

國立交通大學

應用藝術研究所

碩士論文

產品動態特質的社交呈現研究

Enrich the experience of interacting with digital technology –
Exploring the motion of product on social attributes



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摘要

我們相信，在現今通訊、電子技術、微晶片高度發展下，不僅只是消費性電子產品，甚至一般日常生活用品，都將擁有高度回應人們的能力與互動性，而設計師關心的議題，也將從外觀設計延伸向機構動作的設計。一個活潑跳動的電腦，可能讓使用者心情開朗，一個懂得微笑招攬客人，並懂得察言觀色販賣機，將會更加吸引人。而這些重要的元素，是來自於人們於社會的，並且確實能夠激勵人、鼓勵、安撫，或具有說服的能力，同時帶來人與產品之間更多豐富、有趣的互動。

因此本研究希望藉著了解人與人的溝通互動的特質，而將這些特質融入產品互動設計中，為產品注入社交元素，企圖縮短人與機器溝通的距離，本研究將以販賣機銷售員特質作為例子，企圖透過機構動作在互動中來表達社交意圖。第一階段試圖了解人類銷售員具有什麼樣不可或缺的特質，並將這些特質應用在產品設計中並製成模型。在第二階段中，透過實際與模型的互動與觀察紀錄、訪談，探討在透過社交特質呈現的產品上，人們與產品的互動經驗、評價與看法。同時，站在設計師的出發點，檢討以動作設計表達社交意圖為設計策略的新手段，其組成的方式與影響。根據研究結果指出，產品透過機構動作呈現社交意圖可以強烈的影響著人們的身理與心理，同時更能吸引人們並與人們建立更深厚的關係。

Abstract

Human-computer interaction is social and emotional even when interfaces are not designed with such interaction as a goal. Nowadays, the goal is much easier to be reached while the advance in technology makes it possible than ever before. While the computer technology is unceasingly upgraded and products are capable of doing things much more than finishing tasks, usability problems remain, and other problems have already been evoked. We believe that not only general electrical products but also everyday things will be capable of responding human socially sooner or later. For instance, a charming computer may cheer its user; an user friendly and considerable vending machine may be more attractive to people. These attributes are social and be capable of encouraging and pacifying people; meanwhile, it may also bring richness human-product interactions and is much more interesting.

In this study, by understanding the key attitudes of people interaction, we apply these attributes to the interaction design of our product, filled in affection and attempt to diminish the distance between human and product. We took vending machine as an example and a medium to deliver social intentions, and applied these attributes via embodying product with motion capability. Through out a prototype interaction experiment with test subjects, this study also examines the interaction effect between user factors and medium factors on feelings of social presence. On a designer's point of view, we also purpose comments for how to construct a social motion cue as a new leverage for design strategy. Finally, we conclude that social motion attribute can allure people strongly especially psychologically.

Keywords: Human computer interaction, computers as social actors, wizard of Oz, product design.

誌謝

在研究所短短的兩個年頭中，所有的收穫、挫折與對設計想法，都在不斷的接受挑戰與重組，出乎意料外的不論在學識或是對人生的態度上皆有著很大的轉折。很感謝交大應藝所的教授給予我們這麼好的學習環境，更感謝我的指導教授，同時擁有哲學家風骨與設計佈道者角色的鄧怡莘老師，老師給予我的空間，以及思想上的辨證是最難得且珍貴的。這篇論文的完成的同時，也代表著學術生涯的第一個段落，更像是一個起點，集合著眾人的愛心以及支持而誕生。感謝在過程中，應藝所同學，學長姐、外系的學弟妹以及接受採訪的專家給予的協助，還有辛苦模型操作員招財跟育新，和慈祥的莊明振教授、林銘煌教授，賜與我寶貴的知識、建議與想法，乃至於無數位將寶貴知識透過論文分享予我的國外研究學者們。最後，要特別感謝論文誕生前夕，撥控給予我協助的英文老師惠先，讓這本論文文辭更為通暢精準，以及隨時在背後鼓勵、支持我的家人，雖然只負責拍手，但已經足夠。

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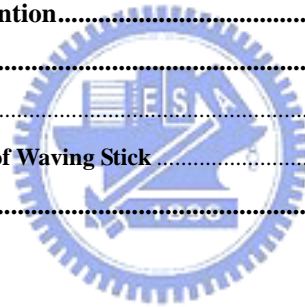


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Chapter 1

INTRODUCTION

1.1 Background & motivation

Over the past decades, the design community has made a lot of effort to create user-friendly products. However, nowadays, rapidly growth of powerful products carrying abundant functions not only distant people interactions but also made further away from its goal – to avoid hard-to-use products and confusing consumers. In order to diminish this gradually increasing distance between human and product, many experts try other ways to achieve the goal besides usability consideration, in hope that people would appreciate and be interested in the products more.

Here is a typical scenario: One day, we walk into McDonalds, after standing in front of the counter, staring around menu on the wall for a while, we finally order a pack of French fries. The clerk takes our money and takes out the French fries, finally, he drops it on the ground at our feet, to let us bend down and pick it up...

We may hardly see this embarrass situation happened actually, but it does truly happen when we buy something from a vending machine, offense has been made. Somehow people have come to accept a standard of respect in human-machine interaction which is very different from that in human-human interaction (Overbeeke et al., 1999). Though it seems that we won't expect such respect form a machine, while having no trouble in use, what if it can be improved? What if it can treat us in a much "respectful manner"?

When a product is aesthetically pleasing and plays to our ideas about ourselves and society, we experience it positively (Donald Norman, 2004).

It is wildly known that people don't just use a product, mostly they become emotionally involved with it. So products come in many kinds of new features beyond functions, and products with pleasing look did enrich

our experiences. Besides using fancy or pleasing appearance to allure the users, some designers hope their product can have certain human's charming attributes. Take the use of "Anthropomorphism" in design of Volkswagen's new beetle (figure 1.1), which has a warm and charming smile on its hood, shows a much friendly temptation, and distinguishes from others.

Apple presented *Imac* with a neck, a head and a hemisphere body in the early 2000s. They declared that personal computer, which was no longer a powerful machine, had become a decent companion in our work or life. On the other hand, *Apple* set a cute look, vivid characteristic and a charming smile to its CD-ROM tray door for *Imac* to be closer and more intimate with people. We could even see *Imac* acting and responding to a passenger through a shopping window as a naughty kid in its own TV commercial (figure 1.2). Having such interesting characteristic like human "personality" in that commercial can make a very impressive image to consumers. In addition, what if product can really respond people as they have personality? and not only by differing from a glance at charming appearances, but also affecting people's emotion or mood via aggressive and active interaction.



Figure 1.1 Volkswagen New Beetle,
<http://www.vw.com>



Figure 1.2 IMac TV commercial,
<http://www.apple.com>

According to a highly development in computer science, both in hardware and software nowadays, the advance in technology enables computers to recognize people, express themselves and respond to people's emotion and status. Products do have chances to participate in context of people's living positively and are capable of responding human in the near future which may be impossible yesterday. Further more, some robots have already integrated into our daily lives in the present times. These interaction topics between human and products will be much more than task-oriented, more aggressive and more emotional beyond form,

taken to be social involvement. The design issue will no longer be concentrated only on concerns of usability and ergonomics, but may have fun.

Since these technologies grow so fast, and even now a gadget can have several computing abilities within, how they should behave and interact properly with people still remain much unknown and become an emerging issue. Moreover, what kind of system should be made, which context should we consider, where they should be placed and what can they do for us are also worth discussing.

Today, designers should create experience, rather than a product. It should provide users to use their senses to enjoy the whole context experience, and whole activity is for user to immerse into the use for a period and get pleasure in the experience. Some may call it an “Aesthetics of Interaction”. In figure 1.3, we can see that B&O has designed their media player with a special manifestation of the opening door, and it may be interpreted as a smile or other meanings for inviting people to use it

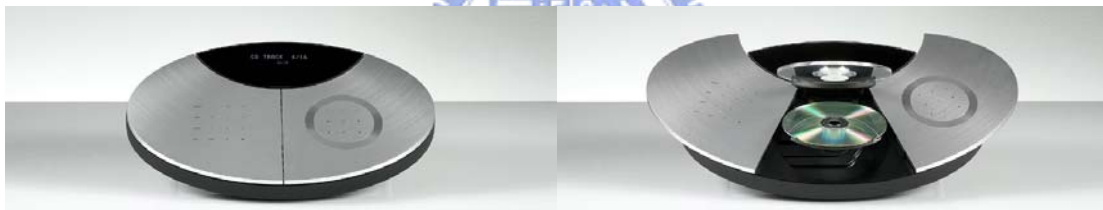


Figure 1.3 BeoCenter 2, B&O An example for product motion delivering psychological meaning,
<http://www.bang-olufsen.com/web2/>

Fogg, a director of persuasive technology lab at Stanford University, points out that designers can change what people think and do through interactive design presented by computer system or computing equipment (Fogg, 2002). The application of design so-called “computers as social actors” is one of the primary design strategies. From a user friendly design point of view, interfaces possessing social attributes may alleviate the anxiety of people while using a computer. By providing intimate and organic feeling, social presence on interface is capable of influencing and encouraging people. In our study, we also approach the problems on product with the aspect as a goal.

1.2 Objectives

Design approaches form as the total expression of the product — not just how something appears, but the whole experience of the interacting with the product. Form includes a product's physical manifestation, materials, and behavioral qualities (DiSalvo, et. al., 2003). Since industrial designers use form to balance the needs of people, the capabilities of technology, and the context of use into a single product, little attention has been given to the raising social interaction aspect in the field of product design. According to present researches, computers consist of social attributes can bring a positive influence or be persuasive to people who interact with them, but most of studies are related to graphic or virtual condition. When it comes to product design field, interface becomes tangible.

This study's objectives are to discuss the possibility of product delivering human attributes and demonstrate how mechanical motion could convey social intentions, acting socially, since communication between people occurs mostly through non-verbal channels (such as eye contact, facial expression, body language), and how people deal with and respond to them. Moreover, finding appropriate materials that would be useful for design is our purpose as well.

In brief, we take social motion attributes as new element into our product design beside the usual material and form. It will act as a new seductive attributes to diminish the distance from product to people.

1.3 Research Limitation

Various types of interaction design capable of delivering social presence have been outlined as a framework including forms, motion, languages, social dynamics, and control (Tung, 2004). Through appearance, physical manifestation or behavior, products may make themselves more human-like. This study is intended to explore the design of social interaction for digital products in their “behavior”, especially how product could express social intensions by their motions of mechanical components. Meanwhile, this study mainly focuses on digital product, possessing possible sensors and abstract mechanical motions. Manifestations that robots behave socially and anthropomorphic form will not be discussed, especially when “motion” is our primary concern. This study take vending machine as a social medium, which is familiar to people.

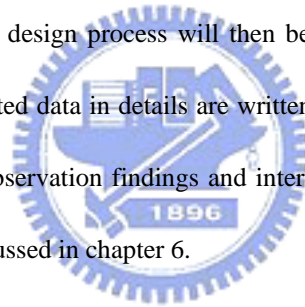
However, it is hard to find a product that is off-the-shelf, providing a ready-made social attribute to interact with people for this study; therefore, in the first step, we have to make a prototype for our experiment and then go through the assessment with social issue.

“Motions”, what we mention here for product, are as body language when human communicate with each other, including gesture, posture, facial expression and other non-verbal communications. In our design, they are as tangible interfaces to express and interact with people. The reason that we chose vending machine is that it has a much bigger size which implies it may have several mechanical components. Its function, selling things to people, is easy to compare with a social role by means of many social communication patterns.

1.4 Research Structure

The structure of this research include: (1.) Finding problems in the circumstance today, and explaining background and motivation with relevant references and examples, and proposing research limitation that depends on resource we could handle. (2.) Scheming out surveys for gathering information to build prototype. (3.) Proceeding experiment with prototype to collect observation data. (4.) Analyzing the aggregated data and arrange findings. (5.) Propose conclusion and comment.

The content covers into the following chapters: In Chapter 1, motivation, research background, objective, scope and limitation are introduced. In Chapter 2, review of relevant studies, human-computer interaction in social aspects, tangible interface and social robot are discussed. Before the primary experiment, a new social vending machine was designed first. Two survey approaches from different perspectives toward clerk were used in gathering design ingredients. The design process will then be introduced in chapter 3. Afterward, how we conducted the experiment and collected data in details are written in chapter 4. Chapter 5 includes the outcome of experiment from analyzing our observation findings and interviews. Finally, conclusions of this studies and achievements we have made are discussed in chapter 6.



Chapter 2

LITERARY REVIEWS

In the past, interface works have primarily be viewed by their designer as the development of tools to facilitate the performance of information tasks. However, many experimental studies in the past decade have shown that instead respond to interactive software as a mere tool, people bear a wide range of social rules and learned behaviors that guide their interactions with, and attitudes toward, interactive system. It is similar that interface can induce a wide range of emotions and social responses in users, and are assigned a wide range of emotions and social presences by users naturally. These factors may become benefit as tricks in interaction design to facilitate and improve how people use products.

In this chapter, several different aspects toward interaction have been reviewed, which beyond usability and allow users having different or even creating their own experience via interacting with computational devices, including several studies related to social or emotional interaction.

2.1 Distribution of Studies

This study mainly focuses on providing social attributes via motion as a design strategy. Computer as social actors in human-computer interaction is the genesis of this domain. While we move the concentration on the interaction with digital product as a product designer's perspective, physical interfaces become our concern. In depiction, our study may locate as the following figure 2.1:

Human-Computer Interaction

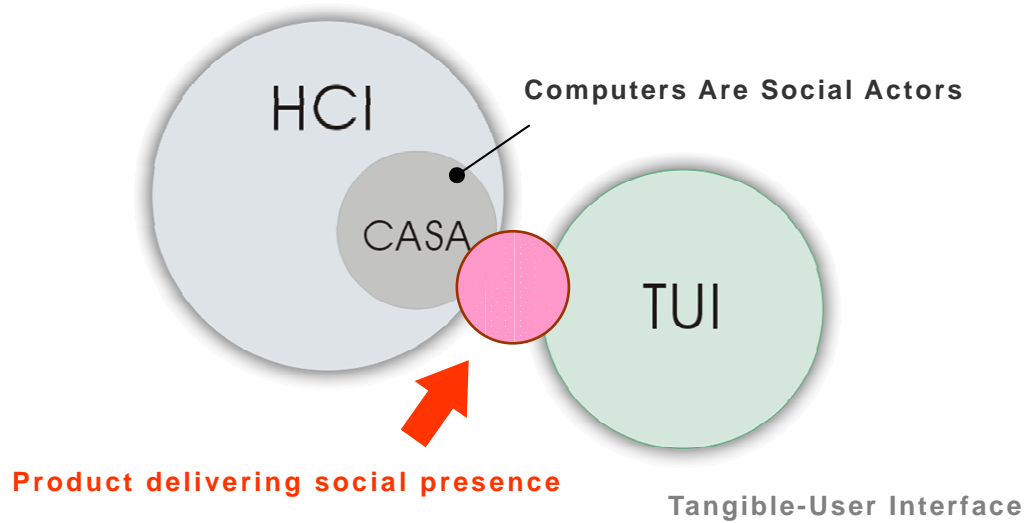



Figure 2.1 Research Scope

2.2 Social-Emotional Interactions



Social and emotional responses occur even when designers do not elicit these responses, and they occur when users know that they should not and believe that they do not exhibit these responses. Furthermore, users present social and emotional responses without explicit training, and regardless of their level of computer experience (Reeves & Nass, 1996). Nowadays, computational chips are implanted almost everywhere, not only in working place but also in our living place, making this phenomenon inevitable and the concern with its rapid growth has also raised. Although traditional human-computer interaction (HCI) disciplines are necessary to properly develop computer-human system, it is believed that social and emotional reactions that users have are important keys to building more useful, successful, and productive systems. These factors will enormously enrich both the conventional interfaces we are all familiar with and new systems we have not even yet considered. We will begin by discussing the following four researcher's address on social-emotional interaction topics from different fields and perspectives:

Nass (1996) introduced their experimental findings which illuminated the theory of social-emotional

interaction with computer interfaces after conducted over 50 studies on the social psychological interfaces. Evidence that individual's interactions with computers are fundamentally social were addressed, in other words, computers are as social actors to people. This claim inspired us and will be discussed in details later in this chapter.

In contrast, Picard (1997) who works in MIT media lab believes that interfaces do not necessarily become more human-like instead she argues that they should be designed with explicit regard for human emotion. One way to study and minimize user frustration is to give the system the ability to sense and infer users' frustration and to respond with skills of emotional intelligence when the computer has caused a problem. Her lab has created new technologies that enable computers to sense, understand, and respond to human signs of confusion, frustration, anger, interest, and joy, among other emotions.

Warwick (2000) and his research team have advanced the possibilities for emotional sensing and social communication to a deeper level — literally — by designing and building implants that sense personal information and communicate it to others. This is also well known as “cyborg”.

Breazeal (2002), designer and developer of the captivating Kismet robot, presented an interface capable of taking on a human-like or creature-like physical form. Her creation also highlights the importance of expressing and responding to social and emotional cues in human-robot interaction. This technology illustrates the potential for interfaces to adapt for better pleasing people, without requiring any special skills on the part of the user.

These researches show different aspects on social and emotional concern due to the arising computational progress, while some base on providing human computing implants for assistance or enhance of sense, and some respect on emotional feed forward and feedback expressed by machines. Part of them may focus on the psychological affection induced by machines' expressing emotion or behaving socially. As product designers always want to know how to provide help and attract their user both physically and psychologically. We think of presenting social intention as a new leverage to communicate and interact with our users instead of putting icons and words of cautions.

2.3 Computers as Social Actors

Reeves and Nass gathered their research findings and published a book called: "*The media equation*" (Reeves & Nass, 1996). In this book, they point out that people respond to computers as they were living beings, and these responses to certain types of computing systems are fundamentally social; human beings are hardwired to respond to cues in the environment, especially to things that seem alive in some way. By providing social cues in human-computer interface, users can sense the social intention and take the computer as a social actor, and this interaction comes into being human-human-like interactive relationship. Thus, Nass purposed the aspect of "computers as social actors" (CASA) to characterize this phenomenon.

Following the psychoanalyst Langer's explanation of mindlessness (Langer, 1992), Nass and Moon conducted a series of experimental studies to demonstrate the "Mindless response to computers", a perspective for the reason that why people act socially with computers (Nass & Moon, 2000). The studies have argued and ruled out the possibilities of "anthropomorphism", "orientation to the programmer" and "characterizing computers" by evidences from experiments. Instead, they point out that "*individuals mindlessly apply social rules and expectations to computers*". In details, it includes three reasons: **(1)** Individuals overuse human social categories, applying gender stereotypes to computers and ethnically identifying with computer agents. **(2)** People exhibit overlearned social behaviors such as politeness and reciprocity toward computers. **(3)** People tend to apply premature cognitive commitments due to their former experiences and impressions.

