TESTING THE THEORY OF PLANNED BEHAVIOR TO PREDICT USED BATTERY DISPOSAL INTENTIONS AMONG UNIVERSITY STUDENTS

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ABSTRACT

Toxic metals are used in batteries which end up in landfill sites and which may reach humans via the food chain and food web. Proper disposal of used batteries is needed. However, the factors related to proper disposal need to be better understood. This study aims to examine the theory of planned behavior (TPB) and its potential for predicting the behavioral intention for proper disposal of used batteries among students at Thammasat University, Rangsit campus. Survey research was conducted by questionnaire. The students responded about their intentions, attitudes, subjective norms (SN), perceived behavioral control (PBC), beliefs, exposure to information, existing waste bins, demographic data, and battery use data. The results revealed that SN, PBC, attitude, and exposure to information are predictors of intention to dispose of used batteries in specific waste bins. Therefore, specific waste bins should be employed to encourage proper disposal of used batteries.

KEY WORDS : THEORY OF PLANNED BEHAVIOR / INTENTION / USED BATTERY DISPOSAL / STUDENTS / RECYCLING

138 pages

การทดสอบทฤษฎีพฤติกรรมอย่างมีแบบแผนในการทำนายความตั้งใจทิ้งซากแบตเตอรี่ของนักศึกษา
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บทคัดย่อ

มนุษย์อาจได้รับโลหะมีพิษที่มีอยู่ในซากแบตเตอรี่ซึ่งโดยทั่วไปถูกทิ้งลงในถังขยะทั่วไป และถูกนำไปฝังกลบในบ่อขยะในที่สุดผ่านทางห่วงโซ่อาหาร ดังนั้นควรทิ้งซากแบตเตอรี่ให้ถูกต้องในถังรองรับจำเพาะที่แยกจากขยะอื่น อย่างไรก็ตามปัจจัยที่เกี่ยวข้องกับการแยกทิ้งซากแบตเตอรี่ควรได้รับการศึกษา การศึกษานี้มีวัตถุประสงค์หลักเพื่อทดสอบทฤษฎีพฤติกรรมอย่างมีแบบแผนว่าสามารถทำนายความตั้งใจแยกทิ้งซากแบตเตอรี่ของนักศึกษมหาวิทยาลัยธรรมศาสตร์ด้วยการสำรวจด้วยแบบสอบถามที่มีข้อคำถามเกี่ยวกับความตั้งใจ ทัศนคติ บรรทัดฐานของสังคม ความเชื่อมั่นในตนเอง ความเชื่อ การได้รับข่าวสาร การมีถังจำเพาะรองรับ ข้อมูลลักษณะทางประชากร และข้อมูลการใช้แบตเตอรี่ ผลการศึกษาชี้ให้เห็นว่า บรรทัดฐานของสังคม ความเชื่อมั่นในตนเอง การได้รับข่าวสาร และทัศนคติ สามารถทำนายความตั้งใจที่จะแยกทิ้งซากแบตเตอรี่ในถังจำเพาะของนักศึกษา ดังนั้นจึงควรจัดให้มีถังรองรับซากแบตเตอรี่เป็นการจำเพาะเพื่อส่งเสริมให้นักศึกษาทิ้งซากแบตเตอรี่อย่างถูกต้องต่อไป

138 หน้า

CONTENTS

CONTENTS (cont.)

CONTENTS (cont.)

LIST OF TABLES

LIST OF TABLES (cont.)

LIST OF FIGURES

CHAPTER I
INTRODUCTION

Batteries are the power supply of electrical and electronic appliances which make our lives more convenient. Batteries can be classified into two main types: (1) wet cells which are mainly lead-acid and used in automotives and (2) dry cells or consumer batteries. Dry cell batteries can be classified into two groups. One is a primary battery which is disposed after being completely used. The other is a rechargeable battery which can be used repeatedly after recharging (1).

Batteries contain various kinds of toxic metals, i.e. lead, cadmium, mercury, nickel, lithium, zinc, silver, and manganese (2,3). These metals are harmful to our body as well as to animals and plants. Lead is toxic to every organ system: the peripheral and central nervous systems, renal function, blood cells, cardiovascular, and reproductive system and affect the growth and development of children (4). Cadmium can cause hypertension, depress immunity, increase cancer risk, and "itai-itai" disease (5). Mercury is very toxic to the neurological, gastrointestinal, and renal systems (6,7). Zinc toxicity involves bloody diarrhea (8). Silver affects the cardiovascular and hepatic systems (9). Lithium affects the central nervous system, and the renal, gastrointestinal, endocrine, and cardiovascular systems (10).

More than three million units of batteries were consumed in the USA in 1998 with a rapid increase in the use of rechargeable batteries (2,3). The data on battery consumption in Thailand are incomplete. However, it is estimated that dry cell disposal is more than 20 million kilograms per year in Thailand. Since there are no special facilities for handling these wastes, used dry cells generally are disposed of into the household waste bin and end up at landfill sites (11).

These disposal behaviors promote the contamination of heavy metals in the batteries into the environment. Once they enter the environment via a landfill or incinerator, they will reach humans via water and/or the food chain (1-3). Research in Thailand suggests that contamination of the environment of some heavy metals from solid waste disposal or wastewater treatment plants has occurred in some areas. For

example, the contamination of leachate from the old Kukot sanitary landfill into the groundwater affected the concentration of lead, and cadmium in the ground water at 0.37, 0.047 ppm higher than the standard level of ≤0.05, ≤0.01 ppm, respectively (12). A study of underground water quality from On-nuch solid waste disposal area in 1996 indicated that the concentration of mercury and cadmium exceeded the standard level (13). In addition, lead amounts in mangrove snails (*Cassidula* sp.) at Leam Pak Bia mangrove area receiving treated wastewater from Phetchaburi municipal treatment system was 1.034 mg/kg exceeding the standard level at 1 mg/kg (14). Though it cannot be concluded that those contaminations exceed the safety level and those in the fauna are caused directly from batteries, it does suggest the possibility of contamination and that prevention and control measures should be considered and implemented rapidly.

To solve this problem, 3R measures - reduce, reuse, and recycle - are believed to potentially reduce contamination. Reducing the use of batteries is probably not effective since it contradicts the demand of convenience of the user. Reuse is implemented by promoting the use of rechargeable batteries but those rechargeable batteries also contain toxic metals. Recycling which means the collection of used batteries to extract some metals for the production of new batteries is considered to be the most effective measure. This method requires the cooperation of users in the proper disposal of used batteries in specific separated waste bins. However, the factors related to the recycling behavior or proper disposal behavior need to be understood better (15).

There are many studies of recycling behavior. Most of them used the Theory of Planned Behavior (TPB) framework (16-24). The theory proposes that attitude, subjective norm and perceived behavioral control are the factors associated with intention which is only one predictor of behavior (25). Attitude was confirmed to be a predictor of intention by all of those studies (16-24). The remaining constructs, i.e. subjective norm and perceived behavioral control were found inconsistently associated with intention (19, 21, 23, 24, 26, 27). Only four studies employed the Altruistic Behavior model framework (24, 28-30). Altruistic behavior model was grounded on personal belief the same as TPB but the constructs are in the linear function which has less possibility in real behavior. By this model, recycling

behavior was directly predicted by social norms and personal norms neither of these constructs is mediated by awareness of consequences or ascription of responsibility. Social norms were also the same as subjective norms in TPB. Personal norms were also the same as attitude in TPB. The Health Belief Model (31) and Neutralization theory (32) were used only one time each in the past recycling studies. These two models considered only the intrapersonal constructs and neglected the higher level constructs such as social norms.

In addition, the application of the TPB in any used battery disposal study was not found. All of the previous studies focused on valuable recycling materials, i.e. paper, glass, metals, and plastics but used batteries are not valuable especially in Thailand. In contrast with those materials, used batteries are toxic to all living things. It is concluded that TPB should be very appropriate to study used battery disposal behavior in Thailand.

Not only the constructs of these theories were studied but many additional variables were also studied. These included incentives, social influence or motivation, situational factors, past behavior, justification, self-organization, trust, and self-realization (16-19, 21, 23, 24, 27-29, 32-43). Furthermore, the association of recycling behavior and socio-demographic variables such as age, education, income, gender, occupation, home ownership, ethnicity, and others were included in many research studies (16, 19, 28, 35-39, 44-48). However, situational factors (convenience) seem to be the greatest influence factors on recycling behavior. These factors should be prepared to support the proper behavior while the behavior is promoted.

Thammasat University, Rangsit campus consists of around 20,000 students, teaching and support staff who use dry cells in various personal electric and electronic appliances. A preliminary study from the assignment of students in the research methodology course using a questionnaire among 15 students revealed that 73.3% used cameras, 66.6% used flash lights, 53.3% used calculators, 40.05 used MP3 players, 20.0% used sound abouts, 13.3% used CD players, and 13.3% used mobile phones. Eighty-seven percent of used dry cells were disposed of with general household waste at their home while 13% disposed of with general waste at TU. Twenty-six percent of them disposed of used battery every 4 months, 19% disposed of

every 1 month and 3 month, equally, 14% disposed of every 1 wk, and the remaining disposed of in various frequencies. This behavior if not changed will increase the contamination of toxic metals in the environment which will be transported to humans through the food chain. Although a recycling program was launched in 2007, used batteries were not included (49). A preliminary study from the assignment of the students in the research methodology course using questionnaire among 50 students of a class of Faculty of Public Health, Thammasat University who has more potential to change the behavior and society revealed that alkaline batteries are the most popular of which 20.7±24.0 units are used per person per year. Nickel-cadmium batteries are the second most popular and 6.9±13.7 units are used per person per year. Nickel metal hydride and Lithium batteries were used 1.0±4.1 and 4.8±10.1 units per person per year, respectively.

Even though a lot of research of recycling behavior has been published, the results are inconsistent. In addition, nearly all of them studied only household recyclable materials such as paper, glass, metals, or plastic. There were few articles on used battery disposal. A study in another context may be useful in understanding the factors behind the used battery disposal behavior and may be useful to us in developing an intervention for behavioral change to prevent diseases caused by toxic metals and to preserve our environment.

Research Questions:

The research questions that guided the present study were:-

1. Which TPB factors have a high correlation to the use battery disposal intention?
2. Which measurement methods, direct and indirect, have a higher validity value in measuring the TPB constructs?
3. How can the proposed model as shown in Figure 1 be applied in predicting used battery disposal intention?

Research Objectives:

The three main objectives of this research were:

1. To indentify factors in TPB which are associated with used battery disposal intention.
2. To examine validity of the direct and indirect measurements recommended by TPB.
3. To test the proposed predicted model as shown in Figure 1.

Research Hypothesis:

We expect that the theory of planned behavior has applicability in understanding and predicting used battery disposal intention in the Thai context. These are

1. All constructs in TPB may be the factors associated with used battery disposal intention.
2. Both direct and indirect measurements of all constructs recommended by TPB may show similar validity.
3. All constructs in the model as shown in Figure 1 may have predictive value to used battery disposal intention.

Conceptual Framework

In this study, intention to dispose of used batteries, attitude toward the disposal, subjective norm associated with disposal, and perceived behavioral control concerning disposal, behavioral beliefs, outcome evaluations, normative beliefs, motivation to comply, control beliefs, perceived power, exposure to information, exiting of waste bins, gender, faculty and year of study will be measured. The data were collected by self-administered questionnaire and the predictability was analyzed with structural equation modeling technique as presented in Figure 1.

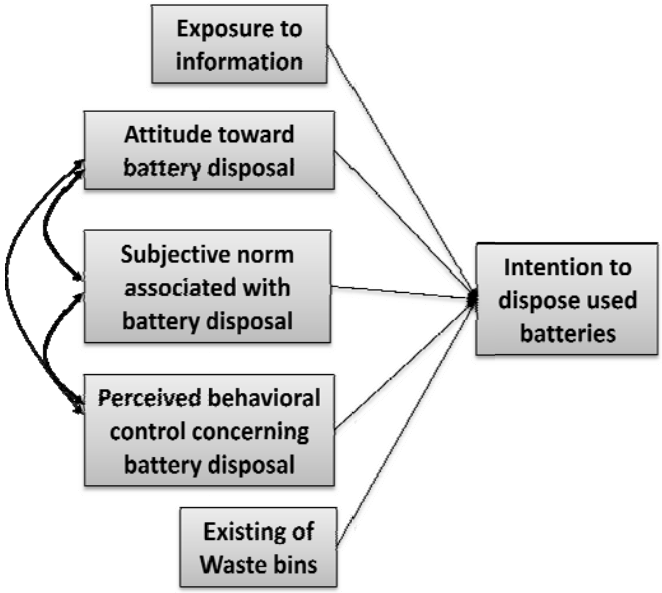

Figure 1.1 the model of predicting used battery intention.

Operational Definitions

The definitions of terms used in this study are the followings.

- Intention to dispose of batteries in a specific separate waste bin refers to the student motivation in the sense of his or her conscious plan to exert effort to dispose of used batteries in specific waste bins on campus within the 1-month period after respondents have completed the questionnaires.
- Attitude refers to the student's belief concerning disposal of used batteries in a specific waste bin and evaluation of the disposal behavior outcome.
- Behavioral belief refers to the student's beliefs about the likely outcomes of the used battery disposal in a specific waste bin.
- Evaluation of behavioral outcome refers to the student's evaluations of the outcomes of the used battery disposal in a specific waste bin.
- Subjective norm refers to the student's perception of social pressure to disposal of used batteries in a specific waste bin.
- Normative belief refers to the student's beliefs about the expectations of others about used battery disposal in a specific waste bin.

- Motivation to comply refers to the extent to which the student feels inclined to match his or her about used battery disposal in a specific waste bin to various sources of social pressure.
- Perceived behavioral control refers to the student's perception of themselves and their ability to dispose of used batteries in a specific waste bin.
- Control belief refers to the student's beliefs about the presence of factors that may facilitate or impede performance of the used battery disposal in a specific waste bin.
- Control belief power refers to the perceived power of factors that facilitate or impede performance of the used battery disposal in a specific waste bin of the student.
- Situational factors refer to physical factors which may facilitate or inhibit used battery disposal in a specific waste bin and exposure to the information on waste management in classroom setting or media environment.
- Socio-demographic variables refer to the student's gender, age, level of study, religious, and faculty of study.

Significance of the study

Pollution control is a widely interested issue in various groups of people in Thailand. Toxic metal contamination by used batteries into the environment is one of those issues since it is harmful to not only human life but also plants and animals. Any methods that can reduce contamination of those toxic metals are urgently needed to be investigated and implemented. The Thai younger generation is a group of people who generally consume many types of technology especially those that use batteries as the source of energy such as digital cameras, calculators, MP3 players, etc. This study is a starting point of an effort to reduce the contamination and to conserve our save environment by a small group population, undergraduate students. Moreover it will also indicate whether the western theory such as TPB can help explain the behavior of the Thai people. Therefore, results of this study will be beneficial to the university administration in applying the founding of the study for used battery disposal management which to conserve the cleanliness and the

environment around the university. This will promote the healthy environment for every life in this area.

CHAPTER II
LITERATURE REVIEWS

Research literatures about recycling, used battery and its hazards and management in the past 20 years were reviewed. These included the related behavioral concepts and theories. Five main topics will be presented, i.e. batteries, behavioral concept and theories, factors that influence recycling behavior, methodology for theory testing in behavioral research, and the present situation of used battery disposal at Thammasat University.

Batteries

In this section, seven topics about batteries will be reviewed. These include types of batteries, their consumption, their hazardous components, toxicity of their components, the contamination of some components of batteries in the environment, proper management of used batteries, and present situation of used battery disposal in Thammasat university.

1. Types of batteries

There are two major categories of batteries: wet cell and dry cell. Most wet cell batteries are lead-acid batteries and are primarily used for automotive products. The remaining, gel cell and sealed lead-acid batteries, are generally used to power industrial equipment, emergency lighting, and alarm systems. Dry cell batteries are also known as non-automotive, or consumer batteries, or household batteries. There are two basic types of dry cell batteries - primary and rechargeable. Most dry cells are primary batteries that must be replaced once discharged. The primary batteries are also classified as alkaline and “button-cell” types. Alkaline batteries are the everyday household batteries which are commonly used in flashlights, remote controls, and other appliances. Most "button-cell" type batteries, small and round, are normally found in items such as watches and hearing aids and

contain mercury, silver, cadmium, lithium, or other heavy metals as their main component.

On the other hand, rechargeable batteries can be used repeatedly because the chemical reaction that creates the energy can be reversed, thereby recharging the battery. Rechargeable batteries initially may be more expensive than primary batteries, and they require the purchase of a recharger, but each rechargeable battery may substitute for hundreds of primary batteries and cost less than the primary batteries it replaced over its life. About 80 percent of rechargeable batteries are composed of nickel and cadmium and are known as Ni-Cds. A Ni-Cd battery can be recharged hundreds of times. In 1993, Rayovac introduced a new mercury-free, alkaline battery that can be recharged. This new battery competes for market share both with primary and rechargeable batteries, but it cannot be recharged as many times as a Ni-Cd (1).

2. **Battery consumption**

Batteries are becoming much more prevalent due to the dramatic increase in items that require their use, such as battery powered toys and tools, small electrical appliances like toothbrushes and shavers, digital and video cameras, cellular phones, and portable computers (1). Over three billion industrial and household batteries were sold in the United States in 1998. The demand for batteries can be traced largely to the rapid increase in cordless, portable products such as cellular phones, video cameras, laptop computers, and battery-powered tools and toys (2,3). Ni-Cd rechargeable batteries are commonly found in cellular and cordless telephones, video cameras, and portable power tools (50). The use of these batteries continues to grow. It has been estimated that one-half billion Ni-Cd batteries were sold in the United States in the year 2000. They are also used in cellular phones, laptop computers, and power tools (51).

3. **Hazard components in the battery**

Many batteries contain toxic constituents - mercury, lead, cadmium, nickel, silver, lithium, manganese, and zinc. Dry-cell batteries include alkaline and carbon zinc (9-volt, D, C, AA, AAA), mercuric-oxide (button, some cylindrical and rectangular), silver-oxide and zinc-air (button), and lithium (9-volt, C, AA, coin,

button, rechargeable). Most small, round "button-cell" type batteries found in items such as watches and hearing aids contain mercury, silver, cadmium, lithium, or other heavy metals as their main component (2,3). Compositions of some household batteries are shown in Table 1. Percentages of hazardous metals in some kinds of battery are presented in Table 2.

Table 2.1 Compositions of household battery types

Battery type (common name)	Cathode (-)	Anode (+)	Electrolyte	Typical mercury or cadmium weight per cell (%)
Alkaline	Manganese dioxide	Zinc	Potassium hydroxide	Mercury <1%
Carbon zinc	Manganese dioxide	Zinc	Ammonium chloride and/or zinc chloride	Mercury <0.01%
Mercury	Mercuric oxide	Zinc	Potassium hydroxide or sodium hydroxide	Mercury 35-50%
Silver	Silver oxide	Zinc	Potassium hydroxide or sodium hydroxide	Mercury approx. 2%
Zinc air	Oxygen taken from the air	Zinc	Potassium hydroxide	Mercury approx. 2%

Source: Shapek RA (52)

Table 2.2 Percentages of hazardous components by weight of batteries

Components	Nickel-Cadmium	Nickel methylanhydride	Lithium ions
Cadmium	6-26	-	-
Nickel or nickel compounds	11-30	30-50	unknown
Zinc	-	5-20	-
Copper	-	2-15	-
Cobalt or cobalt compounds	0-2	2.5-8	<25
Manganese	-	0-2	unknown
Aluminium	-	0-1	2-10
Lithium compounds	<3-10	0-1	<25
Iron	1-25	1-25	15-30
Polyvinylidine fluoride	-	-	0-5
Organic solvent	-	-	10-20
Carbon or graphite	-	-	3-30

Source: Pollution control Department (53)

1. **Toxicity of the metals**

Toxicity is dependent on the type and conditions of metals, and persons. Dose, route of metal entering the body, and the resistance of the body are considered as the main factors. The toxicity of each heavy metal is summarized as following:

Cadmium (Cd) toxicity and storage are greatly increased with zinc deficiency, and good levels of zinc protect against tissue damage by cadmium. Cadmium involved in generating high blood pressure, kidney tissue damage, and increased incidence of calcium kidney stones, and heart disease. Cadmium appears to depress some immune functions, mainly by reducing host resistance to bacteria and viruses. It may also increase cancer risk, possibly for the lungs and prostate. Cadmium toxicity has been implicated in generating prostate enlargement. Cadmium also affects the bones. It has been known to cause bone and joint aches and pains. This syndrome, first described in Japan, where it was termed the “itai-itai” ("ouch-ouch") disease, was caused by cadmium pollution there. It was also associated with weak bones that lead to deformities, especially of the spine, or to more easily broken bones. This disease was fatal in many cases. We may be seeing an increase in emphysema due to cadmium exposure. Anemia also seems to be a problem (5).

Mercury (Hg) toxicity occurs with exposure to both organic and inorganic forms. Minamata disease is an example of organic toxicity. Inorganic mercury toxicity occurs in several forms: metallic mercury (Hg), mercurous mercury (Hg^{1+}), or mercuric mercury (Hg^{2+}). Mercury poisoning can result from vapor inhalation, ingestion, injection, or absorption through the skin (6). Neurological, gastrointestinal, and renal systems are the most commonly affected organ systems in mercury exposure (7).

Zinc (Zn) toxicity occurs when exposure over a tolerable upper limit (UI) of 40 milligrams for daily intake. This limit applies to all individuals age 19 and over. A metallic, bitter taste in the mouth can be indicative of zinc toxicity, as can stomach pain, nausea, vomiting, cramps, and bloody diarrhea (8).

The critical effect in humans of ingesting silver (Ag) is *argyria*, a medically benign but permanent bluish-gray discoloration of the skin. Toxic effects of silver have been reported primarily for the cardiovascular and hepatic systems. This

exposure (about 89 mg/kg/day) resulted in a statistically significant increase in the incidence of ventricular hypertrophy (9).

The central nervous system (CNS) is the major organ system affected by Lithium (Li), although the renal, gastrointestinal (GI), endocrine, and cardiovascular (CV) systems also may be involved (10). Parkinson's disease, hypergyrexia, gastroenteritis, diabetes are the example of health effects by lithium (52).

Manganese potentially affect in liver cirrhosis, pneumonia, bronchitis, and influenza (52).

Nickel showed potential health effect such as dermatitis, pneumonia, lung and nasal cancer (52).

2. **Contamination of some metals from used batteries in the environment**

Data in the United States indicates that about 146,000 tons of consumer batteries are disposed of each year. These accounted for less than 0.1 percent of Municipal solid waste in 1992, but they are of concern because they contribute a disproportionate percentage of certain toxic heavy metals, primarily mercury and cadmium, to the waste stream. Batteries are expected to contribute almost 75 percent of the cadmium in the waste stream by 2000. Discards of cadmium in batteries and appliances nationwide are projected to increase from 1,305 tons in 1990 to 2,032 tons by 2000 (1, 2).

These heavy metals can contaminate the environment when batteries are improperly disposed of. When incinerated, certain metals might be released into the air through incinerator smokestack emissions or may concentrate in the ash produced by the effective air pollution control equipment and cause problems of heavy metals in ashfill leachate. The metals can leach into ground water and surface water from landfills. They are toxic to fish and wildlife and can pass to humans through the food chain (1-3).

3. **Proper management of used batteries**

Batteries are classified as hazardous waste since they contain toxic metals and acids. A specific waste bin is needed from separate disposal from the household

waste. Then, they should be collected and transported to a facility for recycling or storage for treatment.

Most of the specific legislation on portable batteries is generally focused on mercury restriction in alkaline batteries, dry batteries, button batteries, and Ni-Cd batteries. Nevertheless, in some countries such as Switzerland, Norway, Sweden and Germany, there is a general requirement for battery collection which consequently is not limited to specific types of batteries (54).

Specific legislation on batteries, applicable in all States in the US, originated with the Mercury-Containing and Rechargeable Battery Management Act, passed in 1996 (50). Nearly 90 percent of all lead-acid batteries are recycled in the USA. The Rechargeable Battery Recycling Corporation (RBRC), a nonprofit public service organization, targets four kinds of rechargeable batteries for recycling: nickel-cadmium (Ni-CD), nickel metal hydride, lithium ion, and small-sealed lead. Button cells are increasingly targeted for recycling because of the value of recoverable materials, their small size, and their easy handling relative to other battery types. Alkaline batteries, the everyday household batteries used in flashlights, remote controls, and other appliances. Several reclamation companies now process these batteries (3).

