**MEDIA EFFECTS ON PRO-ENVIRONMENTAL BEHAVIORAL
INTENTION: AN EXAMINATION OF ILLUSION IN PERCEIVED
KNOWLEDGE DIFFERENTIAL BETWEEN SELF AND OTHERS**

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**Media Effects on Pro-environmental Behavioral Intention: An Examination of
Illusion in Perceived Knowledge Differential between Self and Others**

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TABLE OF CONTENT

ABSTRACT.....	4
CHAPTER ONE INTRODUCTION	6
<i>Research Background.....</i>	6
<i>Information Deficit Model of Behavioral Change.....</i>	7
<i>The Illusion of Climate Change Knowledge</i>	8
<i>Physical Complexities of Climate Change.....</i>	9
<i>Impersonal Nature of Climate Change.....</i>	9
<i>Public Good Nature of Fighting Climate Change.....</i>	10
<i>Summary.....</i>	11
<i>Context of Study—Climate Change in Singapore</i>	12
<i>Research Gaps</i>	13
<i>The Scope of the Dissertation</i>	14
<i>Overviews of Chapters.....</i>	15
CHAPTER TWO LITERATURE REVIEW.....	17
<i>Media Effects in Climate Change Communication</i>	17
<i>Information Deficit Model.....</i>	19
<i>The Information Deficit Model in Climate Change Communication.....</i>	20
<i>A Review of Criticism on Information Deficit Model.....</i>	21
<i>Revisiting the Information Deficit Model.....</i>	22
<i>Knowledge in Information Deficit Model.....</i>	24
<i>Actual Knowledge.....</i>	24
<i>Illusion of Knowledge.....</i>	24
<i>Positive Illusion.....</i>	27
<i>Theoretical Explanation for Positive Illusion.....</i>	27
<i>The Positive Illusion Model</i>	29
<i>Contemporary Studies of Positive Illusion</i>	31
<i>Summary</i>	35
CHAPTER THREE THEORETICAL FRAMEWORK.....	36
CHAPTER FOUR RESEARCH QUESTIONS AND HYPOTHESES	39
<i>Media Attention and Actual knowledge of Climate change</i>	39
<i>Media Attention and Illusion of Knowledge of Climate change.....</i>	39
<i>Media Attention and Illusion of Self-reported Perceived Knowledge</i>	40
<i>Media Attention and Illusion of Perceived Knowledge Differential between Self and Others</i>	41
<i>Knowledge and Pro-environmental Behavioral Intention</i>	42
<i>Direct Effect of Knowledge on Pro-environmental Behavioral Intention</i>	43
<i>Indirect Effect of Knowledge on Pro-environmental Behavioral Intention</i>	44
CHAPTER FIVE METHODOLOGY	49
<i>Data Collection</i>	49
<i>Measurement.....</i>	50
<i>Control Variables.....</i>	50
<i>Attention Paid to Media Messages about Climate Change</i>	51
<i>Actual Knowledge of Climate Change.....</i>	51
<i>Illusion of Self-perceived Knowledge of Climate Change.....</i>	52
<i>Illusion of Perceived Climate Change Knowledge Differential between Self and Others</i>	52
<i>Attitude toward Pro-environmental Behaviors</i>	53
<i>Private-sphere Pro-environmental Behavioral Intention</i>	54
<i>Public-sphere Pro-environmental Behaviors</i>	54
<i>Analytical Approach.....</i>	54
<i>Independent Sample T-test.....</i>	55

<i>Structural equation modeling (SEM) analysis</i>	55
CHAPTER SIX AN ANALYSIS OF ACTUAL KNOWLEDGE, SELF-REPORTED PERCEIVED KNOWLEDGE, AND ILLUSION IN PERCEIVED KNOWLEDGE DIFFERENTIAL ACROSS DIFFERENT DEMOGRAPHIC GROUPS.....	56
<i>Gender Difference</i>	57
<i>Gender Difference in Actual Knowledge of Climate Change</i>	57
<i>Gender Difference in Illusion of Self-perceived Knowledge of Climate Change</i>	58
<i>Gender Difference in Illusion of Perceived Knowledge Differential between Self and Others.....</i>	59
<i>Age Difference.....</i>	60
<i>Age Difference in Actual Knowledge of Climate Change.....</i>	61
<i>Age Difference in Illusion of Self-perceived Knowledge of Climate Change.....</i>	61
<i>Age Difference in Illusion of Perceived Knowledge Differential between Self and Others</i>	62
<i>Education Difference.....</i>	64
<i>Education Difference in Actual Knowledge of Climate Change</i>	65
<i>Education Difference in Illusion of Self-perceived Knowledge of Climate Change.....</i>	66
<i>Education Difference in Illusion of Perceived Knowledge Differential between Self and Others.....</i>	66
<i>Income Difference</i>	68
<i>Income Difference in Actual Knowledge of Climate Change</i>	68
<i>Income Difference in Illusion of Self-perceived Knowledge of Climate Change.....</i>	69
<i>Income Difference in Illusion of Perceived Knowledge Differential between Self and Others</i>	70
CHAPTER SEVEN RESULTS AND FINDINGS	72
<i>Descriptive Analysis</i>	72
<i>Results.....</i>	75
<i>Replicated Information Deficit Model.....</i>	76
<i>Extended Information Deficit Model.....</i>	76
CHAPTER EIGHT CONCLUSION.....	81
<i>Discussion.....</i>	81
<i>Theoretical and Practical Implications</i>	86
<i>Limitations and Directions for Future Research.....</i>	89
REFERENCE.....	93
APPENDIX A. INFORMATION SHEET AND INFORMED CONSENT FOR PARTICIPANTS	117
APPENDIX B. QUESTIONNAIRE	119

LIST OF TABLES

Table 1 Summary of Statistics of the Demographic and Knowledge Variables	56
Table 2 Summary Statistics of Illusion of Knowledge	73
Table 3 Bivariate Correlations among All Variables	74
Table 4 Summary of Measurement Items	75
Table 5 Measurement and Structural Model Fit Indices	76

LIST OF FIGURES

Figure 1 The hypothesized model	48
Figure 2 Mean Levels of Actual Knowledge of Climate Change for Females and Males	58
Figure 3 Mean Levels of Self-reported Perceived Knowledge of Climate Change for Females and Males	58
Figure 4 Mean Levels of Positive Illusion in Perceived Knowledge Differential between Self and Others for Females and Males	59
Figure 5 Mean Levels of Actual Knowledge of Climate Change for Young People and Middle-aged and Elderly	61
Figure 6 Mean Levels of Self-reported Perceived Knowledge of Climate Change for Young People and Middle-aged and Elderly	62
Figure 7 Mean Levels of Positive Illusion in Perceived Knowledge Differential between Self and Others for Young People and Middle-aged and Elderly	63
Figure 8 Mean Levels of Actual Knowledge of Climate Change for People without Higher Education and People with Higher Education	65
Figure 9 Mean Levels of Self-reported Perceived Knowledge of Climate Change for People without Higher Education and People with Higher Education	66
Figure 10 Mean Levels of Positive Illusion in Perceived Knowledge Differential between Self and Others for People without Higher Education and People with Higher Education	67
Figure 11 Mean Levels of Actual Knowledge of Climate Change for People with Lower Household Income and People with Higher Household Income	69
Figure 12 Mean Levels of Self-reported Perceived Knowledge of Climate Change for People with Lower Household Income and People with Higher Household Income	69
Figure 13 Mean Levels of Positive Illusion in Perceived Knowledge Differential between Self and Others for People with Lower Household Income and People with Higher Household Income	70
Figure 14 Replicated Information Deficit Model	79
Figure 15 Extended Information Deficit Model	80

ABSTRACT

Concerning the severe effects caused by climate change to both the natural and social systems, the mitigation and adaptation to climate change is becoming an urgent public agenda. As the information source for public agenda, media are recognized as being useful in informing public about climate change. Guided by information deficit model, many communication campaigns on climate change mitigation focus on cultivating public understanding of climate change. This model postulates that people will perform behavioral change once they are informed about the issue. Accordingly, a number of communication studies focus on how attention to media messages affects individuals' behaviors through raising their levels of actual knowledge. However, the original information deficit model has been criticized for being oversimplified. Information provision does not only affect individuals' actual knowledge level, but also influences how people evaluate their own knowledge level. People tend to develop illusion in their evaluation of knowledge level and to act upon the illusion of knowledge. Recognizing the flaws of the original information deficit model, this study extends this model by including illusion of knowledge as an important factor that shapes behavioral change in addition to actual knowledge. Regarding illusion of knowledge, both illusion in self-evaluation of knowledge and illusion in perceived knowledge differential between self and others are taken into accounts.

Accordingly, this study examined how individuals' attention to media messages about climate change influences their actual knowledge and illusion of knowledge of climate change, which alters their attitude toward pro-environmental behaviors, and in turn translates into behavioral intention. For data collection, this research conducted a door-to-door survey in Singapore ($N = 705$).

The analyses of demographic differences revealed that people from different social groups have different levels of actual knowledge, illusion in self-evaluation of knowledge, and illusion in perceived knowledge differential between self and others. In line with the criticism over the original model for its over-emphasis of the simple linear process, the results from this study suggested that the extended model performed better in predicting behavioral change compared to the original model. Moreover, the results showed that individuals' attention to media messages about climate change affect both actual knowledge and illusion of knowledge, which

promote their positive attitude toward pro-environmental behaviors, and in turn motivate pro-environmental behavioral intention. In particular, the findings suggested that the more positive illusion people have in self-evaluation of knowledge and in perceived knowledge differential between self and others, the more positive attitude they would develop toward pro-environmental behaviors, which in turn increase their intention of performing the behaviors. Implications of the findings, limitations of the study and directions for future research were also discussed.

CHAPTER ONE INTRODUCTION

Research Background

With increasing frequency of extreme climate events around the world, it is now concerned that climate change rate will continue or accelerate. Climate change could lead to severe consequences to both natural and human systems. The World Meteorological Organization (2013) reported that the global average temperature had risen by 0.6°C (1.1°F) over the 20th century, and was estimated to continue to climb. The Arctic area ice had witnessed dramatic decrease, and sea level had also risen dramatically. Moreover, an increasing trend of extreme climate events, such as powerful heat waves, destructive hurricanes, and major floods, has been observed in many parts of the world.

In spite of those changes in natural systems, our social system is also at high risk. In the Fourth Assessment Report on Climate Change (2007) of the Intergovernmental Panel on Climate Change (IPCC), a summary of vulnerabilities and risks of global social system was discussed. For example, low-altitude areas are at a crisis of having decreased crop yields; the rangeland for animals is decreasing, soil quality and other growing conditions for trees are deteriorating, and freshwater and marine ecosystems are being adversely affected. It is also pointed out that climate change would potentially affect the energy, construction, insurance, tourism and recreation markets (Hamilton, Maddison, & Tol, 2005; Hitz, & Smith, 2004; Tol, 2002). Moreover, human are exposed to health risks, because public health systems are sensitive to the effects of climate change, such as malnutrition, infectious diseases, cardiorespiratory morbidity, and diseases caused by exposure to elevated concentrations of ozone and aeroallergens (IPCC, 2007). It is estimated that “an additional 5-170 million people will be at the risk of hunger by the 2080s as a consequence of climate change” (IPCC, 2007, p. 15), and “hundreds of millions of people would be affected by changes in water quantity and quality” (IPCC, 2007, p.15).

Given the severe effects of climate change, alleviating them is an urgent concern. To minimize the effects from climate change, global efforts have been made to slow the pace of climate change and reduce further global warming. The public is encouraged to take positive actions to mitigate climate change. In particular, many campaign programs for climate change mitigation have used media to promote public

engagement (Staats, Wit, & Midden, 1996; Viklund, 2004). This is determined by the characteristics of climate change. People can hardly detect climate change from personal experiences, as issues related to climate change are beyond the life world and biographical horizons of most people (Lorenzoni, Jones, & Turnpenny, 2007). Given the distinctiveness of climate change issue, it is difficult for people to have a full picture of the phenomenon through direct observation and personal experience. The lack of direct experience has made climate change a problem that requires illustrating and explaining. Therefore, providing the public with the relevant information is imperative.

It is widely recognized that a critical function of media is to inform the public by transferring the messages over spatial and/or temporal distances (McQuail, 2001). Through performing the function of informing, media give people access particularly to those events that they cannot watch with their own eyes (Schulz, 2004). Besides, media translate the complex and scientific concepts to the lay audience. Thus, media are considered important tools in campaigns against climate change. Given that media have a crucial responsibility as a source of information about climate change issue, it is important to examine how individuals' attention to media messages about climate change influences their behavioral intention of fighting climate change.

Information Deficit Model of Behavioral Change

In communication practice, the information deficit model of human behavior has played a predominant role in past public behavioral change campaigns (Burgess, Harrison, & Filius, 1998). This model postulates that people will perform behavioral change once they are informed about the issue (Blake 1999; Burgess et al. 1998; Marteau, Sowden, & Armstrong, 1998). It is assumed that having knowledge is a necessary and sufficient condition for behavioral change (Moser & Dilling, 2011). Those guided by information deficit model focus on providing the public with information. Accordingly, a number of communication studies focus on how attention to media messages affect individuals' behaviors through raising their levels of actual knowledge.