2.3.1 Social presence

"Presence" was first used as "telepresence" by Minsky (1980) to explain the sense of presence from users providing in communication technology. It has become a term for discussing sense presented and conveyed by mediums. Lombard and Ditton (Lombard and Ditton, 1997) defined presence as "the perceptual illusion of nonmediation". The term "perceptual" means that presence "... involves continuous (real time) responses of the human sensory, cognitive, and affective processing systems to objects and entities in a person's environment". By "illusion of nonmediation," they refer to a phenomenon in which "... a person fails to

perceive or acknowledge the existence of a medium in his or her communication environment and responds as he or she would if the medium were not there”.

Physical presence and social presence are two dimensions of presence. Physical presence, the extent to which people feel that they are in a virtual world, is exhibited from medium, such as the presentation form virtual reality. Social presence, the sense that other intelligent beings coexist and interact with us, reflects the social connection or approaching. In advance, Lombard concluded presence in six types: (1) presence as social richness, (2) presence as realism, (3) presence as transportation, (4) presence as immersion, (5) presence as social actors within medium, (6) presence as medium as social actors. “Presence as social actors within medium”, means that actors or virtual actors in medium induce audiences or users to act as unconsciously socially interaction to them. In “presence as medium as social actors”, it means audiences or users exhibit human –human interaction pattern via application of language, real-time interaction and social norms. This type of researches, focusing on the presenting social sense in interaction between people and product or people and system, mainly addressed in “computer are social actors” by Nass. These studies discuss about the human-computer interface in computing medium exhibiting verbal feedback, rich interaction and social role. After perceiving social cues, users tempt to be induced naturally social feedback. Our study here is to discuss about the social presence, exhibiting by computing product, which is as a medium, throughout interactive experience linking with social aspect.

2.3.2 Computers as Persuasive Social Actors

In the book “*Persuasive Technology*” (Fogg, 2002), Fogg has proposed five primary types of social cues being able to cause people to make inferences about social presence in a computing product: Physical, Psychological, Language, Social dynamics, Social roles (table 2.1). These social cues may provide positive feedback and emotional support.

We take these five cues as basic guide line for us to observe what social attribute of a clerk may attract people, and base on this, it is much easier to reconstruct what kind of effect that social motion cues may induce.

Table 2.1 Primary Types of Social Cues, purposed from Persuasive Technology. (Fogg, 2002)

Cue	Example
Physical	Face, eyes, body, movement
Psychological	Preferences, humor, personality, feelings, empathy, “I’m sorry”
Language	Interactive language use, spoken language, language recognition
Social dynamics	Turn taking, cooperation, praise for good work, answering questions, reciprocity
Social roles	Doctor, teammate, opponent, teacher, pet, guide

2.3.3 Five Types of Social Cues

The fact that people respond socially to computational products has significant implications for persuasion. It shows the possibility for applying a host of persuasion dynamics that are collectively described as social influence – the influence type that arises from social situations. “*When perceived as social actors, computer products can leverage these principles of social influence to motivate and persuade users*” (Fogg, 2002.)

(1) Persuasion through Physical Cues

One way a computing technology can convey social presence is through physical characteristics, such as eyes, mouth, movement, and other physical attributes. Furthermore, physical attractiveness

plays an important role; since a more attractive technology (interface or hardware) will have greater persuasive power than an unattractive technology.

(2) Persuasion through Psychological Cues

Psychological cues from a computing product can lead people to infer, often subconsciously, that a product has emotions, preferences, motivations, and personality, in short, the computer is a psychological. The psychological cues can be simple, such as text messages that convey empathy (“I’m sorry, but...”) or onscreen icons that portray emotion, such as the smiling face of the early Macintosh computer. Or cues can be more complex, such as those that convey personality. Such complex cues may become apparent only after the user interacts with technology for a period of time.

(3) Persuasion through Language

Computing products also can use written or spoken language (“You’ve got mail!”) to convey social presence and to persuade. Dialogue boxes are a common example of the persuasive use of language. One of the most powerful persuasive uses of language is to offer praise.



(4) Persuasion through Social Dynamics

Most cultures have set patterns for how people interact with each other- rituals for meeting people, taking turns, forming lines, and many others. These rituals are social dynamics – unwritten rules for interacting with others. Computing technology can also apply social dynamics to convey social presence and to persuade. Some social dynamics can show in dialogue or text.

(5) Persuasion through Adopting Social Roles

Applying powerful and influential social role can be persuasive, such as an authority. Consider the roles of “friend”, “entertainer” and “opponent”, each of which can cause people to change their attitudes or behavior and these will be other influence strategies that don’t leverage power or status but also can

be effective. For computers that play social roles to be effective in motivating or persuading, it is important to choose the role model carefully or it will be counterproductive. Knowing target audience is important for designers to incorporate social roles.

Although people respond socially to computer products that convey social cues, to be more effective in persuasion, designers must understand the appropriate use of those cues. In general, Dr. Fogg believes it is much more appropriate to enhance social cues in leisure, entertainment, and educational products (e.g., smart toys, video games, kids' learning applications). Users of such applications are more likely to indulge, accept, and perhaps even embrace an explicit cyber social actor— either embodied or not.

By applying social roles, people who work in sales, advertising, and other high-persuasion areas know the key attributes of persuasive, and they do what they can to be attractive. Therefore, our approach to the new vending machine which may attract people more as a result, will be finding a social role as a paradigm for our first step, which has to be taken as a survey before design activity.



2.3.4 Relevant CASA Studies

Besides proceeding in improvement of technology, researchers focus on retrieve the value of human-human interaction so that can be the insight in applying more social and more appropriate attributes appreciated by people.

In order to enable more natural and life-like human-robot interactions, Breazeal purposed a guide line for how the social nature of the robot is expressed was taken from social literature on human social interaction (Breazeal, 2003).

Applying social norm on HCI design is able to eliminate sources of frustration and provide emotional and empathetic support. For instance, Klein and his team's research results indicate that a designed HCI (Human-Computer Interaction) agent was able to support users in their ability to recover from negative emotional states, particularly frustration. The agent uses social-affective feedback strategies delivered to the user with text-only interaction (Klein, et. al., 1999).

Providing voice feedback on HCI can also induce social presence. Qvarfordt discusses about the influence from designed voice feedback to users' experience. Their research indicates that the more humanlike the spoken feedback is the more participants preferred the system to be human-like. (Qvarfordt, et. al., 2003)

Another related issue is the impact of autonomy on the social role of an intelligent robotic product. The degree and type of autonomy these products can exhibit will shape their interactions with people greatly. The interactions can range, for example, from: (1) People do all the work (e.g. interacting with a toy like Furby) (Furby, 1998) (2) People team with robotic products to accomplish tasks. (e.g., robots designed to help elders remain independent in their homes (Montemerlo et al, 2002). (3) Products providing simple social response to human interaction (e.g., Kismet, a socially aware research prototype) (Breazeal, 2003). (4) A fully reciprocally social robot. Researchers examined issues related to the design and development of social robots that act autonomously — that is, on behalf of humans without continuous input from humans. A forum for researchers in a variety of disciplines is needed to discuss issues related to the interactions between humans and social robots.

In point (3)'s situation, it is close to what human-social product interaction we want to deal with. But the response that we provide is social motion cues. In these different contact and relationship between human and robots, of course, would come out with various specific problems requiring more studies to deal with and raise a number of design challenges. In many kinds of robots, personal service robots have the highest expected growth rate. They assist people directly in domestic and institutional settings. Robots that work with people is defined as social robot - an autonomous or semi-autonomous robot that interacts and communicates with humans by following the behavioral norms expected by the people with whom the robot is intended to interact.

2.4 Products as Social Actors

Base on several researches purposing types of social presence induced by digital media by Nass, Marakas, Fogg and Brown, Tung (Tung, 2004) purposed a design framework in product design's point of view, through defining aspects of the social interaction toward human and toys. The framework includes five aspects: forms,

motion, languages, social dynamics, and control (Tung, 2004). The study also provided a new thought for designer to develop a friendlier human-computer interaction. The framework (figure 2.2) provides general guidelines for the design of social interaction as it is applied to the “human-product” relationship. It also points out possible directions as design material for further research on the issue. The classified aspects including five types: **(1) Form (2) Language (3) Social Dynamic (4) Control (5) Motion**.

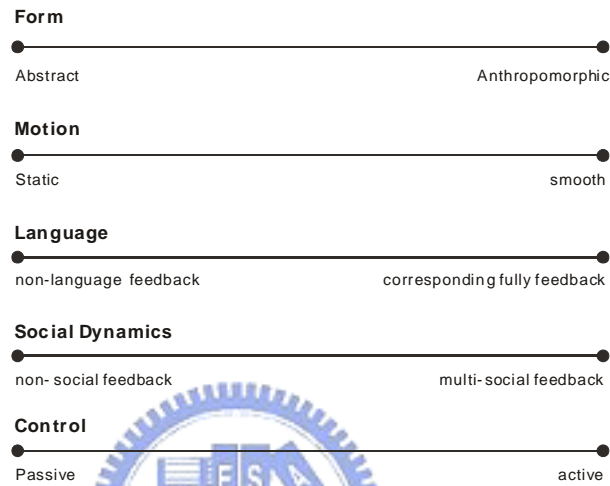


Figure 2.2 Social Interaction design Framework (Tung, 2004)

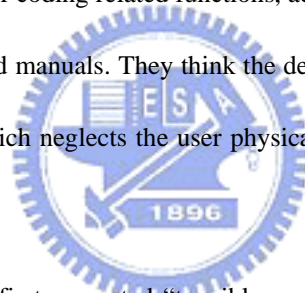
This framework could also help designers to explore social presence exhibited from interaction design of digital learning toys, especially digital media product which have a physical body. In addition to evaluating several present related products and their potential development, the studies then purposed the following directions for design course:

Social presence in interaction design on computer has already been an important issue in HCI, but it is still a novice when applying on physical digital product, and is able to play as an ingredient of industrial design. The study also inspire us a way to transfer the exact attributes from human-human interaction which has a similar function and task into human-product interaction. For instance, if an appreciated attributes from a clerk was applied on vending machine, it may be much persuasive on selling beverages. Further, it also points out an important notice of “corresponding to limitation of digital interface and product’s ability”, this is the congenital restriction of product design when we try to transform human-human interaction.

2.5 Tangible Interfaces

Another field related to our study is the field of tangible user interfaces (TUIs). Comparing with software or graphic designers dealing with HCI, researches in TUIs focus much on tangible product as industrial designers' perspective.

For people with a HCI background, the physical aspect is often new ground, and the physical has of course always formed an essential part of product design. Virtual aspects are gaining foothold in product design, as more and more electronics are embedded into products and distinction between products and computers become blurred. Product has become “intelligent”, and intelligence has no form. Design research naturally turned to the intelligent part of humans and thus to the science of cognition to find answers. This has result in interface design place a heavy burden on human intellect. Some researchers especially argue about how designers start to group and color coding related functions, adding displays with an abundance of text and icons, and writing logically structured manuals. They think the design of electronic product has got stuck as a result of this cognitive approach, which neglects the user physically and emotionally. (Djajadiningrat and et. al., 2004)



At CHI 1997, Ishii and Ulmer first presented “tangible user interfaces (TUIs)”, which they defined as user interfaces that “augment the real physical world by coupling digital information to everyday physical objects and environment.” This paper has aroused a great interest in the research community. There have already been many research efforts devoted to tangible user interfaces (TUIs). Its all share a basic paradigm – a user uses their hands to operate some physical object via physical gestures; a computer system detects this, alters its state, and gives feedback accordingly.

Aesthetics of Interaction

Good interactive products respect all of human skills: cognitive, perceptual-motor and emotional skills, in other words, knowing, doing and feeling (Djajadiningrat and et. al., 2004). Current interactive design emphasizes our cognitive, our abilities to read, interpret and memory. Furthermore, what happens inside

electronic products is intangible, it neither fits the mechanics of our body nor the mechanical view of the world and the electronic world is more opaque to us. The researchers point out that augmented reality - by exploring perceptual-motor and emotional skills - could play a role in restoring the balance in addressing all of man's skills in interaction; With perceptual-motor skills, it means what the user can perceive with his senses and what he can do with his body. With emotional skills, it means our abilities to experience, express emotions and recognize emotions. This includes our susceptibility to things of beauty as well as boredom. And they believe that with emphasizing these two aspects, it is the bridge between virtual world and physical world (Djajadiningrat and et. al., 2000).

According to the study, it focuses on a branch of design called "formgiving". Traditionally, formgiving has been concerned with such aspects of objects as form, color, texture and material. In the context of interaction design, they have come to see formgiving as the way in which objects appeal to our senses and motor skills, both appearance and actions as carriers of meaning and they take usability and aesthetics as inextricably linked. They try to argue that in addition to a data-centered view, it is also possible to take a perceptual-motor-centered view on tangible interaction. They highlight a concept as "aesthetics of interaction" in which three factors play important roles:

(1) Interaction pattern

Interaction pattern spins out between the user and product. The timing, flow and rhythm, linking user actions and product reactions, strongly influence the feel of the interaction.

(2) Richness of motor actions

Current creative program exploits a very narrow range of motor skills. "Skill" in the digital domain has become mainly a cognitive one - the learning and remembering of a recipe. There seems to be a fair amount of space to maneuver between the actions required by those objects and the push-bottom interfaces of today's electronic products.

(3) Freedom of interaction

In most current products, activation of a function requires a fixed order, single course path in which the user does or does not get things correct. In this path the action are prescribed and need to be executed in a particular sequence. Instead of what interaction design has been concerned with optimizing this repetition of a single path for speed and efficiency, the researchers are much interested in products that offer a myriad ways of interacting with users. It implies that the users can express themselves in the interaction. The product allows expressive behavior - not constraining the user-and may even take advantage of it and also allows the feel of the interaction to stay fresh.

The studies in aesthetics of interaction inspire us when we try to deal with physical motion design. In stead of thinking what features should our prototype have, thinking of what people appreciate most in their experience and the fulfillment they get when dealing with a real clerk may be much important since we are try to transfer a real social experience into interaction design. Further more, in contrast to the controls of the current generation of electronic products, whether physical or screen-based, the buttons and labels indicating people is not base on intuition and require learning. We want to overcome this barrier with applying social dynamic design, by guide people under an analog behavior and interactive pattern they already get used to. In advance, different functions should be presented through different actions, and the timing of or prototype responses should be appropriate to the actions and functions involved.

Tangible user interfaces have received much attention. It is believe that, at core, they are leaving the conventional computer virtual world, and taking steps into the physical world. Fitting interactive, physical products to man's perceptual and motor capabilities may ultimately provide not only a route to improved usability, but also to an aesthetically rewarding experience. In our aspect, applying social intention is a way to achieve the goal of aesthetics of interaction.

2.6 Summary

Although efforts toward TUI moving paces into the physical interactive world, they focus most on exploring perceptual and motor skills and try augmenting the aesthetics of interaction. Nevertheless, they still direct a new way to reconsider the form and interactive content. Meanwhile, human-computer interaction relationship is proved to be fundamentally social. The evidences are extracted from experiments; even when test subjects are biased toward social orientation, they sit down at a computer and interact socially. Researches also demonstrated that individuals apply social rules and expectations to computer mindlessly. The cause of mindlessness include: individuals overuse human social categories, people exhibit over-learned social behaviors and premature cognitive commitments. These reasons also point out that when the role of social actor, computer, changed into another similar object – digital product, capable of delivering social cues, it will certainly receive the same conclusion.

As the phenomenon of social presence exists, positive effect resulting from it may be welcome by industrial designers. The key point is that we need to notice about the differentiations between two medium – computer and product. These differentiations may show on restriction of digital product itself, features or functions it has – less computation abilities, physical components and possible voice feedback. A design framework, purposed by Tung (Tung, 2004), suggested several directions for product designers to think about their design course based on a digital-product-specific aspect. Similar robot-human interaction studies also conducted a social framework, but the richness of interactivity and intelligence is much more talented than digital product.

2.7 Relevant Methodology

In this section, we make introduction and comparison with methodologies related to our research including interview, observation and dynamic interaction experiment tools.

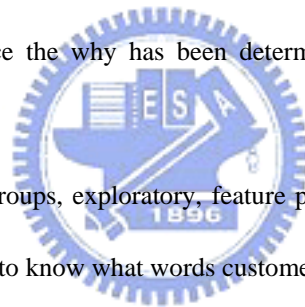
2.7.1 Group Interview - Focus Group

Focus groups are structured group interviews, focusing on schemed topics, which quickly and

inexpensively reveal a target audience's desires, experiences and priorities for their needs and their value. Before we start to design our experimental prototype, we have to realize and gather information from people, and we can use a focus group to understand and get insights about how people perceive in their shopping experiences, as it is a way to get lots of firsthand experience in a short time, and give development an early, solid foundation from which to analyze our target product – vending machine and it's possible user's need.

The session is conducted by a moderator which follows schemed script of discussion guide. By preparing snack and set comfortable environment, audiences can reveal their thoughts and feeling at ease. They may share their views and assumptions that lie at the core of their experience and to relate them to real world situations. Focus groups are not a way to get usability information because it is impossible to show using in practice during the session, and what it gets are not statistically significant samples so the result can be extrapolated to large populations. In contrast, focus group can still give people a good idea of why the audience behaves how it does. Once the why has been determined, it can be verified through statistical research.

There are four types of focus groups, exploratory, feature prioritization, competitive analysis and trend explanation. Our study's objective is to know what words customers talk about clerks, what criteria they use to judge them and what their expectations to an ideal clerk are. This approach can be sorted as the exploratory one. (Kuniavsky, 2003)



2.7.2 Obtaining Dynamic Interactions

Spatial models are a necessary addition to the visualization techniques which support the designer to explore and test interactions. They are beneficial to create contexts for experience. Spatial models come in all kinds of forms throughout the entire design process, from simple paper mock-ups to refined full-scale working prototypes, ranging from low fidelity to high fidelity prototype, and can have high-interaction or low-interaction relevance (Rettig, 1994). The kind of experience which user has depends on the kind of model which is created. With low fidelity models which have high-interaction relevance, such as an easy made paper models. Simple paper models allow designer to explore the interactions early in the process, and clay or

polystyrene foam models are extremely suitable for exploring the appearance of products. A designer can study the aesthetics of appearance with more refined models. Detailed working prototypes are suitable to evaluate the context of use, the response of users and their behavior when interacting with the model. The special models are generally adequate to generate and demonstrate the hardware part but not the virtual part (software) of a digital product.

A way of obtaining a dynamic interaction is the use of a so-called “Wizard-of-Oz”, adapted from the movie of the same name. The wizard is the person who impersonated the product or computer. He interprets the interactions of the user with the product and provides him/her with appropriate feedback. The person acting as the computer is preferably invisible, so that the users can immerse themselves in the activity and create their experience. The Wizard-of-Oz approach enables the designer and user to test interaction concepts early on in the design process, without having to rely on a difficult and expensive (financially as well as in time) implementation phase.