European Community legislation was passed in 1991(91/157/EEC—Batteries and Accumulators Directive). In addition, the European Directive also has the objective of establishing progressive goals, for example, up to 2008, develop a collecting system so that 75% of portable batteries and 95% of industrial batteries are collected; up to 2009, all Cd must be eliminated and recycling processes shall recuperate 55% of the materials within the batteries. The tendency is to have all batteries, especially Ni-Cd batteries, collected in all European countries. The Danish Environmental Protection Agency planned to collect at least 75% of the batteries from 2002. In Germany, since 1998, with Germany's Batteries Ordinance, the responsibility for the collection and destination also relies on the manufacturers and importers. Consumers must turn back any and all types of batteries of whatever origin to a proper collecting system, in which all manufacturers participate (54).

Austrian legislation is more restrictive than the European Community's Directive, since it requires the collection of all types of batteries. Taiwan's

Environmental Protection Agency establishes a reduction of taxes related to the reduction of the quantity of toxic metals, in order to stimulate the reduction of such elements (54).

4. **Present situation of used battery disposal in Thailand**

Statistical data from the Department of Customs shows that various types of battery were imported into Thailand increasingly around 13 million units a year in every year which reached a peak at 118 million units in the year 2005. Figure 2 presents the increasing trend of imported batteries between the years of 2001 and 2007 (55). In addition, there are some, especially alkali, batteries produced by manufacturers in Thailand. There is no report of exactly how many of these units were produced. However, there is an estimation that more than 20 million kilograms of dry cell units are disposed of per year in Thailand (11).

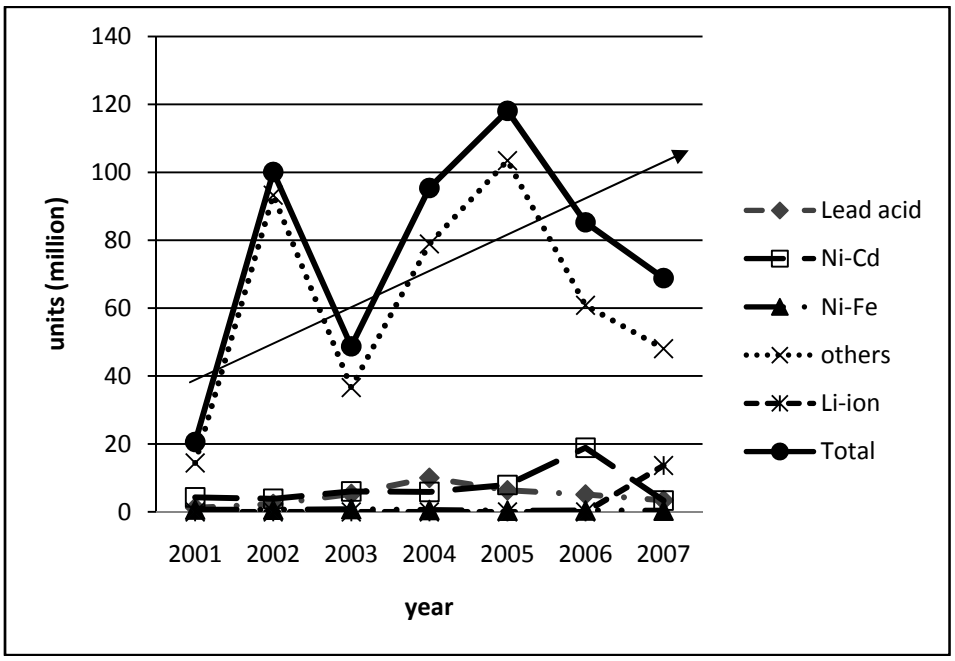

Figure 2.1 Trends of imported batteries in the years 2001 to 2007. [54]

4.1 Disposal and management

The primary battery normally has full electric power when it is purchased. After being used, the electric power is lost gradually until not enough is

left to do the work. That used battery is generally disposed of into the household waste bin. The rechargeable battery needs an electricity charge before first time usage and is then recharged again and again when its power is lost or at low level. After recharging many times, a battery will not be rechargeable or will not maintain its power. It is then normally disposed of the same way as the primary battery and ends up at the landfill site (11).

Ozaki et al (11) reviewed the management of hazardous waste in Thailand in 2001 and found that there are no special facilities for handling these wastes. There are neither well-established systems for separation, storage, collection, and transportation, nor effective enforcement of regulations related to hazardous waste management generated from industrial or non-industrial sectors. Furthermore, Thailand does not have an integrated regulatory framework regarding the monitoring and management of hazardous materials and wastes. In addition to the absence of a national definition of hazardous wastes, limited funding has caused significant impediments to the effective management of hazardous waste. Thus, current waste management practices in Thailand present significant potential hazards to humans and the environment.

In 2005, the Thai Department of Pollution Control initiated a project to collect used cellular phone batteries. This project aimed to create a safety system in managing the used cellular phone battery only. By cooperation among government agencies, telecommunication companies, waste management companies, and other business companies, 3,500 used battery waste bins were produced and distributed to many business shops in the project. A booklet entitled “Hazardous waste: used cellular phone and its battery and its management in Thailand” and a brochure explained how to dispose of a used cellular phone and its battery were distributed to the people. TV and radio announcements were on air in September 2005. The campaign was also published in the newspaper in September 2005. Other activities were also done in this campaign. However, there is no report about the outcome of the project and the project was not continued (56).

4.2 Contamination of some metals in the environment: evidence based data

There is some research data that suggests that the environment has been contaminated by heavy metals from solid waste disposal sites or wastewater treatment plants. The study at the old Kukot sanitary landfill, Patumthanee province that received both domestic and industrial solid waste from surrounding communities revealed that there was contamination of leachate into the groundwater. The contamination made the concentration of lead, and cadmium in the ground water at 0.37, 0.047 ppm, respectively. These concentrations are higher than the standard level at ≤0.05, ≤0.01 ppm, respectively (12). A study of underground water quality from On-nuch solid waste disposal area in 1996 indicated that the concentration of mercury and cadmium exceeded the standard level (13). Although these studies cannot conclude that the heavy metals contamination caused by leachate from solid waste disposal, it showed that there is contamination of heavy metals in the environment. This is an initial sign of catastrophe in our environment. It was also reported that decomposed soil from Nakornrachaseema municipal solid waste plant contained mercury 3.6±0.93 ppm which exceeded the standard level at 3.2 ppm (57). Lead amounts in mangrove snail (*Cassidula* sp.) at Leam Pak Bia mangrove area receiving treated wastewater from Phetchaburi municipal treatment system was 1.034 mg/kg exceeding the standard level of 1 mg/kg (14).

Most studies revealed that the heavy metal quantities in various marine animals are still lower than the standard levels (58-62). If the situation continues as in the present, heavy metals in those living things may increase to higher than the standard level soon. This will endanger humans in the near future. Though it cannot be concluded that those contaminations are caused directly from batteries, it does indicate the possibility of the contamination and suggests that prevention and control measures should be considered and implemented rapidly.

To solve this problem, used battery disposal behavior of the people who are the origin of problem should be changed. To alter behaviors, public education and participation are the keys to success of proper dispose of batteries (51). However, a good intervention plan is needed to understand the factors related to that behavior.

Behavioral Concepts and Theories

There are many studies of the recycling behavior concepts and theories. The intrapersonal level such as Health Belief Model and Neutralization Theory were used in only one study each. Most of them fall into interpersonal level especially the Theory of Planned Behavior. Some studies used the Altruistic Behavior Model. In addition, there are some studies of the effects of social, organization, and policy on recycling behavior. The following section will discuss these theories and factors.

1. Intrapersonal level

1.1 Health Belief Model (HBM)

There is only one study that used the HBM framework in regards to recycling behavior. It found that variables in the HBM significantly predicted recycling behavior and accounted for approximately 27% of the variance of the dependent variable (31). In this model, perceptions of the severity of the household waste problem was one of only two attitudinal variables (the other was intrinsic motivation to recycle) that distinguished between those who did and did not participate in a recycling program.

1.2 Neutralization Theory

Neutralization Theory of delinquency by Sykes and Matza (32, 63) has been widely applied in criminological attitude research and has improved the scientific understanding of people who violate existing social norms. It has also been applied in domains outside of criminology, including the practice of dangerous sports, holding a stigmatized occupation, or the performance of environmentally relevant behaviors such as short-distance flights and recycling. Neutralization Theory states that much delinquency is based on unrecognized extensions of defenses to crimes in the form of justifications that are seen as valid by the delinquent but not by the legal system or society at large (32).

Neutralization Theory additionally considers that justification can neutralize norms, hence preceding deviant behavior. The theory thus helps to explain how deviant behavior can be sustained over time. Rationalizations with respect to past behaviors can simultaneously serve as neutralizations for subsequent

behaviors. Recently a theoretical integration of Altruistic behavior model (MAB) with Neutralization Theory was provided by taking this longitudinal perspective into consideration and conceptualizing (a posteriori) rationalizations for negative environmental behaviors as neutralizations favoring such negative behaviors in the future. A longitudinal empirical study partly supported their integrative model. The variables personal norm and ascribed responsibility, both stemming from MAB, as well as the acceptance of justifications, proved to be significant predictors of self-reported environmental behavior as measured in the same questionnaire (i.e. at time 1) and as reported in a follow-up questionnaire administered 3 months later (i.e. at time 2).

The study of Hansmann et al. (31) presented the relationship between battery recycling and two of the neutralization strategies described by Sykes and Matza (63), namely: (1) the denial of responsibility by arguing that one's own behavior is the result of forces beyond one's control and (2) the denial of injury claiming that no one was hurt, which in the context of recycling corresponds to the claim that the environment is not harmed by non-recycling. These neutralization techniques are related to the concepts of (1) ascribed responsibility and (2) awareness of consequences in Schwartz's model of altruistic behavior.

2. Interpersonal level

2.1 Theory of Reasoned Action & Theory of Planned Behavior (TRA & TPB)

The Theory of Reasoned Action (TRA) was proposed by Fishbein in 1967. It is concerned with the relations between beliefs, attitudes, intentions, and behavior. In this theory, the most important determinant of behavior is a person's intention which is determined by their attitudes toward performing the behavior and their subjective norm associated with the behavior. Attitude is determined by the individual's beliefs about outcomes or attributes of performing the behavior which is called behavioral beliefs weighted by evaluations of those outcomes or attributes. A person's subjective norm is determined by his or her normative beliefs, whether important referent individuals approve or disapprove of performing the behavior, weighted by his or her motivation to comply with those

referents. This theory is explained as behavior under volitional control. It is not clear that all components of the theory are sufficient for predicting behavior in which volitional control is reduced. To predict behaviors over which people have incomplete volitional control, Ajzen and colleagues proposed the Theory of Planned Behavior (TPB) by adding perceived behavioral control to the TRA in an effort to account for factors outside of the individual's control that may affect a person's intention and behavior. Perceived behavioral control is determined by control beliefs concerning the presence or absence of facilitators and barriers to behavioral performance, weighted by the perceived power or impact of each factor to facilitate or inhibit the behavior. This extension was based in part on the idea that behavioral performance is determined jointly by motivation (intention) and ability (behavioral control) (25). The diagrammatic constructs of TPB are shown as Figure 3.

Figure 2.2 The Theory of Planned Behavior constructs.

There are different meanings of recycling behavior. However, it can be concluded that Recycling behavior generally means the behavior of proper disposal of recyclable solid waste to the provided specific bin and which those wastes will be collected and send to the recycling process.

2.1.1 Intention: There are many studies confirmed the relationship between intention and behavior which behavioral intention significantly predicted self-reported behavior (16-23). However, only one research found that intention is not associated with behavior (24).

2.1.2 Attitude: Tonglet et al (23) summarized that recycling attitude was separated into two components, affective (experiential) which

related to feelings and cognitive (instrumental) which is based on knowledge of the outcomes or consequences. Schultz et al. (37) suggested that attitudinal predictors of recycling behavior include both general concern for the environment and specific concern regarding a particular issue. Meneses and Palacio (28) analyzed the scale of Ecological Awareness Attitudes by factorial analysis that resulted in three factors: environmental knowledge, environmental concern, and ecological involvement. Do Valle et al. (38) constructed their attitudinal questions from Schwartz's normative model. Principle Components Analysis was used to reduce their original specific attitudinal 20 items toward recycling into four new dimensions: social norm, awareness of recycling benefits, personal norm, and difficulty and indifference. Barr (16) reviewed many studies and found that household attitude can broadly be attributed to three groups of independent variables: environmental values, situational variables, and psychological factors. He used the term environmental values to define those underlying orientations held by individuals toward the physical environment. The term has been used interchangeably with other concepts such as environmental concern, ecological worldview, and environmental attitudes. Personal situation was defined with regard to behavioral context (for example, service provision), individual characteristics (such as socio-demographics) and individual knowledge and experience of the behavior in question. Psychological factors have been related to waste management behavior. They are personality characteristics of the individual and the perceptions of those individuals toward the actions that they are undertaking. The term altruistic influences, intrinsic motivation, perceived to be a tangible threat to personal well-being, social norm, acknowledged neighbors recycling behavior, awareness of other people acting to recycle, subjective norms, self-efficacy, perceived behavioral control, environmental citizenship are included in psychological factors. It was seen that the definition of attitude are varied. Tonglet's and Schultz's et al. definition were still in the TPB framework while Do Valle defined attitude under the Altruistic Behavior model. However, Barr's definition covered all factors both in TPB framework and the additional factors.

A significant relationship between attitudes toward recycling and intention to recycling behavior was found in many studies (19, 22-24, 32, 36, 38, 48, 64-66). Cheung et al. (17) reexamined the application of TPB in predicting wastepaper

recycling and self-reported behavior and found that attitude and subjective norm were significant predictor of behavioral intention when analyzed by multiple regression analysis. The same result was presented by Knussen et al. (19), Tonglet et al. (23), and Kurz et al. (48) who studied the household waste recycling with multiple regression analysis. A regression analysis done by Davies et al. (24) revealed that attitudes was only one factor exhibited a direct effect on intention to recycle. Do Valle et al. (38) also found that attitude toward recycling is a strong positive related to a superior propensity to participate in the selective-collection program. Gathersleben et al. (46) also proved that pro-environmental attitudes and beliefs appeared to be a good predictors of pro-environmental behavior. Kelly et al. (64) did a survey research in Massey University and found links between personal values, attitudes and self-reported pro-environmental behavior after analysis by the Chi-square test. The relationship between attitude and intention was confirmed in the report of Mannetti et al. (21), Oreg and Katz-Gerro (27) and Barr (16) using structural equation modeling (SEM) analysis in which less error occurs than regression analysis.

Hansmann et al. (32) found that attitudes towards ecological waste disposal related to the denial of responsibility. Meneses and Palacio (28) found that an attitude of environmental knowledge appears to be associated with all the roles. The factor related to environmental concern is only an antecedent of three roles—initiator, persuader, and influencer—with functions that appear to be associated with the special importance of ecological problems in comparison with other matters. The factor defined by an attitude of ecological involvement is associated with the adoption of all of the roles, although this association is weaker than in the case of an attitude of prior environmental knowledge. Barr (16) found that environmental attitudes served as key predictors of sustainable waste management behavior. The two most important attitudes were the level of interest the employees had in the environment and their environmental friendliness. These attitudes were linked to the beliefs and levels of awareness of staff. Although environmental attitudes were found to be among the most important factors, it was the underlying beliefs that played an important role in these attitudes.

Oreg and Katz-Gerro (27) conducted a 38 country survey which a country-by-country analysis of the path model as specified in Ajzen's theoretical model to

gain additional support for the relationships between attitudes, intentions and behaviors. The results validated the model cross-nationally. The model presented good fit in all of the countries.

2.1.3 Subjective norm: By the theory, subjective norm is a predictor of intention. This was confirmed by many researchers (19, 24, 65-67). However, some researchers found that subjective norm did not exhibit a direct effect on intention (21, 23, 24).

2.1.4 Perceive behavioral control (PBC, 68) or Self-efficacy(69): Most research has found a strong association of perceived behavioral control with intention(19, 21, 24, 27, 66). Controversially, Tonglet et al. (23) found that PBC is not a significant predictor. In addition, Cheung et al. (17) studied wastepaper recycling and found that PBC can be replaced by Perceived Difficulty.

Although the TPB provides a useful model for exploring the factors which influence householders' recycling decisions, many researchers argue that the inclusion of additional variables when applying the model to recycling behavior may be required (16, 19, 21, 23, 24, 27, 29, 30, 33).

2.2 Altruistic behavior model (MAB)

The altruistic behavior model was proposed by Schwartz (70). He suggested that "In affluent societies, pro-environmental behaviors like recycling are typically classified within the domain of morality in people's mind. Attitudes regarding this type of behavior are not based on a thorough calculation, conscious or unconscious of the balance of costs and benefits. Rather they are a function of the person's moral beliefs, which is the belief in what is right or wrong." By this model, recycling behavior was directly predicted by social norms and personal norms neither of these constructs is mediated by awareness of consequences or ascription of responsibility as shown in Figure 4 (24). Davies (24) found that the Schwartz model is better predictive of recycling behavior than the TRA or the TPB. However, addition of PBC and affective evaluation of recycling behavior substantially increased the explanation of variance in recycling behavior from 15% to 22%. Controversially,

Ebreo (29) found the absence of any relation between the responsibility respondents' felt for the generation of solid waste and the product attributes to be telling.

Figure 2.3 The Schwartz model of altruistic behavior.

2.2.1 Social norms: An experienced social norm of recycling would not directly influence behavior through a personal norm (30). Ebreo et al. found that measures of social influence are not important predictors of people's ratings-of-environment-related product attributes when compared to measures of their motives and attitudes toward the environment (29). This was supported by Meneses and Palacio (28) who found that the adoption of recycling conduct is not associated with compliance with the social norm, because it requires, sacrifices in terms of space and that implies high commitment.

MAB states that social norms influence personal norms, consequently exerting an indirect influence on recycling behavior. Unlike MAB, TPB assumes that perceived social norms, as well as personal attitudes, have a direct influence on behavioral intentions: Behavioral intentions result from a compromise between both sources of influence, which is moderated by the motivation to comply with the perceived social norms. This assumption of TPB has been supported by empirical studies (30). By the concept of Altruistic Behavior model above, social norm in this model be compared with subjective norm in TRA/TPB (32). Personal norms are strongly internalized moral attitudes (24). So, personal norm in MAB can be compared with normative norm or attitude in TRA/TPB.

Of those theories, The Theory of Planned Behavior was the most popular in the recycling study. Although Altruistic behavior model was grounded on personal belief as same as TPB, the constructs are in the linear function which is less likely to occur in real. Some constructs in MAB were also the same as some constructs in TPB as mentioned above. The Health Belief Model and Neutralization theory were used in only one previous study and they did not cover the interpersonal constructs. Therefore, the TPB may be the most appropriate in used

battery disposal behavior in Thailand. However, it needs the study to support this idea.

3. Organizational level

Tudor et al. (36) studied the recycling behavior at the organizational level by selecting the Cornwall National Health Service (NHS) as a case. They found that the influence of the hierarchical NHS organizational structure on individual behavior was "strong." This influence was manifested in a number of ways, including the levels of bureaucracy, the impact of the centralized controls on the support of the managers and resource provision (e.g. finance) for environmental projects, and the degree of autonomy in decision making that was possible at the local trust level. The organizational structure had a controlling influence not only on the functioning of the organization itself but also on the attitudes and behavior of employees. Finally, the structure affected the support of the managers for environmental management. Hence, the organizational structure affected the culture, employee attitudes, and beliefs, as well as the level of support and resources that was afforded to sustainable waste management.

Both the formal organization (i.e. NHS policies and focus) and the informal organization (group dynamics, norms, and routines) shaped the formation of the culture within the Cornwall NHS. In turn, this culture that was self-perpetuating, ingrained, and resistant to change significantly determined individual employee behavior.

"Organizational size and type" was not found to have a direct impact on behavior; similarly, "site size and type" did influence waste generation patterns. The "organizational focus" was one of the most significant influences on the practice of the Cornwall NHS and behavior of its staff. This centralized focus and control determined the practices and the levels of attention and resources that were directed toward sustainable waste management, as was evidenced in three main ways. First, this focus and control impacted on the attitudes, beliefs, and levels of motivation of staff, in that they resulted in an ingrained culture, a highly pressured work environment. Second, this focus and control resulted in a high degree of apathy coupled with low levels of motivation among staff toward noncore activities. Third,

the main aim of the managers was to meet the health care related targets, with any other issue being secondary.

The factor of "department type and size" was a significant determinant of waste management practices, with large variations existing in the quantities of waste produced by each department. Although department type and size explained the quantities and composition of the waste, taken on their own they did not necessarily directly influence the behavior of the employees. Rather they worked in conjunction with other factors to ultimately influence behavior.

Environmental management practices at home strongly correlated with sustainable waste management behavior at work. Indeed, employees who recycled at home were also more likely to practice sustainable environmental behavior at work.

4. Policy level

Folz (41) studied the performance on waste recycling of various policy implementation in the United States and found that recycling diversion rates were higher in cities that enjoyed a higher level of participation, collected a larger number of recyclable materials, and operated a composting program. Cities that banned yard wastes from landfill disposal had higher levels of both participation and diversion. Cities that added curbside collection also recorded large gains in participation and diversion. The cities that changed from voluntary to mandatory recycling, for example, realized the largest gains in participation. He also suggested that when existing policies do not produce results that compare favorably with other cities, local officials changed or revised their policies in an effort to improve performance.

The previous studies were summarized in Table 3

Table 2.3 Studied variables, design, instruments, and outcome of the literatures on recycling.

Study	Studied level	Theory used	Variables	Design	Instruments	Outcome & Results
Lindsay, JJ & Strathman, A (1997)(31)	Intrapersonal	HBM	Procedural knowledge, recycling behavior, benefits, barrier, perceived severity, perceived susceptibility, self-efficacy, consideration of future consequences, social desirability, norms, and demographic	317 Missouri residents over 18 years of age were survey	Telephone interviewing	The traditional HBM significantly predict recycling behavior approximately 27% of the variance
Hansman, R; et al. (2006)(32)	Intrapersonal	Neutral-ization	General attitude (trust), knowledge about the correct disposal of batteries, rejection (versus of	623 random sampling of households in Switzerland were postal	Question-naires	Recycling knowledge, self-organization of recycling, and disagreement with justifications for non-recycling were positive related to recycling behavior

Table 2.3 (continue) Studied variables, design, instruments, and outcome of the literatures on recycling.

Study	Studied level	Theory used	Variables	Design	Instruments	Outcome & Results
			acceptance) of justification, self-organization of battery disposal behavior, socio-demographic, and correct disposal or recycling of batteries	surveyed		
Barr, S (2007)(16)	Interpersonal	TPB & altruistic model	Recycling behavior, intention, situational var., sociodemographic var., knowledge, environmental values, intrinsic motivation, subjective norms, environmental threat	673 random inhabitants in the county of Devon in the South West of England	Self-adminis-tered ques-tionnaires	Service provision, sociodemographics, behavioral experience, policy intervention /instruments, global environmental knowledge, waste knowledge, policy knowledge, knowing where/how to recycling, perception of environmental problem, outcome beliefs of behavior, active concern

Table 2.3 (continue) Studied variables, design, instruments, and outcome of the literatures on recycling.

Study	Studied level	Theory used	Variables	Design	Instruments	Outcome & Results
			response efficacy, awareness of consequences, response efficacy, self-efficacy, & citizenship			and obligation, logistic of behavior, subjective norms, ascription of responsibility to act, citizen beliefs, intrinsic motivation, & response efficacy
Cheung, SF; et al. (1999) (17)	interpersonal	TPB	Intention, attitude, subjective norm, perceived difficulty, perceived controllability, perceived behavioral control, evaluation of anticipated outcome, belief strength, normative beliefs,	282 undergraduate students from the Chinese	Question-naires	TPB can predicted intention and behavior. Perceived difficulty predicted intention and moderated intention-behavior link.

Table 2.3 (continue) Studied variables, design, instruments, and outcome of the literatures on recycling.