However, many studies have demonstrated that individuals' attention to media content also contributes to behavioral change through influencing their evaluation of how much they know (Ellen, 1994; Ladwig et al., 2012). These findings suggest that providing the public with information will affect individuals' evaluation of their

knowledge level as well as their actual knowledge level. Moreover, these studies suggested attention to media messages could make people develop illusion in evaluation of their knowledge level, as people tend to feel they are knowledgeable while in fact they may not be knowledgeable (Holland, 1995; Park, 2001). This phenomenon is referred to as illusion of knowledge, which means that people tend to overestimate their knowledge level and to act upon what they believe to know rather than on what they actually know (Adoni & Cohen, 1978; Glenberg, Wilkinson, & Epstein, 1982; Jung et al., 2011; Park, 2001; Schneider & Laurion, 1993). Given these findings, the information deficit model could be problematic, as it merely focuses on the role of actual knowledge in promoting behavioral change. To have a comprehensive understanding of media effects on behavioral change, both the level of actual knowledge and the level of illusion of knowledge should be taken into account.

In terms of illusion of knowledge, previous studies mostly focused on the discrepancy between one's perceived knowledge and actual knowledge, whereas the discrepancy between *perceived knowledge differential between self and others* and *actual knowledge differential between self and others* were overlooked. When people evaluate their own competency, the comparison process also plays a role (Tesser, 1986, 1988; Wood, 1989). That is, when people seek to evaluate themselves, they look to others to determine whether they are performing well or poorly. Moreover, a number of study suggest that people tend to have illusory superiority in the comparison, as they are prone to believe they are better than others despite of the facts (Alicke, 1985; Taylor & Brown, 1988). In this case, how people compare their knowledge level to others' should be considered in the examination of illusion of knowledge. Therefore, this study proposes to examine illusion of knowledge from two perspectives. One is the illusion of self's knowledge, which concerns the differences between self-reported perceived knowledge level and actual knowledge level; the other one is the illusion of perceived knowledge differential, which concerns how perceived knowledge differential between self and others is different from actual knowledge differential between self and others.

The Illusion of Climate Change Knowledge

As discussed, media could affect individuals' attitude and behavior not only through influencing their actual knowledge level, but also through influencing how they evaluate their knowledge level. Moreover, people tend to have illusion in the

evaluation of their knowledge level. Considering the distinctiveness of climate change issue, it is imperative to understand how its distinctiveness would affect the level of individuals' illusion of climate change knowledge.

Physical Complexities of Climate Change

As climate change lies beyond most people's life-world and biographical horizons, it is hard for people to have a direct observation of the phenomenon (Lorenzoni, Jones, & Turnpenny, 2007). The causes of climate change are invisible. The signal of climate change is virtually impossible to detect from personal experience. The consequences triggered by climate change are mostly determined by the monitoring of the variations of temperature and precipitation data. These observations have to take a long view, therefore generating long-term predictions. Thus, it is virtually impossible to detect climate change from personal experience. Besides, unlike other natural disasters, such as hurricane, climate change is not a single hazard. It can cause multiple linked hazards (National Research Council, 2010). Also, unlike air pollutants that cause smog, reducing gas emission will not immediately alleviate climate change (Solomon et al., 2009).

These physical complexities of climate change make it difficult for people to have a full picture of the climate change issue (Hansen, Biringer, & Hoffman, 2003; Solomon et al., 2009). Thus, people may find it hard to fully understand this issue. As people tend to employ heuristic procedures to simplify the evaluation when faced with complex problems (Tversky & Kahneman, 1992), it is possible that they would not make an accurate evaluation of their knowledge regarding this issue. For instance, people may believe they are knowledgeable of climate change even though they lack the actual knowledge. Hence, the degree of illusion that people have in self-evaluation should be considered in the examination of how people evaluate their knowledge of climate change.

Impersonal Nature of Climate Change

Climate change is considered an impersonal risk, which is characterized by focusing on something other than personal safety, such as values and distant others (Kahlor, Dunwoody, Griffin, & Neuwirth, 2006). Risk communication scholars have distinguished between personal and impersonal referents when examining public perceptions of risk (Coleman 1993; Dunwoody, & Neuwirth 1991). In particular,

health issues are commonly addressed as personal risks because they are personally relevant and can have direct effects in terms of risk to the self and loved ones (Biek, Wood, & Chaiken 1996; Chaiken 1992; Markova & Power 1992). Conversely, a number of environmental issues, such as climate change, overpopulation, and unsustainable development, are regarded as impersonal risk, because they rarely pose direct personal threats to humans (Tyler, & Cook, 1984). A study on individuals' risk perceptions of climate change indicated that people perceived climate change as a risk that would predominantly affect geographically and temporally distant people and places (Leiserowitz, 2005).

Prior research has suggested that people lack learning motivation when they consider an issue to be impersonal (Oxford & Shearin, 1994). Accordingly, the public may lack the motivation to learn about climate change given its impersonal nature. Thus, people are less likely to master the knowledge regarding this phenomenon. Empirical findings from prior studies suggest that people do not only have poor understanding of climate change (Weber & Stern, 2011), but also tend to overestimate their subjective knowledge about this issue (Stoutenborough & Vedlitz, 2014). Hence, the impersonal nature of climate change may also give rise to individuals' illusion in self-evaluation of their knowledge of climate change.

Public Good Nature of Fighting Climate Change

Unlike other issues, preventing climate change is a public good that will benefit the public, and thus, it does not require only individual effort, but collective effort as well (Aldy, Orszag, & Stiglitz, 2001). Various scales of actors are involved in mitigating and adapting to climate change. Several types of adaptation are individual efforts in response to threats to the climate, whereas other types of actions can only be achieved via collective efforts (Lubell, 2002). Accordingly, the insights about response to climate change as collective action should be taken into account in promoting public engagement in coping with climate change.

Given the recognition of the public good nature of pro-environmental behavior, environmental studies have underscored the calculus of individual decision-making in the collective action setting (Adger, 2003; Lubell, 2002; Rydin & Pennington, 2000). More than that, the collective interest model indicates that individuals will consider the performance of others in the decision-making of engaging in collective action (Olson, 1970). That is, people will compare themselves with others when making

decisions under the collective setting. This suggests that individuals' perception regarding the difference between self and others may influence their behavioral intention of taking actions to cope with climate change. In this case, it is expected that people may compare themselves with others in the process of knowledge evaluation, and this comparison may play a role in their decision-making of engaging in pro-environmental activities to alleviate climate change.

With regards to the comparison between oneself and others, previous research indicated that people tend to hold the biased belief that they are better than others in the comparisons (Taylor & Brown, 1988). In particular, Taylor and Brown (1988) defined this better-than-others perception as positive illusion. Furthermore, they suggested that the positive illusion in comparison with others would influence individuals' behavior. Besides, social comparison theory has also supported the phenomenon of illusion. Specifically, Festinger's social comparison theory (1954) postulated that humans are driven to evaluate their capabilities through engaging in comparisons with others. Furthermore, a large body of evidence reveals that people tend to harbor biased information in a self-serving manner when they make comparisons (e.g. Sackeim, 1983; Gunther, 1995).

As the literature on public good nature and social comparison suggests, people tend to compare themselves with others in the collective action setting and to hold biased belief in the comparison. In this case, it is expected that people may engage in comparison when they evaluate their knowledge level, and may develop illusion in the comparison. For example, people may perceive that they have more knowledge than others even though they are actually less knowledgeable than others. In other words, the perceived knowledge differential between self and others may be greater than the actual knowledge differential. That is, people have positive illusion in the perceived knowledge differential between self and others. Hence, the degree of illusion in individuals' perceived knowledge differential between self and others should be taken into account in the examination of how people evaluate their knowledge of climate change.

Summary

As aforementioned, the physical complexities of climate change, the impersonal nature of climate change issue, and the public good nature of fighting climate change may give rise to individuals' illusion in self-evaluation of knowledge

and illusion in the comparison of knowledge between self and others. Specifically, the illusion in self-evaluation of knowledge concerns the differences between one's perceived knowledge level and actual knowledge level. The illusion in one's comparison of knowledge between self and others concerns how one's perceived knowledge differential between self and others is different from the actual knowledge differential between self and others. Thus, to make a comprehensive understanding of how individuals' attention to media messages about climate change influences their pro-environmental behavioral intention through affecting their evaluations of knowledge, the research should not only examine the degree of illusion in self-evaluation of knowledge, but also examine the degree of illusion in perceived knowledge differential between self and others.

Context of Study—Climate Change in Singapore

I selected Singapore as the locale for this study. As a low-lying island, Singapore is directly influenced by the rising sea level caused by climate change. The National Climate Change Secretariat (NCCS, 2013) reported that the mean sea level in the Straits of Singapore had increased by about 3 mm per year over the past 15 years. From 1972 to 2014, the annual mean temperature has increased from 26.6°C to 27.7°C. The high temperature can lead to heat stress as well as greater use of air conditioning, which increase the energy demands. This in turn leads to higher domestic carbon emissions. The Singapore government has publicly attributed the unusual and repeated episodes of flash floods and heavy rains to climate change (Ismail, 2011). Other dangers of climate change in Singapore include the loss of water resources, higher rate of recurrence of the annual haze, and resurgence of tropical diseases (NCCS, 2013).

Considering the severe effects of climate change, the exigent need to mitigate and adapt to climate change is becoming a vital public agenda in Singapore. What people know about climate change can influence their own behavior (Chew Palmer, Slonska, & Subbioh, 2002), as well as the support they give to public policies that address the issue, such as mandatory industry standards against emissions (Leiserowitz, 2005). Accordingly, the government has launched many plans to address climate change. For example, in the latest plan titled "Take Action Today: For A Carbon-efficient Singapore", Singapore has set a goal of reducing its greenhouse gas emission intensity by 36% compared to 2005 levels by 2030 (NCCS, 2016). In another plan

named “A Climate-resilient Singapore”, a number of measures have been developed to minimize the potential effects caused by climate change (NCCS, 2016). With the release of these plans, the government are encouraging the Singaporeans to understand national strategy to address climate change, and more importantly how the public can play a part.

Moreover, the media is an important information source of environmental information for Singaporeans (Tan, Lee, & Chuan, 1998). The percentage of the respective newspapers’ coverage that refers to climate change in Singapore has increased tenfold between 1997 and 2009 (Schmidt, Ivanova, & Schäfer, 2013). A survey on environmental knowledge of students in Singapore reported that students gathered most of their environmental knowledge from out-of-school sources rather than environmental education program, and 53.7% of them indicated that media was the main source to acquire environmental information (Tan, Lee, & Chuan, 1998).

Besides, unlike the U.S. that is characterized by partisan and polarized news mediums, the government has great influence on the media in Singapore (Starr, 2010; Wong, 2004). Singapore therefore does not have the numerous diverse, dissenting voices in the media that is prevalent in the U.S. Given the unique media landscape, it is worthwhile to assess how factors such as Singaporeans’ media attention about climate change would influence their pro-environmental behaviors in coping with climate change. An understanding the role of media in promoting public engagement in fighting climate change would be helpful for the government and relevant authorities to develop more effective campaign strategies.

Research Gaps

The research gaps that warrant this study are threefold, as explained in the following sections.

Firstly, the information deficit model is constantly challenged for its oversimplification. A deeply seated assumption of the information deficit model is “people will act rationally in response to the information made available to them” (Macnaghten & Jacobs, 1997, p.10). That is, people will be cognitively prepared for the incoming information from media, and there is no doubt that people will acquire actual knowledge after they paying attention to media messages. Nonetheless, many studies have reported that paying attention to media messages not only contributes to actual knowledge, but also makes people feel that they are knowledgeable despite of

the reality (Kahlor & Rosenthal, 2009; Park, 2001). This suggests that paying attention to media messages has other effects than informing the public. However, prior critics mostly focus on its neglect of social or psychological factors. Very few studies on this model underlined that paying attention to media messages would not only influence individuals' actual knowledge acquisition, but also affect their evaluation of how much they know. With the acknowledgement of this flaw in the information deficit model, this study proposes to extend this model by incorporating individuals' evaluation of knowledge in the examination of media effects on behavioral change.

Secondly, most previous studies on media effects emphasize how attention to media messages affects individuals' perception, but rarely shed lights on how media affect the discrepancy between individuals' perception and the facts. For example, the third person effects studies reported that people tend to perceive that others are more likely to be influenced by the negative media messages than themselves (Gunther, 1995; Stavrosit & Kim, 2014; Wei, Lo, & Lu, 2008). However, very few studies have examined whether the third person perception is accurate or not. With an examination of how attention to media messages affects individuals' illusion in their evaluation of knowledge, this study would fill the research gap and offer a new angle to look at media effects.

Thirdly, as a problem that requires collective actions to address, climate change will be significantly reduced only when many people collaborate (Adger, 2003). Following the logic of the collective interest model, people will compare self with others when making decision of engaging in a collective action (Olson, 1970). Accordingly, assessing the climate change knowledge of self and others may affect individual pro-environmental behavior intention. Although political economists have long recognized the collective-good nature of pro-environmental behaviors, models of individual behavior developed in environmental studies have rarely addressed the logic of collective action (Lubell, 2002). Prior studies regarding media effects on pro-environmental behavioral intention have rarely taken account of the collective nature of actions in mitigating climate change. By examining the perceived knowledge differential between self and others, this study would contribute to literature on pro-environmental behaviors.

The Scope of the Dissertation

Previous studies have mostly examined how media attention contributes to the actual knowledge of individuals, which in turn, influences their attitude and behavioral intention. However, these studies, guided by the original information deficit model, have ignored the effects of how people evaluate their knowledge level in promoting their behavioral change. Moreover, previous studies have revealed that people tend to develop illusion in their evaluation of knowledge and to act on the illusion of knowledge. Thus, to gain an integrative understanding of media effects on individuals' behavioral change, this dissertation makes an extension to the original information deficit model by examining both the level of actual knowledge and the level of illusion of knowledge. In particular, there are two aspects of illusion of knowledge; one is the illusion in self-evaluation of knowledge, and the other one is the illusion in the perceived knowledge differential between self and others.

Specifically, a national survey is executed in this study. Given that there is very limited research on illusion of knowledge, this dissertation firstly makes an in-depth examination of it. A series of analyses are carried out to examine the effects of socio-demographic characteristics on it. Besides, the demographic differences in actual knowledge are also provided.