Another way of obtaining a dynamic interaction is called “Interaction Relabelling” technique (Djajadiningrat, Gaver and Frens, 2000), which shows that every day products can also enhance interactive imagery. With this method, participants interact with props, existing products, pretending it is the product to be designed. The participants are asked to relabel the provided prop with their original mechanical components. According to this method, researcher can get rich information mainly on the resulting richness of the gestures and stories, other benefit may show in the metaphor that participants think about.

These dynamic participatory design tools may focus on different demand. Interaction Relabelling are much benefit on exploring the richness of gestures, and it is much like a generative tool for inspiring designers’ innovation and exploring new manipulative possibilities. Making special models could pay much attention to evaluate the designed features. In order to observe and get information from people with a social product, after gathering customers’ opinions from surveys, we have to make experimental model to proceed the study. Making paper mock-up prototype can let us quickly explore and test interactions, while to be seized, turned, moved and used with a spatial model is necessary. Although the shape of the paper mock-up is not yet explicit, the possibility of grasping and using it is often enough to get a first feel of the interaction for us.

Therefore, our prototype needs reactions and feedback and these have to be achieved by using a simulated tool – Wizard of Oz. (Hummels and et. al., 2001)

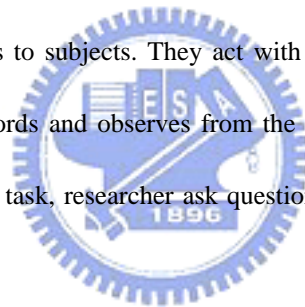
2.7.3 Observation of task performance

Observation of task performance is a method for observing users (Argyle, 1990). In our study, we try to observe behavioral indications such as nonverbal gestures, eye-gaze by using observation of task performance, as opposed to self-report measures such as questionnaires and anecdotal accounts because behavioral observation have the potential to offer greater information over self-report ratings

Individual subject' behaviors were observed by researcher when they operate and execute given task, and then analyze the concepts and relationship between them. There are two ways to go through this method: (a)

Complete observation involves: Researcher participates with highly involved in the subjects' task, and asks questions or different point of views to subjects. They act with frequent interaction during experiment. (b)

Passive observation: Researcher records and observes from the sidelines during the task was proceeded by subjects. After finish the experiment task, researcher ask questions base on their findings in video coding or voice coding.



As the feeling and percept from subjects are important, it will be much better if their engagement could be much immersed in the schemed scenario and the interaction with our prototype. Another reason is that the sequences of task are uncomplex and fixed, and we have certain features need to be assessed while having no wide range of freedom to afford extra operations. So in our concern, we tend to not interrupt their operation during whole task for augment the immersion.

2.7.4 Perceptive Sorting

Perceptive sorting (PS) is a method inspired by the field of visual research. By combining card sorting and keywords it may be used to gain responses to product familiarity, product function, and aesthetic considerations. Our study refers to a use for gathering information about how participants assess product

attributes, assign value, and tell stories of product use (Forlizzi and et. al., 2003). When people evaluate an image, they project meaning upon the image and thereby reveal apperceptive knowledge about how they structure their experience. Stimulus images can also serve as records of social artifacts that help reveal what a particular user group values.

We are interested in the use of photographic images as a stimulus to assess the perceived function and associations of our prototype after operation in experiment.

2.7.5 Affinity Diagram

The affinity diagram, or KJ method (after its author, Kawakita Jiro) is a creative process, used with or by a group, to gather and organize ideas, opinions, issues, etc. Though it wasn't originally intended for quality management, this process has become one of the most widely used of the management and planning tools. In *Seven New QC Tools*, Ishikawa (1990) recommends using the affinity diagram when facts or thoughts are uncertain and need to be organized, when preexisting ideas or paradigms need to be overcome, when ideas need to be clarified, and when unity within a team needs to be created.

In this study, affinity diagram is used for sorting and organizing qualitative concepts into naturally related groups from people's opinion. It was built bottom up, by grouping similar raw concepts into categories, taken as the first consolidation step, and it also helps researchers to think for all the rest of gathered information.

Chapter 3

DESIGN PROTOTPYE

Base on a premise: human-product interaction is fundamentally social. The objective of this study is to demonstrate how motion could convey social intentions and discuss about social motion cues from knowing people's response, opinions and expectations toward socio-product.

Vending machine were chosen as target product because it has a similar function, selling things, as a social role, clerk, which make it easy to compare the differences since they both proceeding similar task "selling things". The most important of all, vending machines these days do have some interactive problem as we mentioned in chapter 1. In order to shape a similar experience from human-human interaction and implant social attributes into a vending machine, we have to realize how a good clerk interacts with their customers and what attributes are most appreciated by people. Although social-emotional interaction is something that all human/users have some expertise in it (we all have experience with human-human interaction), but to transfer this expertise into human-product interaction is difficult, and seldom researches have been made toward product design. Hence realizing popular attributes of clerk will be approach first, and an experimental prototype have be made on our on.

Information was collected in two surveys for extracting design ingredients from a pre-existing relationship between two social roles – clerk and customer, where have interaction for certain specific tasks, modalities and causal behavior patterns. Interview data were then aggregated, organized. According to these insights, we then make a paper mock-up with social motional attributes for following assessment.

3.1 Design Flow

Figure 3.1 demonstrates the prototype design flow of this study. Two approaches, focus group and expert interview, were used to gathered usable design ingredients. A breakdown analysis of human-human interaction and human-machine interaction were also done. It then provided the base patterns of interaction flow for our prototype.

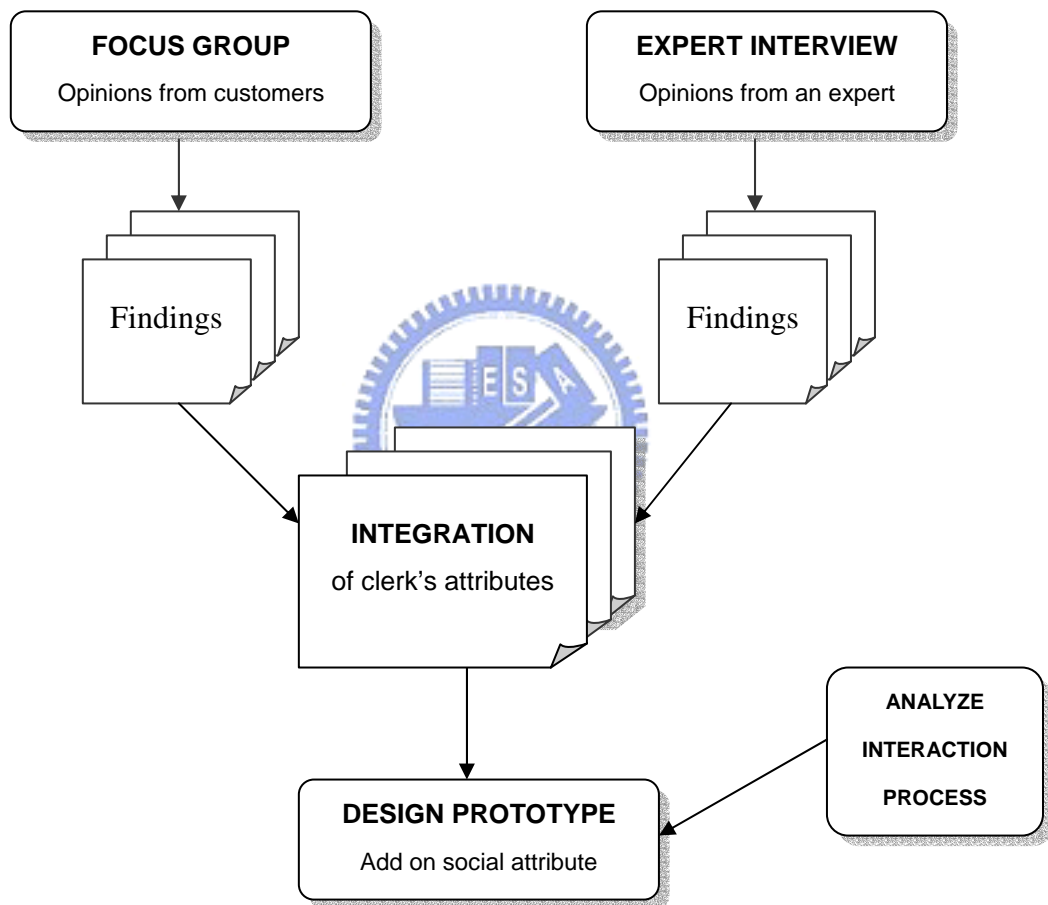


Figure 3. 1 Design Flow. The structure of designing social product

3.2 Exploring Appreciate Social Attributes

In order to collect ingredients for further design course, designing social vending machine, two kinds of survey projects have been set. We approached it from two sides – using focus group to get opinions from customers, and visit a clerk trainer with an interview.

3.2.1 Focus Group

a. Objective

In this survey, the objective was to look for qualitative data derived from people's opinions, especially as a "user", being a customer and willing to share their rich experience of shopping and encountering clerks. This structured group interview was held at the beginning of this study. It is a quick and inexpensive survey which reveals target audiences' desire, experiences, and priorities.

b. Recruiting Audiences

Our interview was held with six carefully selected people, ranging in age from 24 to 29, having interest and rich experience in shopping, brought together to discuss a host of topics about shopping experience. All of them are classmates, so there is no obstacle about discussing with each others. Also, having a design background makes them talk their opinion fluently.

c. Developing Questions

First we conducted the topic on their most impressive shopping experience, including both good and bad feeling in memories, in shops of department stores and restaurant or convenient store. Comparative questions for things that different clerks do in different situations were asked as well. Next, we focus the discussion on what attributes will people appreciate, and what will they do to let people feel better or delighted. After discussion, conclusions have been made by all participants as an ending. Interview questions are designed into the following points:

- (1) Have you ever have good or bad experience when shopping?
- (2) What do you care most while you are shopping?
- (3) What is the difference between those cashiers' attitude, what have they done?
- (4) If you were a cashier, what would you serve customers instead of offending them?
- (5) Conclude the good attributes a clerk should have that is appreciated by people.

d. Planning Session

The focus group session were held in a meeting room. We prepared six planned and structured questions. Equipments we used were the following: (1) Cam-coder x 1, to record interview and capturing body languages. (2) Computer x 1, for presenting schemed process to handle the session. (3) Projector x 1, projecting demonstrative scenario and questions. Different questions were projected with different background colors and scenarios. These changes not only triggered audience to recall their experiences but also reminded them the change in topics. We also prepared soft drinks and snacks for our participants to let them feel comfortable and relax to say anything in their mind.



Figure 3. 2 Focus Group Session. The session was about 2 hours long.

e. Analysis

Notes of each dialogue during the session were typed down first, and concepts that considered meaningful for us were extracted later. Affinity diagram was used to sort these gathered concepts. Afterward, we concluded clerks' attributes into several points.

f. Summary of Result

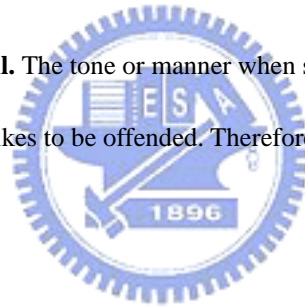
According to customers' opinions, a clerk role model should have the following attributes:

(1) **Keep in appropriate distance.** While providing enthusiastic service, clerk must give sufficient space to customers for appropriate privacy, not being monitored and forced to buy anything.

(2) **Possess pleasant attitudes.** Clerk should deal with problems of their customers actively and aggressively as a friend. If they are able to care about customers' mood and thought or even remember their customers, it will also be considered as friendliness.

(3) **Be helpful.** Provide helpful information, suggestions and assist customers to solve their problems and requests as necessary, even if they don't buy anything from the clerk.

(4) **Good communicate skill.** The tone or manner when speaking should be fastidious and correspond to individuals. No one likes to be offended. Therefore they should possess good communication skill.



(5) **Attract customers.** Be humorous when talk and encouraging their customers to try on clothes or to taste. A kind attitude can also be attractive psychologically.

To sum up findings, appreciate personalities include honesty, reliance and friendliness. A clerk must respect and trust their customers as well. Providing particular suggestions as being perspicacious, providing sufficient information and professional opinion is also important.

3.2.2 Interviewing Expert

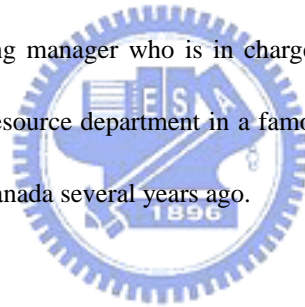
Another approach to find attributes that a clerk should possess and their commitment of work, we visited an expert to get information. It is believe that a person who trains clerks will have the original concept of what a “standard clerk” should be like, since this is his/her expertise.

a. Objective

Base on the concepts we found in former survey, we still need an approach from another side to consolidate clerks’ attributes differing from customers. Opinions from an expert who is profess on train clerk may be a short cut to verify our former findings and get further insight into good attributes that a clerk should possess.

b. Looking for Expert

We chose to interview a training manager who is in charge of training clerk in a department store. The person we visited works in human resource department in a famous department stores in Taiwan, and she once was a cashier in a clothing store in Canada several years ago.



c. Developing Question

According to our former findings, we focused much more on what a clerk should notice and do while encountered with customers. Therefore, to verify the concepts we concluded is also be a task for us. Questions are developed into the following 4 parts:

(1) How does human resource department train their new employees? Why?

(2) What kind of attitudes should a clerk possess?

(3) We want to know about the adjustment of distance between customer and clerk in the shop, what

does the “appropriate distance” mean? For instance, when should a clerk move closer to customers

after they entered the shop?

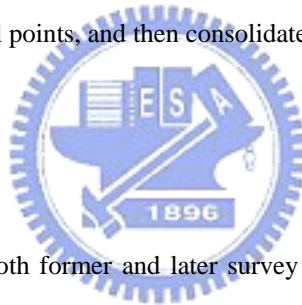
- (4) Are there any other basic requirements for being a clerk? Including words they have to say to customer?

d. Interview

The interview was held in her office, and was about one hour. We recorded the entire interview for future analysis. Findings we had in focus group were proven. Beside the perspective from her expertise, she also mentioned self requirements and attitudes when being a clerk must have due to her own experience.

e. Analysis

We typed down notes of each dialogue, and then extracted opinions that we think is meaningful for us later. Affinity diagram was used again to sort these gathered opinions. Afterward, we concluded clerks' attributes from clerk trainer's perspective into several points, and then consolidated with the findings in focus group.



f. Summary of Result

Corresponding concepts from both former and later survey are found. From a successful clerk's point of view, feeling pleasure for helping people should be their commitment, especially assist people to buy what they really want. The expert also mentioned the necessity of enthusiasm and active attitudes, and a clerk should treat their customers equally without discrimination.

- (1) Be helpful, provide helpful information, suggestions and assist customers to solve their problems and requests, even if they don't buy anything from the clerk.
- (2) Show kindness and friendliness, a clerk must be active to provide assistance as well.
- (3) Keep in appropriate distance, customers normally do not like to be kept in a close watch or followed by the clerks.

(4) Possess perspicacity, in order to suggest correspondingly to individual customers and care about customers' mood and thought, a sharp perspicacity must be possessed by a clerk.

(5) The initiative should hold by customers. While customers want to be cared about, they need clerk to come only when they have questions. What they want is a non-stress and a leisure shopping space instead of being bothered.

3.2.3 Integration

Most expectations toward clerk are beyond buying things. People are looking for more than purchase these days, shopping is considered leisure for them and they tend to enjoy being served. We consolidate two groups of results to form as our survey's conclusion, which is depicted in the following:

(0) Be Polite

Being polite is the basic and one of the most important attributes a clerk should have. People are sensitive, a glance or a word may reveal if they are being treated with respect or not. We found that besides saying "thank you" and "you are welcome", the most impressive way to show respect is a body language - holding things up with two hands. It is strongly implanted into people's mind.

(1) Be Helpful

A helpful clerk is considered as professional and reliable, in customers' perspective. Being helpful means a clerk should achieve at least three points:

- Assist customers to solve their problems.
- Provide suggestion.
- Possess sharp perspicacity

Always put customers' request in the first priority instead of selling things will be rather

appreciated by customers. While having a good impression, even buying nothing and customers may come again next time. Beside basic product information, providing customers professional suggestions correspondingly and individually is required. Further, possessing sharp perspicacity may allow a clerk to sense their customers' mood, condition, taste or preference easily. Especially knowing whether customers are just hanging around or actually looking for something, clerk can give different opinions or say different words, and a sharp perspicacity and professional knowledge may provide people making good decision as well.

(2) Possess Enthusiasm

An outstanding clerk should be extroverted, including kindness and friendliness. A smile, nod or greeting may let customers feel comfortable, because all people need to be respected and care about. Active is an expression of sincere enthusiasm. Moreover, an appropriate compliment would make customer feel delighted. In summary, being enthusiastic includes three points:

- Possessing kindness and friendliness
- Active
- Encouragement



(3) Keep in an Appropriate Distance (a proxemics)

How to let customers feel that they are well taken care of but not under surveillance is difficult. Pretending busy but ask if customers need help casually is a way to avoid stress on customers. By giving them freedom to browse through products and appropriate privacy space and let them know they are noticed may make them feel comfortable. So, the core of maintaining an appropriate distance is to give customers two things:

- Freedom
- Privacy

(4) Give Initiative to Customers

As enjoying being served plays a great part in shopping, for customers, to shop, is to entertain. Having initiative makes them feel superior. It is also a way to provide customers privacy space to feel comfortable. No matter asking question or making choice, it is their right to make the final decision. Once they enter into the shop, they are the boss.

Since shopping has become a leisure activity, killing times and finding interesting things for fun becomes the primary objective, buying is merely an appendix. While, products are the same and easily found in different stores, how to provide good service and attractive shopping context to catch customers' eyes has become a key issue. After all, we found non-verbal expressions such as a smile, nodding for greetings, bowing for saying "thank you" and waving for goodbye are manifestations of being kindness.



3.3 Insight for Design Clerk's Attributes

According to our findings, what people appreciate most is being respected and enjoying the service provided by clerks. It inspires us to emphasize on augmenting politeness and friendly attributes for our prototype. Friendly attributes may show in many ways (e.g., a warm greeting smile, being happy when meeting people, providing thoughtful service, etc.). In the operational context, letting people know that they are noticed is the first step, so, it is thought that a greeting made in the first contact before interacting is required, it can be a smile or a wave or nod. Another way is to keep the initiative for people. Though it is eager to be augmented interactivities attributes on our design, having insights from surveys above, keep the initiative would let people feel superior and comfortable. So the prototype should be active but not too aggressive. This factor may be considered as real shopping condition.

To augment politeness, holding things in both hands may be an easy understandable motion. To provide sense of "being served", the prototype may do something for subjects (e.g., preparing orders from customers).

3.4 Design Prototype – Vending Machine

Base on the findings above, we then came into planning the design of a socio-vending machine, in order to achieve our assessment in the next stage. One of our objectives is to evaluate the motion cues exhibiting social intentions, so motions of mechanical components would become our first priority to design with.