Study	Studied level	Theory used	Variables	Design	Instruments	Outcome & Results
			motivation to comply, control beliefs, perceived power, knowledge, past behavior, & actual behavior in the following month	University of Hong Kong		
Davis, G; et al. (2006) (18)	interpersonal	TPB	Recycling behavior, attitude, subjective norm, perceived control, situational factors, consequence of recycling, attitude of waste minimization, minimization behavior, demographic information	survey	Hand-delivered question-naires	Attitude, subjective norm, and perceived behavioral control did not have a significant predictive power on intention to recycle. Outcome of recycling, concern for the environment, and situational factors made significant contribution to intention.

Table 2.3 (continue) Studied variables, design, instruments, and outcome of the literatures on recycling.

Study	Studied level	Theory used	Variables	Design	Instruments	Outcome & Results
Knussen, C. et al. (2004) (19)	interpersonal	TPB	Intention to recycle, attitude, subjective norm, PBC, past recycling behavior, and perceived habit and lack of facilities	Cross-sectional survey	Question-naires	Attitude and PBC were significant predicted intention. The past behavior-intention relationship was strong for those with no perceived habit of recycling. The attitude-intention relationship was stronger for those who had recycle more in the past. The PBC-intention relationship was weaker when facilities were perceived to be lacking.

Table 2.3 (continue) Studied variables, design, instruments, and outcome of the literatures on recycling.

Study	Studied level	Theory used	Variables	Design	Instruments	Outcome & Results
Ogle, J.P. et al. (2004) (20)	interpersonal	TRA	Intention, attitude, subject norm, environmental concern, environmental behavior, awareness of REI, consumer lifestyle orientation, perceive importance of REI's retail characteristics, and demographic	Survey of 186 consumers	Question-naires	Attitude predicted intention. The model should be extended to include retail characteristics, store atmospherics, merchandise assortment, consumer lifestyle orientation, and demographics

Table 2.3 (continue) Studied variables, design, instruments, and outcome of the literatures on recycling.

Study	Studied level	Theory used	Variables	Design	Instruments	Outcome & Results
Mannetti, L.A. et al. (2004) (21)	interpersonal	TPB	Intention, attitude, subjective norm, PBC, identity similarity	230 subjects were surveyed	Question-naires	TPB variables explain a substantial proportion of variance of the intention to the recycle. PBC is the strongest predictor while subjective norm is the weakest. The identity similarity is also the strongest predictor of the intenion.
Tonglet, M. et al. (2004) (22)	interpersonal	TPB	Recycling behavior, attitude, subjective norm, PBC, situational factors, consequences of recycling, attitude to waste minimization, demographic information	258 Brixworth households were monitored and surveryed.	Question-naires	Recycling attitudes are the major determinant of recycling behavior. These attitude are influenced by having the appropriate opportunities, facilities, and knowledge to recycle and by not being deterred by the issues of physical recycling. Previous recycling experience, and a concern

Table 2.3 (continue) Studied variables, design, instruments, and outcome of the literatures on recycling.

Study	Studied level	Theory used	Variables	Design	Instruments	Outcome & Results
						for the community and the consequence of recycling, are also significant predictors of recycling behavior.
Tonglet, M. et al. (2004) (23)	interpersonal	TPB	Recycling intention, attitude, subjective norm, PBC, moral norm, previous recycling behavior, situational factors, and the consequence of recycling	258 Brixworth households were surveryed.	Question-naires	Attitudes are the major contributor to recycling behavior, and that these attitudes are influenced firstly, by having the appropriate oppor-tunities, facilities and knowledge to recycle, and secondly by not being deterred by the issue of physically recycling. Previous recycling experience, and a concern of the community and the consequence of recycling are also significant predictors of recycling behavior.

Table 2.3 (continue) Studied variables, design, instruments, and outcome of the literatures on recycling.

Study	Studied level	Theory used	Variables	Design	Instruments	Outcome & Results
Davies, J. et al. (2002)(24)	interpersonal	TPB & MAB	Intention, attitude, subjective norm, PBC, experience of recycling, affect, personal norm, awareness of consequence, ascription of responsibily, task knowledge, Cost-benefit trade-off.	Self-completion, mail survey	Question-naires	The belief-based measured PBC was direct and associated with intention and behavior. Intention does not predict recycling behavior. The inclusion of affect and personal norm increases predictability of the TPB. The MAB was more predictive than TPB. The inclusion of PBC and affect increases the sufficiency of MAB.
Ewing, G (2001) (26)	interpersonal	TRA	Attitude, subjective norm, intention	781 individuals were surveyed	interviewed	Two normative factors (the expectations of household members and of friends and neighbors), an altruistic factor (the recycling help protect the environment) and an

Table 2.3 (continue) Studied variables, design, instruments, and outcome of the literatures on recycling.

Study	Studied level	Theory used	Variables	Design	Instruments	Outcome & Results
						egoistic factor (that recycling is inconvenience) are important to decision to recycle.
Oreg, S and Katz-Gerro, T. (2006) (27)	interpersonal	TPB	Harmony, postmaterialism, environmental concern, perceived threat, perceived behavioral control, willingness to sacrifice, proenvironmenatal behavior	27 countries	Face to face interview	Postmaterialistic values affect environmental concern. Environmental concern, perceived threat, and perceived behavioral control affect willingness to sacrificed which then affect the variety of proenvironmental behaviors.
Chen, M & Tung, P. (2010) (65)	interpersonal	TPB	Intention, attitude, subjective norms, perceived behavioral	1,500 persons from 50 village of	Mail questionnaire	Attitude, subjective norms, moral norms, and consequences of recycling are positive related to

Table 2.3 (continue) Studied variables, design, instruments, and outcome of the literatures on recycling.

Study	Studied level	Theory used	Variables	Design	Instruments	Outcome & Results
			control, moral norms, consequences of recycling, perceived lack of facilities	Taiwan were surveyed		recycling intention. Perceived lack of facilities is negatively related to intention.
Mahmud, SND & Osman, K. (2010) (66)	Interpersonal	TPB	Attitude, subjective norms, perceived behavioral control, intention	400 students from 4 secon-dary school in a state of Malaysia were surveyed	questionnaire	Perceived behavioral control and subjective norms are predictors of intention. Attitude have indirect effect to intention through PBC and SN.
Sidique, SF et al. (2010) (67)	interpersonal		Socio-economic and demographic factors, environmental affiliation, perception, attitude toward drop-off recycling	527 recyclers at 8 drop-off recycling sites around the Lansing area in Michigan	In-person interview	Belief about recycling convenience, familiarity with recycling infrastructure, and social pressure are drivers of recycling behavior.

Table 2.3 (continue) Studied variables, design, instruments, and outcome of the literatures on recycling.

Study	Studied level	Theory used	Variables	Design	Instruments	Outcome & Results
Ebreo, A. et al. (1999) (29)	interpersonal	MAB	Product attributes, general environmental concern, recycling attitude, recycling motives, self-reported recycling behavior, sociodemographic variables	Mail survey or 704 residents	Question-naires	Respondent's beliefs in a personal obligation to recycle and in the beneficial consequence of recycling were positively related to both types of product attributes. Several measures of general environmental concern, recycling attitude, and recycling motives were found to be related to both categories of product attributes. Respondent's self reported recycling behavior were found to be related to source reduction and recycling.
Bratt, C. (1999) (30)	interpersonal	MAB	Social norms, assumed consequences of behavior, personal norms, behavior	Mail survey of 780 Norwegian residents	Question-naires	Experience social norms and assumed consequences affected personal norm which then affected behavior.

Table 2.3 (continue) Studied variables, design, instruments, and outcome of the literatures on recycling.

Study	Studied level	Theory used	Variables	Design	Instruments	Outcome & Results
Corral-Verdugo, V. (1996) (33)			Knowledge about and competencies in reusing and recycling practices, beliefs concerning conservation practices, motives to reuse and recycle	100 families were surveyed	Question-naires	Conservation competencies and motives to reuse/recycle to be the most important direct predictors. Situational and demographic factors exerted significant indirect influence on conservation behavior through reuse/recycling motives and competencies.
Tudor, T.L. et al. (2008) (36)	organizational	-	Department type and size, Organizational focus, Organizational structure, Organizational site, type and size, Organizational culture	Survey of the Cornwall National Health Service, UK	An ethnographic study, interviews, waste bin analysis, and question-naires	There were the interlinking of a number of factors, including the impact of organizational focus, structure and culture, and employee attitudes and beliefs. The focus of the organization influenced both organizational practices and individual behavior variables. The

Table 2.3 (continue) Studied variables, design, instruments, and outcome of the literatures on recycling.

Study	Studied level	Theory used	Variables	Design	Instruments	Outcome & Results
						impact of the organizational structure had multiple links. It was closely related to the organizational focus and control, as well as organization culture and the level of support for environmental management from management. Another important behavioral predictor was organizational culture.
Folz, D.H. (1999)(41)	Policy	-	Citizen participation, waste stream diversion, recycling performance	Survey from 158 cities	Interview recycling coordinators	Recycling diversion rates were higher in cities that enjoyed a higher level of participation, collected a larger number of recyclable materials, and operated a composting program. Cities that banned yard wastes from landfill

Table 2.3 (continue) Studied variables, design, instruments, and outcome of the literatures on recycling.

Study	Studied level	Theory used	Variables	Design	Instruments	Outcome & Results
						disposal had higher levels of both participation and diversion. Cities that added curbside collection also recorded large gains in participation and diversion. The cities that mandated recycling policy, added curbside collection were largely. gained in participation and diversity

Factors that Influence Recycling Behavior

Beside the constructs from the behavioral theories, other factors that influence recycling behavior were studied. These are incentives, social influence or motivation, situational factors on convenience, past behavior, justification, self-organization, trust, self-realization, and socio-demographic variables. These variables are discussed below.

Hornik et al. (34) reviewed the factors associated with recycling behavior and categorized them into 5 groups: extrinsic incentives, intrinsic incentives, internal facilitators, external facilitators, and demographic variables. They used meta-analysis technique to determine the relative influence of those predictors on recycling. The results led them to propose a model of consumer recycling behavior as shown in Figure 5. In this model, internal facilitators are the most important in predicting propensity to recycle and relatively enduring effect on recycling. External facilitators, conversely to internal facilitators, have the lowest predictive power and short-lived effect on recycling. External incentives and internal incentives occupy the spots between the two facilitators.

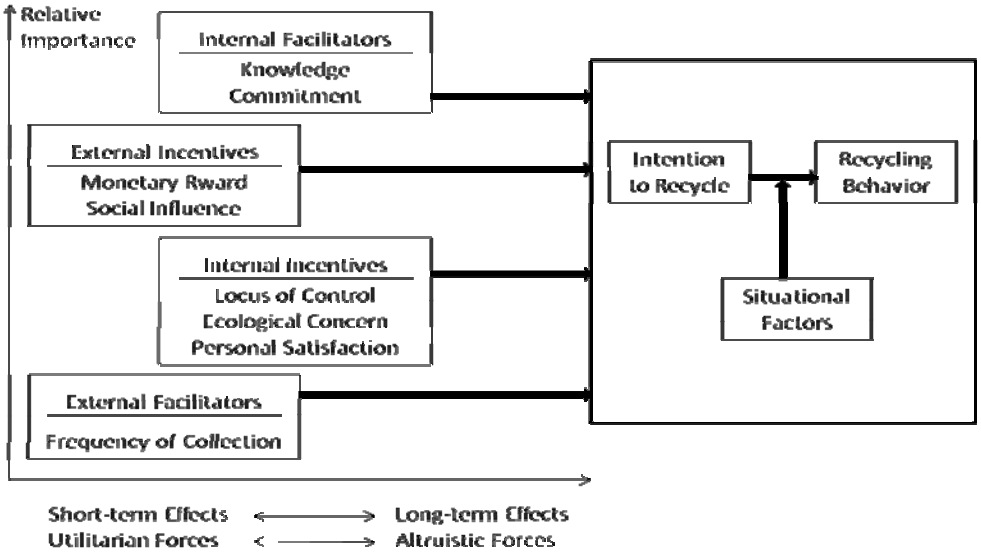

Figure 2.4 A model of consumer recycling behavior proposed by Hornik et al. (34)

The other studies showed the other factors associated to recycling behavior. These are

1. Incentive: The consumer recycling behavior model was support by the survey of Li (35) who found that recycling for cash is one direct incentive to motivate public participation. Similarly, Noehammer and Byer (71) concluded from their survey data that incentives have a positive impact on the success of a recycling program. User fees, fines, and rewards are the general form of incentives that successful implication in promoting recycling behavior.

2. Social Influence or Motivation: The four studies on this factors support Hornik's model. Respondent's motives to recycle due to the influence of one's family and friends also were related to both categories of attributes: conservation and being kind to nature (29). Motivation influenced individual behavior; however, its impact was strongly related to the organizational focus, structure, and culture (36). Conservation motives are significant predictors of recycling (33). Household members with ecological motivation tend to bear a greater burden of the recycling role than those without such motivation (28). This factor is equal to subjective norm in TRA/TPB.

3. Situational Factors (Convenience): Schultz et al. (37) found three specific attitudinal factors that contributed to non-recycling behavior: nuisance, location, and indifference. Nuisance included ideas that recycling does not pay, it is too much trouble, it is too messy, and it requires too much space. Location included beliefs that the recycling center was too far away, that not enough trash was generated to make recycling worthwhile, and lack of knowledge about where to take materials. Indifference included never thought about it', and 'it makes no difference'. This review indicated that situational factors also were a significant predictor of intention and was supported by other studies (18, 23). The following paragraph is the result from studies that support the effects of situational factors on recycling behavior.

The students would recycle more if there were more bins around campus. Many comments were directed at the need to improve the convenience of recycling, primarily by providing more bins at a greater diversity of locations on campus, especially in student accommodation areas (64). The motives of convenience explain

the refusal to adopt the role of initiator and vendor. On the other hand, the role of rejecter is favored when recycling is not convenient or easy (28). The convenience of the recycling program, strongly related to the satisfaction with the provided logistics service, is a significant predictor of recycling participation (38). People who live more than 5 miles away from the nearest drop-off recycling center are less likely to recycle (39). Households are willing to recycle a wider variety of waste materials when the system is more convenient (40). Provision of a free collection container clearly encourages residents to participate in a voluntary recycling program. Higher collection frequencies yield higher participation rates (71). Participation and diversion was statistically higher in cities that mandated recycling. Participation also was statistically higher in cities that provided curbside collection and offered free bins to citizen in which to place materials (41). Convenience and effort are associated with willingness and behavior to recycle (16). The results of Berglund's study (42) showed that the average hourly willingness to pay to let other sort household waste at source was significantly lower than the corresponding income after tax. Communication factor such as bigger signs in more noticeable places nearer to the bins, and pictures on the signs which show the most common types of waste made recycling less confusing to students (64).

4. Past behavior: Although past behavior or experience is a kind of attitude as mentioned above. It was added to TPB in some studies and contributed an additional increase in percentage explanation of variance (17, 19, 23, 24, 33, 39).

5. Justification: Although MAB and the TPB have received empirical support, both models can be criticized in that they ignore how any possible discrepancies between personal attitudes, social norms, and behavior are resolved, given that self-identity and a positive self-image must be achieved. The inconsistency of persons acting in an ecologically harmful manner despite their environmental knowledge and their positive environmental attitudes is supported by arguments of justification. In particular, they assume that the high cost of an environmentally positive behavior can serve as a justification for not performing such behavior.

On the one hand, justification refers to an internal cognitive communication, fulfilling the function of sustaining the self-concept when committing acts that deviate from personal norms. On the other hand, justification is a self-

defense against possible accusations and punishments of the social environment with its formal and informal social norms. The temporal nature of processes of justification is also twofold given their role as antecedents and successors of behavior.

Justifications for non-recycling could be actively targeted in public campaigns. Furthermore, the justifications that are used provide information regarding individuals' subjective viewpoints, particularly of non-recyclers regarding the reasons underlying their inappropriate disposal of batteries. For example, the justification that the appropriate disposal of batteries is frequently forgotten not only denies the responsibility for incorrect disposal but is also an indication that people might indeed have problems reminding themselves to recycle their old batteries (32).

6. Self-organization: The activity of arranging and organizing a household's waste-disposal can also facilitate recycling, making it more manageable. A significant positive relationship between realizing self-organizing strategies and participation in and persistence of recycling was demonstrated by Werner and Makela (43). Hansmann et al. (32) showed that self-organization activities could also serve to remind people to recycle their batteries: pouches installed in exposed position in households could assist in keeping the recycling of used batteries in mind. Organizing battery recycling (e.g. arranging separate storage places in the home, combining battery disposal with the purchase of new products) effectively supports recycling behavior. Not only should such activities be encouraged through public campaigns, there is also the possibility of providing logistical assistance for self-organization.

7. Trust: Hansmann et al. asked a question about trust in administration and waste disposal companies as a part of their attitude measures. They found that trust in waste disposal companies appears important as it was significantly related to participants' knowledge of battery recycling. However, the results indicate that domain-specific knowledge and the acceptance of justifications that specifically address battery recycling are more closely and directly related to self-reported battery disposal behavior than more general psychological variables. This suggests that encouraging battery recycling behavior could be achieved by targeting the specific knowledge and the common justifications given for incorrect disposal (32).

8. Self-realization: Meneses and Palacio (28) set self-realization from factor analysis of their motivation to recycle questions. This factor is made up of needs of an environmental nature and self-satisfaction. They found that ecological self-realization is the factor most closely linked to the carrying out of recycling roles. This motivation appears, above all, as an antecedent of the roles of, in descending order, influencer, persuader, initiator, enforcer, vendor, and decision maker and with a negative association to the rejecter.

As mentioned above, most studies of recycling behavior used the Theory of Planned Behavior framework. Some studies employed the Altruistic Behavior model but all the studies indicated that social norms (subjective norms in TPB) do not directly influence recycling behavior according to the studies on TPB that subjective norms are not important predictor. One study used The Health Belief Model or Neutralization Theory each. Inaddition, some constructs of three latter model are include in TPB model. So, TPB may be the most suitable model in recycling behavior. However, the results of those studies are inconsistent. In addition, there were no studies done on used battery disposal. A study in another context may be useful in the intervention development of behavioral change to promote proper used battery disposal behavior which preventing disease and preserving our environment.

Of those factors, situational factors (convenience) seem to be the most influencial concerning recycling behavior. These factors should be prepared to support the proper behavior while the behavior is promoted.

9. Socio-demographic variables

9.1 **Age:** Older participants who lived in Glasgow, Scotland had stronger intentions to recycle, and were more likely to have done so in the past. There results were from 250 participants. They had more positive attitudes, a stronger subjective norm, and were less likely to perceive a lack of facilities to recycle (19). The study in four communities of the Regional Municipality of Halton (Ontario, Canada) with 673 complete returned questionnaires indicated age was the only demographic variable that significantly predicted recycling intensity, i.e. the older respondents were generally more active recyclers (44). The analysis from 566 completed questionnaires from an organization found that age influenced the waste

management behavior of employees. Older staff members practiced more sustainable waste management behavior compared to younger staff members (36). The analysis of data from the 2000 National Survey on Recreation and the Environment (NSRE) indicated older persons were significantly more likely than others to recycle (45). Adults between 36 and 65 years old are more likely to recycle electronic waste was reported from the study in six counties of California (4 urban counties and two rural area) (39). Two studies in the Netherland with 2,167 and 1,250 completed returned questionnaires demonstrated that age influences recycling (46). The study from 673 useable questionnaires completed by the residents in Exeter located in the county of Devon in the South West of England revealed that age associated with recycle behavior when analyzed by Structural Equation Modeling (16).

Differentially, the study from 358 individuals in a metropolitan area stated that the age of the household member determines the fulfillment of recycling roles in such a way that people whose age is far from the working population's average bear a lesser burden than those whose age is roughly that of the average (28).

In comparison to those studies, personal interviews based on a structured questionnaire from 2,093 households with Portugal residents in 50 municipalities showed no relationships between age and recycling involvement when analyzed by logistic regression (38).

The results of five studies reviewed by Schultz et al. (37) showed similar pattern as above, i.e. the results are ambiguous as to both the existence and direction of the relationship between age and recycling.

9.2 **Education:** A study in Athens-Clarke County, Georgia, found that the average recycling efficiency for a household whose recycler had received additional schooling after high school was higher than those whose recycler had received a high school diploma or less (72). A study in six counties of California (4 urban counties and two rural areas) revealed that people with a college education are more likely to recycle (39). The analysis of data from the 2000 National Survey on Recreation and the Environment (NSRE) indicated that the peoples with postsecondary educations were significantly more likely than others to recycle (45).

A study in the Netherland with 1,250 completed returned questionnaires demonstrated that respondents with a higher level of education performed more pro-environmental behavior (46). Education is a significant predictor of access to recycling service when analyzed from a Canadian data set by discriminant function analysis and regression (47).

The study from 673 useable questionnaires completed by the residents in Exeter located in the county of Devon in the South West of England revealed that education was not associated with recycling behavior when analyzed by Structural Equation Modeling (16). Similarly, personal interviews based on a structured questionnaire from 2,093 households with Portugal resident in 50 municipalities found no relationship between education level and recycling involvement when analyzed by logistic regression (38). A study in the Netherlands with 2,167 completed returned questionnaires also demonstrated that educational level was not significantly related to recycling (46).

Of the six studies reviewed by Schultz et al. (37), three found no relationship, whereas the other three reported a positive relationship. These findings are in accord with the review above in which the relationship between education and recycling behavior is still ambiguous.

9.3 **Income:** A study in Athens-Clarke County, Georgia, found that respondents whose annual household income was $20,000 or less had a marginally significantly lower recycling efficiency than did households whose annual household income was greater than $20,000 (72). A study in Northern Ireland analyzed by ANOVA indicated that participation in the recycling program was higher in the high SES areas of Belfast city than the lower SES areas (48). A study in Netherland with 2,167 completed returned questionnaires also demonstrated that income influencing recycling. (46) Income is a significant predictor of access to recycling service when analyzed from a Canadian data set by discriminant function analysis and regression (47).

The previous review suggests that income has consistently been found to correlate positively with recycling behavior (37). However, there are three articles published after that review that presented controversial findings. The association of income to recycling behavior was not found when studied from 673

useable questionnaires completed by the residents in Exeter located in the county of Devon in the South west of England (16). Personal interviews based on a structured questionnaire of 2,093 Portugal residents in the 50 municipalities presented no relationships between household income and recycling involvement (38). A study in Metropolitan Wuhan, China, and analyzed by logistic regression revealed that the rate of participation was relatively high in the city no matter whether the respondent had lower or higher household incomes. On average, approximately 79% of households in the city collected household recyclables with lower-middle-income household more active in recycling than others (35).

9.4 **Gender**: The previous review from five studies that examined the relationship between gender and recycling were unanimous in finding no significant relationship. Thus, men and women are equally likely to recycle (37). That review was supported by two later studies. Personal interviews based on a structured questionnaire from 2,093 households with Portugal residents in the 50 municipalities found that gender was not a significant predictor of recycling participation (38). Gender was not associated with recycling behavior when studied from 673 useable questionnaires completed by the residents in Exeter located in the county of Devon in the South west of England (16).

However, more recent studies found the opposite findings in which females had recycled more household waste in the past than males. This study included 250 participants who lived in Glasgow, Scotland (19). The study in Metropolitan Wuhan, China, and analyzed by logistic regression revealed that women play a crucial role in taking care of routine housework and are much more active in recycling than men except among the younger generation (35). The study from 358 individuals in a metropolitan area stated that women bear a greater burden of the recycling role than men (28). Men in general are less likely to recycle as reported from a study in six counties of California (4 urban counties and two rural area) (39). The analysis of data from the 2000 National Survey on Recreation and the Environment (NSRE) indicated that women were significantly more likely than others to recycle (45).

9.5 **Occupation:** There are only two reported studies of the relationship between occupation and recycling behavior. One study with 250 participants who lived in Glasgow, Scotland indicated that people in the mid-range non-manual occupational category were younger; further, they had more negative attitudes towards recycling, lower perceived behavioral control, and lower subjective norm scores. Those who were unemployed, retired, or students had stronger intentions to recycle, and had recycled more in the past than those in other occupational groups (19). Controversially, another study of 673 useable questionnaires completed by the residents in Exeter located in the county of Devon in the South west of England revealed occupation was not associated with recycling behavior (16).