Then, an integrative examination is performed on how attention to media messages about climate change influences pro-environmental behavior intention through individuals' actual knowledge and illusion of knowledge. In particular, this study tests both the original and extended information deficit model. The structural equation modeling (SEM) is executed to test models.

Overviews of Chapters

This dissertation is organized into six chapters followed by a list of references and a section for supporting documents. Chapter One provides the research background and presents the research gaps of this study. In particular, this chapter also elaborates on the nature of climate change that may generate illusions of knowledge. Chapter Two firstly provides an in-depth review of previous studies on media effects in climate change communication. Then a review of the information deficit model is conducted. Specifically, a review of criticism of this model has been offered in this

chapter. Next, this chapter offers a review of illusion of knowledge. Then, a review of the concept of positive illusion and the relevant empirical research is provided.

Based on the literature reviewed, Chapter Three further presents the theoretical framework of this study. In Chapter Four, research questions and hypotheses are presented. Chapter Five presents the methodology of this research project. Chapter Six begins with a report of the analyses results of actual knowledge, illusion in self-evaluation of knowledge, and illusion in perceived knowledge differential between self and others among different groups. Then Chapter Seven reports the result of the proposed study in this dissertation. Lastly, Chapter Eight reports and discusses the results of this research. This chapter discusses the theoretical and practical implications of the findings of this dissertation. The limitations of this research and possible directions for future work are also presented.

CHAPTER TWO LITERATURE REVIEW

Media Effects in Climate Change Communication

People rely on various sources to obtain environmental information, among which media are considered one of the most effective agents in informing the public, since it is the central interpretative system of modern societies (Schmidt et al., 2013). Moreover, an increasing number of studies have demonstrated that media play critical roles in identifying and interpreting environmental issues (Hannigan, 2006; Nelkin, 1987; Schoenfeld, Meier, & Griffin, 1979; Slovic, 2000). This observation is particularly true for climate change given that media are considered the main information source for the public to gain understanding of this issue.

Given its widespread circulation and extensive capability to reach the general public, media are extensively used tools for disseminating information and informing the public about climate change (van Aelst & Walgrave, 2011). For example, Bell (1994) reported that media were the sole information source on climate change for most New Zealanders. Also, Wilson (2000) reported that media were the primary source of information about climate change in the United States. In this case, many campaign programs for fighting climate change have used media as the tool to raise public engagement (Staats et al., 1996; Viklund, 2004). For example, the Netherlands and United Kingdom used the mass media for their national campaigns for green house gas emission reduction (Staats et al., 1996; DEFRA, 2007). In the recent decade, new media are becoming important platforms for campaigns against climate change, as the environmental organizations worldwide are creating web-based initiatives to promote awareness of climate change. For instance, the United Nation initiated a social media campaign titled “Seal the Deal!” to promote energy conservation.

To date, there are a substantial number of studies on media and climate change, but many existing studies focused on how climate change is framed in media messages. For instance, Boykoff (2007) examined how climate change was represented in the US newspaper and television, and found that climate change was framed as a contentious issue. In another study, he made an examination of how journalistic activities shaped the climate change coverage (Boykoff & Boykoff, 2007). Besides, Carvalho (2007) examined the representations of scientific knowledge conveyed by the press, and reported that the scientific representation of climate change in media discourse was interlinked with ideology. While these studies do offer an overview of climate change

coverage in the press, they did not provide a direct evaluation of media effects on public understanding of climate change and on their behavioral intention to mitigate climate change.

In terms of media effects on knowledge acquisition, a number of studies examined how media affect public understanding of climate change. Although these studies showed that public drew most of climate change knowledge from media (e.g. Schafer, 2012; Ryghaug et al., 2011), they did not empirically examine the relationship between media attention and knowledge acquisition. Instead, these studies merely asked the respondents to state their main source of information about climate change. For example, Whitmarsh (2009) used a more qualitative approach to examine public understanding of climate change. In the study, the amount of attention that people pay to media messages about climate change was not measured. Instead, the respondents were asked to indicate which medium was the most common source of information about climate change. Moreover, this study had not measured respondents' overall knowledge of climate change, as it gave a particular attention to how respondents understood the terminologies of climate change and global warming.

Despite the important role of media in climate change mitigation campaigns, a limited number of studies have directly examined media effects in promoting individuals' positive engagement. In particular, a significant body of research focused on psychological factors associated with climate change mitigation and adaption. For example, in a study on psychological barriers that limit climate change mitigation and adaption, Gifford (2011) found that ideological worldviews, distrust toward scientists and authorities, and perceived risks of changing current lifestyle could hinder individuals' engagement in ameliorative actions. O'Connor et al. (1999) reported that risk perception of climate change and general environmental beliefs mattered in predicting pro-environmental behavioral intention. In addition, scholars have examined social factors that refrain people from taking interests or actions in alleviating climate change, such as lack of political action, social norms and expectations (Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007).

Given a limited number of direct assessments of media effects in climate change communication, this research aims to make a direct evaluation of media effects on climate change knowledge acquisition and behavioral change. One of the prominent models that used to examine media effects is the information deficit model. This model maintains that the provision of information would increase individuals'

knowledge, which in turn translates into attitude and behavior change. In accordance with this model, media publicity of a certain issue would increase individuals' knowledge of it. However, media publicity does not reflect the amount of attention that people pay to the media information, as people may selectively expose themselves to media content with personal interest. Thus, to make an accurate measurement of media effects on individuals' knowledge acquisition and behavior change, it is requisite to find out how much attention that people have paid to media information. Therefore, this study focuses on how the amount of attention that people pay to media messages about climate change affect their knowledge, attitude and pro-environmental behavioral intention.

Information Deficit Model

The information deficit model operates on the premise that individuals' unsustainable behaviors occur because people do not have enough knowledge (Blake 1999; Burgess et al. 1998). This model postulates that providing information increases individuals' knowledge and awareness, which alters their attitudes toward the behaviors, and in turn translates to behavior change (Burgess et al., 1998; Eden, 1996; Jackson, 2005; Schultz, 2002). With the assumption of a linear passage from information source to audience to action, the information deficit model suggests that people are rational and responsible actors who need the information to alter their behaviors (Potter & Oster, 2008). The rationale of this model is that the provision of information engender a sense of responsibility and change the attitudes, which will motivate individuals' behavioral change (Macnaghten & Jacobs, 1997).

The original purpose of this model was not to describe the communication mode. Coined by scholars studying the science communication in the 1980s, the information deficit model was to characterize a widely held belief that underlines much of the information-intensive public education campaigns (Dickson, 2005). By positing that scientific knowledge inevitably leads to public support for science, the information deficit model has been employed to justify many education and campaign programs that emphasize increasing scientific training is essential in promoting science and technology, as the "public understanding of science" or "scientific literacy" movement has exemplified (Gregory & Miller, 1998; Jenkins, 1997). Moreover, as the public tends to be resistant against controversial scientific research or technologies (e.g. genetic modified food, and nuclear power, etc.), the science community has made

logical complement to the information deficit model by postulating that ignorance and the lack of scientific literacy are responsible for public skepticism concerning science (Freudenburg, 1993; Wynne, 1991). For example, the Committee for Public Understanding of Science (COPUS) in the UK funded many science popularization programs, aiming not only to popularizes science, but also to raise the scientific literature among the British public (Sturgis & Allum, 2004).

In addition to science communication, the information deficit model has underpinned a huge number of communication campaigns in other fields, such as healthcare and environmental campaigns. For example, the information deficit model has been used to design programs to prevent teenagers from beginning to smoke based on the information deficit model (US Department of Health and Human Services, 1994). Those programs assume that teenagers would develop anti-tobacco attitudes and make rational decisions not to smoke once they were provided with appropriate information regarding the harmful impacts of smoking. Also, distributing healthcare information booklets, a frequently used approach in health education programs, is an implication of the information deficit model (Heaney et al., 2001).

Besides, the information deficit model has been extensively used in environmental campaigns, which suggest that people would act environment-friendly when provided with information of environmental issues (Irwin, 1995; Layzer, 2002; Owens, 2000). This belief has been the basis of many information campaigns, such as the ‘Helping the Earth begins at Home’ which was initiatively launched by the UK government in the early 1990s to persuade people to improve home energy efficiency, and more recently “Are You Doing Your Bit?”, which was designed to cultivate public understanding of sustainable development.

The Information Deficit Model in Climate Change Communication

Research on public understanding of climate change began in the late 1980s. The information deficit model soon emerged as a common explanatory frame for the research. Following this model, the research posited that changing individuals’ behaviors is central to the agenda of climate change mitigation, and what drives and enables behavioral change is the provision of information (Blake, 1999). In the early 1990s, climate change was still a relatively new concept in the public discourse, and lay public held a range of misconceptions of it. For example, the public tended to confuse climate with weather, and conflate climate change with the hole in the ozone

layer. In one of the first studies of public understanding of climate change, Kempton (1991) found that people had little knowledge of the causes and effects of climate change. More recent studies have continued to highlight a lack of knowledge of climate change as a central concern for mitigation strategists (Bord, Connor, & Fisher, 2000; Stamm, Clark, & Eblacas, 2000). For instance, a review of public opinion polls reported a cross-national evidence of widespread misunderstanding of climate change (Brechin, 2003).

Given the consistency of these research findings, it is widely proposed that the public need to be better informed about climate change to engage in pro-environmental practices. A firmly held belief that characterizes the approach taken by communicators in climate change mitigation is that “better-informed citizens everywhere are more likely to shape their own behaviors and contribute more positively to protecting their environments” (Brechin, 2003, p.118). In this case, the information deficit model has been taken by many climate change mitigation campaigns as the main approach for promoting public engagement. For example, the Asia-Pacific Media Alliance managed a regional campaign utilizing both traditional and online media to raise public understanding of climate change (Asian Development Bank, 2011). Under the tagline “Redraw the Line”, this campaign was launched in Philippines, Thailand, Vietnam, and Bangladesh. The National Climate Change Secretariat (NCCS) in Singapore regularly organizes climate change awareness programs for schools, such as “Stop Melting My Home”. Besides, the NCCS also launch the annual Clean & Green Singapore campaign to enhance public understanding of climate change and promote their engagement in the mitigation and adaptation to climate change (NCCS, 2016). Considering the prevalence of information deficit model in climate change communication campaign, it is worthwhile to understand the mechanism of this model in promoting individuals’ engagement in fighting climate change.

A Review of Criticism on Information Deficit Model

Although the information deficit model is a common approach taken by many communication campaigns, it has been constantly criticized in academic literature. Most of the criticism focused on its oversimplification. For example, Schultz (2002) criticized the information deficit model for not taking account of the motivations behind behavior change. Owens and Drifill (2008) indicated that behavior change

could be influenced by social, political and cultural factors aside from the provision of information.

Moreover, the criticism of this model has led scholars to look for other factors that determine individuals' pro-environmental behaviors. For example, with considerations of the social and political context of environmental problems, many scholars posited that trust in institutions was crucial in determining individuals' willingness to participate in the resolution (Blake, 1999; Bulkeley, 2000; Thompson & Rayner, 1998). Jaeger et al. (1993) contended that individuals' social networks and social rules played important roles in promoting pro-environmental behaviors. Besides, some scholars have focused on the barriers to pro-environmental behaviors, such as a lack of time or money (Huddart-Kennedy et al., 2009) and personal comfort (Kollmuss & Agyeman, 2002).

Besides, information deficit model has been criticized for the weak relationship between knowledge and behavioral change. For example, a number of studies reported that the relationship between increased knowledge and subsequently behavioral change was weak; especially when general information rather than specific information was provided (McKenzie-Mohr et al., 1995; McKenzie-Mohr, 2000; Kollmuss and Agyeman, 2002). This suggests that increases in knowledge and understanding may not have direct effects on behavior change. In fact, a great number of studies have demonstrated that knowledge drives attitude change, which in turn translates into behavior change (Miller, Booraem, Flowers, & Iversen, 1990; Nwokocho & Nwakoby, 2002; Zhang et al., 2009). In this case, an indirect path from knowledge to behavior via attitude should be included in information deficit model in addition to the direct path.

Revisiting the Information Deficit Model

While the criticisms are undoubtedly in many ways valid, they do not sufficiently problematize the deficit model to justify scrapping it entirely, as the simple logic of the information deficit model is supported by a good deal of cross-national empirical evidence (e.g. Bauer, Durant & Evans 1994; Evans & Durant 1995; McBeth & Oakes 1996; Miller, Pardo & Niwa 1997; Sturgis & Allum 2001). In a re-evaluation of the information deficit model, Sturgis and Allum (2004) contended that although culture, economic and social factors are important in determining public attitude and behavior change, there is no reason to assume that information provision

does not have independent effects in shaping behavioral change. In fact, many scholars have acknowledged that while knowledge does not directly motivate behaviors, the lack of knowledge is a barrier to behavior change (Monroe, 2003; Schultz, 2002; Sweeney et al., 2003). Therefore, it would be problematic to scrap the information deficit model entirely. Instead of scrapping the information deficit model entirely, it would be much more rational to revisit this model by improving it.

In the re-evaluation of the information deficit model, Sturgis and Allum (2004) suggested that previous studies have overstated the importance of the simple linear deficit model, while other effects of information provision have been overlooked. Moreover, one trenchant critique over this model concerns whether the information provision operates in the way the information deficit model suggests (Dickson, 2005). Despite claims of the importance of media in informing audience, a substantial amount of empirical findings suggests that paying attention to media messages has other effects than informing the public (Bennett, 1988; Robinson & Davis, 1990).