3.4.1 Exhibit Social intention via Motion of mechanical component

Inspired by persuasive social cues (Fogg, 2002), the design element we used are adopting social role, adding physical cues, psychological cues and social dynamic cues.

a. Design Strategy

The process of applying social attributes was proceeded in the following steps.

(1) Chose social role →

- Vending machine – clerk



(2) Decide what social cues to apply →

- Physical cues – motion (ways to present)
- Psychological cues – friendliness, politeness
- Social dynamic – service

(3) Construct interaction sequence to add social attributes →

- Move close – choose beverage – pay – leave

(4) Create simple motion features reflecting social cues →

- Politeness – presenting things in two hands
- Friendliness – wave enthusiastically (say hello and good bye)
- Providing service – delivering beverages

b. Analyzing Task Process

Before designing our prototype, the interaction task had to be decided. Through an observation toward buying things from clerk in fast food restaurant, and an observation toward buying soft drinks from vending machine, we recorded and breakdown the main process of both situations, take buying beverages for example(see figure 3.3, figure 3.4). Afterward, we will take the sequences of buying things from clerk as the basis of interaction, and then put designed features into it. The contour is as simple as possible, and some necessary features of contemporary vending machine were preserved. (Functions we do not discuss about, such as buttons for order and slit for payment.)

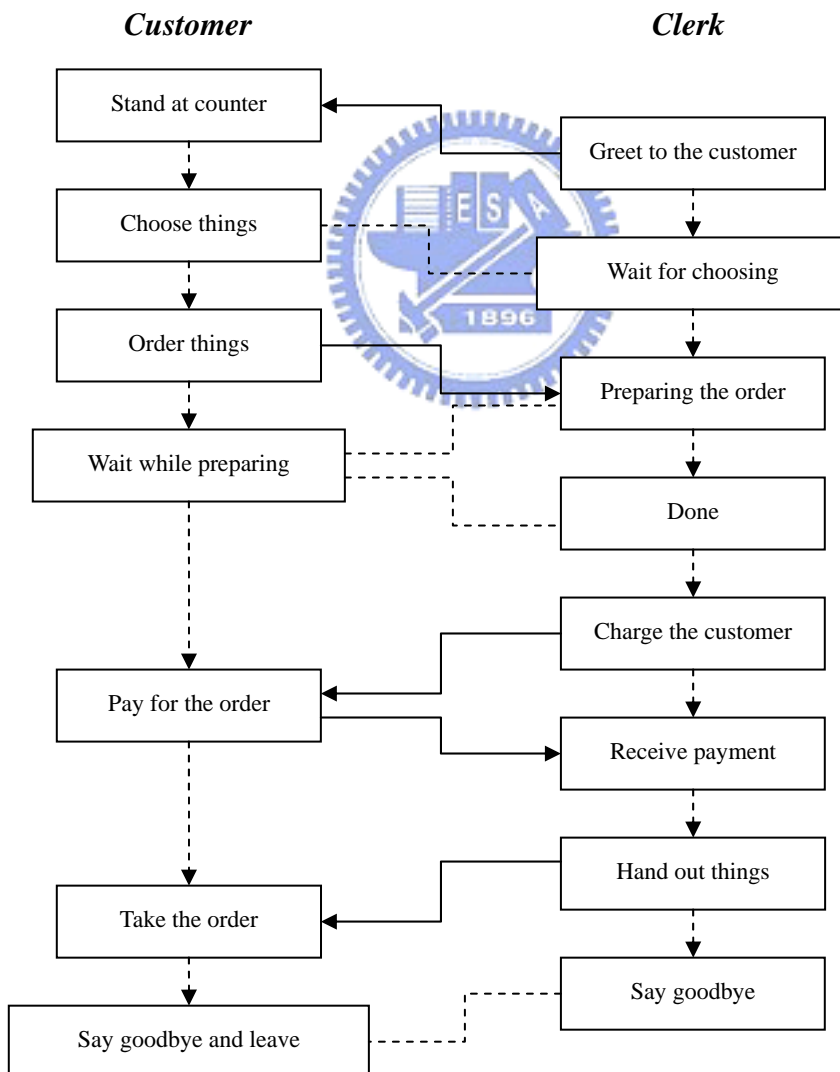


Figure 3.3 Process breakdown - buying things from a clerk

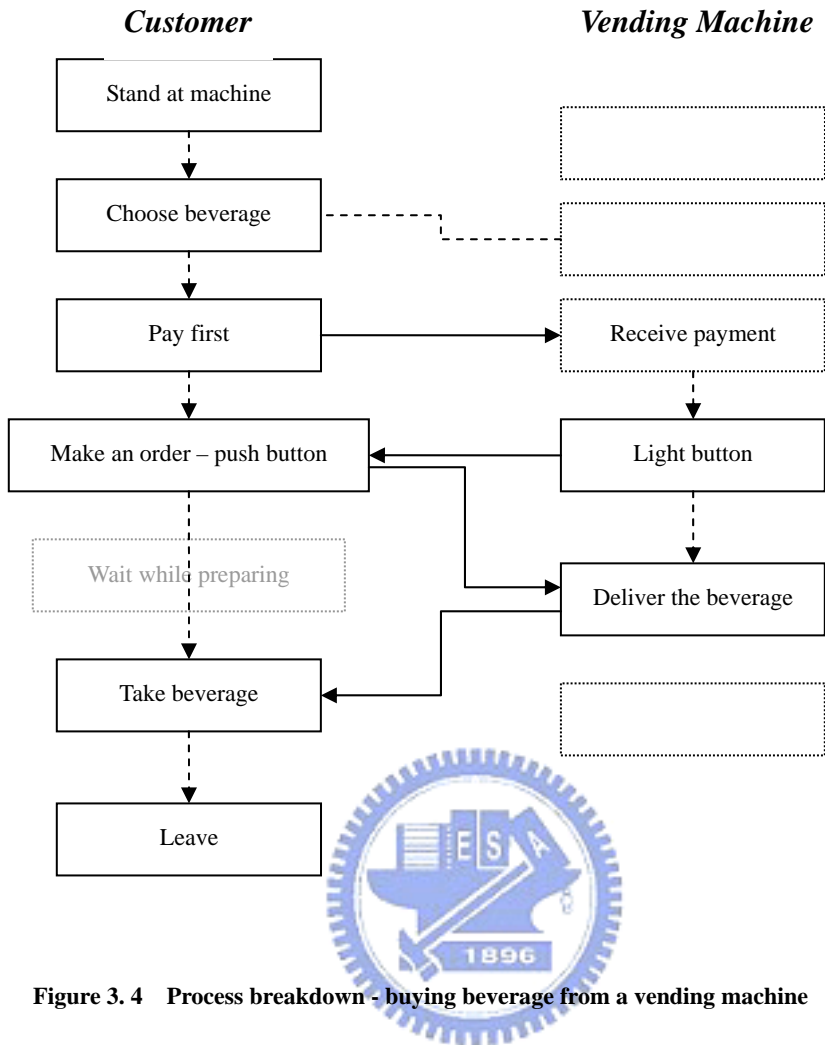


Figure 3.4 Process breakdown - buying beverage from a vending machine

It can be seen that social dynamics in interaction between customer and clerk, as interactivities, they are lack in process of using a vending machine. Meanwhile, the sequences of paying between ordering are different, and people do not need to wait for a preparation. Finally and obviously, there is no any greeting or goodbye between customer and machine. According to these two basic interaction/operation processes, we enrich the customer-machine interaction by adding clerk's actions (see figure 3.5).

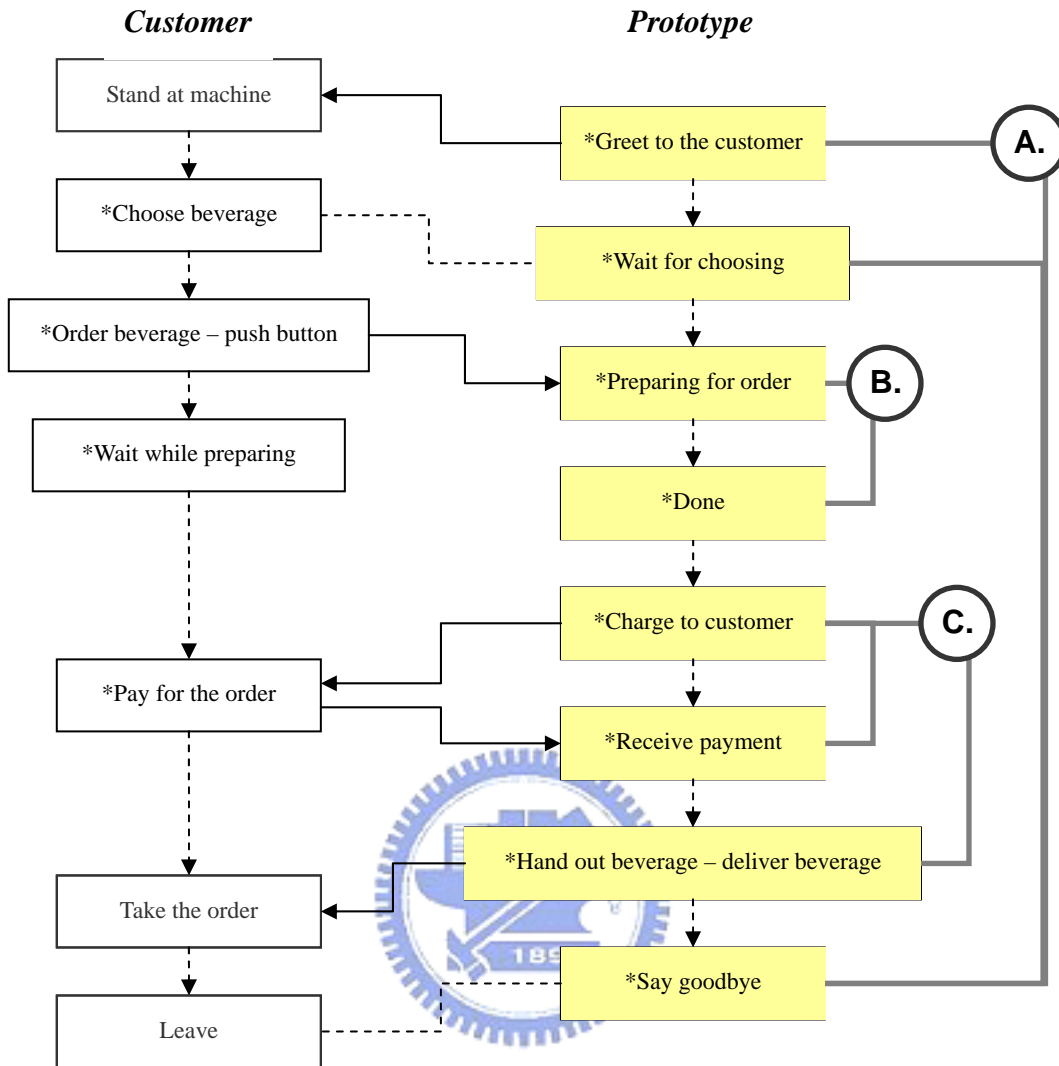


Figure 3.5 Planning task process - buying beverage from prototype
 “* ” means added or changed sequence. “A, B, C” means an added feature.

In order to present the action of “greeting customer” and “wait for choice”, we design “feature A” as a stick which can wave when people approach, and stop for waiting after they stand still and start to choose beverages. “Feature B” represent the preparation for beverage by clerk, it is also a process that exhibit where the beverage come from or be made. With “Feature C” as these sequences are all expressed by hands in customer-clerk interaction, we combined them as one feature, and design it as an outlet and a slit plate inside. The outlet has a door, and after the door opened, slit plate and move up and down.

We then made an adjustment for order of some sequences in order to let the performance flow of delivery become much fluent. The “preparation of beverage” was put after “charging” and “receiving money”. Hence, after people paying money, from preparing to delivery will become a continued process, so it can solidify and augment the implication of serving for people. The whole Social intention features and process we want to attach on prototype which are shown in the figure 3.6.

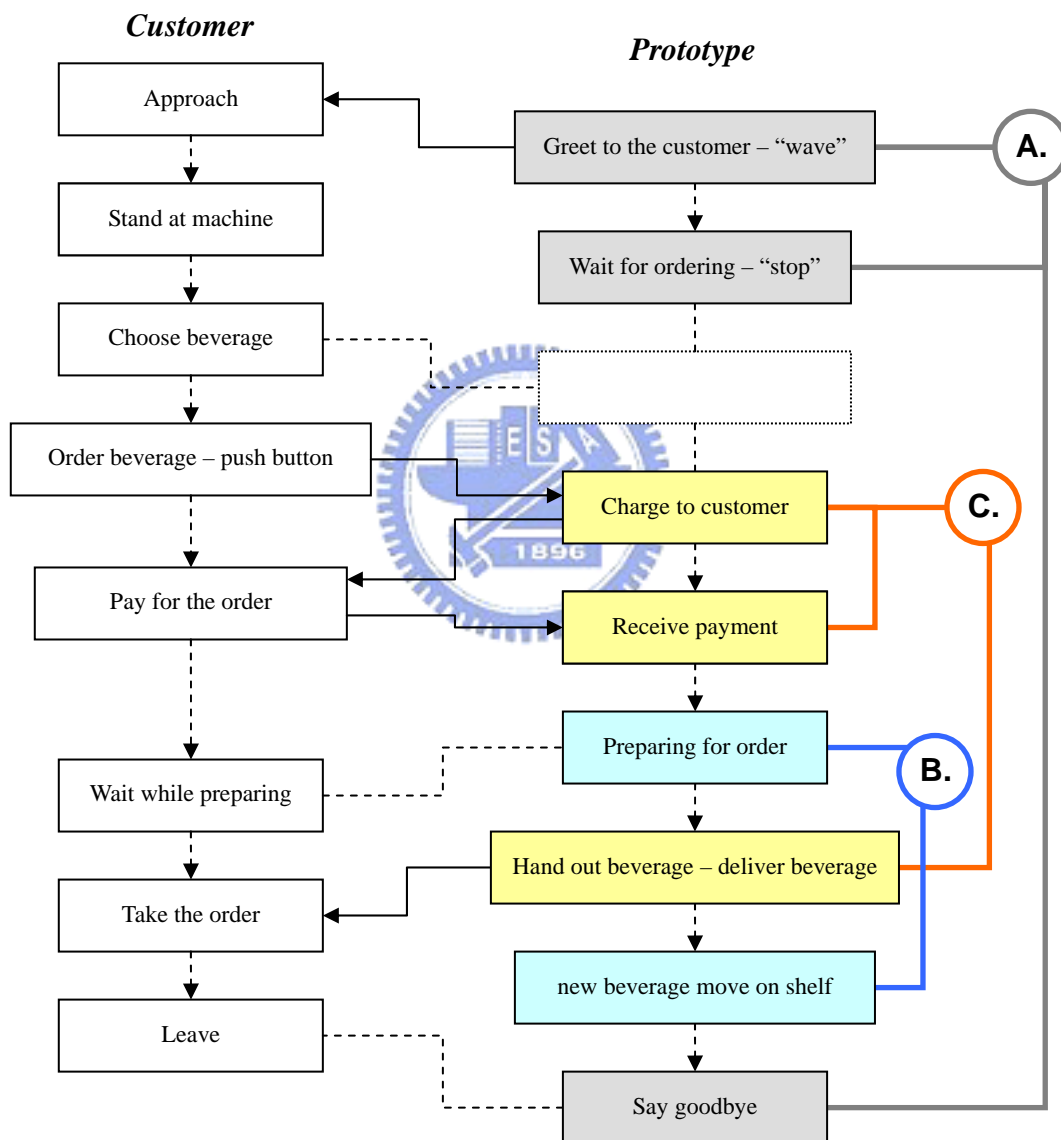


Figure 3.6 Refining task process- buying beverage from prototype “A, B, C” means new feature.

According to this interaction process, this vending machine is designed to have three individual features, A, B, C, for different purposes as the following table:

Table 3.1 features of prototype

<i>Feature</i>	<i>behavior</i>	<i>social cue</i>	<i>related with self function</i>
(A) Waving stick (With analog form)	wave stop	greeting friendly awareness of people wait for order / let people begin the interaction	additional
(B) Outlet & slit (With abstract form)	charge hold up in both hands	physical cues physical cues / politeness	related
(C) Mechanical Device of Delivery (With abstract form)	show preparing process Deliver to people	serve serve	related

c. Avoiding Noise from Other Channel

Contour and form of the prototype should be as simple as possible. In order to avoid noise sense elicited from anthropomorphic form and subjects' over expectation resulted from other hints which produced by sophisticated form, designing form should be restricted as a minimum manifestation and remain abstract.

3.4.2 Feature Descriptions

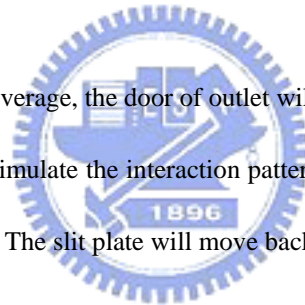
The prototype includes following features:

(1) Waving stick

Waving stick could show social intentions through its movement. Depending on the distance between vending machine and subject, it will wave as saying hello when people moves closer, saying goodbye when people leaves even he/she buys nothing. When people stands still and stare at it, it stops. In addition to enhance friendly characteristic, we add “extroversion personality”, as being more enthusiastic and friendly, an outstanding clerk should be extroverted. We make the expression more obvious and more affective by means of increasing swing speed. Swinging faster and frequently may imply more extroverted.

(2) Outlet & Slit

After people select a beverage, the door of outlet will open, and then slit plate will be lifted up to charge people. We want to simulate the interaction pattern of social dynamic that people order things then pay money to the clerk. The slit plate will move backward after people pay money.



(3) Mechanical Device of delivery

After receiving money, the beverage on the shelf will move down and then show up on the slit plate. The beverage would be lifted up, from bottom to top, for people. It is meant to be politeness toward people as holding up thing in both hands.

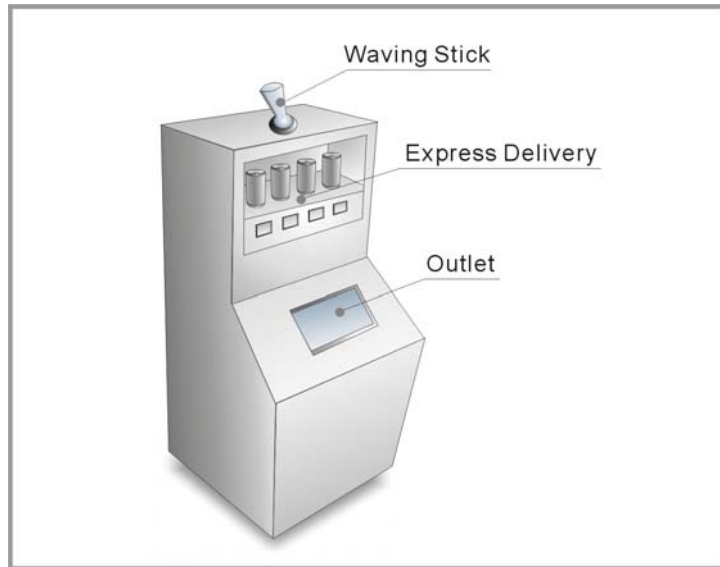
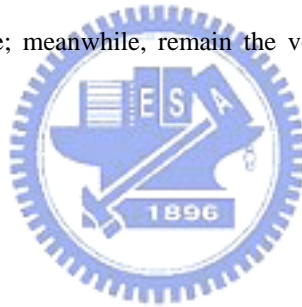


Figure 3.7 Paper mock-up prototype – A new designed vending machine

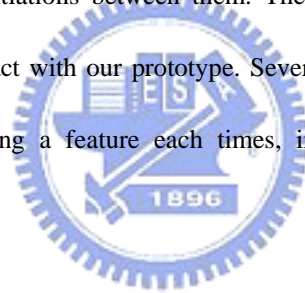
In order to evaluate the effect of social motion cues, we eliminate the possibility of social response that an anthropomorphic form would induce; meanwhile, remain the vending machine-look As well as design it as simple as possible.