9.6 Home owner, space and size (the number of household members): A study in Athens-Clarke County, Georgia, found that the average recycling efficiency for homeowners was significantly greater than that for renters (72). Personal interviews based on a structured questionnaire from 2,093 households in Portugal in 50 municipalities indicated that the existence of some available space in the household to store the recyclable materials is a determinant of the adoption of recycling practices (38).

The study in Metropolitan Wuhan, China, and analyzed by logistic regression revealed that approximately 74% of 57 small-sized households (1 or 2 people) collected recyclables, 89% of 72 large-sized households (5 or more people) took the same action (35). The analysis of data from the 2000 National Survey on Recreation and the Environment (NSRE) also indicated that larger families were significantly more likely than others to recycle (45). Similarly, a study in Netherland with 2,167 completed returned questionnaires also demonstrated that larger households performed more pro-environmental behavior (46).

9.7 Ethnicity and Others: The analysis of data from the 2000 National Survey on Recreation and the Environment (NSRE) indicated that blacks and foreign-born Latinos were significantly less likely than Whites to recycle. This study also showed that urban dweller and liberals were significantly more likely than others to recycle (45).

From the literature review as mentioned above, it can be argued that there are many levels of factors associated with recycling behavior, i.e. individual, social, organizational, and policy. The theory that will guide us should cover multiple levels and multiple types of environmental influences that affect health behavior. These characteristics can be seen in ecological models. In addition, the models can be useful with specific behavior and promote multilevel interventions implementation and evaluation. Moreover, the models that accept the political dynamics affect the ecological interventions (70). So that, the ecological models framework may be fit to these factors. However, nearly all of those studies were done in regards to household recyclable material which has different characteristics than used batteries. This information therefore cannot be used directly to understand used battery disposal behavior. More research is needed to make clear which factors are related to this specific behavior.

Methodology for theory testing in behavioral research

The steps in testing TPB theory were recommended by Francis, JJ *et al*. (74). This includes the following seven main steps.

1. Define the population of interest.
2. Define the behavior under study.
3. Decide how best to measure intentions.
4. Do the elicitation study to determine the beliefs for indirect measure of the constructs.
    a. Determine the most frequently perceived advantages and disadvantages of performing the behavior.
    b. Determine the most important people or groups of people who would approve or disapprove of the behavior.
    c. Determine the perceived barriers or facilitating factors which could make it easier or more difficult to adopt the behavior.
5. Develop the first draft of the questionnaire.
6. Pilot test the draft and reword items if necessary.
7. Assess the test-retest reliability of the indirect measures.

1. **Conduct an elicitation study**

An elicitation study conduct by taking a sample of about 25 people from the population and ask them open-ended questions. The asking may be done by focus group, individual interview, or mailed questionnaire techniques. If done by focus group or interview, the tape recording must be verbatim transcribed to written format. Then, the content of the responses will be independent analyzed with two researchers by labeling the themes. The themes will be listed in order of frequency for each of the behavioral beliefs, sources of social pressure, and control belief strength.

2. Develop the questionnaire

1.1 Measuring behavior intentions

There are three methods to measure the intention to perform the interested behavior. First, use a single question and give the number 0 to 10 for selection. The selected number is the behavioral intention score. Second, use at least three affirmative sentence and 7-points "agree-disagree" scale. The selected number of each item is the item score. The behavioral intention score calculated from the mean of all item scores. This method needs adequate internal consistency. Last, write 10 scenarios, of around 80 to 100 words each, and ask for decision of each scenario with yes/no question and also ask how difficult the decision was by 7-points "difficult-no difficult" scale. This method need more time in developing scenarios and questions. Since the first method use only a single question, there is no other question to confirm the answer. So, the second method is the most suitable to measure intention in this study.

1.2 Measuring attitudes

Direct measurement of attitude can be done by the use of a single affirmative statement with at least four 7-points scale of bipolar adjectives or pairs of opposites which are evaluative e.g. good-bad. The bipolar adjectives include instrumental items, whether the behavior achieves something e.g. useful- worthless, and experiential items, how it feels to perform the behavior e.g. pleasant-unpleasant. These items must be arranged so that the ends of the scales are a mix of positive and negative endpoints. The high internal consistency is needed. Some items may be omitted from the scale to improve internal consistency. The selected number of each item is the item raw score. The item raw score from the negatively worded endpoints

needs to recode on the right to be the item score. The attitude score calculate from the mean of the item scores.

Indirect measurement of attitude by conducting an elicitation study (see item 1 conduct an elicitation study) to elicit to commonly held beliefs, construct questionnaire items to assess the strength of behavioral beliefs, and construct questionnaire items to assess outcome evaluations. Questionnaire items to assess the strength of behavioral beliefs constructs by select the behavioral beliefs most often listed and convert these into a set of statements. These statements should reflect the beliefs which might affect the behavior of the target population and 7-points "likely-unlikely" scale for each statement. Inclusion of 75% of all beliefs stated should give adequate coverage of the belief population. Questionnaire items to assess outcome evaluations constructs by convert each of the belief statements into the form of an incomplete sentence. By completing sentence, the participant expresses a negative or positive evaluation of the belief statement on the 7-points "desirable-undesirable" scale (-3 to +3). Then, pilot test these items (both to assess the strength of behavioral beliefs and outcome evaluation) by asking about five peoples from the relevant population to answer the questions and ask them whether they have any difficulty answering them. Check comprehension and clarity. If necessary, modify the wording of the questions. The number that the participant selected is the item score. The multiplied product of item score of each behavioral belief and the relevant evaluation is the single item score. Then, sum all single item scores to create an overall attitude score. This score reflects only negative or positive attitude by minus or plus sign in front of the score.

2.3 Measuring subjective norms

Direct measurement of subjective norms will be done by the use of questions referring to the opinions of important people in general with 7-points "agree-disagree" scale. Another format is the use of 7-points "should-should not" scale to complete the sentence and a mix of positive and negative endpoints. This method needs high internal consistency. The score can be calculated from the mean of all item scores after recode the items that have negatively worded endpoints to the right.

Indirect measurement of subjective norms by selecting the reference group (or individuals) most often listed (75% of the group or individual listed) and convert these into the 'stems' of normative belief items. These items reflect what important people think a person should do (injunctive norms) or what important people actually do (descriptive norms). The sentence will be incomplete and have 7-points scale to be completed by the respondent. Each of the social pressure will be converted into the form of a statement about the importance of the various sources of social pressure with 7-points "not at all- very much" scale. The participant will select a number to indicate the strength of motivation to comply with each reference group or individual. The questionnaire must be pilot test by asking about five respondents to answer the questions and then ask them whether they have any difficulty answering them. The questions may be modified if necessary. The number selected by the respondent is the score of that item. The summation of item score of normative belief multiply by the item score of motivation to comply is the overall subjective norm score which mean that the respondent have positive or negative to the social pressure.

2.4 Measuring perceived behavioral control

Direct measurement of perceived behavioral control (PBC) is measured by incomplete affirmative sentence reflect people's self-efficacy or their beliefs about the controllability of the behavior. The self-efficacy is accessed by asking about how difficult it is to perform the behavior or how confident they are that they could do it. The controllability is assessed by asking whether performing the behavior is up to them or whether factors beyond their control determine their behavior. The sentence will be completed by the respondent who selecting a number of 7-points "agree-disagree" scale which are arranged to a mix of positive and negative endpoints. It also use complete sentence with bipolar adjectives in assessment the PBC. These assessment items need high internal consistency so that some item may be omitted from the scale to improve internal consistency. The selected number by the respondent is the item score. The mean of all item scores is the overall PBC score.

Indirect measurement of PBC can be done by assessing the strength of control beliefs and their perceived power. Questionnaire items to assess

the strength of control beliefs are constructed by select the beliefs most often listed (75% of all beliefs listed) and convert into a set of statements which reflect the difficulty to perform (or not perform) the target behavior. These sentences are complementary with 7-points "likely-unlikely" scale. Questionnaire items to assess the perceived power are constructed by convert the control belief statements into the form of an incomplete statement about whether this makes it more or less likely that the person will do the target behavior, or whether it makes the behavior easier or more difficult to do. These sentences are complementary with 7-points "less likely-more likely" scale. These items need to pilot test by asking about five respondents to answer the questions and ask them whether they have any difficulty answering them. Wording modification may be needed if necessary. The selected number by respondent is the item score. The summation of the item score of control belief multiply by the item score of the perceive power is the overall perceived behavioral control score. The positive or negative PBC score means the participant feels or do not feel in control to perform behavior, respectively.

There are eight articles that studied the theory of planned behavior testing. These studies followed the steps of methodology as mentioned above and are summarized in Table 4 (16, 18-21, 24, 26, 27). However, there are some studies that did not mention the elicitation study, showed only the questionnaire step. In contrast, some showed only elicitation study without survey research.

Table 2.4 Studies of Theory of Planned Behavior testing

Study	Elicitation study		Main study			
	Participants	Materials	Participants	Materials	Variables	Analysis
Cheung, SF *et al*. (17)	18 male & 18 female undergraduate students from the Chinese U. of Hong Kong	Open-ended questionnaires to identify salient beliefs	282 undergraduate students from the Chinese U. of Hong Kong	Close-ended questionnaires	Int, Att, SN, PD, PCt, PBC, OE, BB, NB, MC, CB, PC, K, PastB, Beh, Dem	Hierarchical linear regression
Tonglet, M *et al*. (22, 23)	20 residents participated in kerbside scheme in the UK	Interview	285 residents	Postal questionnaires	Beh, Att, SN, PBC, SF, consq, Att, Dem	Multiple regression, Factor analysis
Cheng, S. *et al*. (75)	Did not indicated	Focus-group interview	582 diners of eight restaurants in Shanghai	Questionnaires, direct measures only	Int, Att, SN, PBC, Dem	Structural Equation Modeling
Peters, R.M. *et al*. (76)	34 participants ranging in age form 27 to 60 years	Focus group	Did not indicated	Did not indicated	Did not indicate	Did not indicated
Tolma, E.L. et al. (49, 77)	Did not indicated	Face-to-face interview	293 women who visited the outpatient clinics of the General Hospital of Nicosia, Cyprus	Face-to-face interview	Int, Att, SN, PBC, SE	Multiple regression

Table 2.4 (continue) Studies of Theory of Planned Behavior testing

Study	Elicitation study			Main study		
	Participants	Materials		Participants	Materials	
Bledsoe, L.K. (78)	68 adult smokers	Did no indicated	Bledsoe, L.K. (78)	68 adult smokers	Did no indicated	Bledsoe, L.K. (78)
Kakoko, D.C. (79)	Did not indicated	Focused interviews	Kakoko, D.C. (79)	Did not indicated	Focused interviews	Kakoko, D.C. (79)
Jitramontree, N. (80)	Did not indicated	interview	Jitramontree, N. (80)	Did not indicated	interview	Jitramontree, N. (80)

Note: Beh = behavior, Int = intention, Att = attitude, SN = Subjective norms, PBC = perceived behavioral control, SE = self-efficacy, BI = ,BB = behavioral beliefs, OE = outcome evaluation, NB = normative beliefs, MC = motivation to comply, CB = control beliefs, PC = power of control, PR = perceived risk, PD = perceived difficulty, PCt = perceived controllability, K = knowledge, PastB = past behavior, SF = sitational factors, consq = consequence, DEM = demographic variables

Present Situation of Used Battery Disposal in Thammasat University

Thammasat University, Rangsit campus, is located on Phaholyothin road, Klong Luang, Pathumthani. There were 20 faculties/colleges. In 2010, there are around 20,000 students who studied at this campus; and about 12,000 students live on the campus during semesters. These people create a large amount of solid waste, i.e. about 6 tons a day which creates a lot of expense in its management.

The recycling program namely "Recyclable Waste Bank" was launched at this campus in November 2007 by promoting all students and staff to separate and dispose of recyclable materials – paper, plastics, metal, glass, and completely used automotive batteries – in a specific waste bin or collect those materials in order to be sold. These recyclable materials then are sold to a recycling shop. The degradable waste such as food remaining, and uneatable parts of vegetables and fruits is composted and used as fertilizer. The un-biodegradable foam containers have been prohibited for use as food utensils since June 2008. Utensils made from bagasse and reused containers are now used instead of foam containers (49).

However, dry cells are ignored. Dry cells are mostly used in various kind of scientific instruments found in Science and Technology sub-organizations such as the Faculties of Science and Technology, Medicine, Nursing, and the hospital. In addition, students use many electric and electronic devices such as radios, sound abouts, digital cameras, MP3 players, CD players, notebooks, mobile phones, etc. which use dry cells as their power source.

A preliminary study with 50 students of Thammsat University revealed that alkaline batteries are the most popular type of battery of which 20.7±24.0 units are used per person per year. Nickel-cadmium batteries are the second most popular with 6.9±13.7 units used per person per year. Nickel metal hydride and Lithium batteries were used 1.0±4.1 and 4.8±10.1units per person per year, respectively. After being completely used, all of these batteries are disposed of into household waste bins since there is no specific separated waste bin for used batteries. This behavior may lead to contamination of toxic metals in the environment and eventually to humans as discussed above. So, the understanding of factors associated with battery disposal behavior will lead to the development of an effective intervention for solving this problem.

CHAPTER III
MATERIALS AND METHODS

In this study, a survey to determine the factors associated with used battery disposal intention was conducted at Thammasat University, Rangsit campus. There were 2 activities in the survey study – an elicitation study, survey, and the analysis.

The Elicitation Study

1. Research design: A survey was conducted for eliciting the Theory of Planned Behavior (TPB) constructs related to the disposal intention variables by identifying the behavioral beliefs, normative beliefs, and control beliefs which would encourage or discourage proper disposal of used batteries by a set of open-ended questions (74).

2. Population and Sample: Undergraduate students of Thammasat University, Rangsit campus were randomly selected to fill in the questionnaire. To make sure that all determinants were identified, twenty-five students were needed (74).

3. Instrument: Opened-ended questions in the Thai language were used to identify behavioral beliefs, normative beliefs, and control beliefs which would encourage or discourage proper disposal of used batteries. The questions were:-

- What do you believe are the *advantages* of your disposing used batteries into a specific recycling bin?
- What do you believe are the *disadvantages* of your disposing used batteries into a specific recycling bin?
- Is there anything else you associate with your disposing used batteries into a specific recycling bin?
- Are there any individuals or groups who would *approve* of your disposing used batteries into a specific recycling bin?

- Are there any individuals or groups who would *disapprove* of your disposing used batteries into a specific recycling bin?
- Are there any other individuals or groups who come to mind when you think about disposing used batteries into a specific recycling bin?
- What factors or circumstances would enable you to dispose of used batteries into a specific recycling bin?
- What factors or circumstances would make it difficult or impossible for you to dispose of used batteries into a specific recycling bin?
- Are there any other issues that come to mind when you think about the difficulty of disposing used batteries into a specific recycling bin?

4. Analysis: The data were analyzed by descriptive statistics, frequency and percentage, for each of the behavioral beliefs, sources of social pressure (reference individual or groups), and control belief strength. The beliefs in each group were ranked in order from the highest percentage to the lowest percentage. At least 75% of high frequency beliefs were selected to construct the questionnaires for the survey research (74).

The Survey Research

1. Research Design: The survey was designed to identify the factors associated with used battery disposal intention of the undergraduate students of the Thammasat University, Rangsit campus. The survey was done by self-administered questionnaires which the respondents completed and returned to the researcher.

2. Population and Sample: The population for this study was undergraduate students studying at the Rangsit campus. The minimum number of student calculated from the formula

$$n = \frac{z^2\sigma^2}{d^2}$$

where n = sample size,

Z = Z statistic for a level of confidence, 95% = 1.96

σ = standard deviation = 1.48

d = percentage of error of means = 0.1

$$n = \frac{(1.96)^2(1.48)^2}{(0.1)^2} = 841.5$$

The total number of students at Thammasat University, Rangsit campus, is around 20,000 persons. The respond rate was expected to be 50% so that the sample size should be 1,700. Fifty percentage of incomplete questionnaire was predicted. So, 20% of all members, around 4,000 persons, are suitable for the sample size

3. Sampling method: The student sampling was done with a stratified random sampling technique. The sample number from each faculty was proportionate with the total number of all students of the faculty and of the year of study that is 20% (Table 5). The sample was taken by blind selection technique.

4. Instrument: A set of paper-based self-administered questionnaires was constructed. The questionnaire was based on the recycling literature and information obtained from the elicitation study. The construction procedure followed the TPB questionnaire format (74, 81). (APPENDIX B) The following are items used in the questionnaire. All questions were in the Thai language. (APPENDIX C)

Intention: Four items were used to measure intention. Participants rated the following statements on a seven-point "agree-disagree" scale: "I will dispose of my used batteries in a specific recycling bin every time I have a used battery" "I want to dispose of my used batteries in a specific recycling bin every time I have one to be disposed off" "I intend to dispose of my used batteries in a specific recycling bin every time I have one for disposal" and "I plan to dispose of my used batteries in a specific recycling bin every time I have one for disposal".

Attitude: Attitudes was measured by direct and indirect methods. A seven-point scale was used to directly measure attitudes concerning proper disposal of used batteries. The attitudes identified in this study were: Dispose of used batteries in specific waste bins is "good/bad"; "useful/a waste of time"; "responsible/not responsible"; "sensible/not sensible"; "beneficial/harmful"; "pleasant/unpleasant".

Indirect measures of attitude (A) were done by measuring behavioral beliefs (*b*) and outcome evaluation (*e*). Questionnaire items to assess the strength of behavioral beliefs were constructed by selecting the behavioral beliefs most often listed (75%) and were then converted into a set of statements. These statements

Table 3.1 Number of total students and sample classified by faculty and year of study

Faculty	1st year N(n)	2nd year N(n)	3rd year N(n)	4th year N(n)	5th year N(n)	6th year N(n)	Total N(n)
Medicine	200(40)	210(42)	181(36)	169(34)	128(26)	23(5)	911(187)
Dentistry	75(15)	51(10)	64(13)	70(14)	53(11)	60(12)	373(75)
Nursing	101(20)	135(27)	102(20)	92(18)			430(85)
Allied Health Science	187(37)	150(30)	128(26)	130(26)			595(119)
Public Health	98(20)	99(20)	77(15)	91(18)			365(73)
Science & Technology	819(164)	657(131)	689(138)	611(122)			2776(553)
engineering	398(80)	322(64)	315(63)	301(60)			1336(267)
Architecture & Planning	220(44)	186(37)	163(33)	87(17)			656(143)
Commerce & Accountancy	413(83)	367(73)	497(99)	413(83)			1690(336)
Law	570(114)	579(116)	568(114)	533(107)			2250(451)
Political Science	262(52)	309(62)	282(56)	276(55)			1129(226)
Economics	352(70)	345(69)	333(67)	271(54)			1301(260)
Social Administration	237(47)	238(48)	228(46)	255(51)			958(192)
Sociology & Anthropology	231(46)	194(39)	169(34)	81(16)			675(133)
Journalism & Mass Communication	212(42)	193(39)	170(34)	198(40)			773(155)
Liberal Art	468(94)	425(85)	420(84)	414(83)			1727(346)
Fine & Applied Arts	79(16)	63(13)	57(11)	58(12)			257(51)
Total	4922 (995)	4523 (902)	4443 (888)	4050 (809)	181 (42)	83 (16)	18202 (3652)

reflect the beliefs which might affect the proper used battery disposal behavior of the target population and a 7-points “likely-unlikely” scale for each statement. Questionnaire items to assess outcome evaluations were constructed by converting each of the belief statements into the form of an incomplete sentence. By completing each sentence, the participant expressed a negative or positive evaluation of the belief statement on the 7-points “desirable-undesirable” scale (-3 to +3). Then, there items were pilot tested (both to assess the strength of behavioral beliefs and outcome evaluation) by asking five peoples from the relevant population to answer the questions and asking them whether they had any difficulty answering them. This was a check for comprehension and clarity. Where necessary, the wording of the

questions was modified. The number that the participant selected is the item score. The multiplied product of item score of each behavioral belief and the relevant evaluation is the single item score. Then, all single item scores were summed to create an overall attitude score. This score reflects only negative or positive attitude by minus or plus sign in front of the score. A positive overall score of indirect attitude means that the participant is in flavor of disposing of used batteries in a specific separate waste bin. A negative overall score of indirect attitude means that the participant is against disposing use batteries in a specific separate waste bin.

Subjective norms: Subjective norms refer to social pressure to properly dispose of used batteries and were assessed by four questions: “Most people who are important to me think that I should/should not dispose of my used batteries into a specific recycling bin,” “It is expected of me that I will dispose of used batteries in a specific recycling bin.,” “I feel under social pressure to dispose of used batteries into a specific recycling bin,” and “It is expected of me that I dispose of my used batteries into a specific recycling bin”.

An indirect measure of subjective norms (SN) was done by measuring normative beliefs (*n*) and motivation to comply (*m*). The questionnaire items to assess strength of normative beliefs were constructed by converting the reference groups or individuals (75% of the group or individual listed) from elicitation study into items that reflect what important people think should do (injunctive norms) or what important people actually do (descriptive norms). These items were rated -3 to +3. The questionnaire items to assess *m* were constructed by converting each of source of social pressure into the form of a statement about the importance of the various sources of social pressure. The respondents selected 1 to 7 of “not at all - very much” scale to indicate the strength of *m*. The questionnaire was pilot tested by asking five respondents to answer the questions and then asked them whether they had any difficulty answering them. The questions were modified if necessary. The number selected by the respondent is the score of that item. The summation of item score of normative belief multiply by the item score of motivation to comply is the overall subjective norm score which mean that the respondent have positive or negative reactions to social pressure. A positive of overall indirect subjective norms mean that the participant experienced social pressure to dispose of used battery in a

specific separate waste bin. A negative overall indirect subjective norms means that the participant experienced social pressure not to dispose of used batteries in a specific separate waste bin.

Perceived behavioral control: Seven-point "agree-disagree" scales or incomplete question with 7-point scales of easy-difficult were used to directly measure perceived behavioral control of both capability and controllability. The items included are:

- I am confident that I can dispose of used batteries into a specific recycle bin.
- For me to dispose of used batteries into a specific recycle bin (easy/difficult).
- The decision to dispose of used batteries into a specific recycling bin is beyond my control.
- Whether I dispose of used batteries into a specific recycling bin is entirely up to me.

The indirect measures of perceive behavioral control (PBC) were done by measuring control beliefs (*c*) and control belief power (*p*). The questionnaire items to assess the strength of control beliefs were constructed by converting the beliefs most often listed (75% of all beliefs listed) from the elicitation study into a set of statement which reflected the difficulty to dispose (or not dispose) used battery into a specific waste bin. The respondents indicated unlikely or likely to do from 1 to 7 rating scale. The questionnaire items to assess the *p* by converted each of the control belief statements into the form of an incomplete statement about whether this makes it more or less likely that the respondent disposed of the used battery into a specific bin or whether it makes the used battery disposal behavior easier or more difficult to do. The rating scale for these items was -3 to +3. These items were pilot tested by asking five respondents to answer the questions and ask them whether they have any difficulty answering them. Wording was modified if necessary. The selected number by respondent is the item score. The summation of the item score of control belief multiply by the item score of the perceive power is the overall perceived behavioral control score. A positive overall indirect PBC means that the participant feels in control of disposal of used batteries in a specific separate waste bin. A negative of overall indirect PBC means that the participant does not feel in control of disposal of used batteries in a specific separate waste bin.

Situational factors: These situational factors were incorporated into the questionnaire as follows:

- A specific recycling bin for disposal of used batteries is easy to find.
- The specific recycling bin for disposal of used batteries is seen easily.
- A specific recycling bin for used battery disposal is not too far for me to dispose of my used batteries.
- I knew from a class that used batteries must be disposed of into a separate specific waste bin.
- I knew from my friends that used batteries must be disposed of into a separate specific waste bin.
- I knew from the mass media that used batteries must be disposed of into a separate specific waste bin.

Socio-demographic variables: gender, name of faculty in which respondents studying, and year of study were incorporated into the questionnaire.

Using battery variables: list of electric and electronic appliances consumed energy from battery, type of battery, frequency of battery change, and place for dispose of used battery were presented to fill in.

5. Assessment of instrument: Pre-tests with at least 20 students were conducted in order to ensure item clarity and non-ambiguity. The item(s) that were difficult to answer were modified the wording and retested. Cronbach's alpha coefficient of direct measures was computed to measure internal consistency. Some items were deleted to increase the coefficient to 0.6 or more (70).