In the examination of media effects, a number of studies on media effects have demonstrated that information provision would contribute to individuals' factual understanding of the publicized issue, and affect how people evaluate their level of knowledge (Kahlor & Rosenthal, 2009; Park, 2001). In particular, individuals' attention to media messages might not increase their actual knowledge as much as it enhances the impression of one's own knowledge (Holland, 1995; Mondak, 1995; Park, 2001). As a result, in the evaluation, people believe they are knowledgeable while in fact they are not. In this case, media exposure misleads the audience to feel informed rather than actually being informed about it (Graber, 1988; Salwen & Driscoll, 1995), which in turn increase the illusion of knowledge (Park, 2001). Moreover, previous studies have suggested that people act upon the illusion of knowledge to form opinions and take actions (Jung et al., 2011; Weber & Koehler, 2017).

Besides, knowledge studies have suggested that how people evaluate their knowledge level should be inserted into the traditional knowledge deficit model as a substitute for factual knowledge (Ladwig et al., 2012). Accordingly, it is expected that information provision would affect individuals' evaluation of knowledge level, which in turn impacts their attitude and behaviors.

Therefore, rather than scrapping the information deficit model entirely, this study aims to revisit this model by examining the other effects of information

provision. Specifically, this study proposes that paying attention to media messages could affect individuals' attitude and behavioral intention not only through contributing to their actual knowledge, but also through giving rise to their illusion of knowledge.

Knowledge in Information Deficit Model

Knowledge is the central concept in understanding the information deficit model. As the information deficit model outlined, information provision contributes to individuals' actual knowledge, which in turn translates into attitude and behavior changes. Assuming that a lack of knowledge would hinder individuals' behavioral change, this model stresses the importance of enhancing public understanding. In accordance with this model, many communication campaigns focus on increasing individual's actual knowledge. As this study proposes that paying attention to media messages would affect individuals' attitude and behavioral intention via contributing to their actual knowledge and illusion of knowledge, the conceptual distinction between actual knowledge and illusion of knowledge is firstly discussed.

Actual Knowledge

Actual knowledge refers to what individuals actually know (Brucks, 1985). As a representation of individuals' factually stored information, actual knowledge is usually measured by asking respondents a series of true/false questions about the facts (e.g., Chern et al., 2003; Gaskell, Bauer, Duran, & Allum, 1999; Priest, 2000). Many studies have demonstrated that actual knowledge plays an important role in shaping attitude and behaviors. For example, Thøgersen (2009) found that people with more issue-relevant factual knowledge were more likely to adopt new eco-label. In a meta-analysis on the determinants of pro-environmental behavior, Bamberg and Moser (2007) reported that actual knowledge regarding environmental problems is an important indirect determinant. Results from their meta-analysis also underlined that actual knowledge of environmental issues directly influences attitudes toward pro-environmental behaviors.

Illusion of Knowledge

Different from actual knowledge that reflects factually stored information, illusion of knowledge, which is a combination of knowledge and self-confidence,

reflects individuals' evaluation of their own competence (Park & Lessig, 1981). Specifically, people generate illusion of knowledge when they overestimate their knowledge level.

The concept of illusion of knowledge has been extensively studied in different domains, but scholars named it under different terms. For example, early memory research came up with the notion on feeling of knowing. Tulving and Madigan (1970) noted, "one of the truly unique characteristics of human memory is its knowledge of its own knowledge" (p.477). A large volume of research on feeling of knowing emphasized that individuals are often overconfident in evaluating the correctness of their knowledge (Koriat, Lichtenstein, & Fischhoff, 1980; Lichtenstein, Fischhoff, & Phillips, 1982). Likewise, research on metacognition also highlighted the overconfidence effects. Metcalfe (1998) proposed the concept of cognitive optimism. She indicated that in cognitive tasks, people's expectation of their own performance tends to be an overestimate of reality. Those studies somewhat overlapped with one another in their interpretation of the discrepancy between individuals' subjective assessment and objective performance.

Two Dimensions of Illusion of Knowledge

As aforementioned, illusion of knowledge examines how people evaluate their own knowledge level (Adoni & Cohen, 1978; Glenberg, Wilkinson, & Epstein, 1982). While there are plenty of studies touching upon the concept of illusion of knowledge, one of the concerns has been that most previous studies tend to regard illusion of knowledge merely as the discrepancy between self's perceived knowledge and actual knowledge (Koriat & Goldsmith, 1996; Nelson & Narens, 1990; Park, 2001). However, prior studies have suggested that comparison with others is an important source of self-evaluation. For example, Aspinwall and Taylor (1993) maintained that the use of social comparison information for self-evaluation is a major developmental step in children's growing understanding of their own competencies.

Moreover, in the self-evaluation maintenance model, Tesser (1986, 1988) postulated that the comparison process is an important evaluation process. Specifically, he indicated that in the comparison process, people evaluate themselves through engaging in comparisons with others. As these studies suggested, it is expected that people would evaluate their own knowledge level through the comparison with others.

In the comparison process, people assess how much knowledge they and other people have respectively.

In terms of the comparison with others, individuals' perception may not accurately reflect the reality. Stein (1982) denominated this phenomenon as illusion, and referred illusion to "a perception that represents what is perceived in a way different from the way it is in reality. An illusion is a mental image or conception which may be a misinterpretation of a real appearance or may be something imagined" (p. 662). A huge amount of evidence indicate that individuals process information in a way with incomplete data, shortcuts and biases, which result in illusion in their perception (Fiske & Taylor, 1984; Nisbett & Ross, 1980). In this case, people may develop illusion in their comparison with others. For example, people may have better-than-others perception while in fact they are not. Thus, the level of illusion in perceived knowledge differential between self and others should be considered in the examination of illusion of knowledge.

Accordingly, this study proposes to examine two dimension of illusion of knowledge. One is the illusion of self's perceived knowledge, which concerns the discrepancy between how much people believe they know and how much people actually know. The other one is the illusion of perceived knowledge differential in the comparison, which concerns how one's perceived knowledge differential between self and others is different from actual knowledge differential between self and others. Though these two dimensions concerns two distinctive processes that people engage in to evaluate their own knowledge level, they both examine the phenomenon of illusion in self-evaluation.

The phenomenon of illusion in self-evaluation has been extensively examined by social psychologists. In particular, Taylor and Brown (1988) defined such unrealistic positive views regarding themselves as positive illusion in self-evaluation. Moreover, they noted that positive illusion would influence individuals' behavior positively. Given the pervasiveness of illusion in individuals' perception, the present study proposes to examine illusion of knowledge, and expects that the more positive illusion people have in their evaluation of knowledge level, the more likely they would change their behaviors in a positive manner. As positive illusion is an important concept in examining illusion of knowledge, this study offers a review of this concept in the next section.

Positive Illusion

When assessing personal attributes, separating reality from illusion is frequently difficult for people (Taylor & Brown, 1988). Instead of making accurate assessments, people tend to hold unrealistic positive views regarding themselves (Alicke, 1985; Taylor & Brown, 1988). In particular, people mostly expect themselves to be better than most others (Alicke, 1985; Brown, 1986). Taylor and Brown defined this phenomenon as a “positive illusion”, and interpreted it as “unrealistic positive views of the self, exaggerated perceptions of personal control, and unrealistic optimism” (p. 193). Voluminous research has suggested that people typically distort perception in self-serving manners, especially when they compare themselves with others. For example, Beauregard and Dunning (2001) examined how people defined self-worth. They found that when people define positive traits, they tend to exhibit better than others perceptions.

A significant body of literature has shown that positive illusion is common, as positive illusion phenomenon has been identified in various types of individual self-evaluation. For example, most individuals are prone to attribute positive instead of negative outcomes toward self (Bradley, 1978; Ross & Fletcher, 1985). When asked to describe the personality of self, normal subjects judged positive attributes to be more overwhelming characteristics of self than negative traits (Alicke, 1985). People use the information in a manner that is most advantageous to self-interest rather than searching for the objective facts (Fiske & Taylor, 1984). They tend to believe that they face a lower risk of experiencing negative events than others (Fontaine & Smith, 1995). Given such self-serving biased perception, people tend to view themselves in more positive terms than they view others (Helgeson & Taylor, 1993; Reed, 1989; Wood, Taylor, & Lichtman, 1985).

Theoretical Explanation for Positive Illusion

Prior studies have offered several explanations for the phenomenon of positive illusion. Among these theoretical explanations, social cognition and social comparison have been applied most frequently in positive illusion research. The social cognition approach offers an interpretation from the cognitive perspective, whereas social comparison approach focuses on motivational and emotional explanations.

Social Cognition Approach

Early studies in social cognition maintained that similar to scientists, individuals monitor and interact rationally with their surroundings (Fischhoff, 1976; Fiske & Taylor, 1984; Nisbett & Ross, 1980). This view asserts that individuals collect data in an unbiased manner, combine them logically, and finally, attain accurate inferences. However, considerable evidence indicates that individuals process information using incomplete data, shortcuts and biases (Fiske & Taylor, 1984; Nisbett & Ross, 1980). Consequently, people distort the reality to a certain extent, from which an illusion can emerge. Stein (1982) designated this phenomenon as an illusion, and referred to it as “a perception that represents what is perceived in a way different from the way it is in reality. An illusion is a mental image or conception which may be a misinterpretation of a real appearance or may be something imagined” (p. 662).

In particular, a significant body of research has indicated that self-serving interpretation plays an important role in social cognition. Heider (1958) emphasized that people tended to select information that would fit their wishes. Fiske and Taylor (1984) noted that, “Instead of a naïve scientists entering the environment in searching of the truth, we find the rather unflattering picture of a charlatan trying to make the data come out in a manner most advantageous to his or her already-held theories” (p. 88). Within social cognition, self-serving bias is frequently interpreted as evidence for flaws in human information search and processing (Taylor & Brown, 1988). In this case, people may develop an overestimation of self. This approach seems suitable for the positive illusion phenomenon, given the positive illusion occurs in individual social cognition of the self and the environment.

Social Comparison Approach

Another possible explanation for positive illusion can be drawn from social comparison theory. An impressive number of self-related biases have been documented in social comparison literature. In particular, positive illusion can be regarded as conceptually similar to the notion of illusory superiority in social comparison literature (Alicke, 1985; Dunning, Meyerowitz, & Holsberg, 1989). In social comparison, the relative overestimation of individual attributes has been considered as illusory superiority (Hooren, 1993). When people estimate their relative positions on a number of personal attributes, they typically report that they possess

positive traits to a higher, and negative traits to a lower, degree than others. Scholars have noted that people typically use illusory superiority to describe personality traits (Alicke, 1985) and ability (Dunning, Meyerowitz, & Holsberg, 1989).

The self-related bias in social comparison has been assumed to occur through a motivational mechanism. In particular, self-enhancement is one of the most likely motives that produce self-related bias (Wood, 1989). Social comparison can incur individuals' desire for self-enhancement, thereby allowing oneself to develop a favorable view of self. Illusory superiority occurs in the process of enhancing self-esteem and subjective well-being. Thus, in social comparison, people are likely to alter their perception so as to maintain or enhance the positive image of themselves. From the rationale of the social comparison approach, positive illusion may be interpreted as a bias in comparative judgment.

The Positive Illusion Model

The term "illusion" refers to a belief that departs from reality. Positive illusion can be generally conceptualized as an inaccurate and overly positive self-perception (Taylor & Brown, 1988). A substantial number of studies have documented this phenomenon (Alicke, 1985; Bradley, 1978; Fiske & Taylor, 1984; Ross & Fletcher, 1985). In the view of these studies, Taylor and Brown (1988) noted that a considerable overlap occurred in the findings, and three factors consistently emerged: unrealistic positive views of the self, exaggerated perceptions of personal control and unrealistic optimism. These scholars regarded the phenomenon of self-serving perception as positive illusion. Instead of using the terms "bias" and "error", Taylor and Brown (1988) used "illusion", which provided a broader interpretation. Compared with bias and error, illusion implies a more general, enduring and systematic pattern of bias in human cognition. They highlighted that positive illusion did not function to alter reality, but merely enabled people to interpret reality in a self-serving manner.

As noted by Taylor and Brown (1988), positive illusion originates from three perspectives. First, it is based largely on the evidence that people consistently regard themselves more positively and less negatively than they regard others. In reality, the idea of people being better than others is logically impossible in most cases. This "better-than-most" effect consistently emerges in social comparison regardless of the closeness of their relationships with objects. People demonstrate the same self-aggrandizing bias when they are making comparison between themselves with a

general other (Brown, 1986; Brown & Gallagher, 1992) and with those who are similar to them (Campbell, 1986; Dunning, Meyerowitz & Holzberg, 1989). This notion suggests the pervasiveness of the positive illusion phenomenon.

Second, positive illusion originates from the illusion of control. Many theory founders from social psychology (e.g., Heider, 1958), social learning theory (e.g., Bandura, 1977), and psychoanalytic theory (e.g., Fenichel, 1945) have highlighted personal control in their works. They maintained that a sense of personal control is an integral part of self-concept, such as self-esteem and self-efficacy. Research evidence shows that individuals' sense of personal control is frequently greater than what is justifiable (Fleming & Darley, 1986; Langer, 1975). In particular, people typically act as if they have control in circumstances that are actually determined by chance.

Finally, Taylor and Brown (1988) proposed that unrealistic optimism also constitutes positive illusion. They asserted that unrealistic optimism is a pervasive phenomenon, given that most people anticipate that their future is more positive than that of most others or more positive than what can be supported by objective base-rate data (Markus & Nurius, 1986), and that their present is better than the past and their future will be even better (Brickman, Coates, & Janoff-Bulman, 1978).