Chapter 4

METHODOLOGY

How this study proceeded assessment toward social-product will be discussed in this chapter. In the primary experiment, assessment data from subjects were collected by two approaches – comparative observation and structured interview. Observation on subjects' behavior may compensate for blind spots in people's thoughts; sometimes cues are latent and tacit. Compare with observations in same task, buying things, but in different situations, from a machine or a cashier, may let us to know the differentiations between them. These comparisons also lead us to criteria for assessing how people interact with our prototype. Several contrast experiments and interview were also made later by changing a feature each times, in order to verify our finding in previous assessment.



4.1 Research Flow

The whole research structure is mainly divided in two approaches for gathering data and information from human – product social interaction. One is observation and the other is interviews. Not only what people say but also how they behavior is our concern. The research flow can be seen in following figure 4.1:

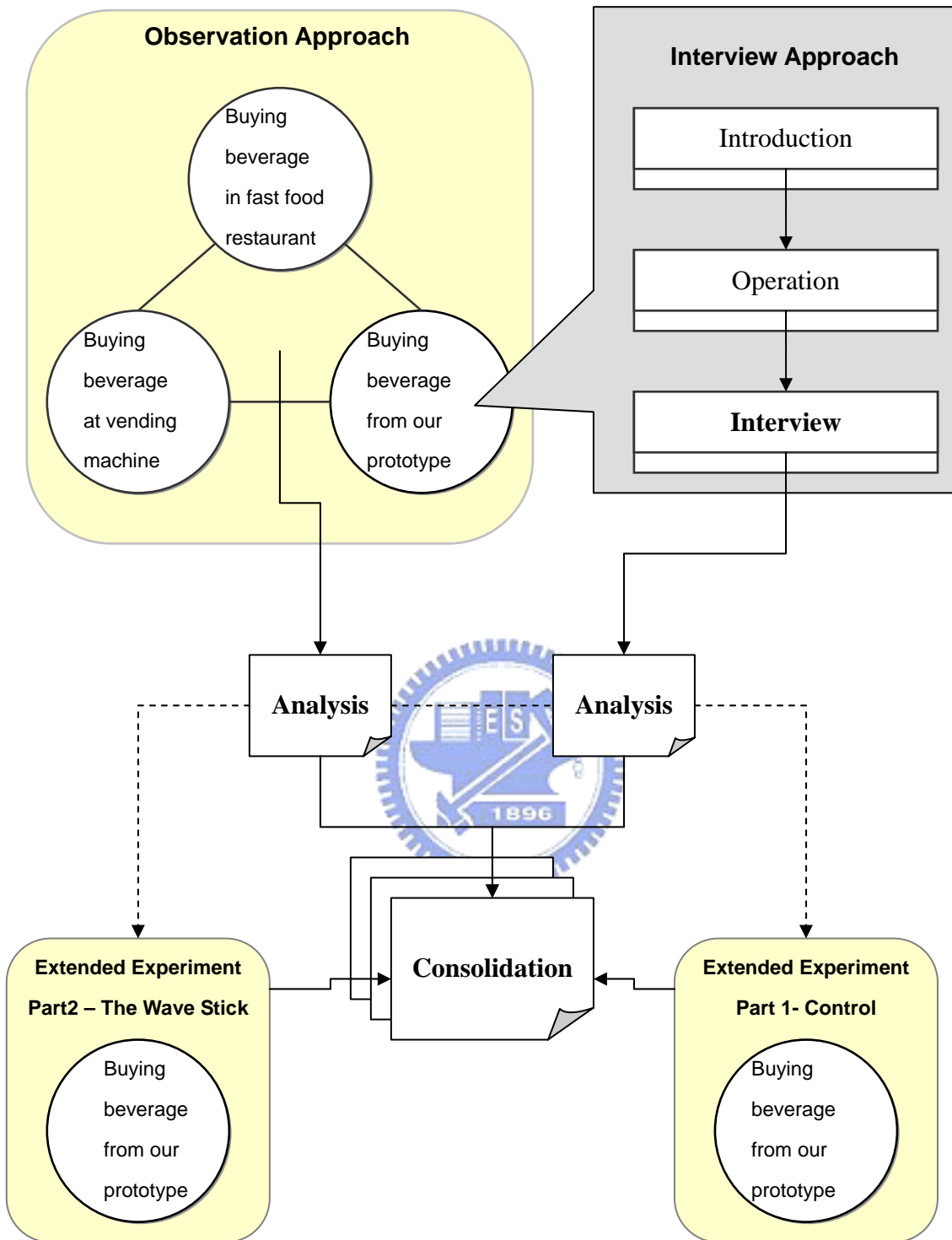


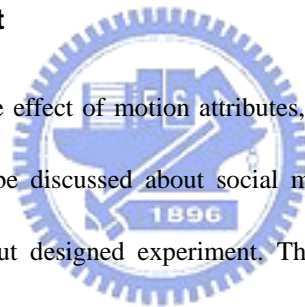
Figure 4.1 Research Flow – How we approach the study of social response from people.

4.2 Research Issues

This study included three stages of experiments. The first one is the primary stage. We evaluate our design mainly with assessment from students who study in product design. The second stage is a control, held for verifying our findings in the former one. The third is an extended experiment, which we recruit three collage students who do not study in design. Only for the first stage of experiment we observed three different situations – buying a beverage from a vending machine, buying a beverage from a clerk in a fast food restaurant, buying a beverage from our experimental prototype. In other two experiments, because we have specific objectives and doubts, so we only held the laboratory one to observe their interaction with our prototype.

4.2.1 Objective of experiment

This objective is to evaluate the effect of motion attributes, and realize what factors of motion can affect social response by people, it then be discussed about social motion cues from knowing people's response, opinions and expectations throughout designed experiment. The most important things are to analyze how motion can influence people (e.g., analogue of human behavior, interaction hint, speed of motion, etc...), do they realize why the prototype do so, and what motion do they appreciate most.



4.2.2 Recruiting Subjects

The experiments were held with eight subjects individually in the primary stage, ranging in age from 21 to 24, also having interest and rich experience in shopping. All of them are students, including five females and three males. Six of them have product design background, two do not have, for the reason that we'd like to know about opinions from product designers' perspective toward new design features and elements. These subjects all participated in three purchase activities providing observation data.

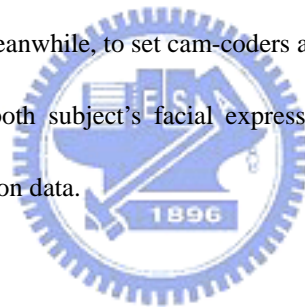
In the control stage, two more product design students participated in this stage. One is male and another is

female, ranging in age 22 to 23. They only operated the prototype in lab and interviewed later.

In the final extended stage, three more subjects were recruited. However, this time all of them are not study in design. They are all female collage students, two is 19 years old, and another one is 23 years old. They only operated the prototype in lab and interviewed later as the control, and there is a different point distinguish from other two experiment stages, we did not tell them to compare with buying things from a clerk which may be a hint of social aspect, instead, they were only asked about the comparison with contemporary vending machine.

4.2.3 Planning

The experiment was held in laboratory, since location plays a part in metaphor (in a semantic view), we consider that placing the prototype in a street corner or in a restaurant may affect people feel it more machine-like or more human-like. Meanwhile, to set cam-coders and computers are much easier in the laboratory. Two cameras were set to capture both subject's facial expression and behavior through whole, operational process, in order to provide observation data.



a. Comparative Observation

The contrast observations were only held in the primary stage. Before the primary experiment starts, we recorded each subject's behavior of buying things in a fast food restaurant and buying beverage from a vending machine in a campus corner, for realizing if there were any individual differentiations varied from each subjects, at the same time, we also need to compare their different behaviors with other two different situations (figure 4.2).



Figure 4.2 Observation from other two activities. a. Buying beverage from vending machine, b. Buying beverage from a clerk in fast food restaurant.

b. Wizard of Oz

Wizard of Oz is an approach to obtain a dynamic interaction and with a person impersonates the product, especially the part of “computing program”. In the experiment, a person will hide behind the model and control the mechanical part of the paper mock-up. By realizing the designed functions and interaction sequences, this person will watch subject’s behavior through a monitor connecting with one of the cam-coder, and responses after subject does specific things. So the whole interaction task can be complete. The conductor of experiment stood behind the main cam-coder and monitored the whole process; he would not involve and disturb subjects’ operation.

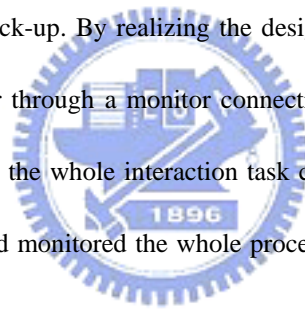


Figure 4.3 Experiment set up. The operation course was held in laboratory. Two cam-coders were set, one recorded whole behavior and process of task, another recorded subjects’ facial expression and connected with monitor behind prototype for operator.

c. Introduction

Every subject was told that it is a new designed vending machine, implanted sensors and having special mechanical device. Though it is a paper mock-up, subjects may imagine it is real with a die cast and possessing computing abilities. There is one thing need to be mentioned that according to the different operational sequences against contemporary vending machines, the process are particularly reminded to them: “order first then pay”, and all they have to do is to finish the five steps mentioned above.

A scenario was given to them: “One day you walk on the street and feel thirsty, suddenly you see a vending machine standing on the street, and then you walk toward it...” Then subjects may begin to buy a beverage. Each time every subject was given adequate money for buying one beverage and a fixed task proceeded in several main procedures: approaching, paying, taking beverage and leaving. Function for choosing beverage was not under discussion while we go through this procedure by same operational cues as normal vending machine does – a slit for dropping money in.



d. Operation Task

In order to focus on the evaluation points for our interactive design, we constrained the operation task in the following steps: (1) Approach, (2) Order, (3) Pay for order, (4) Get beverage, (5) Leave. (See details in figure 4.5 to figure 4.10) These five steps base on five subject’s actions. Subject only need to choose and buy a beverage from our prototype. The whole purchase procedure is depicted as following figure.

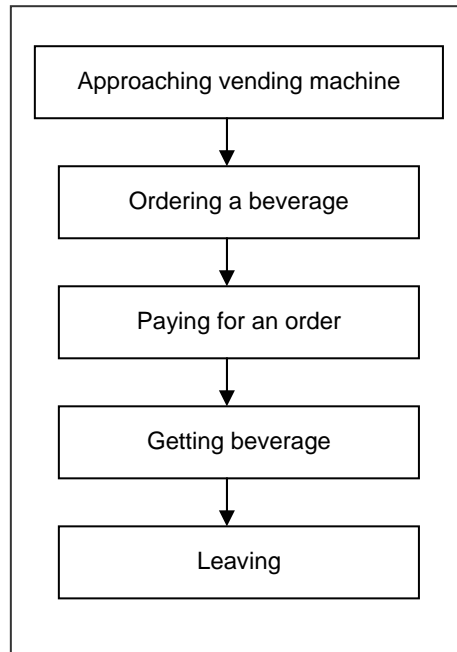
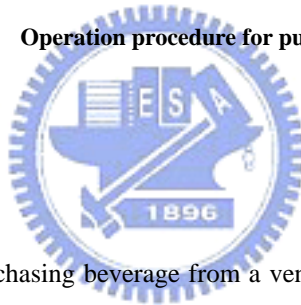


Figure 4.4 Operation procedure for purchase a beverage



Although a real situation of purchasing beverage from a vending machine is much more complicated, and people do have frustrations, sometimes their money paying for nothing, sometimes they regret after depositing coins into vending machine and want to get their money back. These situations are interesting but unable to be discussed while the experimental prototype lacking of complete functions and these situation may blur the main focus.

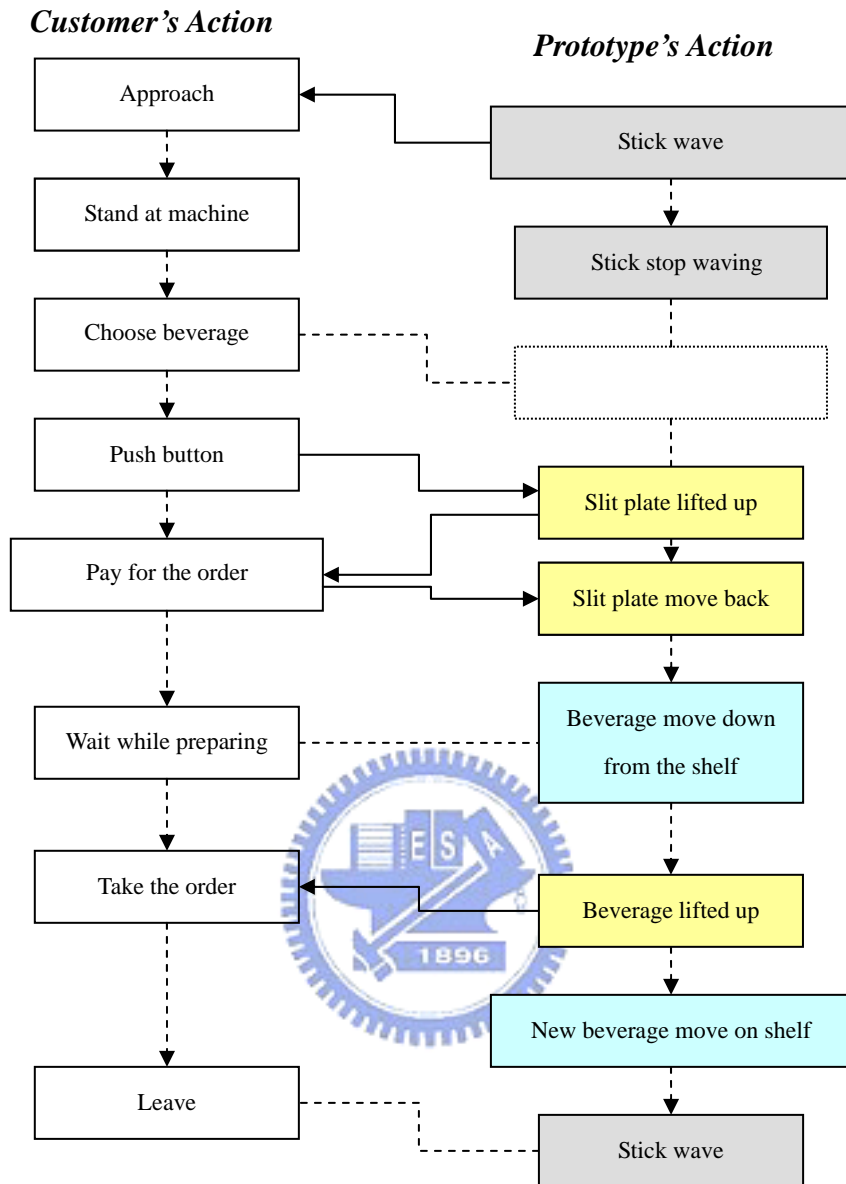


Figure 4.5 Sequences of subject's operating prototype and prototype's reactions.



Figure 4.6 Approaching Step: Approach, stick wave, stick stop, subject choose beverages. When somebody approaches, the stick will wave. While being stared, it stops and waits for customers' choice.



Figure 4.7 Ordering Step: Order beverages. Outlet's door opens. Slit plate lifted up. After customer chooses one beverage, the outlet's door will open and slit plate will then be lifted up to charge for order.



Figure 4.8 Paying Step: Pay for order. Slit plate move back. After receiving money, the slit plate then move back.



Figure 4.9 Getting Beverage Step a: Beverage moves down first and shows up in the outlet later.

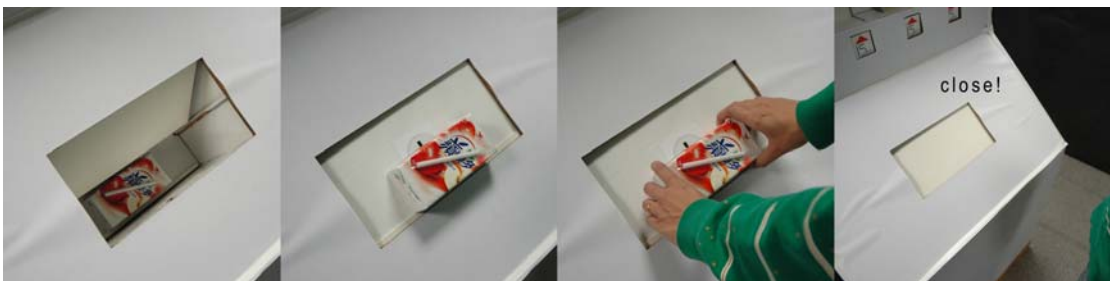


Figure 4.10 Getting Beverage Step b: Beverage lifted up for customers. Door closes. After slit plate lifted the beverage out, subjects take away their order, then the door will close.



Figure 4.11 Leaving Step: New beverage moves up to the shelf. Stick wave. After customer take their beverage, new beverage move up to the shelf and then the stick wave to customers.

e. Developing Questions in Interview

The following questions were asked during the interview after subjects interact with the prototype.

Part 1

- During operation, what are the most impressive features?
- What is that mean to you?
- How do you feel about its motion (behavior)?
- Compare with buying things from vending machine and normal purchase experience; please tell the difference you find in our prototype.
- After interacting with the prototype, what are your expectations on it and for further advance product?



Part 2

- Use keywords (Table 4.1) to compare with contemporary vending machine and our prototype.

Inspired from perceptive sorting method (Forlizzi, J., 2003), 12 keywords have been given to help subjects inducing their experience (see Table 4.1), including two categories, narrative words and affective words. Narrative words relate to people's mechanistic models of how they understand products and systems and their ability to control them; affective words relate to people's emotional response, as our goal is to

understand people’s attitude and feeling toward the new-designed features. In each descriptive category we have 3 pairs of adjective words. Further, subjects may be allowed to add other words by their opinions. We change two original words “simple” and “complex” into “simple performance” and “high performance”, in order to know whether the prototype have a functional improvement over contemporary vending machine, though they have the same purpose as “selling beverage”, and we know the adding motion attributes actually do not improve in any usability function.

