the checklist to explain how to use the design checklists for designing pleasurable kitchen tools.

Chapter Five

Application of Design Guidelines

5.1 Introduction

This chapter will show designers how to use the design checklist developed in Chapter Three by designing a pleasurable egg mixer.

5.2 Physio-pleasure design rules/recommendation

5.2.1 Handle ergonomics

According to the design checklist for mixing tools in Chapter Three, we can know that the handle length should be greater than 121 mm. The egg mixer belongs to the mixing tool; thus the handle length for the egg mixer should be larger than 121 mm. Based on the design recommendation, the handle diameter for the egg mixer should be from 25 to 45 mm. To ensure the greatest power, the handle part of the egg mixer is better to be straight and cylindrical.

In the concept of the egg mixer shown below (Figure 5.1), the total length of the egg mixer is around 25 cm. The handle part of the egg mixer is around 180 mm which fits the design rules (handle length is larger than 121 mm). The least diameter for the handle part is around 25 mm and the greatest diameter is around 38mm, which fits the recommendation for handle diameter (handle diameter is from 25 to 45 mm). And the shape of the handle part is straight and almost cylindrical.

- The length of the egg mixer is around 25 cm.
- The least diameter of the handle part is 25 mm and the largest is 38 mm.
- The handle shape is almost straight and cylindrical

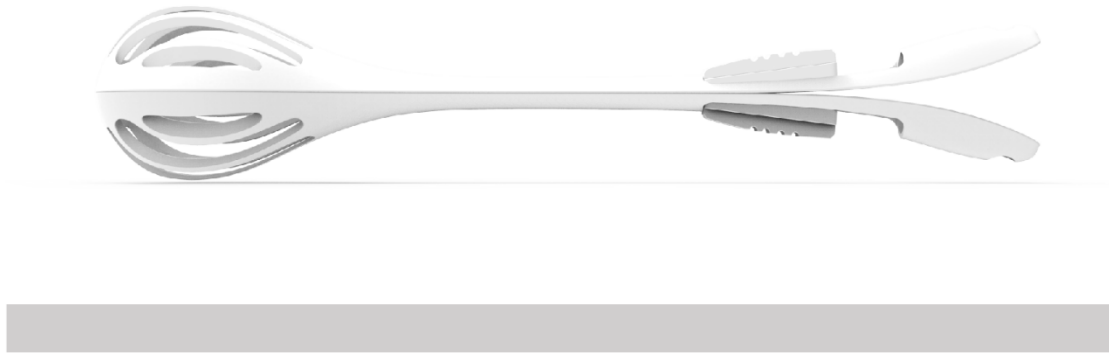


Figure 5.1, Ergonomics details of the egg mixer

5.2.2 Materials

The egg mixer belongs to the mixing tools. According to the design checklist for mixing tools, materials selected for the egg mixer should focus on lightness, temperature, and being food safe. Based on the design recommendation in Chapter Three, PP is considered as the food safe plastic that can be used to make the food contact part. Besides this, because people mix eggs at the room temperature which is around 23°C, PP is confirmed to work well at that temperature. The egg mixer needs users to hold it for a long time when they mix eggs. PP is also considered as the light material. Hence, the author will choose PP for the tool material.

5.2.3 Aesthetics

The egg mixer is usually safe to use. Based the design checklist in Chapter Three, the mixing part can be any style as long as it can mix food. As for the color selection, adding white to color hue (which is called tint) can make people feel pleased. And the

tint range is suggested to be from 60% to 70% (color hue is 100%).

The concept below shows the color selection and the shape style (Figure 5.2). To make a happy feeling for the egg mixer, the author will add white to the red hue. 70% red tint makes a happy feeling. In the RGB color space, the suggested color is composed of 100% red, 30.6% green and 30.6% blue, whereas in the CMYK color space, it is composed of 0% cyan, 69.4% magenta, 69.4% yellow, and 0% black. The color has a hue angle of 0 degrees, a saturation of 100% and a lightness of 65.3%. For the style of the egg mixer, the whole tool is made from the style of the rocket. The end bifurcation of the tool looks like the two wings of the rocket which means that users can mix eggs very quickly.