These positive illusions frequently involve important aspects of the self and the surroundings, and therefore cannot be ignored as inconsequential. After documenting the prevalence of positive illusion among general populations, Taylor and Brown (1988) made an examination on the effects of positive illusion. They proposed that the pattern of self-serving perception could contribute to good mental health by promoting positive mood, increasing the ability to care for others, and facilitating intellectual functioning. They argued that positive illusion could indirectly affect mental health by increasing individuals' good feeling, self-esteem, and self-confidence. Taylor and Brown (1988) emphasized that positive illusion would also affect behavior because it could enhance individual motivation, persistence, and performance. They also indicated that individual behavior could be facilitated by positive illusion through the perception that a person would be capable and efficacious.

In summary, the positive illusion model, as outlined by Taylor and Brown (1988), proposes that adjustment varies as a function of the extent to which individuals hold optimistic views regarding themselves. This model is an integrative framework for social cognition that concerns perception of the self and the surroundings. Given the constraints in their ability to search and sort data in a completely unbiased manner,

people find it difficult to accurately estimate self. Instead of creating an objective image of the self, people typically generate a self-serving perception. This positive illusion can potentially generate positive outcomes, such as fostering good mental health, enhancing motivations to engage in productive work, and promoting positive behaviors.

Contemporary Studies of Positive Illusion

Since Taylor and Brown (1988) proposed the model of positive illusion, a large body of research has examined the positive illusion phenomenon. Most of those studies focus on the following aspects: 1) identifying the factors that determine the strength of positive illusion; 2) examining the effects of positive illusion. The following section is a review of the relevant empirical studies in these two aspects.

The Factors that Shape Positive Illusion

With regard to the determinants of positive illusion, Taylor and Brown's work (1988) summarized that the nature of the circumstance may alter the prevalence of positive illusion. In particular, self-enhancing biases are more in evidence as the perceived importance of the issue increase (Miller, 1976). To put it differently, positive illusion is more likely to occur for issues that are important to individuals. Additionally, positive illusion is found to be more obvious when the perceived adversity increases (Greenwald, 1981). In other words, people will present more positive illusion when they perceive more threats.

Research on positive illusion also suggests that goal-directed context may increase the strength of positive illusion. Taylor and Gollwitzer (1995) carried out an experiment to examine the effects of mindset on positive illusion. They induced an implemental mind-set in some participants by asking them to consider how they would plan to resolve a complex project where a course of action had been decided on and there was a determination to achieve the project. In a control condition, no mindset was introduced in the participants. Then all the participants are asked to rate themselves better or worse than the average others of their age on a self-assessment. The findings showed that positive illusion was greater in implemental condition than in the control condition. The results suggested that positive illusion is related to goal-directed actions or consideration of these actions.

Moreover, a number of studies have examined the antecedents of individuals' illusion in knowledge assessment. For example, Epstein, Glenberg and Bradley (1984) examined the effects of text attributes. Specifically, they referred such positive illusion in knowledge assessment as the phenomenon that a reader's self-assessment of comprehension is high while an objective assessment reveals a low comprehension. Through conducting an experiment to manipulate the text conditions, they found that positive illusion occurs when subjects was instructed to find contradictions between sentences, and the phenomenon is more frequent when the contradictory sentences were in separate paragraphs. Afterwards, Commander and Stanwyck (1997) examined the effects of text length on individuals' illusion in knowledge assessment. They found that a short version of the passage is more likely to elicit positive illusion. Besides, Eakin (2005) conducted another experiment to examine illusion in learning activities. In the experiment, subjects were assigned to each group with different semantic cues. The illusion in knowledge assessment was examined in the meta-memory phase during which people predicted their performance on a subsequent recall test. The experiment represented a phenomenon in which people experienced positive illusion such that they were overconfident in their ability to remember information that they subsequently were unable to recall.

From these studies, we can see that most of them concentrated on the effects of text attributes on illusion in knowledge assessment; whereas how individuals interpret the text was largely neglected. How individuals process the texts in their learning activities may also exert influence to their illusion. Besides, those studies merely examined individual factors and did not take into account the social context. As social comparison theory denoted, a comparison with others may potentially trigger the mechanism behind the illusion. Thus, social context should be taken into consideration in the examinations of individuals' illusion in knowledge assessment.

Moreover, most of these studies endeavored to examine individuals' illusion in knowledge assessment in formal learning or education activities; whereas very few studies had shed lights on such illusion in informal learning, such as learning from media. Although formal learning or education can shape some of the individuals' understanding of certain subjects, the contribution of formal learning to individuals' long-term understanding of public agenda is very limited (Falk, Storksdieck, & Dierking, 2007). This is especially true for climate change. As an environmental issue that causes severe impacts to our nature and society, climate change is extensively

publicized in public sphere, in which media plays an important role in cultivating public understanding of it. Besides, media is an important information source for individuals' informal learning (Eveland, 2001; Schmidt et al., 2013). But the examination of media effects on illusion in knowledge assessment is far from adequate.

The Effects of Positive Illusion

As outlined by Taylor and Brown (1998, 1994), positive illusion could bring about good outcomes. Their efforts have initiated a large body of empirical research with an exploration of the effects of positive illusion. Most of these studies have primarily focused on its effects on maintaining and promoting mental health. Others have examined the behavioral component of positive illusion effects.

Taylor and Brown (1988) initially proposed the model of positive illusion to examine its effects on promoting mental health. Early work on mental health asserted that inaccurate self-perception suggested poor mental health (e.g., Jahoda, 1958; Maslow, 1950). However, in reviewing empirical research on mental health, Taylor and Brown (1988) found a substantial amount of evidence that suggested that instead of being associated with maladjustment, self-serving perception was associated with the criteria that indicated mental health, particularly, the ability to feel good about self, to form and maintain relationships, to be content and happy, and to achieve success under pressure. As a challenge to traditional views of mental health, Taylor and Brown (1988) proposed that the mental health of individuals varies with the extent to which they hold optimistic views about themselves. That is, the more that individuals hold positive views about themselves, the better their mental health will be.

A significant body of contemporary research has confirmed the aforementioned notion. In support of this view, Taylor et al. (2003) used multiple measures of self-enhancement along with a measure of mental health to assess the relationship between positive illusion and mental health. They reported that people with positive illusion scored higher in the mental health measure than those without positive illusion. Bonanno, Field, Kovacevic, and Kaltman (2002) examined the effects of positive illusion on mental health in the context of the civil war in Bosnia and premature martial loss. In both studies, self-enhancement served as a buffer against extreme adversity. People with positive illusion exhibited better performances in mental adjustment. By examining normal people instead of those who experiences extreme adversity, Brookings and Serratelli (2006) reported that individuals with

positive illusion demonstrated higher life satisfaction and lower anxiety. In a recent study, Stephan, Caudroit, and Chalabaev (2011) examined the mental health of older adults. They reported that older adults who had a youthful bias were likely to have high self-esteem and good mental health.

In their studies, Taylor and Brown (1988, 1994) briefly introduced that positive illusion could have behavioral effects. After collecting evidence from various sources, they posed that positive illusion could foster motivation, persistence at tasks, and ultimately effective performance. Specifically, they interpreted the effects of positive illusion on behavior in terms of self-enhancing perception, beliefs in personal control, and optimism.

A number of studies have examined the effects of positive illusion on behavior. These studies have indicated that optimistic self-belief is beneficial for individual behavior change because of their operative power that helped set goals, initiate actions, and maintain motivation. For example, Davidson and Prkachin (1997) demonstrated the importance of positive illusion in changing behaviors. They found that unrealistic optimism, i.e., a negation of the relative risk of later health problems, could predict changes in exercise behaviors. Barnoy, Bar-Tal, and Treister (2003) reported that people with optimism bias would more likely engage in the early detection of breast cancer, which suggested that positive illusion would be an influential factor in promoting health behavior. Catina and Iso-Ahola (2004) further examined behavioral effects and suggested that people with positive illusion about self would likely take effective actions and tend to achieve positive behavioral outcomes. They found that positive illusion among competitive athletes was positively associated with their success.

The review of empirical studies on positive illusion reveals that very few studies have examined the phenomenon of positive illusion in knowledge assessment. As the model of positive illusion noted, the illusion that people develop in self-evaluation would have effects on their behaviors. In particular, individuals' positive illusion in self-evaluation could generate positive outcomes, such as maintaining good mental health and enhancing motivation and intention to take effective actions (Taylor & Brown, 1988, 1994). As discussed, illusion of knowledge concerns how people evaluate their own knowledge level.

Thus, on the basis of the positive illusion model, individuals' illusion of knowledge is expected to bring about effects to their behaviors. Specifically, the more positive

illusion of knowledge that people have, the more willing that people will be to perform the relevant behaviors

Summary

This chapter firstly offers an overview of prior studies on media effects in climate change communication. Subsequently, a review of the information deficit model is presented. After a review of the criticism of this model, this study proposes to revisit the information deficit model by improving it. In particular, this study proposes that both actual knowledge and illusion of knowledge should be included in the information deficit model to provide a comprehensive understanding of media effects in promoting behavior change. Next, this chapter describes the conceptual difference between actual knowledge and illusion of knowledge, followed by an in-depth review of two dimensions of illusion of knowledge. The review of prior studies on self-evaluation reveals that people tend to have positive illusion in the evaluation. Thus, this study proposes to employ the concept of positive illusion in the examination of illusion of knowledge. In particular, this chapter provides an in-depth review of positive illusion studies.

The next chapter develops a theoretical framework to examine media effects in climate change communication, aiming to provide an in-depth look into how attention to media messages about climate change contributes to individuals' pro-environmental behavioral intention.

Given the limited number of direct examinations of media effects in climate change communication, this study proposes to examine how attention to media messages about climate change affects individuals' pro-environmental behavioral intention. In particular, information deficit model is one of the most extensively used models to examine media effects. Moreover, this model has underpinned a great number of climate change communication campaigns. Thus, information deficit model is employed as a basis in the examination of media effects in climate change communication. In line with the information deficit model, a great number of prior studies have focused on examining how the attention given by individuals to media regarding environmental issues fosters relevant behavioral intention by increasing their actual knowledge of publicized issues (Arlt, Hoppe, & Wolling, 2011; Sampei & Aoyagi-Usui, 2009; Stamm, Clark, & Eblacas, 2000).

However, the information deficit model has been constantly challenged for its overemphasis on the simple linear process from actual knowledge to behavioral change. In particular, Sturgis and Allum (2004) suggested that other elements of knowledge in addition to factual scientific knowledge should be included in the model to capture the nature of knowledge. Moreover, the information deficit model has been challenged that information provision may not operate in the way the model suggests (Dickson, 2005). For example, a great number of studies have demonstrated that paying attention to media messages not only increase individuals' actual knowledge, but also make them feel that they are becoming more knowledgeable (Mondak, 1995; Park, 2001). In this case, it is expected that information provision affect both actual knowledge and illusion of knowledge, which in turn translate into attitudinal or behavioral change.

Furthermore, previous studies have reported that people make decision not only based on their cognition, but also based on the perception (Araujo, Davids, & Hristovski, 2006; Kim, Ferrin, & Rao, 2008). This suggests that how people evaluate their knowledge levels would also have impacts in changing behaviors. In particular, the positive illusion model suggests that people tend to develop unrealistic positive views toward themselves (Taylor & Brown, 1986). In this case, people would have illusion of knowledge as they overestimate their knowledge level.

Thus, this study posits that both actual knowledge and illusion of knowledge should be included in the information deficit model to provide a comprehensive understanding of media effects in promoting behavioral change.

Regarding illusion of knowledge, this study proposes to examine illusion in both self-perceived knowledge and perceived knowledge differential between self and others. With recognition that comparison with others is an important source of self-evaluation, this study postulates that how people compare their own knowledge level with others' is an important dimension of self-evaluation in addition to self-reported perceived knowledge. Specifically, people would believe they have more knowledge when they perceive that they have more knowledge than others. The greater knowledge differential that people perceive between self and others, the more knowledgeable people would believe they are.

Moreover, prior studies on self-evaluation reveal that people tend to hold biased belief in the comparisons with others, as people are likely to believe they are better than others. Taylor and Brown (1988) defined this better-than-other phenomenon as a form of positive illusion, and suggested that this overly positive perception would yield positive behavioral outcomes. In line with their studies, people are expected to have positive illusion that they are more knowledgeable than others, irrespective of the actual situation. In other words, positive illusion occurs when the perceived knowledge differential between self and others is greater than the actual knowledge differential, and this illusion would play a role in changing behaviors.

Taken together, the information deficit model offers the basis for the examination of media effects in climate change communication. With recognition of the flaws in the original information deficit model, this study extends this model by including illusion of knowledge as an important factor that shapes attitude and behavior change in addition to actual knowledge. In terms of illusion of knowledge, both self-perceived knowledge and perceived knowledge differential between self and others are taken into consideration. The next chapter provides a specific explanation for the hypothesized relationships in the proposed model.

Particularly worth mentioning is that, actual knowledge, illusion of self-reported perceived knowledge, and illusion of perceived knowledge differential between self and others are examined as the main factors in determining pro-environmental behavioral intention in this study. An examination of the distribution of these three knowledge factors among Singaporeans would offer a basis for the

understanding of the role of knowledge in promoting pro-environmental behavioral intention in fighting climate change. To the best of my knowledge, previous studies had not examined the demographic differences in actual knowledge and illusion of knowledge. Moreover, the illusion of perceived knowledge differential between self and others is a relatively new concept, which remains largely unexamined in pro-environmental behavior studies. To bridge these research gaps, this dissertation makes an in-depth examination of demographic differences in these three knowledge factors first before testing the proposed model.