Table 4.1 12 keywords to help recalling experience “*” is the word we change for our experimental purpose.

Narrative Words	Affective Words
Breakable	Bewilder
*High performance	Boring
Easy to use	Delight
Requires Efforts	Disappoint
*Simple performance	Entertain
Durable	Understandable



4.3 Extended Experiment

After primary experiment, we held two more different experiments for certain purposes. One is for controlling the effect from the form of the slit. Another is to find the relationship between association and interpretation, and we take the waving stick for assessed target. Both these two experiment only include an operation task and an interview. It is their opinions we want in these two stages.

4.3.1 Part 1 – Control

In the eight experiments, including pilot tests, we found an interesting question about the slit. During the interviews, subjects were asked about the hint of paying money. All of them considered that the form of the slit informed them most when the slit plate were lifted up, not the motion. So we then held another new experiment with no sign of form to figure out what if there is no form, can motion provide a hint for function (charge)? This time, we inform them that “after ordering beverage/pushing button, the prototype will charge to them” with a particular reminding.

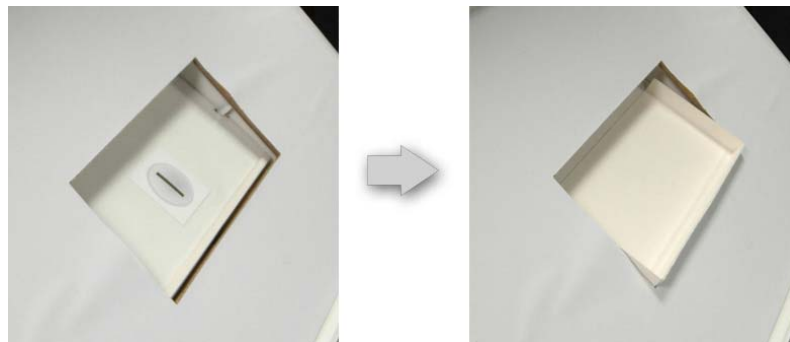


Figure 4.12 Change in the design of charging in extended experiment

4.3.2 Part 2 – Association of waving Stick

Another point is about the waving stick. All of the subjects have noticed it and can figure out its purpose. But easy as it may be seen, the interpretations were based on different associations varied from a happy dog to a clerk who is waving them to come. Being a notice for us, it shows that the same motions presented at the same timing may induce different psychological responses base on different connotations of attitudes. It not only shows a glance of diversity for human’s response (caring about social ritual or being evoked a much wilder imagination), but also reminded us, while being a designer, we should notice the target user’s possibly opposite interpretations. Sometimes it could be serious when touch on a cultural issue. But as a diverse opinions base on different interpretations, we are not going to change this feature so we can keep assessing it

about how many different associations and interpretations will be shown with this point. Beside, in stead, we want to verify about how people's association may affect the interpretation they make toward the same waving stick.

This time we recruited three students and none of them studies in product design. We provided nine cards with photographic images of different kind of machines (see figure 4.12) to subjects, instead of the original keywords in a group interview after each of them has interacted with our prototype. Since, we know that form plays a critical role in allowing people to talk about their relationships to products (Forlizzi, 2003). These images vary in functions, form, style (e.g., friendly or cold) and complexity of mechanism, and are as catalysts to elicit their thought and attitude toward our prototype. They are also asked to pick up one or two machines which are most similar with our prototype in their perspective. After their assignment, they are asked to sort these machines in orders base on functions, for which they think it can provide more service and do things for people. Thus we can know the position of our prototype in their mind base on what they emphasize on.

Finally, we didn't tell them to compare with buying things from a clerk. All we want to know is that how deep can people perceive the social intention, and what's the most obvious one among the three features.

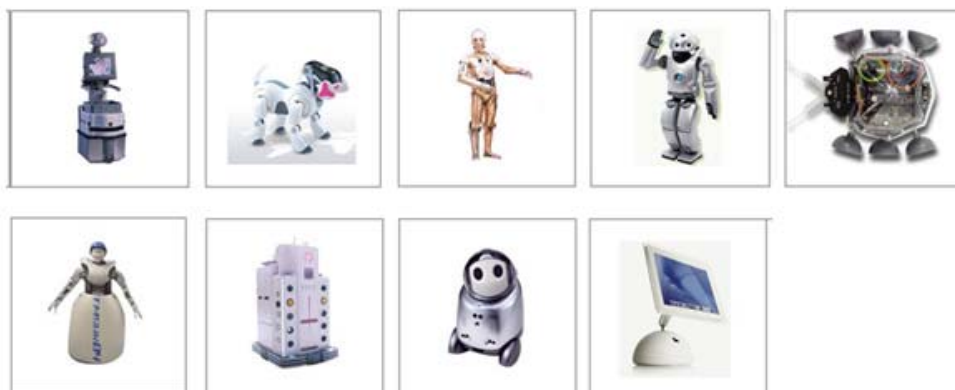


Figure 4. 13 Photographic images use to help subjects tell their opinion and thought.

Row 1, Pearl, Sony Aibo, C3PO, Sony Qrio, Robotic insect; Row 2, Tsmuk, Pyxis, Nec PaPeRo, Apple Imac.

Chapter 5

FINDINGS

In this chapter, we demonstrate the findings and how they were approached, after holding experiments with “Wizard of Oz” and the following assessment interviews. First, we analyzed observation data based on the steps of the “customer – clerk interaction flow”, which were mentioned in chapter 3 (figure 3.3), and compare with different behaviors toward similar task (e.g., waiting, ordering...).

In the primary stage, the first two experiments were pilot tests for assessing whether prototype was well in function and gather some opinions toward the effective of expressed attributes. At the same time, rough opinions were collected from the interviews followed the experiment. Then the experiment was made little adjustment on waving stick and revise part of mechanical components. After the preparation and adjustment, six test subjects operated the prototype first and their assessments were interviewed later.

Further, opinions gathered from other six subjects were collected and classified, including: **(1)** Approaching, **(2)** Paying money, **(3)** Delivery of beverage and **(4)** Leaving. The results can also refer to recorded videos, including their behaviors, face and eyes. Questions from the observation were also asked during interviews to verify what were saw and how they meant to it. After consolidating outcomes above, two more experiments were held, one is control and the other is extended experiment, to verify questions found in the first stage.

5.1 Comparing Three Observation – Primary Stage

In this section, we are going to demonstrate our observation of people's behavior. This will span into three situations and base on several stages. First of all, three kinds of purchasing process – from a clerk, from a vending machine and from the prototype (see figure 3.3, figure 3.4 figure 3.6 in chapter 3), were used to develop our observation result. We compared these three situations in order to understand what the differentiations are within. Further, the flow breakdowns into six steps, base on the actions of clerk. In this clerk's action-based category, the contemporary vending machine can not provide any actions, but in order to compare with the similar sequences much easier, the subject's behaviors were depicted in same row.

In which prior interested behavior we are concern, the first is that where they put their attention on, and the further is dynamic interaction pattern – what reaction of subject will occur after the clerk/VM (vending machine)/prototype do certain things and where the motion occurs, including relevant body language. The third is their facial expression. The six subjects' observation were recorded and categorized in tables (see in appendix, table 6.1 to table 6.6).



Subject A smiled when she found the slit plate lifted up in the outlet. She then mentioned it in the following interview and considered it “*just like my pet come for me asking for money*” (maybe she actually mentions about food?). She smiled partly because of her wondering where the slit was and then it showed up in the opened outlet, also, she felt surprise on this action. The motions attracted her eyes easily.

Subject B also felt delighted to the prototype and she smiled when she found the slit just as subject A. She first noticed the waving stick and smiled, and the slit plate also surprised her. We found that the motions can attract her focus easily, and she stood back after being charged by slit plate and look into outlet. After noticed her order moved down from the shelf, she looked down at the outlet directly. Though we found that subject B is an extrovert and always acts exaggerated, but it is still easy to distinguish that she is surprised by the actions according to her laugh sound.

We found that Subject C also stood back and wait for what will happen next, after slit plate charged him. He looked into outlet for a while and then was aware of his order moving down from the shelf. He then moved

his eyes back to the outlet (his said he predicted his order will show on slit plate in the outlet). It is interesting that base on people's experience, while using a vending machine, they look directly at the outlet after they push the button. However, for our prototype, subjects will look up and down to check reactions, or they begin to anticipate what will happen next.

Subject D smiled after the outlet door opened. She also looked up and down to check the prototype and wondered what the next action will be. Just like other subjects, she stared at the slit plate moved back and then notice her order moved down from the shelf, and quickly looked into the outlet and then she found her order appeared in it. She then stretched her hand into outlet before her order was lifted up. One worth mention is that after she took the beverage from outlet on the slit plate, she looked at the outlet and "nodded", but she did not remember why. After taking her order, she stood in front of our prototype and checked if there were still any other actions. The waiting only remained for a moment and she left before saw the stick waving.

Subject E paid the money directly when she saw the slit after outlet door opened. (She said that she had been looking for a slit for a while when we asked her during interview). And then she stared at the slit plate moving back. She looked at her order first and also predicted that the order will show up in the outlet. Like subject D, she waited for only a moment after getting her order and missed the waving stick.

In all cases we found that the motions were easily to be noticed so subjects can clearly know what the prototype do in the whole process. Subject F also stared at the slit plate when it moved back, and as other subjects did, he constantly check up and down for cues that may inform him what will happen next.

Summary of Observation

Comparing with other two activities, the findings from the observation in operating prototype are summarized below:

- All subjects tried to figure out what will happen next with curiosity after they noticed the prototype may have lots of motion, but they did not pay much attention to the waving stick.
- What subjects gave the waving stick no more than a glance is similar to people who tend to move

their eyes away from a clerk when ordering.

- 4 subjects smiled to the opening outlet.
- All subjects stared at the motion of receiving payment, and it is similar to what people do (look at the hands of a clerk when a clerk settling account) at a counter.
- 2 subjects stood back after payment. It seems to be an overused social proxemics.
- 4 subjects left immediately after getting beverage.
- One subject nodded to the outlet unknowingly after she took her order.

Almost every one gave only a glance to the waving stick, even though they saw it clearly, and ignored it later in the operation task. We consider that one reason subjects did not stare at the waving stick more than a glance is also similar to people who tend to move their eyes away from a clerk's.

Four female subjects all smiled while being surprised by the prototype, especially when the outlet door opened and then slit plate came out for charge. In the interview followed this experiment, we knew that partially due to their bewilderment of "Where is the slit?" at the first sight, although they were informed a fixed task to proceed - pay after ordering. The motions can easily noticed by subjects and transfer their focus. Another interesting finding is that some of them will stand back and present a waiting behavior, (one cross his arms over chest, another stand with hands on waist). This type of action (standing back and wait) never happen when they choose beverage or waiting for a delivery at a vending machine. For this new prototype, they stand still and wait for other reactions to come, they did not stand back and stare at "what is going on" of the prototype but check up and down.

Another difference is that when people already paid and made an order from a vending machine, they tend to look down at the outlet directly for the delivery of their order. In the contrast, when interacting with our prototype, the focus is on the moving back slit plate, then transfer on the shelf, and return to outlet eventually. It is similar to that every subject stares at the clerk's behavior (hand) whiles the clerk receiving payment from subjects. In the contrast, they won't stare at the slit after paying money.

During the experiment, all subjects tried to figure out and predict the next reaction of the prototype,

learning and defining things as they saw. Everyone can easily figure out that the beverage will come out from the outlet, which was not told to them before. They looked at the outlet immediately after they saw their order moved down from the shelf. The expectation toward our prototype seems to be high after operating it. People will wait for a while after they had already got their orders, looking to see if something would happen afterwards.

Moreover, one subject even nodded unknowingly to the outlet which just lifted up a beverage to her is the evidence for this.

5.2 Assessment Interview – Primary Stage

After finishing each experiment course, we interviewed each subject individually. Structured questions were asked, for the purpose to assess and compare our prototype with purchasing from clerk and vending machine and for specific purpose we mention before. We used voice recorder to record the conversations during interviews. Questions for emotional feeling were emphasized.

First we typed down all important dialogues and made notes from voice recording play back. Then we split all dialogues into 7 categories, including (a) approaching, (b) during payment, (c) delivery and getting beverage, (d) leave, (e) associate experience, (f) estimate as a whole (g) expectation and suggestion (see in appendix). In each category, they may include different or same comments from subjects. The times of replicate comments were recorded so we can easily see what is much preferred or paid attention to.

Finally, opinions (original quotations may be seen in appendix) and finds were classified into four categories: (1) being approached, (2) charging, (3) delivering beverage, (4) ending. These categories were classified base on prototype's four reactions.

a. Being approached

When subjects approached to the prototype, many subjects ignored the waving stick unwittingly even they clearly saw it waves; but all of them can easily told what may be its purpose. Three of them consider the waving

stick as “waving at them for them to come” when approaching, but taken as impolite behavior for the reason that “*nodding is much polite for an unfamiliar relationship*” said two subjects. “Waving at them for them to come” seems to force them to buy something. One subject considered it a happy dog waving its tail quickly for welcome. Contrary to designer’s expectation for “saying hello enthusiastically”, only one can feel the psychological purpose. Other subjects seemed to show no appreciation on it, and the attraction is low. Another reason is mentioned by subject that the position was too high to be noticed.

b. Charging

After choosing which to buy and pressing the button, the slit plate lifted up. Five subjects said that it is a clear implication for informing charge, mainly due to affordance of the slit and the order of prototype’s reaction after they order a beverage. Two of the subjects think that the way slit plate lifted up for charge and then receded back after subjects drop money is similar with the way a clerk would do. Partly because of the position is located in an appropriate place for subject’s hands to take things, and where subjects pay for is just under their hands. One subject smiled when she found the slit plate lifted up for the reason that she considered it as a cute pet coming for asking money. There is one other thing worth mentioning, another described this similarity as “parallel” and “face to face”. Three of the subjects mentioned the word “active”, one of them said this active of charge is just like a pet intimately coming for charging; another would have more expectation due to the initiative action. One considered the “slow speed” of the lifting and receding action as a courteous behavior.

c. Delivering Beverage

Four subjects felt the prototype had done this process in an active and automatic way, which lead them to relate the process done by a clerk. The delivery process is considered important because of following reasons: (1) Reliability – seeing is believing, showing procedure can make people feel explicit, (2) Certainty – they can clearly see what they buy is the “right one”: what they want on the shelf, instead of getting the “same kind of beverage”. (3) Real purchase experience – buying a beverage from a contemporary vending machine is like

“exchange” things, but showing the delivery process seems like it replicates the situation of buying things from a store. *“The motion of moving beverage down from the shelf and then showing up on the slit plate is just like a clerk takes things for you and then hands it to you.”* moreover, their rights have been guaranteed, feel at ease and think prototype as credible instead of being cheated. The movement of lifting beverage to people is clearly recognized by all subjects as a mean of presenting things respectfully to people. One even mentioned about the similarity with *“holding things by clerk in both hands”*. In conclusion, this presentation is considered polite because the beverage was lifted up, which the position changes from bottom to top, even though the slit plate does not look like a hand at all (there is no formal implication).

d. Ending

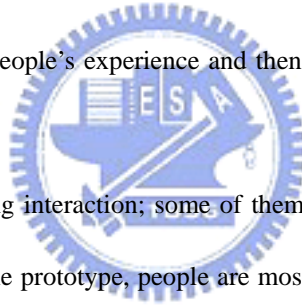
After operating the prototype, most subjects left immediately after they got their beverage. Few noticed about the waving stick would wave again at the same time when they leave. Two subjects who noticed it knew that it presents meaning of “farewell”, one of them considered it like a waving gesture of “saying goodbye”. In addition, we summed up how many times the subjects used keywords (table 5.1). Adjective words were used toward different features or opinions. First, subjects think the added motion features make our prototype perform better than contemporary vending machines. According to the interviews, we found that “high performance” usually grouped with “breakable” and “complex”, and some may also link with high-tech. It seems that in some people’s experience, the more powerful machine can be the more breakable they are. “High-tech” and “high performance” tend to give people a breakable impression due to “complexity”.

Table 5.1 Score of Adjective words toward Prototype

Narrative words	score	Affective Words	score
Breakable	4	Bewilder	3
High performance	5	Bore	0
Easy to use	5	Delight	6
Require Efforts	1	Disappoint	0
Simple performance	1	Entertain	4
Durable	0	Understandable	5

- Other words -			
Newfangled	3	Interesting	3
Active	4	Reliable	2
Complex	4	convenient	3
High-tech	2	sincerity	2
		vivid	2
		considerate	2
		friendly	2

Further, “easy to use” usually comes with both “understandable” and “complex” in our experiment, while “complex” is used toward the added motion features. It shows that even the hints from reactive motion are complex, if they can correspond to people’s experience and then guide them will, operation problem will be solvable.



All subjects feel delighted during interaction; some of them also feel entertained. No one feel bored or disappointed. At the first glance to the prototype, people are most bewildered by the paying slit because they had trouble finding it, as this prototype is told to be a vending machine. Subjects said that they have already got used to search the slit first when using a vending machine. But after they push the button to order a beverage, the slit lifted and confusion disappeared. They feel surprised and appreciative of the functionality.

Summary of Interviews

- Intention of greeting by waving stick was clearly perceived, but interpreted in different ways with different associations.
- 5 subjects paid no more than a glance at the waving stick.
- All subjects could easily tell the intention of the lifted up slit plate but have different associations.
- The slow motion of the lifted slit plate was considered as being polite.
- The motion of delivering beverage was related with real purchase experience by all subjects in

different.

- The motion of lifting beverage from bottom to top was easily associated with “a clerk hand out beverage to them”.
- The lifting up motion was considered as holding beverage in both hands respectfully.
- “Active performance” and “doing things for them” let subjects feel of being served.
- The prototype was considered as easy to use and understood by 5 subjects though it was also considered as complex, and also link with high performance.
- Positive opinions were given mostly on emotion descriptions, including “delightful”, “entertaining”, “interesting” and “vivid”. Three psychological descriptions also appeared: “reliable”, “considerate” and “friendly”.

In conclusion, applying social cues by motion feedbacks is as cues of our prototype, and which are considered to be active, guiding people what to do next and reduce people’s work to make subjects feel like being served. *“Watching machine preparing/working for us or being occupied may let us feel delighted and bring an experience of pleasure”*, said one subject. Two subjects also feel reliable toward our prototype. They think it is much powerful in function and competitive to other contemporary vending machines. The augment in active “service” – receiving money and delivering beverage, induced subjects to have more expectation on service from it. It is also worth mentioning that two female subjects consider our prototype a pet. However, these additional motion attributes are still not enough for. Subjects pointed out the need of voice cues may give a more complete interaction.

5.3 Assessment of Design Intention

We compare the new features of our prototype with designer’s purpose and subject’s interpretations in order to realize how they think about these features and the distance between them.