Egg Mixer: Aesthetics

- Color feeling: happiness
- Color RGB: 100% red, 30.6% green, and 30.6% blue
- Color CMYK: 0% cyan, 69.4% magenta, 69.4% yellow, and 0% black
- Shape: rocket style



Figure 5.2, Aesthetics details of the egg mixer

5.3 Psycho-pleasure

5.3.1 Usability (efficiency/effectiveness)

According to the design recommendations for mixing tools, good usability for the egg mixers comes from handle texture, material heat resistance, tool weight, safe use, and main function.

The concept below shows how the author follows the design rules in Chapter Three (Figure 5.3). First, to ensure the good texture of the handle part, the pattern which is made of repeated lines is added to the wing part of the egg mixer. The pattern on the wing can increase the roughness of the handle part to ensure safe use. Secondly, the author selects PP as the material for the egg mixer. PP is light and users can easily hold the tool for a long time. Thirdly, in the former step, since the author has already focused on the ergonomics, the handle is considered to be comfortable and safe to hold.

- Texture: add repeated lines to increase the roughness
- Material selection: PP
- Ergonomics: handle length is around 180 mm; handle diameter is from 25 to 38 mm; straight shape



Figure 5.3, Usability details of the egg mixer

5.4 Ideo-pleasure

5.4.1 Value/Personality

From the design recommendation checklist of mixing tools in Chapter Three, we know that the egg mixer can be made to give satisfaction and confidence to users. PP is considered as the food safe and light plastic that can work well when the temperature is around 23 °C. The handle part of the egg mixer is around 180 mm. The diameter range of the handle is from 25 mm to 38 mm. The handle of the egg mixer is

almost straight and cylindrical.

5.5 Socio-pleasure

5.5.1 Relationship/With others

Based on the recommendation in Chapter Three, the egg mixer provides amusement or relaxation for users. The author made the egg mixer look like a rocket. The rocket always means a fast speed. When users see the rocket-style egg mixer, they could have the feeling that they can mix egg very quickly; thus they can have more time to communicate with others. The rocket style could also create conversation for people who are curious about outer space.

The egg mixer uses 70% red tint color to be the main color of the tool. The color can make a romantic feeling that can create a chat between the couple.

- Shape: rocket style
- Color: 0% cyan, 69.4% magenta, 69.4% yellow, and 0% black; 100% red, 30.6% green, and 30.6% blue
- Create romantic feelings; create a chat for people who are curious about outer space



Figure 5.4, Relationship details of the egg mixer

5.6 Summary

Chapter Five has shown an example successfully following the design recommendation checklist for designing a mixing tool. The author applied these guidelines to the design of an egg mixer and presented it to many people around him. The design is highly appreciated and believed that it has all the mentioned pleasures (physio-; psycho-; socio-; and ideo-pleasure) in it. The feedback from the real-world users has demonstrated the effectiveness of these design guidelines generated from this thesis research.

Chapter Six

Conclusion and Suggestions for Future Research

The purpose of the thesis was to develop a set of design guidelines for designers to use when designing non-electric kitchen tools for more pleasurability. The generated guidelines provide a comprehensive approach to the design of non-electric kitchen tools that are aimed to provide great pleasures to the real-world end users. The application has shown that the design guidelines for mixing tools is effective. The guidelines for cutting and squeezing kitchen tools should be effective as well.

However, research in the thesis only focused on the non-electric kitchen tools. There are still many kitchen tools which use electric that need to be designed for more pleasurability. A suggestion for future research is that the author could study the design factors of electric kitchen tools to create design guidelines for both non-electric and electric kitchen tool.

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