Media Attention and Actual Knowledge of Climate Change

According to the literature reviewed above, information deficit model insists that information provision contributes to public understanding of the publicized issue (Burgess & Harrison, 1998; Eden, 1996; Jackson, 2005; Schultz, 2002). In line with this model, a great number of scholars examined the influences of media attention on cultivating public actual knowledge of a publicized issue. McCombs and Shaw (1972) asserted that media play critical roles in generating knowledge. Attention to media has been advocated as an important factor in determining knowledge acquisition from media (Chaffee & Schleuder, 1986; Drew & Weaver, 1990; McLeod & McDonald, 1985). Schmidt et al. (2013) maintained that people essentially rely on various sources to obtain environmental information and knowledge; among which, media are considered one of the most effective agents in informing the public about climate change and climate policies, given that they are the central interpretative system of modern societies.

Numerous studies have empirically demonstrated that paying attention to environmental issues on media is positively associated with individuals' environmental knowledge (Mazur & Lee, 1993; Nelkin, 1987; Stamm, et al., 2000). For example, Ostman and Parker (1987) reported that newspapers and television were the most frequently used media sources of environmental information by the public. In a study on public understanding of environmental problems, Stamm et al. (2000) asserted that media positively contributed to individuals' factual understanding of climate change. Accordingly, the following hypothesis is proposed:

H1: Individuals' attention to media messages about climate change is positively associated with their actual knowledge of climate change.

Media Attention and Illusion of knowledge of Climate change

Next, we examine the relationship between paying attention to media messages about climate change and illusion of knowledge of this issue. As reviewed in previous chapters, self-reported perceived knowledge and the perceived knowledge differential between self and others are two important dimensions of self-evaluation of knowledge level. Thus, this study examines the effects of media attention illusion of self-reported

perceived knowledge and illusion of perceived knowledge differential between self and others respectively.

Media Attention and Illusion of Self-reported Perceived Knowledge

Despite claiming the importance of media in informing audience, a substantial amount of empirical findings suggest that media could also increase audiences' perceived knowledge (Mondak, 1995; Park, 2001). In particular, it is found that new media exposure may not increase actual knowledge as much as it might enhance the impression of one's knowledge.

For example, in the 1992 presidential campaign, nontraditional news coverage, such as talk show and late night television programs, emerged as a major factor in political communication. Holland (1995) examined the effects of watching these television programs on citizens' political knowledge, and reported that media exposure had a stronger correlation with self-perceived knowledge than with actual knowledge. Also, Mondak (1995) found that attention to local newspaper did not contribute to actual knowledge of politics, but enhanced self-perceived knowledge.

Moreover, the cognitive miser model posits that people are cognitive misers who tend to use a minimal amount of effort to make judgment (Fiske & Taylor, 1991). In line with this model, it is expected that people are more likely to evaluate their level of knowledge by taking self-perceived knowledge as a heuristic cue, rather than making cognitive efforts in the evaluation. Self-perceived knowledge reflects how people monitor their own knowledge (Park, 2001). Based on familiarity with an issue, feeling knowledgeable does not necessarily imply any concrete knowledge. Thereby a substantial discrepancy between actual and perceived knowledge would develop, which results in illusion of self-perceived knowledge.

As media exposure increases, audience may increasingly recognize frequently portrayed events as familiar, without necessarily obtaining knowledge. Consequently, people who use the media more frequently would develop illusion of knowledge about the publicized issue, as compared to those who use the media less frequently. Thus, the following hypothesis is posited:.

H2: Individuals' attention to media messages about climate change has an influence on their illusion of self-perceived, in which the more attention that individuals pay to media messages, the more positive illusion they will develop in their self-perceived knowledge.

Media Attention and Illusion of Perceived Knowledge Differential between Self and Others

Second, the effects of media attention on perceived knowledge differential between self and others are examined. As the literature reviewed above, people are not only overconfident in making self-assessment, but may also demonstrate self-enhancement bias when comparing between self and others. Taylor and Brown (1988) indicated that most people would rate desirable attributes to be more descriptive of themselves than of others. In particular, self-enhancement bias plays an important role in media effects on self-evaluation (Davison, 1983). For example, the third-person perceptions indicate that people are driven to enhance a positive self-image after their exposure to media messages (Gunther & Mundy, 1993). Stronger evidence is provided by the first-person perception, which notes that people tend to believe that they are more influenced by socially desirable messages than others (Duck, Terry, & Hogg, 1995). These studies suggest that people tend to apply a self-serving bias in interpreting media effects on self and others. In particular, people would believe that they are more likely to be positively affected by media as compared to others.

With regard to media effects on individual evaluation of knowledge differential between self and others, a similar self-enhancement bias is expected. Consuming media messages increases audiences' familiarity with the publicized events (Slater & Rasinski, 2005). The nature of media coverage on climate change is informational, educational, and beneficial to the receivers. Learning about climate change is regarded as a socially desirable conduct. People are motivated to maintain or enhance their positive self-image in social comparison with others due to the self-enhancement bias (Brown, 1986; Krueger, 1998). In this case, people tend to believe that they would learn more about climate change issue from media than others do.

Regarding climate change issue, prior studies have demonstrated that media attention would increase one's perceived knowledge about this phenomenon (Zhao, 2009). The more attention that individuals pay to media messages on climate change, the more likely they believe that they are becoming knowledgeable of this issue. Given that people tend to apply self-serving bias in their perception of media effects on self and others, they will believe that they have learned more from media than others. Such belief would lead to an illusory superiority in the knowledge comparison between self and others. In this case, the more attention individuals pay to media messages on

climate change, the more positive illusion that they will develop in the perceived knowledge differential between self and others regarding this issue. Therefore, the following hypothesis is proposed:

H3: Individuals' attention to media messages about climate change has an influence on their illusion of perceived knowledge differential between self and others, in which the more attention that individuals pay to media messages, the more positive illusion they will develop in the perceived knowledge differential between self and others.

Knowledge and Pro-environmental Behavioral Intention

Before examining the relationship between knowledge and pro-environmental behavioral intention, the nature of pro-environmental behavior in the context of climate change is first highlighted. Early research on pro-environmental behaviors presumed such behavior to be one-dimensional action without making a specific classification. Recently, different types of pro-environmental behavior have become apparent. In particular, private- and public-sphere behaviors have been highlighted (Stern, 2000; Zald, 1992).

Private-sphere behavior involves personal actions of an individual, such as consuming environment-friendly products and services (e.g., taking public transportation, purchasing recycled products), and conserving environmentally important goods (e.g., home heating and cooling systems). An important feature of pro-environmental behaviors in private sphere is that they have direct environmental consequences (Stern, 2000). The impacts of these behaviors, however, are small. The aggregate effects of such individual behaviors can only be achieved when many people independently perform the same behaviors (Kilbourne & Pickett, 2008).

Public-sphere behavior focuses on environmental citizenship, such as signing petitions for environmental issues, and joining and contributing to environmental organizations. Unlike pro-environmental behaviors in private sphere, pro-environmental behaviors in public sphere mostly affect the environment indirectly by influencing public policies (Stern, 2000). The effects of pro-environmental behaviors in public sphere may be very significant, as public policies can change the behaviors of many people and organizations at once (Kilbourne & Pickett, 2008).

As reviewed, alleviating climate change effects is a public good (Aldy, Orszag, & Stiglitz, 2011). There are various scales and actors involved in the alleviation of climate change (Adger, 2003). Some types of actions are to be undertaken by

individuals, while others are to be undertaken by the relevant stakeholders (e.g. governments, enterprise, and environmental organizations). In this case, people should not only perform the private-sphere pro-environmental behaviors to mitigate the climate change effects individually, but should perform the public sphere pro-environmental behaviors to prompt the relevant stakeholders to cope with climate change collectively. For example, people could engage in the pro-environmental behaviors in public sphere, such as petitioning on environmental issues to influence the policy-making, which would exert significant impacts in the alleviation of climate change. However, prior environmental behavior studies mostly focus on promoting individuals' pro-environmental behaviors in private sphere (Finger, 1994; Kollmuss & Agyeman, 2002; Laroche, Bergeron, & Barbaro-Forleo, 2001; Mainieri et al., 1997). Aiming to provide a comprehensive understanding of media effects on pro-environmental behaviors in fighting climate change, this research proposes to examine pro-environmental behaviors in both private sphere and public sphere. Specifically, this study would examine both direct and indirect effects of knowledge on pro-environmental behavioral intention.

Direct Effects of Knowledge on Pro-environmental Behavioral Intention

A huge number of studies have examined the direct effects of actual knowledge on individuals' behavior, and reported a very weak link between them (Macnaghten & Jacobs 1997; Owens 2000). Besides, a certain number of studies reported that actual knowledge had no direct influence on behavioral change (Harrigan & Curley, 2010; Jaeger et al., 1993). Given those mixed findings, this study proposes to reexamine the relationship between actual knowledge and pro-environmental behavioral intention.

Though a few studies have investigated the effects of illusion of knowledge on behavior change, they merely examined the dimension of illusion of self-perceived knowledge, whereas the effects of illusion of perceived knowledge differential remains largely unexamined. Thus, to obtain a comprehensive understanding of their relationship, this study proposes to explore whether there is direct relationship between illusion of knowledge and pro-environmental behavioral intention.

In particular, the research questions concerning the direct effects of knowledge on pro-environmental behavior intention are proposed as following:

RQ1: *Is there a direct relationship between individuals' actual knowledge about climate change and their pro-environmental behavioral intention?*

RQ2: *Is there a direct relationship between individuals' illusion of self-perceived knowledge about climate change and their pro-environmental behavioral intention?*

RQ3: *Is there a direct relationship between individuals' illusion of perceived knowledge differential and their pro-environmental behavioral intention?*

Indirect Effect of Knowledge on Pro-environmental Behavioral Intention Knowledge of Climate Change and Attitude toward Pro-environmental Behaviors

Attitude toward behavior refers to the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in questions. The relationship between knowledge and attitude toward behavior has been extensively examined in prior research (Madden, Ellen, & Ajzen, 1992; Shepherd & Towler, 1992).

Actual Knowledge and Attitude. Actual knowledge about a certain issue is demonstrated to be positively associated with a positive attitude toward performing the relevant behaviors. For example, Fishbein et al. (1993) found that actual knowledge about AIDS was positively associated with attitude toward performing prevention practices. The positive relationship between knowledge and attitude toward certain behavior has also been confirmed in environmental behavior studies. For example, Kuhlemeier et al. (1999) found that factual knowledge of environmental issues was positively associated with individuals' attitude toward pro-environmental behaviors.

Accordingly, the present study expects a positive relationship between actual knowledge of climate change and attitude toward pro-environmental behavior. In particular, the more actual knowledge people have of climate change, the more likely they will be aware of its threats. In this case, people will be more likely to believe that it is worthy to execute actions to mitigate climate change. Moreover, people with actual knowledge of climate change tend to know which action to take in coping with climate change. Compared with people who have less knowledge of climate change, those who are more knowledgeable about this issue are more likely to determine how they can address problems caused by climate change, and thus, to alleviate this phenomenon. Thus, people with more actual knowledge of climate change are more

likely to find pro-environmental behavior easy to perform. Therefore, the following hypothesis concerning the relationship between actual knowledge of climate change and attitude toward pro-environmental behavior is postulated:

H4: Individuals' actual knowledge about climate change is positively associated with their attitudes toward pro-environmental behaviors.

Illusion of Knowledge and Attitude. Prior studies have documented that individuals' confidence about self's understanding of a certain issue will affect attitude toward the issue (Davies, 2000; Rohaan, Taconis, & Jochems, 2010). In particular, high confidence in self-evaluation will increase positive attitude. For example, Davies (2000) found that teachers with low confidence about their understanding of technology felt frustrated about upgrading their skills, which increased their negative attitude toward adopting technology. Accordingly, this research expects that people who are confident about their understanding of climate change would develop positive attitudes toward pro-environmental behaviors in addressing this issue. As positive illusion occurs when people have over-confidence in self-evaluation, it is possible that the more positive illusion that people have in the evaluation of their knowledge level, the more positive attitude they will develop toward the relevant issue.

As the positive illusion model implies, people tend to exhibit optimism bias and overconfidence in self-assessment (Taylor & Brown, 1988). Furthermore, prior research reported that individuals' overconfidence would make them feel that it is easy to execute the relevant actions (Ortoleva & Snowberg, 2015). In line with these findings, this study expects that people who exhibit illusory superiority when comparing knowledge between self and others tend to demonstrate overconfidence in solving problems, and this overconfidence would lead them to develop positive attitudes that are conducive to solving problems.

Moreover, a number of studies on metacognition have revealed that how people evaluate their thoughts matters in the process of attitude and behavior change. For example, the research on human memory found that the stronger one's feeling of knowledge about an issue, the more time one is willing to spend searching for the issue before giving up (Koriat & Goldsmith, 1996; Nelson & Narens, 1990). This suggests that illusion of knowledge would have effects in attitude change. In particular, prior research has highlighted that feeling of knowing about environmental issues would increase individual internal attribution of responsibility (Aertsens et al., 2011;

Bamberg & Moser, 2007). Ellen (1994) found that feeling of knowing is positively related to one's commitment to environmental friendly behaviors, such as recycling materials and conserving energy. In the field of pro-environmental behaviors, the perceived understanding of an individual will trigger guilty feelings of harmful behaviors (Bamberg & Moser, 2007). Such feelings of guilt will increase individual responsibility and perceived importance to protect the environment. With the appreciation of the importance and benefits of certain behavior, people tend to develop positive attitudes toward it (Ajzen, 1991). Accordingly, the present study expects that individuals' feeling that they know much more about climate change than others may increase the sense of responsibility to mitigate the climate change effects, which in turn, promote their positive attitude toward addressing the problems.

Thus, the following hypothesis is presented:

H5: Individuals' illusion of self-perceived knowledge about climate change is positively associated with their attitudes toward pro-environmental behaviors, in which the more positive illusion that individuals have in self-perceived knowledge, the more positive attitude they will develop.