Table 5.2 Comparison between designer’s purpose and people’s interpretations

<i>Features</i>	<i>Designer’s purpose</i>	<i>People’s interpretations</i>
Waving Stick (Applying enthusiasm)	Say hello (by waving hand)	Wave hand for beckoning people to come (impolitely)
		Dog waves tail for welcome (enthusiastically)
	Say goodbye (by waving hand)	Preset farewell
		No meaning
Outlet and Slit Plate (mimic human motion)	Stretch hand for charge and receive money	Receive money politely and actively
		Charge for the order
		Like pets come for asking some things
	Hold up things in both hands to people	Deliver
		Bring to people
		Hold up things in both hands
Mechanical Device for Delivery (mimic human motion, being polite)	Take things for people/ prepare for order	Take things (then bring to people)
		Prepare for people
		Being occupied
		Have feeling of buying something

Summary of Design Assessment

Below is the design assessment summary:

- All intentions can be perceived and realized but interpreted in different psychological meaning.
- Only one subject perceived the “enthusiastic characteristic”, but associated with a happy dog.
- 5 subjects can tell waving stick’s intention but pay no more attention on it.
- Slow speed of lifting up may be considered as polite.
- The changing position of motion is mapped on a real person’s behavior.
- The position of where activity happens is mapped to a real situation.
- Both abstract and analog motion works.

An aggressive personality - enthusiasm we applied on the waving stick is ignored by most of the subjects. Some thought it is inappropriate and impolite. Another reason is the location. It has been placed on a higher place and almost out of the site when operating.

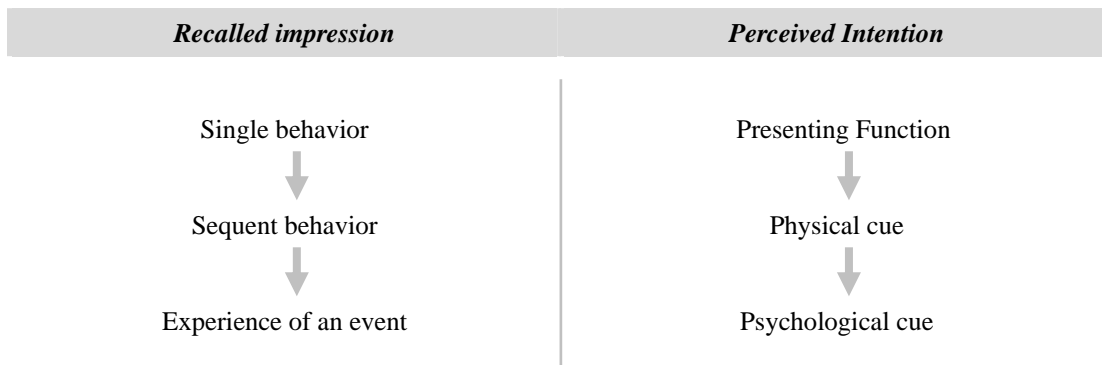
According to the interviews, we found that position is a key factor to present social cues. The beverage moved down from the shelf and then delivered to subjects induced them to associate with a clerk taking things from the shelf to them, and the height of where beverages deliver to people is on an appropriate position (under subject's hand) which was considered as a clerk hands things out to them; therefore, position where behaviors occur is a key point.

Moreover, the slit plate lifted beverage "from the bottom to the top" is similar to the gesture of "holding beverage up". The functional hints of form here are the shelf, the beverage and the plate. Besides, there is no more formal hint. In the formal analysis we knew that plate is the meaning of hand, hence, "holding up beverage in both hands with politeness" is due to the transfer of position, "from the bottom to the top".

Further more, we found that people interpret their perception of social presence depending on different individual's experiences, and the perception may be varied in different degrees. The first, easiest perception is toward functions, such as "*My order delivered out...*". Some would say "*Brings my order to me*" which is a physical cue. Then, we can find psychological cue perceive from subjects while they said "*Just as holding up my order in both hands with politeness*". The feeling of being respected is a kind of psychological effect induced by motion.

Interpretations toward mechanical delivery device can be divided into various degrees, from a single behavior of taking things to people to an event of buying things. First, it is easily to tell "the one I ordered was delivered to me", which is considered a single behavior. Moreover, some said "*the device is just like a clerk busy preparing things for me*", which includes several behaviors. Finally, an experience was recalled as "*exhibition of the delivery device lets me think of a real purchase experience: I took what I want to the counter, and the clerk charged me...*". Though the interpretations may have lots of difference, however, its implications of social intention are apparent (summary in table 5.3).

Table 5.3 Degrees of being aware of social intention



5.4 Extended Experiment

This section includes two extended experiments, one is a control for verifying the effect of form, and another is for advance understanding toward the waving stick. Each of them has its own purpose to evaluate with.

5.4.1 Part 1 – Control

Analysis Result



In the former experiments of primary stage, subjects can easily perceive the intention of “stretch hand for charging”, but in the composition of this hint, it seems that the implication of slit is stronger than the motion of “lifting up”. In the extending experiment part 1 as a control, both two subjects (subject 2-A and subject 2-B) did not know what the plate lifted up for, they got stuck even they were particularly reminded with “the machine will charge to you after you push the button” before. They said that even though they thought of paying money, but the plate did not look like the paying slit, moreover, they did not even know where to “drop in”.

Obviously, the motion of “lifting up” is merely a hint for “doing something at the moment”, but lack in “what to do”. In other words, when it comes to the implication of function, using form to guide people what to do is better than using motion (implication of function – form > motion). So when we took out the slit, the implication of intention for “Stretch for charge” disappeared. For instance, the lifting up motion means

“stretch hand for”, and the slit means “charge”. The implication of form is much important, but only by combining these two elements can the social intention be integrated.

We may also examine this thought to the waving stick. The stick was considered as a tail of a dog because of the form, the motion of waving then made subject felt the waving stick as a waving tail. If there is a waving ball, or a waving box, they may be interpreted as other things or behaviors. Still, the waving stick was considered as a waving tail of a happy dog by one subject and a gesture for beckon by another.

Summary

The findings in this control are listed as summary in the following descriptions:

- Motion can not be independent without function hint.
- Implication of function – form > motion

5.4.2 Part 2 – Association of Waving Stick

Result and Analysis

In the beginning of interview, subjects could only tell about their feeling of the waving stick, obviously, the waving stick is the strongest social attributes to them, but during the card sorting assessment, they can told more things about the other two features. Here we are going to introduce how they sort these cards and what is the association of feature that impressed them most.

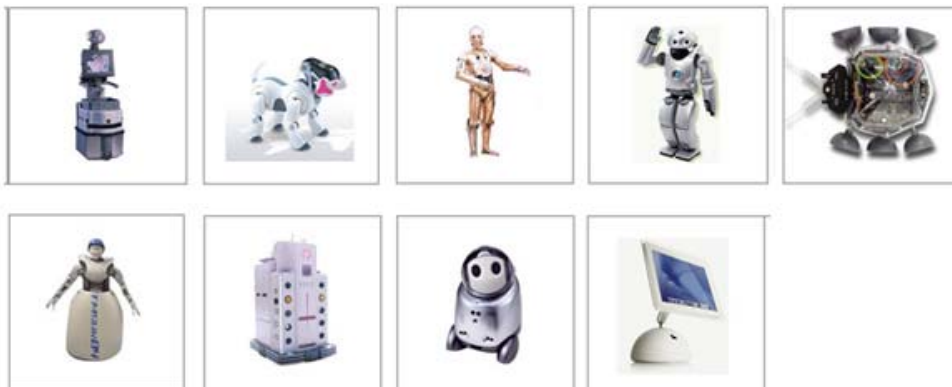


Figure 5.1 Card sorting: photographic images use to help subjects tell their opinion and thought.

Row 1, Pearl, Sony Aibo, C3PO, Sony Qrio, Robotic insect; Row 2, Tsmuk, Pyxis, Nec PaPeRo, Apple iMac.

Subject 2-C



Figure 5.2 Subject 2-C's sorting, She assigned Pyxis and PaPeRo as our prototype like.

According to the complexity of machines, subject 2-C sorted the more complex in mechanical component to be powerful such as domestic robot, and she sorted the more entertainment to be weak in functions. Thus, although the Qrio is complex too and as a humanoid robot, it looks much cuter than others and is taken as less in functions. *"It can only say hello for welcome people"*, said the subject.

First, she thought the waving stick as a happy dog waving its tail excitingly and it is cute. Second, Pyxis looks like a contemporary vending machine, so does our prototype. She chose PaPeRo because of the cute form and its eyes, it seems that it can solace people, she recalled the feeling when the outlet door opened and slit plate was lifted out, she felt like something stared at her from the outlet. *"I felt it was telling me what to do next, so the whole procedure let me felt comfortable and satisfied"*, she said. So our prototype is like a contemporary vending machine but capable of entertaining and solacing people.

Subject 2-D



Figure 5.3 Subject 2-D's sorting, She assigned Qrio as our prototype like.

In subject 2-D's opinion, the Robotic insect was considered as the powerful one in function because of its most complex mechanical components. Tsmuk and Qrio seem to have arms to do lots of things than PaPeRo

and Pearl. Imac is merely a computer. Humanoid robots look like they can talk to people while Imac does not. C3PO looks too stiff and cold. Aibo is a fake dog (though it was true), so she does not like it. It is obvious that she sorted these cards mainly because of the complexity, and then accord to the friendly form. Differing from others, Subject 2-E thought the waving stick as a waving hand but also with excitement for welcome people.

Qrio waves its hand just like our prototype does and it moves slowly as the prototype presented. Moving slowly implies no hurry. Waving hand seems being thoughtful for people actively. *“Its eyes look cute and make me associate with the waving stick of the prototype, and it also makes me have a better mood when I see it waving to me. Its friendliness and cuteness look like it can help me to do things and allure me very much and I want to make friends with it”*. Base on her sorting, our prototype is much more friendly and cute than a common machine.



Figure 5.4 Subject 2-E's sorting, She assigned Pearl (and Tsmuk, for a little bit) as our prototype like.

Base on the reason of consideration, subject 2-E considered a machine like dog which can take people's order such as getting a newspaper may be much powerful. *"It is much willing to do everything for me"*, she said. In brief, what she cares about is whether machine can serve people in a friendly way, and that is why she chose a robotic puppy, Aibo, as the most powerful machine. At the same time, it is because that Pearl and Tsmuk looks less considerably, so she put them after Qrio and PaPeRo. As both Pyxis and C3PO looks cold and unfriendly, she does not expect them do anything for her. An interesting thing worth mention about is that she likes robotic dog more than a robotic man. In her opinion, communicate with real person is enough; she does not need another "fake person" to interact with her.

Subject 2-E, just like subject 2-C, thought the waving stick as a happy dog waving its tail with excitement for welcome people. But she took the wave as a gesture of goodbye. *“It is because that it looks like a hand first, so I considered it as a waving hand”* (She then make a gesture of wave), she said. In her opinion, both Pearl and Tsmuk have arms to “take out beverages from their body for people”, taking beverages out also gave her a feeling of surprise, and they look like to have capacity for storing beverages. Actually, she thinks Pearl has the closet similarity as our prototype. The Tsmuk looks like a bosom friend, *“especially as the prototype can take beverages for me, it is a feeling of consideration”*, and *it also let me recall the wave”*. It is because of the “consideration” made her chose them. Apparently, our prototype is better than a cold machine in function, and also much more considerable and friendly.

Analysis

Dramatically, in this stage, differing from the former, all subjects replied in concert that they all considered the waving stick as a connotation of being friendly, cute and excited for welcome people. Two of them said it looked like a cute, happy dog quickly waving its tail; the other considered it as a cute person waving at her (it is also found that she did not appreciate a robotic dog either in the interview). Everyone thought that its form looks like a tail or a hand at the first sight and affects their association most. All of them took this feature as the most obvious and cute attribute. In comparison with the results of primary experiment as a whole, waving stick exhibits the most obvious social intention than others due to the assistance in formal cues.

In the sorting course, although there are different sorting results between each subjects, they all mentioned about friendliness and consideration which is considered important to them. Photographic images showed their influence. All subjects was able to relate the prototype doing the action to “bringing beverage to them” when they saw a robot’s arm in cards. Our prototype always located in a position that is friendlier than a machine, also more like a robot and considered as being considerable and friendly.

In this stage of experiments, the waving stick conveys an exciting characteristic when its expression is attached on an image of a cute person or a happy dog. In contrast with the former stage, when the prototype is

associated with a clerk, waving stick became a waving hand and may be considered as being impolite. The feature is the same, but the interpretations vary. Further, we infer reasonably that why some of the subjects pay no more than a glance to it may be the same situation when facing a clerk. To avoid the embarrassing eye contact, people tend to move their eyes away from the clerk's eyes, but the social ritual told us watching people's eyes while speak to them is polite.

Again, we find the motion affects people's associations psychologically, which was considered as friendliness, excited. Form still does a good job when exhibiting social intention especially providing assistant implication. But meanwhile, psychological responses could also result from their feeling more than their cognition of prototype's intention toward the delivery feature. In other words, they can also perceived the intentions but not through an analog body language. Abstract motions also work more emotionally than cognitively.

As a whole impression, our prototype is friendlier, more considerate and powerful than a common machine. That is why our prototype is more attractive than newfangled. As it is not defined to perform a specific role in form (e.g., a pet or a clerk...), so it diversifies the associations and interpretations and finally affects the psychological perception by motions.



Summary

The findings in this stage are listed below:

- A quickly waving stick is considered as a friendly, cute and excited character.
- Form leads to an associative object, then, the motion affects what the object do.
- Interpretations depend on individual's preference.
- What prototype does for them may let them feel considerable.
- Abstract motion affects more in emotion than cognition.
- One subject responded to the waving stick by waving her hand when she left.

5.5 Consolidation

In section 5.3, we have realized that the position of where motion occurs and the changing position that component moving from one place to another place are key points for expressing social intention. Another key factor of motion to present social intention is speed, which was mentioned in section 5.2 and 5.4.2. A quickly waving tail is considered as a dog happily waving its tail to welcome people. A slow speed for the slit plate being lifted up to charge was considered as a polite behavior. Hence we know speed and position are not only the factor of motion, but also factors of social cues.

Moreover, according to the discussion of lifted slit plate in section 5.4.1, the position of slit plate cause subjects to associate with gesture of hands, since the lifting up motion means “stretch hand for”, and the slit means “charge”. When it comes to the “lifting beverage motion”, a slow motion of the lifted slit plate was considered as “holding beverage up in both hand with politeness”, because we have know the plate means hands, the position was mapped to gesture, thus the slow speed directly connects to politeness. In section 5.4.2, a quickly waving stick is considered as an excited, happy dog waving its tail, since we have known that the form of the stick provide basic associated image of dog’s tail, and the wave directly maps to the wave behavior of a dog, thus the quick speed connects to excitement and happiness. Obviously, though form can provide basic and initial characteristic in psychological cues (e.g., it looks friendly and considerable), but only the motion can provide deeper and more powerful psychological cues, instead of an “expectation” induced by form, such as attitudes of politeness, reliability, consideration or excitement. We can say that only by exhibiting motion, can product provide stronger psychological cues. Therefore, we can say that in social psychological effect, motion is stronger that form (implication of psychology: motion > form).

In summary, we collect our findings in several points: **(0)** Form is decisive cues in presenting social intention. **(1)** Position and speed are factors of social motion cues. **(2)** Form and motion are interwoven when exhibiting social intention. When it comes to provide implication of function, the form is much more effective than the motion, and the motion can not be independent. When it comes to psychological cues, motion is far more effective than form. **(3)** What people behave while interact with our prototype have some similarities

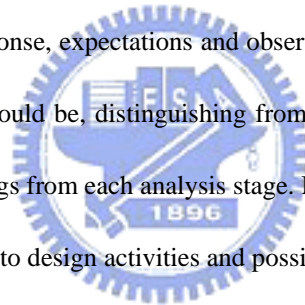
with what they behave when buying things from a clerk. (4) Through motion, product can provide more than functions and enhance the relationship with people. Most important of all, it can be considered as being reliable (by seeing what it is doing) and feel it friendliness. (5) Motion can solve usability problems. (6) The degrees of awareness that people perceive a social intention may vary from person to person. The more social consideration is taken, the more respect it may shows to people. Since we know form can conduct associations well, to use an explicit form can solve this diversity problem. (7) Naturally applied social norm were observed. For one subject nod to the prototype unintentionally, two subjects try to keep a proxemics and one even say goodbye to the waving stick naturally.



Chapter 6

CONCLUSIONS

According to the possibilities that digital product can provide more interactivities to people, applying social intention on product can be encouraging and seductive. Since functions between products are getting much similar with each other and all of them are powerful, how to catch users' eyes becomes much competitive. In product design's perspective, besides form, the issue will expand into engaging with users' life and living context socially. We demonstrate how motion could convey social intentions by a product, as a leverage to attract people, and discuss about social motion cues from knowing people's response, expectations and observing their behaviors. Finally we exhibit how different a social product would be, distinguishing from contemporary ones. In this chapter, we are going to conclude the findings from each analysis stage. Meanwhile, make a review to the experiment and then purpose comments to design activities and possible extending studies.



6.1 Research Conclusion

After consolidate all results aggregated from experiments and observations, the following conclusion were obtained:

(1) Position and speed are key factors of psychological cues in motion. Through analog gesture or body language, motion can convey social intentions. The position of where motion occurs and the positions of component moving from one place to another place would induce different association. Speed is also a key point of presenting social cues, especially in psychology. A quickly waving tail is considered as a dog happily waving its tail to welcome people. A slow speed for the slit plate being lifted up to charge was considered as a

polite behavior.

(2) Form and motion are interwoven when exhibiting social intention, especially form can provide decisive functional hint. Form leads to an associative object first, then, the motion affects what the object do in people's association. Though we did not focus on discussing form, but we still found the relationship and connection between them. When it comes to provide implication of function, the form is much more effective than the motion, and the motion can not be independent. In stead, it requires other assistant channel, such as voice and form to complete an implication of functions. In the contrast, when it comes to psychological aspect, motion is far more effective than form.

(3) Embodied motion exhibits a strong social dynamic. As we may see people not only respond socially in mind but also respond in their body language. The kinetic of social presence can trigger people's body to respond socially by trying to keep a proxemics or nodding unintentionally, even presenting a reciprocal greeting to the social motion. The performance of interactivity is high when using a social motion cue. Thus we know that motion design can attract people intensely, it would also be a good design ingredient to catch people's eyes.

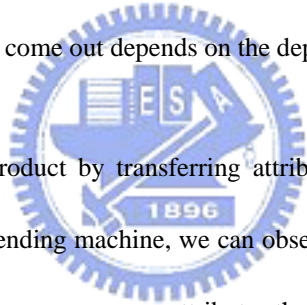
(4) Abstract motions, presented without anthropomorphic form, affect more in emotion than cognition in comparison with analog motions. An analog motion, which can be easily mapped with a body language, is easily associated with a real person's behavior because of its contour, but abstract motion is capable of affecting people emotionally while having no clear image of connotation. Throughout whole interaction process, people are able to distinguish or perceive attitudes through motion, including politeness or consideration.