6. Data collection: The self-administered questionnaires were distributed to the sample through the academic service of each faculty. The completed questionnaires were collected back in a week. The remaining was collected in the second week. The questionnaires which were returned later than two weeks were ignored and were not analyzed.

7. Data analysis: The returned questionnaires were examined for completion. Questionnaires were excluded from analysis when there was no answer in any questions on the socio-demographic variables or the using batteries variables, or there were no answers on more than two questions in any direct or indirect measures variables. The completed questionnaires were coded and recorded in the

computer. The items that have negatively worded endpoints were recoded by reversing the score to the right. Missing data were substituted by the mean of that variable. The above analysis was done using the SPSS program. The average score of direct measured attitude, subjective norms, and PBC was calculated from the sum scores of all items for each construct. The high score consistently reflected greater attitude, social pressure, and PBC, respectively. The variance of average score of each construct and group of faculties or level of studies were compared by Barlett's test. The results showed equal variances. Therefore, the average score of each constructs were compared among group of faculties (Health Science, Science & Technology, and Social Science & Humanity) and among level of studies by Analysis of Variance (ANOVA) at 95% confidence level and compared a pair of treatments by Least Significant Difference (LSD) method. The average score of each constructs were compared between male and female by Mann-Whitney U test at 95% confidence level.

The item score of indirect measured attitude, subjective norms, and PBC was calculated by the above methods. All item scores were summed to be the overall construct score. The overall construct scores were classified into 7 groups (-3 to 3) by the difference of maximum score and minimum score of each construct divide by 7. The percentage of each construct was analyzed. The variance of overall score of each constructs and group of faculties or level of studies were compared by Barlett's test. The equal variances of the results bring to compared overall score of each constructs among group of faculties and among level of studies by ANOVA at 95% confidence level and compared a pair of treatments by LSD. The overall score of each constructs were compared between male and female by Mann-Whitney U test at 95% confidence level.

The validity of the indirect measures was analyzed by Spearman's bivariate correlation between average score of direct measures and group overall scores of indirect measures of the same construct. The high correlations mean that indirect measures are valid.

The variance of each construct was calculated. The relationship among variables related to intention in properly disposing of used batteries as shown in figure 1.1 was analyzed by structural equation modeling by the Amos program. The high λ

score means the strong relationship between the constructs. The non-related construct were omitted from the final model. The fit of model was assessed by comparative fit index (CFI) and the root mean square error of approximation (MRSEA). CFI value greater than 0.95 was used for indicated of good-fitting models. RMSEA value less than 0.10 also was used for decided good-fitting models (82).

The direct measured constructs and additional variable, existing of waste bins and exposure of information, were tested to be predictors of intentions by multiple regression technique. Each pair of belief and its weigh variables were tested to be predictor of its direct measure construct by multiple regression technique at 95% confidence level.

CHAPTER IV
RESULTS

The Elicitation Study

The answers to the open-ended questions were analyzed by identifying the themes of behavioral beliefs, sources of social pressure (reference individual or groups), and control belief strength. The behavioral beliefs are toxic chemical contamination, separate waste, correct and easy elimination, environmental conservation, waste time, increased expense, and others (Table 4.1). The social pressures are students or friends, general people, waste separator, waste collector, natural conservationist, family, careless people, instructor, government agency, and others (Table 4.2). The control beliefs are high number of specific waste bins, located nearby, easily seen, clear and strike the eyes label, information release, lazy, know the danger of non separate waste, there are a few units of used battery, difficulty, and others (Table 4.3). These beliefs were used in questionnaire development.

Table 4.1 behavioral beliefs from the elicitation study

	Themes	number	Percent	Cumulative percent
Behavioral beliefs	Toxic chemical contamination	22	28.57	28.57
	Separate waste	11	14.29	42.86
	Correct and easy elimination	9	11.69	54.55
	Environmental conservation	6	7.79	62.34
	Waste time	6	7.79	70.13
	Increased expense	6	7.79	77.91
	Safe to waste collector	4	5.19	83.10
	Can be recycle	3	3.90	87.00
	Difficult to find specific bin	3	3.90	90.90
	inconvenience	2	2.60	93.50
	Not increase climate change	2	2.60	96.10
	Everyone must be known	1	1.30	97.40
	Reduce waste collecting cost	1	1.30	98.70
	Uncollected waste	1	1.30	100.00
	Total	77	100	

Table 4.2 Social pressures from the elicitation study

	Themes	number	percent	Cumulative percent
Social	Students or friends	11	15.94	15.94
	General people	11	15.94	31.88
	Waste separator	8	11.59	43.46
	Waste collector	7	10.14	53.60
	Natural conservationist	5	7.25	60.85
	family	4	5.80	66.65
	Careless people	4	5.80	72.45
	Instructor	3	4.35	76.80
	Government agency	3	4.35	81.15
	Private sector	2	2.90	84.05
	House keeper	2	2.90	86.95
	Parent	1	1.45	88.40
	Working people	1	1.45	89.85
	Adolescence	1	1.45	91.30
	Child	1	1.45	92.75
	Star	1	1.45	94.20
	Online leader	1	1.45	95.65
	Technician	1	1.45	97.10
	Environmental agency	1	1.45	98.55
	Public health	1	1.45	1000.00
	Total	69	100	

Reliability of the Questions

There was reliability among the direct measured questions of intention, attitude, subjective norms, and perceived behavioral control. Cronbach's alpha of four questions about intention to dispose of used batteries into a separate specific waste bin is 0.884. Cronbach's alpha when deleted first question is 0.904 while deleted question 2 is 0.862. When deleted question 4 or question 3, Cronbach's alpha is 0.838 or 0.796, respectively.

Cronbach's alpha of 6 questions about attitude of used battery disposal into a separate specific waste bin is 0.555. When deleted question 2, Cronbach's alpha is 0.663. When deleted question 1 or question 5, Cronbach's alpha is 0.609 or 0.566, respectively. However, Cronbach's alpha is 0.521, 0.294 or 0.160 when deleted question 3, question 4, or question 6, respectively.

Table 4.3 Self-efficacy from the elicitation study

	Themes	number	percent	Cumulative percent
Self-efficacy	High number of specific waste bins	16	21.33	21.33
	Located nearby	8	10.67	32.00
	Easily seen	8	10.67	42.67
	Clear & strike the eyes label	6	8.00	50.67
	Information release	5	6.67	57.34
	Be lazy	5	6.67	64.01
	Know the danger of non separated waste	4	5.33	69.34
	Having a few units of used battery	4	5.33	74.67
	difficulty	3	4.00	78.67
	recycle	2	2.67	81.34
	Correct elimination	2	2.67	84.01
	Everyone cooperation	2	2.67	86.68
	Self safety	2	2.67	89.35
	Be hurry	1	1.33	90.68
	A lot of waste	1	1.33	92.01
	Inconsistent location	1	1.33	93.34
	Control measures	1	1.33	94.67
	Education area	1	1.33	96.00
	slum	1	1.33	97.33
	Good environment	1	1.33	98.66
	Mixed waste	1	1.33	100.00
	Total	75	100	

The analysis of reliability of 4 questions about subjective norm showed Cronbach's alpha equal to 0.673. However, Cronbach's alpha is 0.867 when deleted question 3. When deleted question 1, question 2, or question 4, Cronbach's alpha is 0.571, 0.460, or 0.354 respectively.

The reliability of 4 questions about perceived behavioral control of used battery disposal into a separate specific waste bin is 0.648. However, when deleted question 2, Cronbach's alpha is 0.752. When deleted question 1, question 4, or question 3, Cronbach's alpha is 0.609, 0.506, or 0.352, respectively.

Demographic of Sample

Of 3,652 sets of sent out questionnaires, 1,809 questionnaires or 49.5% were returned. Of those, 27 sets or 1.5% could not be identified as battery users or non users. The respondents declared as battery non users 140 persons or 7.7%. Incomplete questionnaires are 210 sets or 11.6%. Therefore, complete return questionnaires are 1,432 sets or 79.2% of return questionnaires or 39.2% of delivery questionnaires. The sample size was therefore sufficient.

The demographic data of responded students are 33.4% male and 66.6% female. They are freshmen 28.5%, sophomore 26.5%, junior 25.8%, senior 17.5%, fifth year of study 1.1% and sixth year of study 0.6%. They studied Health Science 18.5%, Science and Technology 30.4%, and Social Science and Humanity 51.1%. (Table 4.4)

The Average score of the Direct Measured Constructs

The calculation from all direct questions about intention to dispose of used batteries in a specific waste bin showed the average score equal to 5.42 ± 1.14 (from 1 to 7 scale). The average score of attitude to dispose of used batteries in a specific waste bin is 4.58 ± 0.71. The average score of subjective norms about disposal of used batteries in a specific waste bin, was 5.37 ± 1.12. The average score of all questions about perceived behavioral control about disposal of used batteries in a specific waste bin was 5.48 ± 1.15. These average scores means that the student has high scores of intention, subjective norms, and perceived behavioral control and medium scores of attitude. Percentages of each score classified by the questions of direct measures are presented in Table 4.5.

The comparison of average scores among groups of faculties by ANOVA presented that at least one pair of group of faculties showed statistical significant different of intention, and subjective norms (Table 4.6).

Table 4.4 Number and percentage of respondents classified by faculty and year of study

Group of study	Faculty	1st year		2nd year		3rd year		4th year		5th year		6th year		Total	
		D[1]	R[2](%)	D	R(%)	D	R(%)	D	R(%)	D	R(%)	D	R(%)	D	R(%)
Health Science	Medicine	40	3(7.5)	42	21(50.0)	36	15(41.7)	34	14(41.2)	26	0(0.0)	5	4(80.0)	187	57(30.5)
	Dentistry	15	13(86.7)	10	2(20.0)	13	9(69.2)	14	6(42.9)	11	10(90.0)	12	0(0.0)	75	40(53.3)
	Nursing	20	16(80.0)	27	17(63.0)	20	7(35.0)	18	10(55.6)	0	1	0	0	85	51(60.0)
	Allied Health Sciences	37	23(62.2)	30	8(26.7)	26	12(46.2)	26	9(34.6)	0	0	0	0	119	52(43.7)
	Public Health	20	0(0)	20	11(55.0)	15	31(206.7)	18	23(127.8)	0	0	0	0	73	65(89.0)
	subtotal	132	55(47.1)	129	59(45.7)	110	74(67.3)	110	62(56.4)	37	11(29.7)	17	4(23.5)	539	265(49.2)
Science & Technology	Science & Technology	164	54(32.9)	131	70(53.4)	138	88(63.8)	122	76(62.3)	0	2	0	0	553	290(52.4)
	Engineering	80	10(12.5)	64	7(10.9)	63	18(28.6)	60	5(8.3)	0	0	0	0	267	40(15.0)
	Architecture & Planning	44	41(93.2)	37	30(81.1)	33	18(54.5)	17	15(88.2)	0	0	0	1	143	105(73.4)
	subtotal	288	105(36.5)	232	107(46.1)	234	124(53.0)	199	96(48.2)	0	2	0	1	963	435(45.2)

[1]D = number of distributed questionnaire

[2]R = number of complete return questionnaire

Table 4.4 (cont.) Number and percentage of respondents classified by faculty and year of study

Group of study	Faculty	1st year		2nd year		3rd year		4th year		5th year		6th year		Total	
		D[1]	R[2](%)	D	R(%)	D	R(%)	D	R(%)	D	R(%)	D	R(%)	D	R(%)
Social Science & Humanity	Commerce & Accountancy	83	118(142.2)	73	49(67.1)	99	14(14.1)	83	28(33.7)	0	2	0	2	336	213(63.4)
	Law	114	1(0.9)	116	11(9.5)	114	4(3.5)	107	3(2.8)	0	1	0	0	451	20(4.4)
	Political Science	52	5(9.6)	62	42(67.7)	56	5(8.9)	55	9(16.4)	0	0	0	0	226	61(27.0)
	Economics	70	41(58.6)	69	37(53.6)	67	50(74.6)	54	2(3.7)	0	0	0	1	260	131(50.4)
	Social Administration	47	43(91.5)	48	21(43.8)	46	30(65.2)	51	6(11.8)	0	0	0	0	192	100(52.1)
	Sociology & Anthropology	46	13(28.3)	39	26(66.7)	34	27(79.4)	16	7(43.8)	0	0	0	0	133	73(54.9)
	Journalism & Mass Communication	42	9(21.4)	39	8(20.5)	34	14(41.2)	40	1(2.5)	0	0	0	1	155	33(21.3)
	Liberal Art	94	5(5.3)	85	9(10.6)	84	16(19.0)	83	28(33.7)	0	0	0	0	346	58(16.8)
	Fine & Applied Arts	16	14(87.5)	13	10(76.9)	11	11(100.0)	12)	8(66.7)	0	0	0	0	51	43(84.3)
	subtotal	518	236(45.6)	505	187(37.0)	511	144(28.2)	485	85(17.5)	0	3	0	4	2017	659(32.7)
	Total	995	409(41.1)	902	379(42.0)	888	369(41.6)	809	250(30.9)	42	16(38.1)	16	9(56.3)	3652	1,432(39.2)

[1]D = number of distributed questionnaire

[2]R = number of complete return questionnaire

Table 4.5 Percentage of each score classified by the items of direct measures (n = 1,432)

variables	score						
	1	2	3	4	5	6	7
INT2	0.8	1.5	6.1	20.7	19.9	21.0	30.0
INT3	1.1	1.5	3.7	11.6	24.0	24.7	33.4
INT4	1.4	2.4	6.3	22.1	22.4	20.9	24.5
ATT1	0.8	2.0	7.8	14.5	15.2	19.0	40.7
ATT3	2.0	1.3	4.5	13.6	17.9	21.8	38.5
ATT4	6.6	7.7	11.9	13.8	9.7	11.4	38.8
ATT5	1.0	2.4	6.9	15.3	14.5	16.9	42.8
ATT6	3.2	6.1	11.4	19.4	17.0	15.8	27.0
SN1	1.0	1.4	7.0	19.9	22.9	20.1	27.7
SN2	2.0	2.8	6.8	18.9	21.2	20.9	27.4
SN4	0.7	1.3	4.8	17.7	22.5	20.6	32.3
PBC1	1.3	4.4	9.0	21.0	20.5	18.5	25.1
PBC3	1.0	1.4	4.4	13.8	17.6	17.1	44.5
PBC4	2.4	1.3	5.2	14.0	19.8	20.6	36.7

Table 4.6 Average scores and *p* values of direct measure variables classified by group of faculties

Variables	Health Science (n = 265)	Science & Technology (n = 435)	Social Science & Humanity (n = 732)	F
Intention	5.64±1.02	5.43±1.17	5.33±1.16	7.053*
Subjective norms	5.54±1.05	5.38±1.16	5.31±1.12	4.096*
Attitude	4.67±0.74	4.58±0.69	4.55±0.70	2.928
Perceived behavioral control	5.56±1.18	5.46±1.18	5.46±1.14	0.953

* p value < 0.05

The LSD indicated that some pairs were significant difference (Table 4.7). Health Science student showed the highest score of intention. However, Science and Technology students presented the same intention scores as Social Science and Humanity students. Health Science students presented their subjective norms scores higher than those of Social Science and Humanity students but did not present the difference to those of Science and Technology students.

Table 4.7 Multiple comparison of intention and direct measured variables among groups of faculties

Direct measured variables	Health Science	Science & Technology	Social Science & Humanity
Inetention			
Health Science	-	0.2140*	0.3066*
Science & Technology	-0.2140*	-	0.0926
Social Science & Humanity	-0.3066*	-0.0926	-
Attitude			
Health Science	-	0.0960	0.1224*
Science & Technology	-0.0960	-	0.0264
Social Science & Humanity	-0.1224*	-0.0264	-
Subjective norms			
Health Science	-	0.1523	0.2289*
Science & Technology	-0.1523	-	0.0766
Social Science & Humanity	-0.2289*	-0.0766	-
Perceived behavioral control			
Health Science	-	0.1079	0.1093
Science & Technology	-0.1079	-	0.0015
Social Science & Humanity	-0.1093	-0.0015	-

* p value < 0.05

The average scores were compared between male and female. The comparison of average scores of subjective norms and perceived behavioral control revealed that p values were 0.004 and 0.032, respectively which means subjective norms and perceived behavioral control were statistically significant difference between female and male. The p values of comparison of intention and attitude were 0.153 and 0.381, respectively (Table 4.8).

Table 4.8 Average scores of direct measured variables classified by sex

Variables	Male (n = 479)	Female (n = 953)	F
Subjective norms	5.25±1.14	5.43±1.11	0.837*
Perceived behavioral control	5.38±1.20	5.53±1.14	1.117*
Intention	5.36±1.156	5.45±1.14	0.019
Attitude	4.55±0.76	4.60±0.68	5.620

* p value <0.05

The comparison of average scores among level of study were shown that at least one pairs of level of studies were significant difference in intention, perceived behavioral control, subjective norms, and attitude (Table 4.9). Some pairs of level of studies that presented significant difference were shown in Table 4.10. Junior, senior, and 5th year students presented their intention and perceived behavioral control scores than freshman. Senior and 5th year students also showed higher intention, perceived behavioral control, and subjective norms scores than sophomore scores. Fifth year students also presented their higher intention, perceived behavioral control, and subjective norms scores than senior and junior. Junior presented their higher perceived behavioral control scores than sophomore. Senior and 5th year students presented their higher subjective norms scores than freshman and sophomore. Senior had higher attitude scores than freshman only.

Table 4.9 Average scores of direct measure variables classified by level of study

Variables	Freshman (n = 409)	Sophomore (n = 379)	Junior (n = 369)	Senior (n = 250)	5th year (n = 16)	6th year (n = 9)	F
Intention	5.30±1.17	5.33±1.15	5.48±1.14	5.60±1.10	6.25±0.67	5.67±0.99	4.509*
Attitude	4.55±0.68	4.52±0.72	4.59±0.66	4.70±0.81	4.64±0.65	4.78±0.49	2.264*
Subjective norms	5.27±1.15	5.32±1.09	5.42±1.12	5.51±1.12	6.19±0.74	5.33±1.36	3.452*
Perceived behavioral control	5.31±1.19	5.29±1.17	5.68±1.09	5.67±1.09	6.27±0.86	5.82±1.51	9.135*

* p value < 0.05

The Overall Score of the Indirect Measured Constructs

The analysis of overall score of indirect measures indicated that their attitude, subjective norms, and perceived behavioral control are good. Attitude scores are 93.3% positive and negative 6.0%. As shown in Table 14, 95.3% of the indirect subjective norms score was positive and negative score was 4.1%. When indirect perceived behavioral control was examined, it was found that 94.6 % are positive scores and 4.4% are negative scores. The percentages of low, middle, or high negative or positive scores (group overall score) of each construct are shown in Table 4.11.

Table 4.10 Multiple comparison of intention and direct measured variables among level of studies

Direct measured variables	Freshman	Sophomore	Junior	Senior	5th year	6th year
Intention						
Freshman	-	-0.0307	-0.1810*	-0.2923*	-0.9468*	-0.3635
Sophomore	0.0307	-	-0.1503	-0.2616*	-0.9161*	-0.3328
Junior	0.1810*	0.1503	-	-0.1113	-0.7658*	-0.1825
Senior	0.2923*	0.2616*	0.1113	-	-0.6545*	-0.0712
5th year	0.9468*	0.9161*	0.7658*	0.6545*	-	0.5833
6th year	0.3635	0.3328	0.1825	0.0712	-0.5833	-
Attitude						
Freshman	-	0.302	-0.0381	-0.1480*	-0.0866	-0.2269
Sophomore	-0.0302	-	-0.0683	-0.1783*	-0.1169	-0.2571
Junior	0.0381	0.0683	-	-0.110	-0.0486	-0.1888
Senior	0.1480*	0.1783*	0.1100	-	0.0614	-0.0789
5th year	0.0866	0.1169	0.0486	-0.0614	-	-0.1403
6th year	0.2269	0.2571	0.1888	0.0789	0.1403	-
Subjective norms						
Freshman	-	-0.0481	-0.1493	-0.2391	-0.9186	-0.0644
Sophomore	0.0481	-	-0.1012	-0.1909*	-0.8704*	-0.0163
Junior	0.1493	0.1012	-	-0.0898	-0.7693*	0.0849
Senior	0.2391*	0.1909*	0.0898	-	-0.6795*	0.1747
5th year	0.9186*	0.8704*	0.7693*	0.6795*	-	0.8542
6th year	0.0644	0.0163	-0.0849	-0.1747	-0.8542	-
Perceived behavioral control						
Freshman	-	0.0199	-0.3638*	-0.3622*	-0.9601*	-0.5040
Sophomore	-0.0199	-	-0.3837*	-0.3821*	-0.9799*	-0.5239
Junior	0.3638*	0.3837*	-	0.0016	-0.5963*	-0.1402
Senior	0.3622*	0.3821*	-0.0016	-	-0.5978*	-0.1418
5th year	0.9601*	0.9799*	0.5963*	0.5978*	-	0.4560
6th year	0.5040	0.5239	0.1402	0.1418	-0.4560	-

* p value <0.05

Table 4.11 Percentages of group overall score of each indirect measure constructs (n = 1,432)

Variables	scores						
	-3	-2	-1	0	1	2	3
Attitude	0	0.1	5.9	0.6	23.2	53.2	16.9
Subjective norms	0	0	4.1	0.6	29.8	40.8	24.7
Perceived behavioral control	0	0	4.4	1.0	29.7	41.1	23.8

The comparison of average of overall score of indirect measured variables among groups of faculties by ANOVA showed statistically significant difference of indirect measured constructs (Table 4.12).

Table 4.12 Average of overall score of indirect measured variables classified by groups of faculties

Variables	Health Science (n = 265)	Science & Technology (n = 435)	Social Science & Humanity (n = 732)	F
Attitude	60.33±29.49	58.11±30.99	53.47±32.72	5.780*
Subjective norms	98.34±55.44	88.52±53.20	81.89±51.31	9.765*
Perceived behavioral control	95.43±53.93	88.02±50.75	82.28±51.40	6.576*

* p value < 0.05

Some pairs were statistically significant difference by LSD analysis (Table 4.13).

Table 4.13 Multiple comparison of indirect measured variables among groups of faculties

Compared group	Health Science	Science & Technology	Social Science & Humanity
Attitude		2.2235	6.8615*
Health Science	-		
Science & Technology	-2.2235*	-	4.6380*
Social Science & Humanity	-6.8615*	-4.6380*	-
Subjective norms			
Health Science	-	9.8109*	16.4467*
Science & Technology			
Social Science & Humanity	-9.8109*	-	6.6357*
Perceived behavioral control			
Health Science	-	7.4018	13.1420*
Science & Technology	-7.4018	-	5.7401
Social Science & Humanity	-13.1420*	-5.7401	-

* p value < 0.05

Health Science students present the highest overall scores of indirect subjective norms, perceived behavioral control, and attitude. Science and Technology students also have higher subjective norms scores than Social science and Humanity. Health Science students have higher perceived behavioral control than Social Science and Humanity. Social Science and Humanity have lowest attitude scores. The average of overall score of indirect measured variables between male and female were compared.

The comparison of the average of overall scores of perceived behavioral control, attitude, and subjective norms showed *p* value equal to, <0.001, 0.001, and 0.003, respectively (Table 4.14). This means that indirect measured constructs are different between male and female, female had higher scores than male.

Table 4.14 Average of overall score of indirect measure variables classified by sex

Variables	Male (n =479)	Female (n = 953)	F
Attitude	52.22±32.80	58.12±31.00	4.557*
Subjective norms	81.62±52.70	89.62±52.96	0.047*
Perceived behavioral control	79.18±52.32	90.12±51.30	0.181*

* *p* value < 0.05

The comparison of average of overall score of indirect measured variables among levels of study by ANOVA indicates *p* value less than 0.001 in all variables (Table 4.15). This means that there are differences in all variables at least one pair of level of study.