H6: Individuals' illusion of perceived climate change knowledge differential between self and others has an influence on their attitude toward pro-environmental behaviors, in which the more positive illusion that individuals have in perceived knowledge differential, the more positive attitude they will develop.

Attitude toward Behaviors and Pro-environmental Behavioral Intention

In terms of the determinants of behavioral change, attitude toward behaviors has long been recognized as a powerful factor in shaping one's behaviors. Ajzen (1991) asserted that attitude toward behavior refers to "the degree to which one has a favorable or unfavorable evaluation or appraisal of the behavior in question" (p.188). In general, a favorable attitude with respect to a certain behavior should enhance the intention of an individual to engage in this behavior (Ajzen, 1991). This assumption has been supported by empirical evidence (Clark, Kotchen, & Moore, 2003; Fujii, 2006; Kaiser, 1996; Sia, Hungerford, & Tomera, 1986). Moreover, a significant body of research has demonstrated that attitude toward pro-environmental behavior is a strong predictor of individuals' pro-environmental behavioral intention (Bamberg & Möser, 2007; Fielding, McDonald, & Louis, 2008; Whitmarsh & O'Neill, 2010).

On the basis of the findings of previous studies, the current research expects that in the context of climate change, people with favorable attitudes toward coping with this issue are likely to perceive that performing relevant behaviors is enjoyable, beneficial, important and worthwhile. In this case, they will be willing to engage in pro-environmental behaviors in both private and public spheres. Accordingly, the following hypotheses are proposed:

H7: Individuals' attitudes toward pro-environmental behaviors are positively associated with their intention to engage in (a) private-sphere pro-environmental behaviors and (b) public-sphere pro-environmental behaviors.

Figure 1. The hypothesized model

CHAPTER FIVE METHODOLOGY

Data Collection

This research adopted a door-to-door survey in Singapore. The latest report on resident households by type of dwelling in Singapore indicates that 81.9% of households live in housing development board (HDB) blocks (Singapore Department of Statistics, 2014), which cover the majority of Singaporean citizens and permanent residents. Thus, this research project included a sample of residents from HDB blocks.

The target sample size was 750 respondents. A group of fifteen interviewers were recruited and trained for the survey. To ensure the consistency in the selection of respondents from each HDB block, the interviewers were asked to visit the lowest, middle and highest floors of each HDB block. Then, interviewers were required to survey two households from each floor, namely, the nearest and farthest households from the elevator. In this manner, six households were selected from each HDB block. As required, one family member from each household was asked to complete the survey. Thus, the interviewers had to interview six respondents from each HDB block¹. Given this setup, a number of 125 HDB blocks were included in this research to achieve the target sample size of 750 respondents.

To achieve a sample that is close to a representative sample of Singaporeans, the stratified sampling procedure was performed to select 750 respondents from 125 HDB blocks. As a city-state, Singapore is divided into 82 districts based on postcodes. Among these, only 24 districts have HDB block buildings. Thus, the 24 residential districts were included in the sampling in this research. However, each residential district has a distinctive number of HDB blocks. In statistical surveys, when subpopulations within an overall population vary, it is advantageous to sample each subpopulation independently. Given this, the stratified sampling technique was employed to select HDB blocks from each district in this research.

In the stratified sampling, the sample size of each stratum is taken in proportion to the size of the stratum. Given that each district has a distinctive number of HDB blocks, using the stratified sampling technique will provide better precision than a simple random sampling technique. Specifically, to randomly select HDB blocks from the districts, I first collected the postcodes for all the HDB blocks. A

¹If the designated residents refuse to complete the survey, interviewers will go to next-door household or nearby floor till they get a total number of six respondents from each HDB block.

specific number of HDB blocks were randomly chosen from each district based on the proportion of the number of HDB blocks in each district to the number of HDB blocks nation-wide.

To ensure that all the respondents have a consistent understanding of the survey questions, an instruction on how to conduct the survey was provided to the interviewers. This process ensured that when the respondents had certain issues regarding the survey, the interviewers would be able to provide a consistent explanation. To maximize the response rate, the interviews were conducted in either English or Mandarin. This survey used the next birthday technique to randomly select respondents from each household. This technique has been extensively applied in social research, and has been demonstrated to be effective in obtaining randomly representative samples (Link et al., 2008; O'Rourke & Blair, 1983).

Finally, this research project obtained a valid sample of 705 respondents. The respondents aged between 21 and 84 years old ($Mdn = 40$, $M = 41.73$, $SD = 14.83$). For gender, 54.5% of the respondents were female. The median monthly household income ranged from S\$3,001 to S\$4,000. The response rate was 46.6 % based on AAPOR formula 3. The margin of error was approximately $\pm 3\%$ at the 95% confidence level. The age, gender distribution, and education, and household income of the sample were comparable with those of the general population.²

Measurement

Control Variables

Demographic items were used as controlled variables, including age ($Mdn = 40$, $M = 41.73$, $SD = 14.83$), gender (54.5% of the respondents were female), education (ranged from “1” = “No formal education” to “9” = “Postgraduate,” $Mdn = 7$, $SD = 2.02$), and monthly household income (ranged from “1” = “SGD 1,000 and below” to “13” = “above SGD 12,000,” $Mdn = 4$, $M = 5.01$, $SD = 3.22$).

Attention Paid to Media Messages about Climate Change

²Our sample demographics are similar in terms of age and gender distribution to the characteristics of the 2010 Singapore population census (DOS, 2011). The median age in our sample was 40 years as compared to 37.4 years in the census. In our sample, 54.5% of the respondents were female while 50.6% were female in the census. Education and household income variables exhibited several differences. The median education level attained in the census was secondary education, whereas that of our respondents was “Diploma”. The median household income reported in the Singapore census was \$5000, whereas that of our respondents was “\$3001-to \$4000”. These differences are not of major concern because they were regarded as control variables in this study.

Individuals' attention to media messages about climate change was measured using items adopted from previous studies (Chaffee & Schleuder, 1986; Liao, Ho, & Yang, 2016). Respondents were asked to indicate how much attention (1 = *no attention at all*, 7 = *very close attention*) they paid to pro-environmental and environmental crisis messages related to climate change in four media channels: newspapers (including print and digital edition), television, the Internet, and social media³ (Cronbach's $\alpha = .82$).

Actual Knowledge of Climate Change

For actual knowledge, this research project used 12 items adapted from previous studies regarding knowledge about climate change (Dijkstra & Goedhart, 2012; Hart, Nisbet, & Myers, 2015). The respondents were asked to answer if the given statements were "1 = true," "2 = "false," "0 = don't know." The statements were as follows: (a) "The hole in the ozone layer is the primary cause of global warming. (F)," (b) "The average temperature of the Earth has increased significantly in the last 100 years. (T)," (c) "China is the largest emitter of carbon dioxide (the greenhouse gas that has been linked to global warming) in the world. (T)," and (d) "The output from the Sun contributes to global warming more than greenhouse gases produced by people. (F)," (e) "Reducing human emissions of greenhouse gases will have an immediate effect on global warming with average global temperatures dropping in just a few years. (F)," (f) "Climate change is happening, and is mostly caused by human activities. (T)," (g) "Climate change is only defined as the rising of temperature of the earth's surface. (F)," (h) "Climate change is partly caused by the increase in the emission of heavy metals. (T)," (i) "Rise in sea level and drought are some of the consequences of climate change. (T)," (j) "The ocean can absorb CO₂ emitted by humans. (T)," (k) "Because of climate change, the water in sea and oceans will expand. (T)," (l) "Because of climate change, certain plants and animals may become extinct. (T)." "T" or "F" indicates the correct answer to the statements. The average score of the twelve responses was computed as the measurement for actual knowledge ($M = .55$, $SD = .20$, $KR-20 = .60$).

³In this research project, information about climate change on the Internet and social media refers to all the information except for news coverage about climate change on newspapers and television, and television programs about climate change. During the survey, the interviewers were required to explain this point to the respondents. Moreover, interviewers are required to provide examples of social media platforms, which would make it easy for the respondents to differentiate the Internet from social media.

Illusion of Self-Perceived Knowledge of Climate Change

Illusion of self-perceived knowledge represents the gap between individuals' actual knowledge level and their perceived knowledge level (Park, 2001; Weber & Koehler, 2017). Accordingly, the score of perceived knowledge was subtracted from the score of the actual knowledge to measure illusion of self-perceived knowledge. In particular, positive illusion of self-perceived knowledge refers to the case in which the perceived knowledge level is greater than the actual knowledge level.

To measure the illusion of self-perceived knowledge, this research calculated the scores for individuals' actual knowledge level and perceived knowledge level. For perceived knowledge, respondents were asked to rate how much do they think they currently know about climate change using a 10-point scale (0 = knowing nothing and 10 = knowing everything). As described above, the average score of the twelve responses was computed as the measurement for actual knowledge, which represents the percentage of correct answers that people have for all the twelve items. As actual knowledge and perceived knowledge were measured using different scale, a transformation of the measurements has to be done before performing the subtraction. Thus, the score for perceived knowledge was transformed into percentage. Finally the scores for actual knowledge were subtracted from perceived self's knowledge to measure illusion of self's perceived knowledge. ($M = .02$, $SD = .22$)

Illusion of Perceived Climate Change Knowledge Differential between Self and Others

Illusion represents what is perceived in a manner different from the way it is in reality (Stein, 1982, Taylor & Brown, 1988). From this definition, illusion of perceived knowledge differential is conceptualized as the situation in which individuals' perception of knowledge differential between self and others does not reflect the actual knowledge differential. In particular, positive illusion in perceived knowledge differential refers to the case in which the perceived knowledge differential between self and others is greater than the actual knowledge differential between self and others.

To measure illusion of perceived knowledge differential between self and others, this research calculated the scores for perceived knowledge differential and actual knowledge differential respectively. Specifically, perceived knowledge differential between self and other is operationalized as the subtraction of perceived others' knowledge from perceived self-knowledge. The same as the measurement for

self-reported perceived knowledge of climate change, the measurement for perceived climate change knowledge of others was adapted from a previous study (Milfont, 2012). For perceived others' knowledge, the respondents were asked to rate how much they think other people currently know about climate change using a 10-point scale (0 = knowing nothing, 10 = knowing everything). Then the score of perceived self's knowledge was subtracted from the score of perceived others' knowledge to measure illusion of perceived knowledge differential between self and others.

Actual knowledge differential between self and other is operationalized as the subtraction of others' actual knowledge from each respondent's actual knowledge. As indicated above, to measure actual knowledge, respondents were asked to answer 12 questions concerning the facts of climate change issue. Then, the mean value of all respondents' actual knowledge in the sample of this study was calculated to denote others' actual knowledge score.

Illusion of perceived knowledge differential between self and others were calculated by subtracting actual knowledge differential from perceived knowledge differential between self and others⁴. The measurement for illusion of perceived knowledge differential between self and others is a continuum of score. In particular, a positive number indicates positive illusion in perceived knowledge differential between self and others, a negative number denotes negative illusion, and a zero value indicates no illusion ($M = .08$, $SD = .22$).

Attitude toward Pro-environmental Behaviors

To measure the attitude toward pro-environmental behaviors, seven items were adapted from prior research (Cordano & Frieze, 2000). Respondents were asked to indicate their agreement with the following statements on a scale from 1 (strongly disagree) to 7 (strongly agree): "I think that engaging in pro-environmental behavior is (a) enjoyable, (b) beneficial, (c) important, (d) worthwhile, (e) easy, (f) compatible

⁴ In the survey, perceived knowledge differential and actual knowledge differential were measured using different scales. Thus, this study made a transformation of these measurements. In particular, the percentage of perceived knowledge was calculated. Also, by averaging the responses to 12 items, the score for actual knowledge in this study is transformed into percentage. In this manner, the measurements for perceived knowledge and actual knowledge are on the same scale. Then, the percentage of actual knowledge differential was subtracted from the percentage of perceived knowledge differential score to measure the illusion. Thus, the measurement of illusion of perceived knowledge differential between self and others should be a continuum of score.

with my lifestyle, and (g) satisfying”. A higher average score indicates a more positive attitude toward pro-environmental behavior (Cronbach’s $\alpha = .87$).

Private-sphere Pro-environmental Behavioral Intention

Six items were adopted from prior studies to measure private-sphere pro-environmental behavioral intention (Chen, 2015; Homburg & Stolberg, 2006). Respondents were asked to indicate their agreement with the following statements on a scale from 1 (strongly disagree) to 7 (strongly agree): (a) “I intend to buy products in a refillable packages in the next six months,” (b) “When cooking I would use a lid to cover the pot or pan to avoid wasting energy in the next six months,” and (c) “I would buy products which come with minimal packaging in the next six months,” (d) “I would buy paper and plastic products that are made from recycled materials in the next six months,” (e) “I would use energy-efficient household devices in the next six months,” and (f) “I would recycle used paper and plastic in the next six months”(Cronbach’s $\alpha = .89$).

Public-sphere Pro-environmental Behavioral Intention

The items used to measure individuals’ intention to engage in public-sphere pro-environmental behaviors were adopted from previous studies (Chen, 2015; Homburg & Stolberg, 2006). Respondents were asked to indicate their agreement with the following statement on a scale from 1 (strongly disagree) to 7 (strongly agree): (a) “I would sign a petition in support of promoting the environment in the next six months,” (b) “I would try to convince others of the importance of environmental protection in the next six months,” (c) “I intend to consider together with others how we can protect environment in the next six months,” and (d) “I would contribute money to support an environmental group or organization in the next six months”(Cronbach’s $\alpha = .87$;).

Analytical Approach

Before testing the proposed research questions and hypotheses, this study provided an overview of actual knowledge, illusion of self-perceived knowledge, and illusion of perceived knowledge differential across different demographic groups. A series of independent sample T tests was conducted to compare the knowledge means of different demographic groups to determine whether there is statistical evidence that

the associated populations means are significantly different. Then, to answer the proposed research questions and hypotheses, structural equation modeling (SEM) analysis was performed to make an examination of media effects on pro-environmental behavioral intention through the paths of actual knowledge and illusion of knowledge.