(5) Social motion cues may solve the usability problem as well and provide more than use. Through motion,

product can not only guide people when using it. Our prototype is considered to be easy to operate. Although they think it is complex and of high performance, they will not repel it, in stead, it guides them actively in operation. Further, a social product can provide more than functions and enhance the relationship with people. In our study, the social attributes we add in may let people feel delighted. For one reason is because they feel of being served by seeing “motions”, another is the feeling of considerable and friendly. In other words, customers obtain more than buying a beverage, and they appreciate it more. Most important of all, people take it as much reliable.

(6) The degrees of awareness that people perceive a social intention varied first in presenting functions, and then physical cues, finally is the psychological cue. The degrees of recalled association when they perceive social intention varied in single behavior, and then sequent behaviors, finally recall an experience of one event.

These degrees of differentiations may come out depends on the depth of this experience is evoked



Applying social attributes on product by transferring attributes through observing the similar role of human is efficient: when designing vending machine, we can observe clerks; when designing learning toy, we can observe teachers. These social roles may possess attributes that will make people appreciate. Once we find the key attributes or personalities, augmenting seduction of product will be much easier.

According to the address above, we believe that a social motion attribute can allure people strongly especially in psychological meanings, regardless of whether it is anthropomorphic in appearance or not, and affects deeper than a form. In other words, moving products may be more attractive than a static one.

6.2 Design Social Product

Base on our study, we address several comments to design social product:

- (1) Both analog and abstract motion could present social intentions
- (2) Position and speed is the key factor to construct psychological cues.

- (3) Utilizing explicit form as assistance in providing function hint.
- (4) Motion attributes should correspond to form by people's expectation.
- (5) Extrovert characteristic is much appreciated.

The associations toward social presence may vary from people to people, especially depending on their preference. If the association is much entertaining or interesting and less human-like (e.g., a dog or a cute person), it will lead to a positive connotation considered. We can say that the more social it is perceived, the more critical it may show by people. Since we know form can conduct associations well, it is form that can solve this diversity problem. Finally, to deal with social attribute, designers should be much careful, the more social presence user can perceive, the more serious and critical attitude they may care.

6.3 Contribution

In this study, from prototype design to experiments and observations, following achievements have been made:



- (1) Demonstrate how to design a social product.
- (2) Provide a way to evaluate the effect of social motion cues.
- (3) Demonstrate how people response and assess to the tangible social interaction.
- (4) Purpose the key factors toward designer while designing social motion cues.
- (5) Demonstrate how social product can affect people through motions.

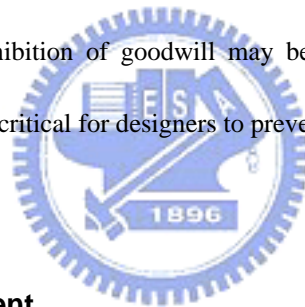
In conclusion, assume that social-emotional interaction is a knowledge database which every one possesses them fundamentally and naturally. Therefore, by connecting to this data base, we can not only diminish confusion and frustration while using products, but also augment positive experiences and fulfill human expectations. According to our assessment and literature reviews, designing motion may be a new strategy for product designer to "catch user's eyes", and even engage more.

So what is the differentiation between contemporary motional designs in comparison with our study? We believe that the attributes distinguishing from other attractive designs are: apply meaningful and significant

social attributes, create reliability between human and machine and respect human beings. There are lots of different vending machines for the purpose of selling tickets, soft drinks and etc. Many of them may be operated differently and require learning.

Our experiment demonstrates that by applying social dynamic pattern and social norm in interaction design which is familiar to people, could also reduce the burden of operation confusions. Further more, the effect of providing reliability and feeling at ease is out of our expectation, but it is also the requirement of “service” by people. We also notice that even with a product which contain special attractive attributes, if it keeps doing the same things and have no variety, people will get use to it and the attraction would be lower and lower. So it is much better if we augment interactivities, in other words, when it comes in social aspect, it means rich in social dynamic design.

Also, for a designer to know what are in people’s mind is important, especially when it comes to perceiving social intentions by people. An exhibition of goodwill may be considered as a bad will by people, and moreover, understanding why is also critical for designers to prevent offending their user.



6.4 Further Research Comment

Base on our conclusion, the effect of motion and form while presenting social intentions should be examined by a quantitative tool, in our research it seems that they also depend on different situations.

The relationship between motion speed and percept of politeness is uncertain. We found that a quickly waving tail is considered as a dog happily waving its tail for welcome. A slow speed for the slit plate being lifted up for charge was considered as a polite behavior. But what we do not know is the actual frequency of speed: how fast will people perceive as a friendly, and how slow will people consider it to be polite.

Since we know that motion is hard to be independent while presenting social intentions, how could other channels interweave with motion and how these combinations can convey variety of means or differentiate in effectiveness are interesting issues waiting to be discovered.

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APPENDIX

a. Wizard of Oz 操作員 操作手冊

<i>Subject's Action</i>	<i>Responded Operations</i>
<< 接近 >> (進入 4 公尺距離內)	搖動棒子 (每晃 4 下，間隔 3 秒)
<< 離開 >>	搖動棒子 (每晃 4 下，間隔 3 秒)
<< 目視棒子 >>	停止搖動棒子
<< 按下選擇按鈕 >>	停止搖動棒子
<< 按下選擇按鈕 >>	門開啓 → 投幣孔上升 (緩緩地)
<< 投幣 >>	1. 投幣孔降下 (門維持開啓) 2. 降下選取的飲料，將飲料置於投幣平台上 3. 平台抬昇將飲料送出
<< 拿取 >>	投幣平台降回，門關上，飲料遞補回架上 (若使用者將手伸入直接拿取飲料，則不需將平台再抬起)

觀察員配有一台電腦，透過副攝影機與電腦連線，從螢幕中觀察使用者接近、操作情形，同時負責操作錄影功能。飲料為冷藏過之冷飲，從架上降下之飲料實為展示品，觀察員必須手動拿取準備好的新飲料放置投幣平台上。



b. Observation Task Performance

Table 6.1 Subject A's Action toward three situations

<i>Clerk's Actions</i>	<i>Actions toward Clerk</i>	<i>Actions toward Prototype</i>	<i>Actions toward VM</i>
Greeting	<ul style="list-style-type: none"> ▪ <u>Eyes on clerk for a moment</u> 	<ul style="list-style-type: none"> ▪ <u>Glance the waving stick and then look at beverages on the shelf</u> 	<ul style="list-style-type: none"> ▪ Stare at the beverages displayed.
Waiting for choice (Look at the subject)	<ul style="list-style-type: none"> ▪ Look at the menu. ▪ Look at the clerk and make an order 	<ul style="list-style-type: none"> ▪ Look at beverages on the shelf ▪ Order (push button) ▪ Eyes move down by awareness of outlet opening. (for charge) 	<ul style="list-style-type: none"> ▪ Look at beverages on the shelf. ▪ Order/push button (after payment)
Preparing for giving order (Go to the preparation section)	<ul style="list-style-type: none"> ▪ Play purse while waiting, look at clerk casually. ▪ after preparing, give money to clerk actively 	<ul style="list-style-type: none"> ▪ Notice beverage move down from the shelf. 	<ul style="list-style-type: none"> (no need to wait) ▪ Bend down naturally when hear the dropping sound.
While Charging (Wait subject's payment passively)	<ul style="list-style-type: none"> ▪ <u>Look at clerk's hand</u> (settle account) 	<ul style="list-style-type: none"> ▪ After slit lifted up, she smiles cheerfully and then drops money. ▪ <u>Stare at the slit plate moving back</u> 	<ul style="list-style-type: none"> ▪ Deposit money to the slit
Delivering things (Hand in order on both hand)	<ul style="list-style-type: none"> ▪ Say thank you while seeing the clerk takes out her order and gives to her ▪ Receive and prepare to leave 	<ul style="list-style-type: none"> ▪ Saw the beverage show up on the slit plate and she moved close. ▪ Take beverage after beverage lifted up, aware of new beverage move up to the shelf and leave 	<ul style="list-style-type: none"> ▪ Bend and pick up
Saying "thank you"& "good bye"	<ul style="list-style-type: none"> ▪ Nod and leave 	<ul style="list-style-type: none"> ▪ Leave immediately. 	<ul style="list-style-type: none"> ▪ Leave immediately after get the beverage

Table 6.2 Subject B's Action toward three situations

<i>Actions</i>	<i>actions toward clerk</i>	<i>Actions toward Prototype</i>	<i>Actions toward VM</i>
Greeting	<ul style="list-style-type: none"> ▪ Eyes on clerk for a moment ▪ <u>Smile for response</u> 	<ul style="list-style-type: none"> ▪ <u>Smile while find the stick waving</u> 	<ul style="list-style-type: none"> ▪ Stare at the beverages displayed
Waiting for choice (Look at the subject)	<ul style="list-style-type: none"> ▪ Look at the menu. ▪ Look at the clerk and make an order 	<ul style="list-style-type: none"> ▪ Look at beverages on the shelf ▪ Order (push button) ▪ Eyes move down by awareness of outlet opening. (for charge) 	<ul style="list-style-type: none"> ▪ Look at beverages on the shelf and smile. ▪ Order/push button (after payment)

Preparing for giving order (Go to the preparation section)	<ul style="list-style-type: none"> Look at the clerk first and the last. after preparing, smile to the clerk and give money to him/her actively 	<ul style="list-style-type: none"> <u>She moves back to see what will happen next.</u> Aware of beverage move down from the shelf. 	<p>(no need to wait)</p> <ul style="list-style-type: none"> Bend down naturally when hear the dropping sound.
While Charging (Wait subject's payment passively)	<ul style="list-style-type: none"> <u>Look at clerk's hand</u> (settle account) 	<ul style="list-style-type: none"> <u>Stare at the slit plate moving back.</u> After slit lifted up, she smiled cheerfully and then drop money. Push the plate but found it move back automatically <u>After slit move down she stands back and looks into the outlet.</u> 	<ul style="list-style-type: none"> Deposit money to the slit
Delivering things (Hand in order on both hand)	<ul style="list-style-type: none"> Receive things in both hands from clerk. 	<ul style="list-style-type: none"> Find beverage show up on the slit plate and she moves closer. Smile and take the beverage after beverage lifted up, aware of new beverage move up and she points it out with a surprised smile. 	<ul style="list-style-type: none"> Bend and pick up
Saying "thank you" and "goodbye"	<ul style="list-style-type: none"> Say thank you and leave 	<ul style="list-style-type: none"> Turn to see the outlet again when leaving. (with happy mood) 	<ul style="list-style-type: none"> Leave directly after take her order

Table 6.3 Subject C's Action toward three situations

<i>Actions</i>	<i>actions toward clerk</i>	<i>Actions toward Prototype</i>	<i>Actions toward VM</i>
Greeting	<ul style="list-style-type: none"> Look at the menu. (didn't look at the clerk) 	<ul style="list-style-type: none"> Glance for a moment and look at beverages on the shelf 	<ul style="list-style-type: none"> Stare at the beverage displayed
Waiting for choice (Look at the subject)	<ul style="list-style-type: none"> Look at the menu. Look at the clerk and make an order 	<ul style="list-style-type: none"> Look at beverages on the shelf Order (push button) Eyes move down by awareness of outlet opening. (for charge) 	<ul style="list-style-type: none"> Look at beverages on the shelf and smile. Order/push button (after payment)
Preparing for giving order (Go to the preparation section)	<ul style="list-style-type: none"> Play his purse, look around while waiting, and look at the clerk casually. after preparing, look at clerk walks toward him 	<ul style="list-style-type: none"> <u>He stands back too for waiting</u> and see what happen next and look at shelf casually. Notice beverage moving down 	<p>(no need to wait)</p> <ul style="list-style-type: none"> Stare at the outlet after order one and bend down naturally when hear the dropping sound.

	and give money to him directly	from the shelf.	
While Charging (Receive the payment directly)	<ul style="list-style-type: none"> ▪ <u>Look at clerk's hand</u> (settle account) 	<ul style="list-style-type: none"> ▪ <u>Stare at the slit plate moving back.</u> ▪ After slit lifted up, he drops money in. 	<ul style="list-style-type: none"> ▪ Deposit money in slit actively
Delivering things (Put the order on counter)	<ul style="list-style-type: none"> ▪ Take things from the counter. 	<ul style="list-style-type: none"> ▪ See beverage show up on the slit plate and move close. ▪ Take beverage after beverage lifted up, notice new beverage move up. 	<ul style="list-style-type: none"> ▪ Bend and pick up
Saying "thank you" and "goodbye"	<ul style="list-style-type: none"> ▪ Nod and say thank you and then leave 	<ul style="list-style-type: none"> ▪ Look the outlet while it moves back then leave. (do not see stick wave) 	<ul style="list-style-type: none"> ▪ Leave directly after get beverage

Table 6.4 Subject D's Action toward three situations

<i>Actions</i>	<i>actions toward clerk</i>	<i>Actions toward Prototype</i>	<i>Actions toward VM</i>
Greeting	<ul style="list-style-type: none"> ▪ Look at the menu. (didn't look at the clerk) 	<ul style="list-style-type: none"> ▪ Look at stick for a moment and smile. 	<ul style="list-style-type: none"> ▪ Stare at the beverage displayed
Waiting for choice (Look at the subject)	<ul style="list-style-type: none"> ▪ Look at the menu. ▪ Look at clerk and make an order 	<ul style="list-style-type: none"> ▪ Look at beverages on the shelf ▪ Order (push button) and wonder what will happen by looking around ▪ Eyes move down by awareness of outlet opening and smile 	<ul style="list-style-type: none"> ▪ Look at beverages on the shelf and smile. ▪ Order/push button (after payment)
Preparing for giving order (Go to the preparation section)	<ul style="list-style-type: none"> ▪ Play his purse, look around while waiting, and look at the clerk casually. ▪ after preparing, look at clerk and give money to him 	<ul style="list-style-type: none"> ▪ Notice beverage move down from the shelf. 	<p>(no need to wait)</p> <ul style="list-style-type: none"> ▪ Stare at the outlet after order one and bend down naturally when hear the dropping sound.
While Charging (Wait subject's payment passively)	<ul style="list-style-type: none"> ▪ <u>Look at clerk's hand</u> (settle account) 	<ul style="list-style-type: none"> ▪ After slit lifted up, she drops money in and smiles. ▪ <u>Stare at the slit plate moving back.</u> 	<ul style="list-style-type: none"> ▪ Pay money in slit actively
Delivering things (Hand in order on	<ul style="list-style-type: none"> ▪ <u>Take things from the counter and nod for</u> 	<ul style="list-style-type: none"> ▪ See beverage show up on the slit plate and she take it away directly. 	<ul style="list-style-type: none"> ▪ Bend and pick up

both hand)	<u>thanks.</u>	<ul style="list-style-type: none"> ▪ <u>Look at outlet and nod unawares.</u> ▪ Notice beverage move up and look for what will happen next. 	
Saying “thank you” and “goodbye”	▪ Nod and leave	▪ Wait for a while then leave.(do not see stick wave)	▪ Leave directly after get beverage

Table 6.5 Subject E’s Action toward three situations

<i>Actions</i>	<i>actions toward clerk</i>	<i>Actions toward Prototype</i>	<i>Actions toward VM</i>
Greeting	▪ <u>Look at clerk for a while</u> then stare at menu.	▪ <u>Look at stick for a moment.</u>	▪ stare at the beverages displayed
Waiting for choice (Look at the subject)	<ul style="list-style-type: none"> ▪ Look at the menu. ▪ Order things and then glance the clerk. 	<ul style="list-style-type: none"> ▪ Look at beverages on the shelf ▪ Order (push button) ▪ Eyes move down by awareness of outlet opening and smile 	<ul style="list-style-type: none"> ▪ Look at beverages on the shelf and smile. ▪ Order/push button (after payment)
Preparing for giving order (Go to the preparation section)	<ul style="list-style-type: none"> ▪ Think while waiting, and look at the clerk casually. ▪ Give money to clerk actively after clerk finish preparing 	▪ Notice beverage moves down from the shelf and predict the beverage will show up in outlet (look down)	(no need to wait) <ul style="list-style-type: none"> ▪ Stare at the outlet after order one and bend down naturally when hear the dropping sound.
While Charging (Wait subject’s payment passively)	▪ <u>Look at clerk’s hand</u> (settle account)	<ul style="list-style-type: none"> ▪ <u>Stare at the slit plate moving back.</u> ▪ When find the slit (after door open but not be lifted yet), she drops money in directly and smiles 	▪ Deposit money to the slit actively
Delivering things (Hand in order on both hand)	▪ Take things in both hands and nod	<ul style="list-style-type: none"> ▪ After beverage lifted up, she takes it away quickly ▪ Notice new beverage move up and look what will happen next 	▪ Bend and pick up
Saying “thank you” and “goodbye”	▪ Say thank you and then leave	▪ Wait for a while then leave (do not see stick wave)	▪ Leave directly after get beverage

Table 6.6 Subject F's Action toward three situations

<i>Actions</i>	<i>actions toward clerk</i>	<i>Actions toward Prototype</i>	<i>Actions toward VM</i>
Greeting	<ul style="list-style-type: none"> ▪ Look at menu (no response to clerk's greeting) 	<ul style="list-style-type: none"> ▪ Glance at stick for a moment. 	<ul style="list-style-type: none"> ▪ stare at the beverages displayed
Waiting for choice (Look at the subject)	<ul style="list-style-type: none"> ▪ Look at the menu. ▪ Order things when stare at menu. ▪ Take out the money put on the counter. 	<ul style="list-style-type: none"> ▪ Look at beverages on the shelf ▪ Order (push button) ▪ Eyes move down by awareness of outlet opening (for charge) 	<ul style="list-style-type: none"> ▪ Look at beverages on the shelf and smile. ▪ Order/push button (after payment)
Preparing for giving order (Go to the preparation section)	<ul style="list-style-type: none"> ▪ Play the menu while waiting, and look at the clerk casually. 	<ul style="list-style-type: none"> ▪ Notice beverage move down from the shelf and then look down on outlet. 	<ul style="list-style-type: none"> (no need to wait) ▪ Stare at the outlet after order one and bend down naturally when hear the dropping sound.
While Charging (Wait subject's payment passively)	<ul style="list-style-type: none"> ▪ <u>Look at clerk's hand</u> (settle account) 	<ul style="list-style-type: none"> ▪ <u>Stare at the slit plate moving back.</u> ▪ Deposit money and stare at the slit plate move back into outlet. 	<ul style="list-style-type: none"> ▪ Deposit money to the slit actively
Delivering things (Hand in order on both hand)	<ul style="list-style-type: none"> ▪ Take things and nod for thanks. 	<ul style="list-style-type: none"> ▪ After beverage lifted up and then he takes it away. 	<ul style="list-style-type: none"> ▪ Bend and pick up
Saying "thank you" and "goodbye"	<ul style="list-style-type: none"> ▪ leave 	<ul style="list-style-type: none"> ▪ Leave directly after take away the beverage. (do not notice the stick wave) 	<ul style="list-style-type: none"> ▪ Leave directly after get beverage