Table 4.15 Average of overall score of indirect measure variables classified by level of study

Variables	Freshman (n = 409)	Sophomore (n = 379)	Junior (n = 369)	Senior (n = 250)	5th year (n = 16)	6th year (n = 9)	F
Attitude	52.37±30.54	52.87±33.46	59.45±30.15	61.84±32.10	69.31±32.37	49.33±24.11	5.081*
Subjective norms	80.62±52.90	81.38±50.09	90.07±54.33	98.05±53.15	121.81±37.78	110.22±61.73	6.303*
Perceived behavioral control	78.72±52.07	81.13±51.23	91.61±52.02	96.68±50.29	121.18±32.92	105.89±47.44	7.124*

* *p* value < 0.05

Pairs of levels of studies that showed significant difference were shown in Table 4.16. Junior, senior, and 5th year students had higher attitude and subjective norms scores than freshman and sophomore. Fifth year students had higher subjective norms scores than junior. Senior had higher perceived behavioral control scores than freshman and sophomore.

Table 4.16 Multiple comparison of indirect measured variables among level of studies

Direct measured variables	Freshman	Sophomore	Junior	Senior	5th year	6th year
Attitude						
Freshman	-	-0.4975	-7.0751*	-9.4687*	-16.9406*	3.0385
Sophomore	0.4975	-	-6.5776*	-8.9712*	-16.4431*	3.5360
Junior	7.0751*	6.5776*	-	-2.3936	-9.8655	10.1136
Senior	9.4687*	8.9712*	2.3936	-	-7.4720	12.5072
5th year	16.9406*	16.4431*	9.8655	7.4720	-	19.9792
6th year	-3.0385	-3.5360	-10.1136	-12.5072	-19.9792	-
Subjective norms						
Freshman	-	-0.7620	-9.4533*	-17.4340*	-41.1921*	-29.6018
Sophomore	0.7620	-	-8.6913*	-16.6721*	-40.4301*	-28.8398
Junior	9.4533*	8.6913*	-	-7.9808	-31.7388*	-20.1485
Senior	17.4340*	16.6721*	7.9808	-	-23.7580	-12.1677
5th year	41.1921*	40.4301*	31.7388*	23.7580	-	11.5903
6th year	29.6018	28.8398	20.1485	12.1677	-11.5903	-
Perceived behavioral control						
Freshman	-	-2.4089	-12.8911*	-17.9639*	-42.4579*	-27.1693
Sophomore	2.4089	-	-10.4822*	-15.5550*	-40.0489*	-24.7603
Junior	12.8911*	10.4822*	-	-5.0728	-29.5667*	-14.2781
Senior	17.9639*	15.5550*	5.0728	-	-24.4939	-9.2053
5th year	42.4579*	40.0489*	29.5667*	24.4939	-	15.2886
6th year	27.1693	24.7603	14.2781	9.2053	-15.2886	-

* p value < 0.05

Validity of the Indirect Measures

The Spearman's correlation between average scores of direct measures and group overall scores of indirect measures of attitude presented r equal to 0.398 at $p <$ 0.001. The correlation between average score of direct measures and group overall scores of indirect measures of subjective norms showed Spearman's correlation (r)

equal to 0.690 at $p < 0.001$. When analyzed Spearman's correlation of perceived behavioral control between average score of direct measures and group overall scores of indirect measures, the result showed r equal to 0.690 at $p < 0.001$. These indicated validity of all indirect measured constructs.

The Relationship among Variables Related to Intention

The assumption of multivariate normality and linearity were evaluated through SPSS. There were normality and linearity in all variables. There were no outliers. Structural equation modeling (SEM) analysis was performed using data from 1,432 samples. There were no missing data.

Each direct measured construct was put in the model with intention. First, intention and attitude were put in the model. The results presented fit model with CFI = 0.928, and RMSEA = 0.092. Next couple of constructs, intention and subjective norms, were put in a new model to test. The results revealed fit model with CFI = 0.991, and RMSEA = 0.046. Another couple of constructs, intention and perceived behavioral control, were tested. Unfitted model were shown with CFI = 0.937, and RMSEA = 0.126.

Then, additional constructs were added to above models. A model composed of intention, attitude, and subjective norms was tested but the model did not fit (CFI = 0.812, and RMSEA = 0.126). Next model consisted of intention, attitude, and perceived behavioral control. This model did not fit with CFI = 0.724, and RMSEA = 0.160. Next model was tested with intention, subjective norms, and perceived behavioral control. The results revealed unfitted model with CFI = 0. 789, and RMSEA = 0.166.

The last model was composed of all constructs in the Theory of Planned Behavior that are intention, attitude, subjective norms, and perceived behavioral control. This model did not fit with CFI = 0.667, and RMSEA = 0.154 (Figure 4.1).

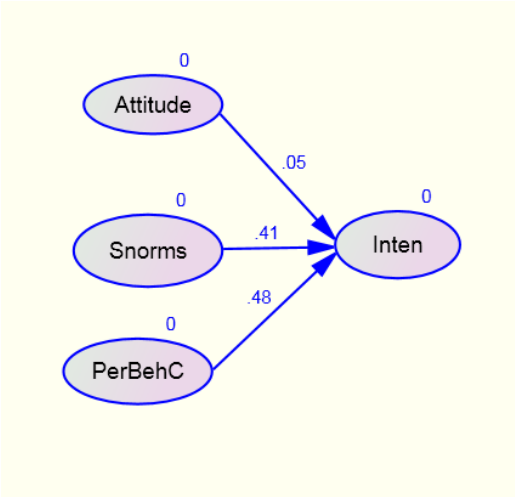

Figure 4.1 Model of association among direct measured intention (Inten), attitude, subjective norms (Snorms) and perceived behavioral control (PerBehC)

Indirect measured variables were performed in the same way as direct measured variables. First, intention and attitude were tested. The fit model was presented by CFI = 0.932, and RMSEA = 0.073. Intention and subjective norms were tested in next model. This model fit with CFI = 0.941, and RMSEA = 0.069. Next couple of constructs, intention and perceived behavioral control, were tested. This model did not fit by CFI = 0.819, and RMSEA = 0.120.

Next step, third construct was added to the above models. Intention, attitude, and subjective norms were tested. The results showed unfitted model by CFI = 0.812, and RMSEA = 0.092. Intention, attitude, and perceived behavioral control were tested in a model. This model did not fit with CFI = 0.705, and RMSEA = 0.118. Intention, subjective norms, and perceived behavioral control were also tested in a next model. This model did not fit with CFI = 0.746, and RMSEA = 0.103.

All indirect measured constructs and intention were tested in the last model. This model did not fit with CFI = 0.691, and RMSEA = 0.101 (Figure 4.2).

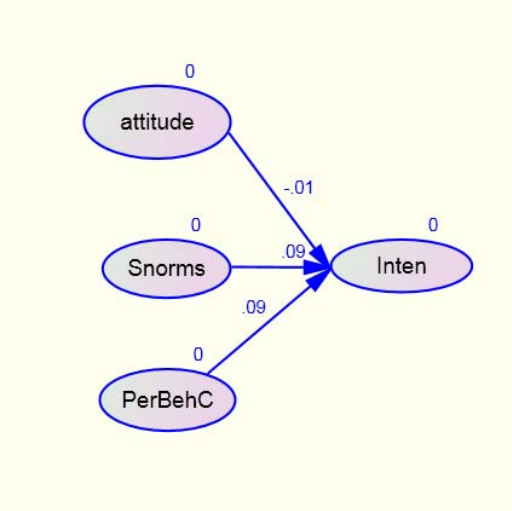

Figure 4.2 Model of association among direct measured intention (Inten), and indirect measured attitude, subjective norms, and perceived behavioral control

Two additional latent variables were added to the complete direct measured models, existing of waste bins (ExWB) and exposure to information (ExInf). The direct measured models with two additional constructs did not fit (Figure 4.3). This model presented CFI = 0.602, and RMSEA = 0.137.

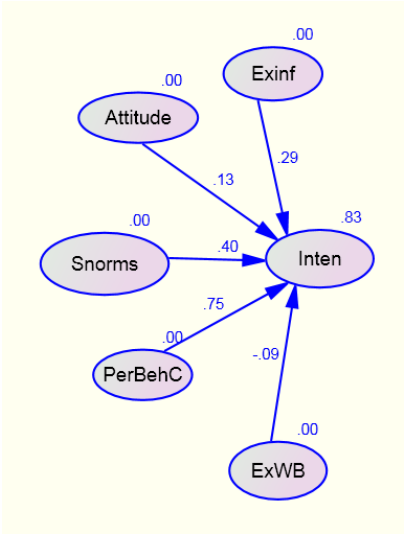

Figure 4.3 A model with direct measured constructs with two additional variables: Inten = intention, Snorms = subjective norms, PerBehC = perceived behavioral control, Exinf = exposure to information, and ExWB = existing of waste bins.

The indirect measured model with two additional constructs was tested. This model did not fit with CFI = 0.644, and RMSEA = 0.098 (Figure 4.4).

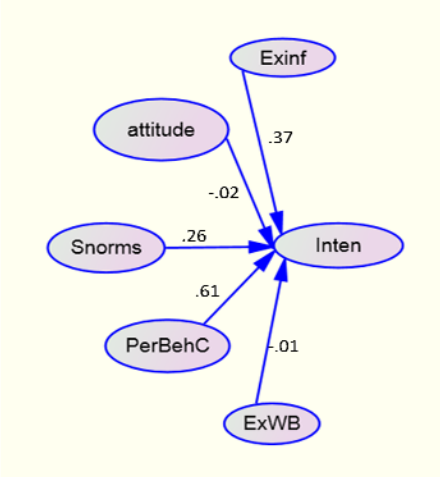

Figure 4.4 A model with indirect measured constructs with two additional variables: Inten = intention, Snorms = subjective norms, PerBehC = perceived behavioral control, Exinf = exposure to information, and ExWB = existing of waste bins.

Predictive Value Analyzed by Multiple Regression

Stepwise multiple regression was performed to test the relationship among those constructs in the hypothesized model. The results reveal that subjective norms, perceived behavioral control, exposure to information, and attitude were predictors of intention. About 51% of the variation of intention score can be explained by attitude, subjective norms, perceived behavioral control, and exposure to information (Table 4.17).

Table 4.17 coefficients, standard error, *p* value, and R^2 of variables in stepwise multiple regression with intention

variables	B	SE	*p* value	R^2
constant	0.608	0.151	<0.001	
Subjective norms	0.346	0.025	<0.001	0.396
Perceived behavioral control	0.317	0.023	<0.001	0.483
Exposure to information	0.136	0.019	<0.001	0.503
Attitude	0.119	0.035	0.001	0.508
R^2	0.508			

CHAPTER V
DISCUSSION

The Elicitation Study

The result from the analysis of themes of behavioral beliefs showed that "toxic chemical contamination" is the highest frequency. Separate waste, correct and easy elimination, environmental conservation, waste time, and increased expense are the themes that showed the frequency respectively less than that of "toxic chemical contamination". These themes have an accumulative percentage of more than 75%. Therefore, these themes are suitable to use for developing questions to identify indirect attitudes (74). These themes indicated that most students have positive beliefs about disposal of used batteries in a separate specific waste bin. They believe that disposal in a separate bin can prevent contamination of toxic chemicals from used batteries into the environment. They also believe that this method is correct and makes it easy to eliminate toxic metals from used batteries. A way to conserve the environment is also their positive belief. However, some students have negative beliefs that this method will make them waste their time. Some thought it would increase expenses in purchasing new waste bins.

The analysis of themes of social pressure showed that "students or friends" and "general people" are the two highest frequencies. Waste separator, waste collector, natural conservationist, family, careless people, instructor, and government agency showed respectively less frequency than that of the first two themes. However, the cumulative percentage of these themes is higher than 75%. Therefore, these themes are suitable to use for constructing indirect measure questions to identify subjective norms (74). These themes showed that student's friends, general people, waste separators or collectors, any person in their family, their instructors, and government agencies can force them to dispose of used batteries in a separate specific waste bin. However, careless people who will dispose used batteries in general waste bin can make them dispose used batteries in general waste bin too.

"High number of specific bins" is the highest frequency of the control beliefs. Located nearby, easily seen, clear and strike the eyes label, information release, lazy, know the danger of non separated waste, there are a few units of used batteries, and difficulty were respectively less frequent than that of "high number of specific bins". However, the accumulative percentage of all these themes is higher than 75%. Therefore, they are suitable to use for constructing questions to identify indirect perceive behavioral control (74). These indicated that students will have high self-efficacy to dispose of used batteries in a separate specific waste bin when there are many specific waste bins. These waste bins should be located near places where they have daily activities such as living or studying. The waste bin should also be seen easily and labeled with clear information and strike the eyes. Students will separately dispose of used batteries if they receive information to persuade them and to indicate the danger of non separated waste. In contrast, being "lazy", having few units of used batteries, and difficulty in finding specific waste bins are all barriers that reduce their self-efficacy to disposing used batteries in a separate specific waste bin.

Reliability of the Questions

Although Cronbach's coefficient of four questions about intention (0.884) is higher than the minimum required level of 0.6, this coefficient increased to be 0.904 when the second question was deleted (74). Since there were then three remaining questions which is the minimum number of questions recommended by Francis, *et al* (74). Therefore, question 2 was omitted to increase internal consistency. The remaining questions:

- I will dispose of my used batteries in a specific recycling bin every time I have a used battery.

  Strongly disagree 1 2 3 4 5 6 7 strongly agree

- I intend to dispose of my used batteries in a specific recycling bin every time I have one for disposal.

  Strongly disagree 1 2 3 4 5 6 7 strongly agree

- I plan to dispose of my used batteries in a specific recycling bin every time I have one for disposal.

Strongly disagree	1	2	3	4	5	6	7	strongly agree

This coefficient is similar to that of Cheung *et al* (17) who used 4 questions about household recycling. Their coefficient was 0.89. However, it is higher than that of Kakoko, *et al* (79) who developed 3 questions about HIV with a coefficient equal to 0.75. The similarity or difference can occur when the topic or the population is different since there are differences among populations in knowledge, understanding, literacy, and other factors.

Cronbach's coefficient of six attitude questions is less than 0.6 (0.555) which indicates a possible low internal consistency. However, this coefficient can be increase to 0.663, higher than the required level, when question 2 is deleted. Therefore, the question 2 was omitted to increase internal consistency of the questions (74). The 5 remaining questions are the follow.

For me to dispose of used batteries in specific waste bin is

• Bad	1	2	3	4	5	6	7	good
• not responsible	1	2	3	4	5	6	7	responsible
• not sensible	1	2	3	4	5	6	7	sensible
• harmful	1	2	3	4	5	6	7	beneficial
• unpleasant	1	2	3	4	5	6	7	pleasant

The coefficient of this variable is less than those of previous studies, i.e. 0.76 of Cheng, *et al* (75) who studied communication, 0.85 of Cheung *et al* (17) and Mannetti, *et al* (21) who studied household recycling, 0.87 of Kakoko, *et al* (79) who studied HIV, and 0.90 of Jitramontree (80) who studied physical activity.

The analysis of four questions about subjective norms indicated a Cronbach's coefficient equal to 0.673. Although this coefficient is higher than the required level at 0.6, it can be increased to 0.867 when question 3 was deleted and the number of questions is still not less than the minimum number. To increase internal consistency of the questions, therefore, question 3 should be omitted (74). So, the 3 remaining questions about subjective norms are the follow.

- Most people who are important to me think that I

Should not 1 2 3 4 5 6 7 should

dispose of my used batteries into a specific recycling bin.

- It is expect of me that I will dispose of used batteries in a specific recycling bin.

Strongly 1 2 3 4 5 6 7 strongly
disagree agree

- People who are important to me want me to dispose of used batteries in a specific recycling bin.

Strongly 1 2 3 4 5 6 7 strongly
disagree agree

The coefficient of subjective norms questions is similar to that of Cheung, *et al* (17) and Cheng, *et al* (75) who presented the coefficient equal to 0.84 and 0.86, respectively on 7 and 8 questions, respectively. However, this coefficient is less than that of Kakoko, *et al* (79) who worked on 20 questions with a coefficient equal to 0.94. In contrast, it is higher than that of Jitramontree (80) who studied about the physical activities in Thai people with coefficient equal to 0.79 with only 8 questions.

Although Cronbach's coefficient of four questions about perceived behavioral control (0.648) is higher than the required level, it can be increased to 0.752 if the question 2 is deleted. Since the overall number of remaining questions is 3, the minimum number required for internal consistency, and the internal consistency of the questions will be increased, so question 2 was omitted (74). The remaining questions about perceived behavioral control are the following.

• I am confident that I dispose of used batteries into a specific recycle bin.

Strongly 1 2 3 4 5 6 7 strongly
disagree agree

• The decision to dispose of used batteries into a specific recycling bin is beyond my control.

Strongly 1 2 3 4 5 6 7 strongly
disagree agree

• Whether I dispose of used batteries into a specific recycling bin is entirely up to me.

Strongly disagree	1	2	3	4	5	6	7	strongly agree

This coefficient is less than that of Cheung, *et al* (17), Cheng, *et al* (75), Kakoko, *et al* (79), and Jitramontree (80) who presented the coefficient equal to 0.80, 0.81, 0.84, and 0.91, respectively. Although the number of questions are similar to that of Jitramontree, (80), i.e. three questions, it less than that of the others, i.e. four questions of Cheung, *et al* (17) and Cheng, *et al* (75), and 16 questions of Kakoko, *et al* (79).

Demographic of Sample

Nearly a half of the questionnaires were returned as predicted. Since the distribution of questionnaires was done in the last week of the semester before final examinations, students may have been worried about the exams and did not want to answer the questionnaire. The return rate might have been higher if the questionnaires were distributed a month before the final exam. However, the return rate from Social Science and Humanity student group was the lowest. This response rate is lower than that of previous studies which were two third or higher, this may be due to differences in population group, culture, and smaller sample size in those studies (15, 19, 22-23). In contrast this response rate was higher than that of Davis's study (18) which is nearly a quarter. However, when comparing with the study conducted with the same population, undergraduate student, which response rate was 48.6% (17), the response rates were similar. A few questionnaires were unidentified to be battery users or non-users since the questions about using electric or electronic appliances were blank. Some declared as battery non-users. Higher than one tenth were incomplete because the questions may be difficult to understand (83). These difficulties are seen from the written responses of some students on the returned questionnaires. So, the remaining completed returned questionnaires are around four out of ten.

Compared to males there were twice as many females who responded, which is the normal population of Thammasat University students. Freshmen, sophomore, and junior are nearly equal, i.e. one fourth of the population. Senior is less than one fifth since some of them finished their study since last semester. There

are only a few who were studying in the fifth and sixth years. They are those from mainly two faculties, Medicine and Dentistry, and those who cannot graduate in four years study from other program.

Nearly one in five were Health Sciences programs, this was the lowest group. Nearly one third was Science and Technology students. The most students, more than a half, are Social Science and Humanity programs. As we know that health sciences need sophisticated instruments and human subject for practice, this limited the number of students. Many programs in Science & Technology also need sophisticated instruments for practice. In contrast, Social Science and Humanity have no limitation from sophisticated instruments and human subjects. Therefore, the number of students from Social Science and Humanity programs were higher than those from other programs.

The Average Score of the Direct Measured Constructs

The means of intention, subjective norms, and perceived behavioral control are high while the mean of attitude is moderate. Lack of facility for dispose of used battery, lack of campaign to separate waste, lack of experience, and Thai culture which does not express their feeling or ideas openly may be reasons to explain these results. When consider the itemized scores, we found that the most are positive in every items.

The comparison among groups of faculties indicated that there is statistically significance difference of mean score of intention, and subjective norms. There is at least one pair of these groups of faculties which has different average score of intention, attitude, and subjective norms to dispose of used battery behavior in a specific separate waste bin. Health Science student showed the highest score of intention. However, Science and Technology students presented the same intention scores as Social Science and Humanity students. Health Science students presented their subjective norms scores higher than those of Social Science and Humanity students but did not presented the difference to those of Science and Technology students. This may be caused by the fact that Health Science students study about health, so they are more concerned about the worse effect of battery components to health.

Subjective norms and perceived behavioral control of female were higher than those of male statistically significant but intention and attitude were not different between male and female. The students learned about environmental conservation in high school and first year of undergraduate study where both male and female studied together. So, their intention and attitude were not different. In Thai culture, females normally were educated to care for other people and manage household while males generally pay less attention in these topics than females. This cultural influence may cause females to present their subjective norms and perceived behavioral control higher than those of males.

There is at least one pair of level of study which presented different intention, perceived behavioral control, and subjective norms scores. The familiarization with location of general waste bins around the campus may be a factor of this difference and helped the students trust and intend to dispose of used battery in a proper way. The respect of seniority in Thai culture may be another factor that makes them more respect to subjective norms when study at high level.

The Overall Score of the Indirect Measured Constructs

Most of the students indirectly express their high positive attitude, subjective norms, and perceived behavioral control to dispose of used battery in a specific separate waste bin. Most of them declared that they knew that used battery must be disposed in a specific separate waste bin from classroom, friends, or mass media.

There is at least one pair of group of faculties have significantly different overall scores. Health Science students present the highest overall scores of indirect subjective norms, perceived behavioral control, and attitude. Science and Technology students also had higher subjective norms scores than Social science and Humanity. Health Science students had higher perceived behavioral control than Social Science and Humanity. Social Science and Humanity had lowest attitude scores. This may be due to Health Science students study about health which made them concerned about health and aware of the toxicity of used batteries.

Overall scores of indirect measured constructs of females were higher than those of males. By Thai style nurturing, females were trained to take care of the

household and other people, this may trigger them to respond higher in the overall score of attitude, subjective norms and perceived behavioral control than males. These results were the same as those of direct measured except attitude which shows significant different only when measured indirectly. This may be caused by the different ways of measurement.

There is at least one pair of level of study that has significant different overall score of all indirect measured constructs. Junior, senior, and 5th year students had higher attitude and subjective norms scores than freshman and sophomore. Fifth year students had higher subjective norm scores than that of thejunior. Senior had higher perceived behavioral control scores than that of the freshman and the sophomore.

The Validity of the Indirect Measures

There are statistically significant correlations between direct measures and indirect measures of attitude, subjective norms, and perceived behavioral control. The correlations are in positive direction which means that when direct measured score is high, the indirect measured score is also high. This result indicated that indirect measures are valid for all constructs (74).

The Relationship among Variables related to Intention

Only both direct measured and indirect measured intention – attitude and intention – subjective norms models fit. The models did not fit when other constructs were added. The interaction among constructs may affect the models. Homogeneous population, the students who had similar age, knowledge, etc, may also cause unfitted model. The other reason is that the questions were difficult to understand as we seen some comments in the returned questionnaires. This reason was confirmed by Darker and French (83) who found the questions developed followed theory of planned behavior guideline were problematic. These questions were interpretative and responsive in nature. Interpretation problems consisted of confusion, opinions on the questionnaire, and spontaneous inference which the participant did not know the answer to the question, and generated a possible hypothetical solution. Response

problems consisted of basic overall response problems with questionnaires and questionnaires being reactive. Participants who experienced problems with questions were more likely to select the middle or neutral option on the scale for that item.

In addition, this may be occurred by the difference in culture. By the nature of Thai people, they do not express their feeling to the other. The environmental issue is also far away from their daily life which is infatuated in working to be alive. Theory of planned behavior (TPB) was developed in developed country where most of the population has high level education. The people in those countries generally are fluent in reading and writing. Therefore, they understand well the questionnaires. In contrast, Thai students are not much influence in reading and understanding the language used in the questionnaire. In combination with long questionnaire, 9 pages and more than one hundred questions, the respondents may be tired as seen from the high rate of incomplete questionnaires, 11.6%. Moreover, the guideline for questionnaire construction presented in English but the survey questionnaires were translated into Thai language. Therefore, it needs back-translation to establish equivalence with the original version. We also found that the data showed some skewness, however, large sample size can reduce this effect (82). So, it was not a problem.

Predictive Value Analyzed by Multiple Regression

The results from multiple regression analysis supported the applicability of Theory of Planned Behavior to understanding the proper disposal of used battery intention. The relationship among direct measured constructs, attitude, subjective norms, and perceived behavioral control, and intention were statistically significance. That means those constructs were predictors of intention to dispose of used batteries (74). However, this result was different to that of SEM. Since SEM considers the effects of other constructs in the model while MR does not, the MR results presented only the relationship of those constructs (82).

Predictors in this study are the same as previous studies (17, 75, 77, 79). This supports the Theory of Planned Behavior that attitude, subjective norms, and perceived behavioral control are predictors of intention. These three components

explained 48.9% of variance in recycling intention. This is similar to the study of Cheung (17) who found that these components explained 54.4% of variance since both studied in university students. Percent of explaned variance was lower to 26.7% (77) and 12% (79) in different populations. In contrast, this study was different from the studies of Tonglet (22-23) who found that only attitude was a predictor of intention. This also is different from Bledsoe (78) who found that only attitude and subjective norms were predictors of intention because of the difference in population and subject of those studies.

The results also suggested modification to the original Theory of Planned Behavior by adding exposure to information. Since all students were educated about environmental conservation and recycling behavior from high school and first year of study in the university, exposure to information was a predictor of proper used battery disposal intention. Oppositely, it was not supported when existence of waste bins is included. During the period of this study, the university had not facilitated specific waste bins for used batteries, therefore, existing of waste bins were not a predictor of proper used battery disposal intention.

Recommendations

As we found that there was no specific separate waste bin for the used battery disposal behavior on the campus, specific separate waste bins should facilitate used battery disposal around the campus. We also found that subjective norms, perceived behavioral control, and attitude were predictors of intention to dispose of used battery in specific separate waste bins. Any method that can change these determinants can be applied to change student behavior to dispose of used batteries in specific separate waste bins. These methods are, for example, persuasive communication, active learning, feedback, facilitation, modeling, etc. However, these constructs are founded on beliefs (68). Therefore, any methods that can change the beliefs can be applied to change these determinants. Fishbein and Ajzen (68) recommended persuasive communication as the most suitable method since it is simply and cheap.

Limitations of the Study

This study concerns only the expression about used battery disposal behavior of undergraduate students at Thammasat University, Rangsit campus. The result can not be generalized to other population or other behavior. The questionnaire used in this study encountered the difficulty to understand by the respondents. Therefore, more studies are needed in order to modify the questions to be easier to understand. In addition, the modification of questionnaire should be tested for cultural sensitivity.

CHAPTER VI
CONCLUSION

In the elicitation study, we found that behavioral beliefs were toxic chemical contamination, separate waste, correct and easy elimination, environmental conservation, waste time, and increased expense. Social pressures were students or friends, general people, waste separator, waste collector, natural conservationist, family, careless people, instructor, and government agency. Self-efficacy included high number of specific waste bins, located nearby, easily seen, clear and strike the eyes labels, information release, being lazy, know the danger of non separated waste, having a few units of used batteries, and difficulty. A set of questionnaires was developed with direct measures of intention, attitude, subjective norms, and perceived behavioral control, and indirect measures of attitude, subjective norms, and perceived behavioral control from those beliefs found in the elicitation study. In addition, situation factors and socio-demographic variable were added in the questionnaire. A pretest with 20 students was performed. Clearity and reliability were checked and acceptable.

The main survey was done and 1,432 complete questionnaires or 39.2% were returned. The proportion of female and male students was 2:1. Most of students were freshmen and studied Social Science and Humanities. The average score of direct measured intention, subjective norms, and perceived behavioral control are high while the average score of direct measured attitude is moderate. There was at least one pair of group of faculties that showed average score difference. Subjective norms and perceived behavioral control of female students were higher than those of male students. There is also at least one pair of level of study presented average score difference in intention, perceived behavioral control, and subjective norms.

Most of students indirectly express their high positive attitude, subjective norms, and perceived behavioral control. There is at least one pair of studies that found difference in overall scores of indirect attitude, subjective norms, and perceived

behavioral control. Female students showed overall scores of all indirect measured constructs higher than male students. There is at least one pair of level of study that showed their overall score difference of all indirect measured.

The indirect measured and direct measured questions are correlated. Therefore, indirect measured questions are valid for all constructs. The hypothesized model was tested by structural equation modeling but it was not fit. So, multiple regression was performed and the results indicated that attitude, subjective norms, perceived behavioral control, and exposure of information are predictors of intention. These components explained 50.6% of variance in recycling intention. All indirect measured constructs are predictors of their direct measured constructs.

This study can be concluded that subjective norms, perceived behavioral control, exposure to information, and attitude are predictor of intention to dispose of used battery in separate specific bins. Both direct and indirect measured recommended by TPB are valid. However, the proposed model was not fit based on this study data.

The results of this study suggest that specific separate waste bins should be facilitated around the campus. Persuasive communication should be used to change students' intention to dispose of used batteries in specific separate waste bins.

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APPENDICES

APPENDIX A

QUESTIONNAIRE FOR ELICITATION STUDY

1. What do you believe are the *advantages* of your disposing used batteries into a specific recycling bin? (Beh. Belief)
2. What do you believe are the *disadvantages* of your disposing used batteries into a specific recycling bin? (Beh. Belief)
3. Is there anything else you associate with your disposing used batteries into a specific recycling bin? (Beh. Belief)
4. Are there any individuals or groups who would *approve* of your disposing used batteries into a specific recycling bin? (normative belief)
5. Are there any individuals or groups who would *disapprove* of your disposing used batteries into a specific recycling bin? (normative belief)
6. Are there any other individuals or groups who come to mind when you think about disposing used batteries into a specific recycling bin? (normative belief)
7. What factors or circumstances would enable you to dispose of used batteries into a specific recycling bin? (control factor)
8. What factors or circumstances would make it difficult or impossible for you to dispose of used batteries into a specific recycling bin? (control factor)
9. Are there any other issues that come to mind when you think about the difficulty of disposing used batteries into a specific recycling bin? (control factor)

APPENDIX B
QUESTIONNAIRE FOR SURVEY STUDY

Used Battery Disposal Survey:

The present survey is part of an investigation that tries to discover some of the reasons why people dispose of or not dispose of used batteries in a specific recycling bin. Specifically, we are interested in your personal opinions regarding dispose of used batteries. Please read each question carefully and answer it to the best of your ability. There are no correct or incorrect responses; we are merely interested in your personal point of view.

All responses to this survey are completely confidential. Anyone cannot see your responses except the researchers. All identifying information will be removed from this questionnaire and destroyed as soon as all data has been collected. Please be assured that the information you provide in this study will have no effect on you.

Thank you for your participation in this study.

Instructions:

Many questions in this survey make use of rating scales with 7 places; you are to circle the number that best describes your opinion. For example, if you were asked to rate "The Weather in Chapel Hill" on such a scale, the 7 places should be interpreted as follows:

The Weather in Chapel Hill is:
good :___1___:____2___:____3___:____4___:____5___:____6___:____7___: bad
extremely quite slightly neither slightly quite extremely

If you think the weather in Chapel Hill is extremely good, then you would circle the *number 1*, as follows:
The Weather in Chapel Hill is:
good :_ (1) _:___2____:____3___:____4___:____5___:____6___:____7___: bad

If you think the weather in Chapel Hill is quite bad, then you would circle the *number 6*, as follows.
The Weather in Chapel Hill is:
good :___1____:____2___:____3___:____4___:____5___:_ (6) _:___7____: bad

If you think the weather in Chapel Hill is slightly good, then you would circle the *number 3*.
The Weather in Chapel Hill is:
good :___1____:____2___:_ (3) _:___4____:____5___:____6___:____7___: bad

If you think the weather in Chapel Hill is neither good nor bad, then you would circle the *number 4*.
The Weather in Chapel Hill is:
good :___1____:____2___:____3___:_ (4) _:___5____:____6___:___7___: bad

In making your ratings, please remember the following points:
* Be sure to answer all items – do not omit any.
* Never circle more than one number on a single scale.

Please answer each of the following questions by circling the number that best describes your opinion. Some of the questions may appear to be similar, but they do address somewhat different issues. Please read each question carefully.

1. Eliminating easily and correctly is OE2

Extremely undesirable	-3	-2	-1	0	1	2	3	Extremely desirable

2.My friends think I NB1

Should not	-3	-2	-1	0	1	2	3	Should

dispose of used battery into a separate specific waste bin

3. Chemical uncontamination environment is OE1

Extremely undesirable	-3	-2	-1	0	1	2	3	Extremely desirable

4. For me to dispose of used batteries in specific waste bin is Att3

not responsible	1	2	3	4	5	6	7	responsible

5. Separate dispose of is OE3

Extremely undesirable	-3	-2	-1	0	1	2	3	Extremely desirable

6. The careless person approval my used battery disposal into a separate specific waste bin is important to me MC7

Not at all	1	2	3	4	5	6	7	very much

7. The conservationists think I NB5

Should not	-3	-2	-1	0	1	2	3	Should

dispose of used battery into a separate specific waste bin

8. Most people expected that I will dispose of used battery into a separate specific waste bin

Strongly disagree	1	2	3	4	5	6	7	Strongly agree	SN2

9. For me to dispose of used batteries in specific waste bin is Att6

Unpleasant 1 2 3 4 5 6 7 pleasant

10. My family approval my used battery disposal into a separate specific waste bin is important to me MC6

Not at all 1 2 3 4 5 6 7 very much

11. My family think I NB6

Should not -3 -2 -1 0 1 2 3 Should
dispose of used battery into a separate specific waste bin

12. The careless person think I NB7

Should not -3 -2 -1 0 1 2 3 Should
dispose of used battery into a separate specific waste bin

13. When used battery disposal into a separate waste bin is difficult, I am PC9

Less likely -3 -2 -1 0 1 2 3 more likely
to dispose of used battery into a separate specific waste bin

14. Waste selector approval my used battery disposal into a separate specific waste bin is important to me MC3

Not at all 1 2 3 4 5 6 7 very much

15. Waste collector approval my used battery disposal into a separate specific waste bin is important to me MC4

Not at all 1 2 3 4 5 6 7 very much

16. When separate waste bin is strike the eyes or have clear lable, I am PC4

Less likely -3 -2 -1 0 1 2 3 more likely
to dispose of used battery into a separate specific waste bin

17. When there are a lot of separate waste bins, I am PC1

Less likely -3 -2 -1 0 1 2 3 more likely
to dispose of used battery into a separate specific waste bin

18. The instructor approval my used battery disposal into a separate specific waste bin is important to me MC8

Not at all	1	2	3	4	5	6	7	very much

19. Environmental conservation is OE4

Extremely undesirable	-3	-2	-1	0	1	2	3	Extremely desirable

20. If I dispose of used battery into a separate specific waste bin, I separate waste BB3

Unlikely	1	2	3	4	5	6	7	Likely

21. General people approval my used battery disposal into a separate specific waste bin is important to me MC2

Not at all	1	2	3	4	5	6	7	very much

22. When a separate specific waste bin located nearby I dispose of used battery into a separate specific waste bin CB2

Unlikely	1	2	3	4	5	6	7	Likely

23. Waste separator think I NB3

Should not	-3	-2	-1	0	1	2	3	Should dispose of used battery into a separate specific waste bin

24. Instructor think I NB8

Should not	-3	-2	-1	0	1	2	3	Should dispose of used battery into a separate specific waste bin

25. When I know that dispose of used battery into the genera waste bin is dangerous, I am

Less likely	-3	-2	-1	0	1	2	3	more likely to dispose of used battery into a separate specific waste bin PC7

26. Government agency think I NB9

Should not	-3	-2	-1	0	1	2	3	Should dispose of used battery into a separate specific waste bin

27. I knew from my friends that used battery must be disposed of into a separate specific waste bin SF5

Less likely	1	2	3	4	5	6	7	more likely

28. When I am lazy, I am PC6

Less likely	-3	-2	-1	0	1	2	3	more likely

to dispose of used battery into a separate specific waste bin

29. If I dispose of used battery into a separate specific waste bin, I conserve the environment

Unlikely	1	2	3	4	5	6	7	Likely BB4

30. If dispose of used battery into a separate specific waste bin, increase the expense

Unlikely	1	2	3	4	5	6	7	Likely BB6

31. Increase the expense is OE6

Extremely undesirable	-3	-2	-1	0	1	2	3	Extremely desirable

32. When separate specific waste bin are easily seen, I am PC3

Less likely	-3	-2	-1	0	1	2	3	more likely

to dispose of used battery into a separate specific waste bin

33. I dispose of used battery into a separate specific waste bin since I know that dispose of into general waste bin is dangerous CB7

Unlikely	1	2	3	4	5	6	7	Likely

34. General people think I NB2

Should not	-3	-2	-1	0	1	2	3	Should

dispose of used battery into a separate specific waste bin

35. Most important people to me wish mel dispose of used battery into a separate specific waste bin SN4

Strongly disagree	1	2	3	4	5	6	7	Strongly agree

36. Waste collector think I NB4

Should not	-3	-2	-1	0	1	2	3	Should

dispose of used battery into a separate specific waste bin

37. I intend to dispose of my used battery into a specific recycling bin every time I have it for disposal Int3

Extremely unlikely	1	2	3	4	5	6	7	extremely likely

38. When separate specific waste bin are located not so far, I am PC2

Less likely	-3	-2	-1	0	1	2	3	more likely

to dispose of used battery into a separate specific waste bin

39. A separate specific waste bin should be located where the people easily found SF1

Less likely	1	2	3	4	5	6	7	more likely

40. The decision to dispose of used battery into a separate specific waste bin is beyond my control PBC3

Strongly disagree	1	2	3	4	5	6	7	Strongly agree

41. I dispose of used battery into a separate specific waste bin although it is very difficult

Unlikely	1	2	3	4	5	6	7	Likely CB9

42. A separate specific waste bin should be strike the eyes SF2

Less likely	1	2	3	4	5	6	7	more likely

43. waste time is OE5

Extremely undesirable	-3	-2	-1	0	1	2	3	Extremely desirable

44. When a separate specific waste bin is easily found I dispose of used battery into a separate specific waste bin CB3

Unlikely	1	2	3	4	5	6	7	Likely

45. Natural conservationist approval my used battery disposal into a separate specific waste bin is important to me MC5

Not at all 1 2 3 4 5 6 7 very much

46. I knew from a class that used battery must dispose of into a separate specific waste bin

Less likely 1 2 3 4 5 6 7 more likely SF4

47. It is mostly up to me whether or not I dispose of used batteries into a specific recycle bin PBC4

Strongly 1 2 3 4 5 6 7 strongly
disagree agree

48. A separate specific waste bin should be located not so far to dispose of SF3

Less likely 1 2 3 4 5 6 7 more likely

49. I knew from the mass media that used battery must dispose of into a separate specific waste bin

Less likely 1 2 3 4 5 6 7 more likely SF6

50. When a separate specific waste bin strike the eyes and clear label I dispose of used battery into a separate specific waste bin CB4

Unlikely 1 2 3 4 5 6 7 Likely

51. When there is a campaign or information release about used battery disposal into a separate specific waste bin, I am PC5

Less likely -3 -2 -1 0 1 2 3 more likely
to dispose of used battery into a separate specific waste bin

52. If dispose of used battery into a separate specific waste bin, it is easily and correctly to be eliminated BB2

Unlikely 1 2 3 4 5 6 7 Likely

53. If dispose of used battery into a separate specific waste bin, it prevent the toxic chemical contamination into the environment BB1

Unlikely 1 2 3 4 5 6 7 Likely

54. Most important people to me think I SN1

Should not	1	2	3	4	5	6	7	Should

dispose of used battery into a separate specific waste bin

55. I plan to dispose of my used battery into a specific recycling bin every time I have it for disposal Int4

Strongly disagree	1	2	3	4	5	6	7	strongly agree

56. When there are a few units of used battery, I am PC8

Less likely	-3	-2	-1	0	1	2	3	more likely

to dispose of used battery into a separate specific waste bin

57. For me to dispose of used batteries in specific waste bin is Att5

Harmful	1	2	3	4	5	6	7	beneficial

58. For me to dispose of used batteries in specific waste bin is Att4

not sensible	1	2	3	4	5	6	7	sensible

59. If dispose of used battery into a separate specific waste bin, it waste time BB5

Unlikely	1	2	3	4	5	6	7	Likely

60. I want to dispose of my used battery into a specific recycling bin every time I have it for disposal Int2

definitely false	1	2	3	4	5	6	7	definitely true

61. When there are a lot of separate specific waste bin I dispose of used battery into a separate specific waste bin CB1

Unlikely	1	2	3	4	5	6	7	Likely

62. My friends approval my used battery disposal into a separate specific waste bin is important to me MC1

Not at all	1	2	3	4	5	6	7	very much

63. Although I am lazy I dispose of used battery into a separate specific waste bin CB6

Unlikely 1 2 3 4 5 6 7 Likely

64. I confident to dispose of used battery into a separate specific waste bin PBC1

Strongly 1 2 3 4 5 6 7 strongly
disagree agree

65. Government agency approval my used battery disposal into a separate specific waste bin is important to me MC9

Not at all 1 2 3 4 5 6 7 very much

66. When there is a campaign or information release about used battery disposal into a separate specific waste bin I dispose of used battery into a separate specific waste bin

Unlikely 1 2 3 4 5 6 7 Likely CB5

67. For me to dispose of used batteries in specific waste bin is Att1

Bad 1 2 3 4 5 6 7 good

68. When there is a few unit of used battery I dispose of used battery into a separate specific waste bin CB8

Unlikely 1 2 3 4 5 6 7 Likely

Please put a right mark (✓) in appropriate box in front of the word of phrase that corresponded to your information.

69. Sex Sex

- ❍ 1 Male
- ❍ 2 Female

70. Now, which year are you studying? Level

- ❍ 1 first year (freshman)
- ❍ 2 second years (sophomore)
- ❍ 3 third years (junior)
- ❍ 4 fourth years (senior)
- ❍ 5 fifth years
- ❍ 6 sixth years

71. What Faculty are you studying? Fac

- ❍ 1. Law
- ❍ 2. Commerce & Accountancy
- ❍ 3. Political Science
- ❍ 4. Economics
- ❍ 5. Social Administration
- ❍ 6. Liberal Arts
- ❍ 7. Journalism & Mass Communication
- ❍ 8. Sociology & Anthropology
- ❍ 9. Science & Technology
- ❍ 10. Engineering
- ❍ 11. Medicine
- ❍ 12.Dentistry
- ❍ 13. Allied Health Sciences
- ❍ 14. Nursing
- ❍ 15. Architecture & Planning
- ❍ 16. Fine & Applied Arts
- ❍ 17. Public Health

Please put a right mark (✓) in appropriate box or fill in with a number that corresponded to your information.

Electrical appliances	Battery use		Type of Battery (1)	Frequency of battery change (2)	Place where you dispose of used battery		
	Not use	Use			Home	TU	Etc.
MP3 player							
CD player							
Calculator							
Soundabout							
Camera							
Flash Light							
Etc. (please specify)							

(1) 1 = Alkaline battery (Alk), 2 = Nickle-Cadmium battery (Ni-Cd), 3 = Nickle methylalhydride battery (Ni-M), 4 = Button battery, 5 = Lithium ion battery (Li-ion), 6 = Lithium polymer battery (Li-poly)

(2) 1 = once a week, 2 = every two weeks, 3 = every three weeks, 4 = once a month, 5 = every two months, 6 = every three months, and 7 = once a semest

Table B1 Summary of variables, variable name, number, and page of the questionnaire (English version)

Variables	Variable name	Number	Page
Intention	Int3	37	110
	Int2, Int4	60, 55	112
Attitude	Att3	4	106
	Att6	9	107
	Att4, Att5	58, 57	112
	Att1	67	113
Subjective norms	SN2	8	106
	SN4	35	109
	SN1	54	112
Perceived behavioral control	PBC3	40	110
	PBC4	47	111
	PBC1	64	113
Behavioral belief	BB3	20	108
	BB4, BB6	29,30	109
	BB1, BB2	53, 52	111
	BB5	59	112
Outcome evaluation	OE1, OE2, OE3	3, 1, 5	106
	OE4	19	108
	OE6	31	109
	OE5	43	110
Normative belief	NB1, NB5	2, 7	106
	NB6, NB7	11, 12	107
	NB3, NB8, NB9	23, 24, 26	108
	NB2	34	109
	NB4	36	110
Motivation to comply	MC7	6	106
	MC3, MC4, MC6	14, 15, 10	107
	MC5	45	111
	MC2, MC8	21, 18	108
	MC1	62	112
	MC9	65	113
Control belief	CB2	22	108
	CB7	33	109
	CB3, CB9	44, 41	110
	CB4	50	111
	CB1	61	112
	CB5, CB6, CB8	66, 63, 68	113
Perceived control	PC9	13	107
	PC1, PC4	17, 16	107
	PC7	25	108
	PC3, PC6	32, 28	109

Table 20 (Cont.) Summary of variables, variable name, number, and page of the Questionnaire (English version)

Variables	Variable name	Number	Page
Perceive control	PC2	38	110
	PC5	51	111
	PC8	56	112
Existing of waste bins	SF1, SF2	39, 42	110
	SF3	48	111
Exposure of information	SF5	27	109
	SF4, SF6	46, 49	111
Demographic variables	Sex, Level	69,70	113
	Fac	71	114
Battery using			114

APPENDIX C

แบบสอบถาม

ความคิดเห็นเกี่ยวกับการทิ้งซากแบตเตอรี่

เรียน นักศึกษา

แบบสอบถามที่ท่านอ่านอยู่นี้เป็นส่วนหนึ่งของการศึกษาเพื่อทราบถึงปัจจัยที่เกี่ยวข้องกับการแยกทิ้งหรือไม่แยกทิ้งซากแบตเตอรี่ในถังจำเพาะของประชาคมธรรมศาสตร์ แบตเตอรี่ในที่นี้หมายถึง ถ่านไฟฉาย ถ่านกระดุม แบตเตอรี่โทรศัพท์มือถือ โน๊ตบุ๊ค รวมถึง แบตเตอรี่ที่ใช้กับเครื่องใช้ไฟฟ้าทุกชนิด แต่ไม่รวมแบตเตอรี่ที่ใช้กับรถยนต์ รถจักรยานยนต์ และแบตเตอรี่แห้ง (sealed lead acid) ที่ใช้กับไฟฉุกเฉินหรือโคมไฟติดที่ศีรษะ (head light) การศึกษานี้มุ่งเน้นที่ความคิดเห็นส่วนบุคคลของท่านเกี่ยวกับการแยกทิ้งแบตเตอรี่ในถังจำเพาะ ท่านเป็นผู้หนึ่งที่ได้รับเกียรติได้รับคัดเลือกให้เป็นผู้ตอบแบบสอบถามนี้ ขอความร่วมมือท่านกรุณาสละเวลาอันมีค่าสักเล็กน้อยช่วยตอบแบบสอบถามนี้เพื่อนำไปเป็นข้อมูลประกอบการตัดสินใจปรับปรุงสภาพแวดล้อมของมหาวิทยาลัยธรรมศาสตร์ให้สะอาด ปลอดภัย น่าอยู่อาศัยยิ่งขึ้น

แบบสอบถามนี้มีทั้งหมด 82 ข้อ โปรดใช้ความรอบคอบในการอ่าน และเลือกตอบข้อที่ตรงกับความคิดเห็นของท่านมากที่สุด บางข้ออาจทำให้ท่านรู้สึกเหมือนว่าถามซ้ำแต่คำถามนั้นมีจุดมุ่งหมายที่แตกต่างกัน **ขอความกรุณาท่านช่วยตอบให้ครบถ้วนทุกข้อ** คำตอบที่ท่านเลือกเป็นเพียงความคิดเห็นของท่านเท่านั้น **ไม่มีถูกหรือผิด** และ**ทั้งหมดจะถูกเก็บเป็นความลับ** เมื่อวิเคราะห์ข้อมูลด้วยวิธีการทางสถิติแล้วจะนำเสนอเป็นภาพรวม **ไม่มีผลกระทบใด ๆ กับท่านทั้งสิ้น**

ขอขอบคุณในความร่วมมือของท่านเป็นอย่างยิ่ง

ผู้วิจัย

คำแนะนำวิธีการตอบแบบสอบถาม

คำถามส่วนใหญ่ในแบบสอบถามนี้มีคำตอบให้เลือก 7 คำตอบ เป็นตัวเลขเรียงลำดับตั้งแต่หมายเลข 1 ถึงหมายเลข 7 และมีความหมายเขียนกำกับไว้ที่ปลายทั้งสองข้างของคำตอบซึ่งตรงกันข้ามกัน เช่น ดี – ไม่ดี ขอให้ท่านแบ่งระดับความหมายทั้งสองเป็น 7 ระดับแล้วเลือกตอบข้อที่ตรงกับความคิดเห็นของท่านมากที่สุดเพียงข้อเดียว ด้วยการเขียนวงกลมล้อมรอบหมายเลขนั้น

ตัวอย่างเช่น

วันนี้อากาศ

ดี:	1	2	3	4	5	6	7	:แย่
	เยี่ยม	มาก	พอสมควร	ไม่แตกต่างจากวันอื่น	เล็กน้อย	มาก	มากที่สุด	

ถ้าท่านคิดว่าวันนี้อากาศดีเยี่ยม ท่านก็เขียนวงกลมล้อมรอบหมายเลข 1 ดังนี้

วันนี้อากาศ

ดี:	(1)	2	3	4	5	6	7	:แย่

ถ้าท่านคิดว่าวันนี้อากาศแย่มาก ท่านก็เขียนวงกลมล้อมรอบหมายเลข 6 ดังนี้

วันนี้อากาศ

ดี:	1	2	3	4	5	(6)	7	:แย่

ถ้าท่านคิดว่าวันนี้อากาศดีพอสมควร ท่านก็เขียนวงกลมล้อมรอบหมายเลข 3 ดังนี้

วันนี้อากาศ

ดี:	1	2	(3)	4	5	6	7	:แย่

ถ้าท่านคิดว่าวันนี้อากาศไม่แตกต่างจากวันอื่น ท่านก็เขียนวงกลมล้อมรอบหมายเลข 4 ดังนี้

วันนี้อากาศ

ดี:	1	2	3	(4)	5	6	7	:แย่

บางข้อตัวเลือกตอบอาจแตกต่างไป แต่ก็มี 7 ตัวเลือกเหมือนกัน เช่น

วันนี้อากาศ

ดี:	-3	-2	-1	0	+1	+2	+3	:แย่

โปรดตอบคำถามต่อไปนี้แต่ละข้อเพียงคำตอบเดียว โดยเลือกวงกลมคำตอบข้อที่ตรงกับความคิดเห็นของท่านมากที่สุด บางคำถามอาจทำให้ท่านรู้สึกว่าเหมือนกันแต่คำถามเหล่านั้นมีจุดมุ่งหมายที่แตกต่างกัน โปรดอ่านคำถามด้วยความรอบคอบ

แบตเตอรี่ในแบบสอบถามนี้หมายถึง ถ่านไฟฉาย ถ่านกระดุม แบตเตอรี่โทรศัพท์มือถือและโน๊ตบุ๊ค รวมถึง แบตเตอรี่ที่ใช้กับเครื่องใช้ไฟฟ้าทุกชนิด แต่ไม่รวมแบตเตอรี่ที่ใช้กับรถยนต์ รถจักรยานยนต์ และแบตเตอรี่แห้ง (sealed lead acid) ที่ใช้กับไฟฉุกเฉินหรือไฟที่ติดที่ศีรษะ (head light)

1. การกำจัดง่ายและถูกวิธีเป็นสิ่งที่ฉัน OE2

ไม่ปราถนาอย่างยิ่ง: -3 -2 -1 0 +1 +2 +3 :ปราถนาอย่างยิ่ง

2. เพื่อนฉันคิดว่าฉัน NB1

ไม่ควร: -3 -2 -1 0 +1 +2 +3 :ควร

ทิ้งซากแบตเตอรี่ลงในถังจำเพาะ

3. สิ่งแวดล้อมที่ไม่ปนเปื้อนสารเคมีเป็นสิ่งที่ฉัน OE1

ไม่ปราถนาอย่างยิ่ง: -3 -2 -1 0 +1 +2 +3 :ปราถนาอย่างยิ่ง

4. สำหรับฉันการแยกทิ้งซากแบตเตอรี่ในถังจำเพาะเป็นสิ่งที่ Att3

ไม่ใช่หน้าที่: 1 2 3 4 5 6 7 :เป็นหน้าที่

5. การช่วยแยกขยะเป็นสิ่งที่ฉัน OE3

ไม่ปราถนาอย่างยิ่ง: -3 -2 -1 0 +1 +2 +3 :ปราถนาอย่างยิ่ง

6. การที่คนมักง่ายเห็นด้วยกับฉันที่ทิ้งซากแบตเตอรี่ในถังจำเพาะเป็นสิ่งสำคัญสำหรับฉัน MC7

ไม่ใช่: 1 2 3 4 5 6 7 :ใช่

7. นักอนุรักษ์ธรรมชาติคิดว่าฉัน NB5

ไม่ควร: -3 -2 -1 0 +1 +2 +3 :ควร

ทิ้งซากแบตเตอรี่ลงในถังจำเพาะ

8. คนส่วนใหญ่คาดหวังว่าฉันจะแยกทิ้งซากแบตเตอรี่ลงในถังจำเพาะ SN2

ไม่เห็นด้วย: 1 2 3 4 5 6 7 :เห็นด้วย

9. สำหรับฉันการแยกทิ้งซากแบตเตอรี่ในถังจำเพาะเป็นสิ่งที่ Att6

ชอบ 1 2 3 4 5 6 7 :ไม่ชอบ

10. การที่ครอบครัวของฉันเห็นด้วยกับฉันที่ทิ้งซากแบตเตอรี่ในถังจำเพาะเป็นสิ่งสำคัญสำหรับฉัน

ไม่ใช่: 1 2 3 4 5 6 7 :ใช่ MC6

11. ครอบครัวขอฉันคิดว่าฉัน NB6

ไม่ควร: -3 -2 -1 0 +1 +2 +3 :ควร

ทิ้งซากแบตเตอรี่ลงในถังจำเพาะ

12. คนมักง่ายคิดว่าฉัน NB7

ไม่ควร: -3 -2 -1 0 +1 +2 +3 :ควร

ทิ้งซากแบตเตอรี่ลงในถังจำเพาะ

13. หากการทิ้งซากแบตเตอรี่ในถังจำเพาะยุ่งยาก ฉัน PC9

ไม่อยาก: -3 -2 -1 0 +1 +2 +3 :อยาก

ทิ้งซากแบตเตอรี่ในถังจำเพาะ

14. ฉันการที่พนักงานแยกขยะเห็นด้วยกับฉันที่ทิ้งซากแบตเตอรี่ในถังจำเพาะเป็นสิ่งสำคัญสำหรับฉัน MC3

ไม่ใช่: 1 2 3 4 5 6 7 :ใช่

15. การที่คนเก็บขยะเห็นด้วยกับฉันที่ทิ้งซากแบตเตอรี่ในถังจำเพาะเป็นสิ่งสำคัญสำหรับฉัน MC4

ไม่ใช่: 1 2 3 4 5 6 7 :ใช่

16. หากถังจำเพาะสดุดตา หรือมีป้ายบอกชัดเจน ฉัน PC4

ไม่อยาก: -3 -2 -1 0 +1 +2 +3 :อยาก

ทิ้งซากแบตเตอรี่ในถังจำเพาะ

17. เมื่อมีถังจำเพาะจำนวนมาก ฉัน PC1

ไม่อยาก: -3 -2 -1 0 +1 +2 +3 :อยาก

ทิ้งซากแบตเตอรี่ในถังจำเพาะ

18. การที่ครู อาจารย์เห็นด้วยกับฉันที่ทิ้งซากแบตเตอรี่ในถังจำเพาะเป็นสิ่งสำคัญสำหรับฉัน

ไม่ใช่: 1 2 3 4 5 6 7 :ใช่ MC8

19. การรักษาสิ่งแวดล้อมเป็นสิ่งที่ฉัน OE4

ไม่ปราถนาอย่างยิ่ง: -3 -2 -1 0 +1 +2 +3 :ปราถนาอย่างยิ่ง

20. การทิ้งซากแบตเตอรี่ในถังจำเพาะเป็นการช่วยแยกขยะ BB3

ไม่ใช่: 1 2 3 4 5 6 7 :ใช่

21. การที่คนทั่วไปเห็นด้วยกับฉันที่ทิ้งซากแบตเตอรี่ในถังจำเพาะเป็นสิ่งสำคัญสำหรับฉัน MC2

ไม่ใช่: 1 2 3 4 5 6 7 :ใช่

22. การที่ถังจำเพาะตั้งอยู่ไม่ไกลเกินไปช่วยให้ฉันทิ้งซากแบตเตอรี่ในถังจำเพาะ CB2

ไม่ใช่: 1 2 3 4 5 6 7 :ใช่

23. พนักงานแยกขยะคิดว่าฉัน NB3

ไม่ควร: -3 -2 -1 0 +1 +2 +3 :ควร

ทิ้งซากแบตเตอรี่ลงในถังจำเพาะ

24. ครู อาจารย์คิดว่าฉัน NB8

ไม่ควร: -3 -2 -1 0 +1 +2 +3 :ควร

ทิ้งซากแบตเตอรี่ลงในถังจำเพาะ

25. เมื่อฉันรู้ว่าการทิ้งซากแบตเตอรี่รวมกับขยะอื่นเป็นอันตราย ฉัน PC7

ไม่อยาก: -3 -2 -1 0 +1 +2 +3 :อยาก

ทิ้งซากแบตเตอรี่ในถังจำเพาะ

26. องค์กรภาครัฐคิดว่าฉัน NB9

ไม่ควร: -3 -2 -1 0 +1 +2 +3 :ควร

ทิ้งซากแบตเตอรี่ลงในถังจำเพาะ

27. ฉันรู้ว่าซากแบตเตอรี่ต้องแยกทิ้งในถังจำเพาะจากเพื่อน SF5

ไม่เห็นด้วย: 1 2 3 4 5 6 7 :เห็นด้วย

28. เมื่อฉันขี้เกียจ (รักสบาย) ฉัน PC6

ไม่อยาก: -3 -2 -1 0 +1 +2 +3 :อยาก

ทิ้งซากแบตเตอรี่ในถังจำเพาะ

29. การทิ้งซากแบตเตอรี่ในถังจำเพาะเป็นการรักษาสิ่งแวดล้อม BB4

ไม่ใช่: 1 2 3 4 5 6 7 :ใช่

30. การทิ้งซากแบตเตอรี่ในถังจำเพาะทำให้ต้องเสียค่าใช้จ่ายเพิ่มขึ้น BB6

ไม่ใช่: 1 2 3 4 5 6 7 :ใช่

31. การเสียค่าใช้จ่ายเพิ่มขึ้นเป็นสิ่งที่ฉัน OE6

ไม่ปราถนาอย่างยิ่ง: -3 -2 -1 0 +1 +2 +3 :ปราถนาอย่างยิ่ง

32. หากหาถังจำเพาะได้ง่าย ฉัน PC3

ไม่อยาก: -3 -2 -1 0 +1 +2 +3 :อยาก

ทิ้งซากแบตเตอรี่ในถังจำเพาะ

33. ฉันจะแยกทิ้งซากแบตเตอรี่ในถังจำเพาะเพราะฉันรู้ว่าการทิ้งรวมกับขยะอื่นเป็นอันตราย

ไม่ใช่: 1 2 3 4 5 6 7 :ใช่ CB7

34. คนทั่วไปคิดว่าฉัน NB2

ไม่ควร: -3 -2 -1 0 +1 +2 +3 :ควร

ทิ้งซากแบตเตอรี่ลงในถังจำเพาะ

35. คนส่วนใหญ่ที่มีความสำคัญต้องการให้ฉันแยกทิ้งซากแบตเตอรี่ลงในถังจำเพาะ SN4

ไม่เห็นด้วย: 1 2 3 4 5 6 7 :เห็นด้วย

36. คนเก็บขยะคิดว่าฉัน NB4

ไม่ควร: -3 -2 -1 0 +1 +2 +3 :ควร

ทิ้งซากแบตเตอรี่ลงในถังจำเพาะ

37. ฉันตั้งใจจะแยกทิ้งซากแบตเตอรี่ลงในถังจำเพาะทุกครั้ง Int3

ไม่ใช่: 1 2 3 4 5 6 7 :ใช่

38. เมื่อถังจำเพาะตั้งอยู่ไม่ไกล ฉัน PC2

ไม่อยาก: -3 -2 -1 0 +1 +2 +3 :อยาก

ทิ้งซากแบตเตอรี่ในถังจำเพาะ

39. ถังจำเพาะสำหรับรองรับการแยกทิ้งซากแบตเตอรี่ควรพบเห็นได้ง่าย SF1

ไม่เห็นด้วย: 1 2 3 4 5 6 7 :เห็นด้วย

40. การตัดสินใจแยกทิ้งซากแบตเตอรี่ลงในถังจำเพาะขึ้นอยู่กับตัวฉันเอง PBC3

ไม่เห็นด้วย: 1 2 3 4 5 6 7 :เห็นด้วย

41. แม้ว่าจะยุ่งยากสักเพียงใดฉันก็จะทิ้งซากแบตเตอรี่ในถังจำเพาะ CB9

ไม่ใช่: 1 2 3 4 5 6 7 :ใช่

42. ถังจำเพาะสำหรับรองรับการแยกทิ้งซากแบตเตอรี่ควรสะดุดตา SF2

ไม่เห็นด้วย: 1 2 3 4 5 6 7 :เห็นด้วย

43. การเสียเวลาเป็นสิ่งที่ฉัน OE5

ไม่ปราถนาอย่างยิ่ง: -3 -2 -1 0 +1 +2 +3 :ปราถนาอย่างยิ่ง

44. การที่หาถังจำเพาะได้ง่ายช่วยให้ฉันทิ้งซากแบตเตอรี่ในถังจำเพาะ CB3

ไม่ใช่: 1 2 3 4 5 6 7 :ใช่

45. การที่นักอนุรักษ์ธรรมชาติเห็นด้วยกับฉันที่ทิ้งซากแบตเตอรี่ในถังจำเพาะเป็นสิ่งสำคัญสำหรับฉัน MC5

ไม่ใช่: 1 2 3 4 5 6 7 :ใช่

46. ฉันรู้ว่าซากแบตเตอรี่ต้องแยกทิ้งในถังจำเพาะจากการเรียนในห้องเรียน SF4

ไม่เห็นด้วย: 1 2 3 4 5 6 7 :เห็นด้วย

47. ทั้งหมดขึ้นอยู่กับฉันไม่ว่าฉันจะแยกทิ้งซากแบตเตอรี่ลงในถังจำเพาะหรือไม่ PBC4

ไม่เห็นด้วย: 1 2 3 4 5 6 7 :เห็นด้วย

48. ถังจำเพาะสำหรับรองรับซากแบตเตอรี่ควรอยู่ไม่ไกลนักที่ฉันจะเดินไปแยกทิ้งซากแบตเตอรี่

ไม่เห็นด้วย: 1 2 3 4 5 6 7 :เห็นด้วย SF3

49. ฉันรู้ว่าซากแบตเตอรี่ต้องแยกทิ้งในถังจำเพาะจากสื่อมวลชน SF6

ไม่เห็นด้วย: 1 2 3 4 5 6 7 :เห็นด้วย

50. การที่ถังจำเพาะสดุดตาหรือมีป้ายบอกชัดเจนช่วยให้ฉันทิ้งซากแบตเตอรี่ในถังจำเพาะ CB4

ไม่ใช่: 1 2 3 4 5 6 7 :ใช่

51. หากมีการรณรงค์ หรือประชาสัมพันธ์ให้ทิ้งซากแบตเตอรี่ในถังจำเพาะ ฉัน PC5

ไม่อยาก: -3 -2 -1 0 +1 +2 +3 :อยาก

ทิ้งซากแบตเตอรี่ในถังจำเพาะ

52. การทิ้งซากแบตเตอรี่ในถังจำเพาะช่วยให้กำจัดง่ายและถูกวิธี BB2

ไม่ใช่: 1 2 3 4 5 6 7 :ใช่

53. การทิ้งซากแบตเตอรี่ลงในถังจำเพาะเป็นการป้องกันการปนเปื้อนของสารเคมีที่มีพิษสู่สิ่งแวดล้อม BB1

ไม่ใช่: 1 2 3 4 5 6 7 :ใช่

54. คนส่วนใหญ่ที่มีความสำคัญต่อฉันคิดว่าฉัน SN1

ไม่ควร: 1 2 3 4 5 6 7 :ควร

แยกทิ้งซากแบตเตอรี่ลงในถังจำเพาะ

55. ฉันวางแผนว่าจะแยกทิ้งซากแบตเตอรี่ลงในถังจำเพาะทุกครั้ง Int4

ไม่เห็นด้วย: 1 2 3 4 5 6 7 :เห็นด้วย

56. เมื่อฉันมีซากแบตเตอรี่จำนวนน้อย ฉัน PC8

ไม่อยาก: -3 -2 -1 0 +1 +2 +3 :อยาก

ทิ้งซากแบตเตอรี่ในถังจำเพาะ

57. สำหรับฉันการแยกทิ้งซากแบตเตอรี่ในถังจำเพาะเป็นสิ่งที่ Att5

เป็นอันตรายมาก: 1 2 3 4 5 6 7 :เป็นประโยชน์มาก

58. สำหรับฉันการแยกทิ้งซากแบตเตอรี่ในถังจำเพาะเป็นสิ่งที่ Att4

มีเหตุผล: 1 2 3 4 5 6 7 :ไม่มีเหตุผล

59. การทิ้งซากแบตเตอรี่ในถังจำเพาะทำให้เสียเวลา BB5

ไม่ใช่: 1 2 3 4 5 6 7 :ใช่

60. ฉันต้องการแยกทิ้งซากแบตเตอรี่ลงในถังจำเพาะทุกครั้ง Int2

ผิด: 1 2 3 4 5 6 7 :ถูกต้อง

61. การมีถังจำเพาะจำนวนมากช่วยให้ฉันทิ้งซากแบตเตอรี่ในถังจำเพาะ CB1

ไม่ใช่: 1 2 3 4 5 6 7 :ใช่

62. การที่เพื่อน ๆ เห็นด้วยกับฉันที่ทิ้งซากแบตเตอรี่ในถังจำเพาะเป็นสิ่งสำคัญสำหรับฉัน MC1

ไม่ใช่: 1 2 3 4 5 6 7 :ใช่

63. แม้ว่าฉันรักความสบาย แต่ฉันก็จะแยกทิ้งซากแบตเตอรี่ในถังจำเพาะ CB6

ไม่ใช่: 1 2 3 4 5 6 7 :ใช่

64. ฉันมั่นใจว่าฉันจะแยกทิ้งซากแบตเตอรี่ลงในถังจำเพาะ PBC1

ไม่เห็นด้วย: 1 2 3 4 5 6 7 :เห็นด้วย

65. การที่องค์การภาครัฐเห็นด้วยกับฉันที่ทิ้งซากแบตเตอรี่ในถังจำเพาะเป็นสิ่งสำคัญสำหรับฉัน

ไม่ใช่: 1 2 3 4 5 6 7 :ใช่ MC9

66. การรณรงค์หรือประชาสัมพันธ์ให้ทิ้งซากแบตเตอรี่ในถังจำเพาะช่วยให้ฉันทิ้งซากแบตเตอรี่ใน

ถังจำเพาะ CB5

ไม่ใช่: 1 2 3 4 5 6 7 :ใช่

67. สำหรับฉันการแยกทิ้งซากแบตเตอรี่ในถังจำเพาะเป็นสิ่งที่ Att1

แย่มาก: 1 2 3 4 5 6 7 :ดีมาก

68. แม้ว่าจะมีซากแบตเตอรี่จำนวนน้อยฉันก็จะทิ้งในถังจำเพาะ CB8

ไม่ใช่: 1 2 3 4 5 6 7 :ใช่

โปรดทำเครื่องหมายถูก (✓)ลงในวงกลมหน้าข้อความที่ตรงกับความจริงของฉันมากที่สุด หรือเติมข้อความที่ตรงกับความจริงของฉันลงในช่องว่าง

69. เพศ

- ❍ชาย
- ❍หญิง

70. ปัจจุบันฉันเรียนอยู่

- ❍ 1. ชั้นปีที่ 1
- ❍ 2. ชั้นปีที่ 2
- ❍ 3. ชั้นปีที่ 3
- ❍ 4. ชั้นปีที่ 4
- ❍ 5. ชั้นปีที่ 5
- ❍ 6. ชั้นปีที่ 6

71. ฉันเรียนที่

- ❍ 1. คณะนิติศาสตร์
- ❍ 2. คณะพาณิชยศาสตร์และการบัญชี
- ❍ 3. คณะรัฐศาสตร์
- ❍ 4. คณะเศรษฐศาสตร์
- ❍ 5. คณะสังคมสงเคราะห์ศาสตร์
- ❍ 6. คณะศิลปศาสตร์
- ❍ 7. คณะวารสารศาสตร์และสื่อสารมวลชน
- ❍ 8. คณะสังคมวิทยาและมานุษยวิทยา
- ❍ 9. คณะวิทยาศาสตร์และเทคโนโลยี
- ❍ 10. คณะวิศวกรรมศาสตร์
- ❍ 11. คณะแพทยศาสตร์
- ❍ 12. คณะทันตแพทยศาสตร์
- ❍ 13. คณะสหเวชศาสตร์
- ❍ 14. คณะพยาบาลศาสตร์
- ❍ 15. คณะสถาปัตยกรรมศาสตร์และการผังเมือง
- ❍ 16. คณะศิลปกรรมศาสตร์
- ❍ 17. คณะสาธารณสุขศาสตร์

กรุณาเขียนเครื่องหมายถูก (✓) หรือเติมข้อความลงในช่องว่างบรรทัดเดียวกับเครื่องใช้ไฟฟ้าแต่ละชนิดที่ตรงกับความจริงของท่าน

เครื่องใช้ไฟฟ้า	การใช้แบตเตอรี่		ชนิดของแบตเตอรี่(1)	ความถี่ของการทิ้ง (2)	แบตเตอรี่หมดแล้วทิ้งที่		
	ไม่ใช้	ใช้			บ้าน	มธ.	ที่อื่น (ระบุ)
เครื่องเล่น MP3							
เครื่องเล่น CD							
เครื่องคิดเลข							
ซาวด์อะเบาท์							
กล้องถ่ายรูป							
ไฟฉาย							
อื่น ๆ (ระบุ)							

(1) Alk = ถ่านไฟฉายหรือถ่านอัลคาไลน์ Ni-Cd = ถ่านรีชาร์ตหรือถ่านนิเกิ้ลแคดเมียม
Ni-Ma = ถ่านนิเกิ้ลเมททอลแอนไฮไดรด์ Button = ถ่านกระดุม
อื่น ๆ (กรุณาระบุ)

(2) สัปดาห์ละครั้ง สองสัปดาห์ครั้ง สามสัปดาห์ครั้ง
เดือนละครั้ง สองเดือนครั้ง สามเดือนครั้ง
ภาคเรียนละครั้ง

กรุณาส่งคืนผู้แจกแบบสอบถาม

ขอขอบคุณท่านที่กรุณาให้ความร่วมมือตอบแบบสอบถามนี้

Table C1 Summary of variables, variable name, number, and page of the questionnaire (Thai version)

Variables	Variable name	number	page
Intention	Int3	37	124
	Int2, Int4	60, 55	126
Attitude	Att3	4	119
	Att6	9	120
	Att4, Att5	58, 57	126
	Att1	67	127
Subjective norms	SN2	8	120
	SN4	35	123
	SN1	54	126
Perceived behavioral control	PBC3	40	124
	PBC4	47	125
	PBC1	64	127
Behavioral belief	BB3	20	121
	BB4, BB6	29,30	123
	BB2	52	125
	BB1, BB5	53, 59	126
Outcome evaluation	OE1, OE2, OE3	3, 1, 5	119
	OE4	19	121
	OE6	31	123
	OE5	43	124
Normative belief	NB1	2	119
	NB5, NB6, NB7	7, 11, 12	120
	NB3, NB8, NB9	23, 24, 26	122
	NB2, NB4	34, 36	123
Motivation to comply	MC7	6	119
	MC6	10	120
	MC2, MC3, MC4, MC8	21,14, 15, 18	121
	MC5	45	125
	MC1, MC9	62, 65	127
Control belief	CB2	22	122
	CB7	33	123
	CB3, CB9	44, 41	124
	CB4	50	125
	CB1, CB5, CB6, CB8	61, 66, 63, 68	127
Perceived control	PC9	13	120
	PC1, PC4	17, 16	121
	PC7, PC6	25, 28	122
	PC3	32	123
	PC2	38	124

Table 21 (Continue) Summary of variables, variable name, number, and page of the questionnaire (Thai version)

Variables	Variable name	number	page
Perceive control	PC5	51	
	PC8	56	125
Existing of waste bins	SF1, SF2	39, 42	124
	SF3	48	125
Exposure of information	SF5	27	122
	SF4, SF6	46, 49	125
Demographic variables	Sex, Level, Fac	69,70, 71	128
Battery using			129

BIOGRAPHY

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