Independent Sample T-test

Firstly, a set of independent sample T-tests was conducted to compare whether actual knowledge of climate change was significantly different across different age, gender, education, and income groups. Then, another two sets of T-tests were conducted for illusion of knowledge.

Structural equation modeling (SEM) analysis

Firstly, I replicated the original information deficit model and tested it using structural equation modeling (SEM), with maximum likelihood estimation in *Mplus 6* (Muthén & Muthén, 2012). Then, the hypothesized model concerning media effects on pro-environmental behavioral intention through the paths of actual knowledge and illusion of knowledge was tested using SEM. Following a two-step analytical approach, we first estimated measurement model using confirmatory factor analysis (CFA) and then tested the structural equation models (Anderson & Gerbing, 1988). Specifically, CFA was conducted first to validate the measurement components, which provided foundation for structural model testing. Then, we replaced the correlations between latent variables with the hypothesized causal relationships and tested the structural model. In the hypothesized model, age, gender, household income, and education were included as control variables.

Model fit was evaluated using the following goodness-of-fit indices: the maximum likelihood chi-square (χ^2), relative chi-square (χ^2/df), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and the root mean square error of approximation (RMSEA). A small ratio χ^2/df indicates a good model fit. A ratio of between 1 and 5 is acceptable (Wheaton et al., 1977). TLI over .90 and CFI exceeds .90 are considered acceptable (Hu & Bentler, 1999). RMSEA value less than .05 indicates good fit (Hu & Bentler, 1999).

CHAPTER SIX AN ANALYSIS OF ACTUAL KNOWLEDGE AND ILLUSION OF KNOWLEDGE ACROSS DIFFERENT DEMOGRAPHIC GROUPS

As the literature reviewed above, actual knowledge and illusion of knowledge should be included in the information deficit model to examine media effects in climate change communication. In terms of illusion of knowledge, self-perceived knowledge, and perceived knowledge differential between self and others should be taken into account. To the best of my knowledge, very few studies have examined demographic difference in actual knowledge, and illusion of knowledge. In particular, perceived knowledge differential between self and others remains largely unexamined. To fill in this research gap, an overview of these types of knowledge across different demographic groups is reported as following. Table 1 summarized the basic statistics of the demographic variables and knowledge variables.

Table 1. Summary of Statistics of the Demographic and Knowledge Variables

Variable	N	Min	Max	Median	<i>Mean</i>	<i>SD</i>	Measurement
							scale
Gender	705	1	2	-	-	.50	1 ~ 2
Age	705	21	84	40	-	14.83	21 ~ 84
Education	705	1	9	7	-	2.02	1~9
Household Income	705	1	13	4.00	5.06	3.22	1 ~ 13
Actual Knowledge ⁵	705	0	1	.58	.55	.20	0-1
Illusion of Self-Perceived Knowledge	705	-.82	.82	.02	.02	.22	-1~1
Illusion of Perceived Knowledge Differential between Self and Others	705	-.87	.85	.06	.07	.22	-1 ~ 1

⁵ Actual knowledge was measured using multiple items and averaged to form composite index. The mean value of actual knowledge is that of the index of combined items.

Gender Difference

Studies in education have identified gender as one of the factors affect science literacy learning. Specifically, reports of gender differences on science literacy in favor of males have been found across different countries (Chao & Wei, 2009; Feingold, 1993; Lubinski & Humphreys, 1990). Furthermore, international assessments indicate that gender effects for science achievement in favor of males are pervasive (Beller & Gafni, 1996). Specifically, McCright (2010) examined gender effects on climate change knowledge, and found that men tend to have more factual knowledge of climate change as compared to women. However, most previous studies focus on gender differences in actual knowledge, whereas the gender effects in illusion of knowledge remain largely unexamined. Besides, very few studies have examined gender difference in knowledge of climate change in Singapore. Thus, this study made an in-depth examination of the gender effects in climate change knowledge.

A series of independent sample t-test was conducted to examine gender differences in actual knowledge, illusion of self-perceived knowledge, and illusion of perceived knowledge differential. Of the respondents in this study ($N=705$), 54.5% were female ($N= 384$), 45.5% were male ($N=321$).

Gender Difference in Actual Knowledge of Climate Change

The t-test results showed that there was a significant difference in the scores for the females ($M= .53$, $SD = .19$) and the males ($M= .57$, $SD= .20$); $t(703)= 2.25$, $p< .05$. These results suggest that gender difference does have an effect on actual knowledge of climate change. In particular, the results suggest that the males are more knowledgeable of climate change than the females. The sample means are displayed in Figure 2.

Figure 2. Mean Levels of Actual Knowledge of Climate Change for Females and Males (Significant Differences Observed)

Gender Difference in Illusion of Self-Perceived Knowledge of Climate Change

Regarding the gender difference in illusion of self-perceived knowledge of climate change, the results showed that there was no significant difference in the scores for the females ($M = .03$, $SD = .22$) and the males ($M = .01$, $SD = .21$); $t(703) = -.90$, $p = .37$. This suggests that the illusion of self-perceived knowledge of the females were quite similar to that of the males. The sample means are presented in Figure 3.

Figure 3. Mean Levels of Illusion of Self-Perceived Knowledge of Climate Change for Females and Males (Nonsignificant Differences Observed)

Gender Difference in Illusion of Perceived Knowledge Differential between Self and Others

In terms of the gender difference in illusion of perceived knowledge differential between self and others, the analysis failed to reveal a significant difference between the females and the males, $t(703) = -1.56, p = .12$. The results suggest that the level of female's illusions of perceived knowledge differential ($M = .09, SD = .22$) were similar to the level of the males ($M = .06, SD = .21$). The sample means are presented in Figure 4.

Figure 4. Mean Levels of Illusion of Perceived Knowledge Differential between Self and Others for Females and Males (Non-significant Differences Observed)

The above analyses show that gender differences exist in actual knowledge but not in illusion of knowledge. This is consistent with previous studies, which reported that the males tend to perform better in science literacy achievement (Beller & Gafni, 1996; Feingold, 1996; Lubinski & Humphreys, 1990). Prior studies on gender differences in science knowledge noted that the gender differences first emerge in middle school (e.g., Catsambis, 1995), increase during high school (e.g., Miller, Blessing, & Schwartz, 2006), and persist throughout the college years and beyond (e.g., Etkowitz, Kemelgor, & Uzzi, 2000). These differences lead to women talking fewer about science than men (COSEPUP, 2007). The cumulative effect of these dynamics is that men, on average, tend to be more interested in science topics and demonstrate greater science knowledge than do women (e.g., Hayes, 2001; Miller, 2007). Moreover, Gendall and Smith (1995) compared environmental knowledge

between men and women, and found that men tended to have more knowledge than women. In a recent study, Briggs et al., (2003) also found that men had higher levels of environmental knowledge. In accordance with these studies, men would exhibit more actual knowledge about climate change as compared to women.

Age Difference

A number of studies have analyzed how socio-demographic factors are related to knowledge (Arcury, Johnson, & Scollay, 1986; Suki, 2013). In particular, age has been explored by a number of scholars (e.g., Aaker & Bagozzi, 1982; Hume et al., 1989; Roberts, 1996; Zimmer, Stafford, & Stafford, 1994). There is a general belief that the young people tend to be more sensitive to environmental issues. In line with this belief, many studies reported a significant and negative relationship between age and environmental sensitivity (e.g. Anderson, Henion, & Cox, 1974; Van Liere & Dunlap, 1981; Zimmer et al., 1994). Moreover, in a study on consumers' environmental knowledge and ecological behavior, Suki (2013) found that age was negatively correlated with environmental knowledge. Accordingly, age is an important correlates to environmental knowledge. However, very few studies have examined the relationship between age and knowledge of climate change. Given that climate change is an urgent issue that needs the whole society to work together to address, having an overview of the knowledge level among different age groups would be helpful for the relevant authorities to develop effective campaigns to the targeted population. Thus, this study made an in-depth examination of age effects in climate change knowledge.

Specifically, a series of independent sample t-test was conducted to examine age differences in actual knowledge and illusion of knowledge. Given the belief that young people are more sensitive to environmental issues (Straughan & Roberts, 1999), the respondents in this study were categorized into two groups, which include the young people, and the middle-aged and elderly. Based on the age stratification in Singapore, the young people are defined as adults below 40, and the middle-aged and elderly are defined as individuals above 40 (Lim, 2016). Of the respondents in this study ($N=705$), 52.1% were young people ($N= 367$), 47.9% were middle-aged and elderly ($N= 338$).

Age Difference in Actual Knowledge of Climate Change

With regard to the age difference in actual knowledge of climate change, the analysis revealed a significant difference between the young people, and the middle aged and elderly, $t(703) = 5.51, p < .001$. The sample means are displayed in Figure 5, which shows that the young people score significantly higher on actual knowledge of climate change than the middle aged and elderly (for young people, $M = .59, SD = .19$; for the middle aged and elderly, $M = .51, SD = .20$). These results suggest that age really does have an effect on actual knowledge of climate change.

Figure 5. Mean Levels of Actual Knowledge of Climate Change for Young People and Middle-aged and Elderly (Significant Differences Observed)

Age Difference in Illusion of Self-Perceived Knowledge of Climate Change

The t-test results showed that there was a significant difference in illusion of self-perceived knowledge scores for the young people ($M = -.01, SD = .22$) and the middle aged and elderly ($M = .05, SD = .22$); $t(703) = -3.15, p < .01$. These results suggest that the middle aged and elderly are more likely to have positive illusion of self-perceived knowledge of climate change. The sample means are displayed in Figure 6.

Figure 6. Mean Levels of Illusion of Self-Perceived Knowledge of Climate Change for Young People and Middle-aged and Elderly (Significant Differences Observed)

Age Difference in Illusion of Perceived Knowledge Differential between Self and Others

The analysis of illusion of perceived knowledge differential between self and others also revealed a significant difference between the young people, and the middle aged and elderly, $t(703) = -2.73, p < .01$. The sample means are displayed in Figure 7. Specifically, the middle aged and elderly scored significantly higher on positive illusion of perceived knowledge differential than the young people (for young people, $M = .06, SD = .22$; for the middle aged and elderly, $M = .10, SD = .21$). The results show that age does have an effect on illusion of perceived knowledge differential between self and others.

Figure 7. Mean Levels of Illusion in Perceived Knowledge Differential between Self and Others for Young People and Middle-aged and Elderly (Significant Differences Observed)

The analyses of age differences in knowledge of climate change reveal that the young people, and the middle-aged and elderly not only score differently in actual knowledge, but also in illusion of knowledge on this issue. The young people performed better than the middle-aged and elderly in terms of climate change knowledge. Consistent with prior studies, the young people are more knowledgeable of climate change than the middle-aged and elderly. This could be explained by the learning ability differences between the two age groups, as the young adults tend to have better sense of recalling and recognizing as compared to the older adults (Head & Isom, 2010). Another possible explanation would be that the young people have grown up in a time period, in which environmental concerns have been a salient issue, and they are more likely to be sensitive to the environmental issues, such as climate change (Straughan & Roberts, 1999). In this case, young people are more likely to be aware of environmental issues and have more relevant knowledge.

Moreover, the results reveal an age effect in illusion of knowledge of climate change, which suggests that young people are more likely to believe they are knowledgeable of climate change. This is in line with prior research, which reported that the young people were more confident than the middle-aged and elderly when rating their feeling of knowing (Marquié & Huet, 2000). One possible explanation could be the age differences in memory self-efficacy belief. Marquié and Huet (2000)

noted that the middle-aged and elderly tend to have less memory self-efficacy belief as compared to the young people.

The results also demonstrate age differences in illusion of knowledge. Specifically, the middle-aged and elderly are more likely to have positive illusion. This finding could be possibly explained by the motivation of maintaining life satisfaction. Aging studies found that individuals' life satisfaction tend to decline with aging (Gerstorf et al., 2008; Mroczek & Spiro, 2005; Thompson & Heller, 1990). Social comparison research noted that there is a human tendency that people are driven to develop positive illusion in order to maintain positive self-image or life satisfaction (Festinger, 1954). As the older people have less life satisfaction than the young people, it is possible that the older people are more likely to develop positive feeling in order to maintain positive self-image. In this case, the middle-aged and elderly may be more likely to develop positive illusion when they evaluate their own knowledge level. Another possible explanation could be that the middle-aged and elderly tend to engage in downward comparison. This notion has been supported by life-span theories, which postulate that people shift towards downward social comparisons more frequently as they advance in age (Heckhausen, 1999; Heckhausen & Brim, 1997; Heckhausen & Schulz, 1995). Thus, the middle-aged and elderly people tend to have positive illusion in their comparison to others, which lead to a high level of positive illusion in perceived knowledge differential between self and others.

Education Difference

Environmental studies have long recognized that education is one of the major correlates of environmental knowledge (Arcury & Johnson, 1987; Brothers, Fortner, & Mayer, 1991; Ostman & Parker, 1987). In particular, these studies reported a positive relationship between education level and environmental knowledge. For example, Ostman and Parker (1987) found that education was not only positively correlated with environmental knowledge, but also had positive effects on environmental concerns and behaviors. Brothers et al. (1991) found that education level was the demographic factor that most closely related to environmental knowledge, as the better-educated people tend to possess more environmental knowledge. Besides, Haron et al., (2005) reported that the less-than-high-school-educated respondents possess less environmental knowledge than the high-school-educated respondents.

In terms the relationship between education level and environmental knowledge, most prior studies focus on actual knowledge, whereas the education differences in illusion of knowledge has been rarely examined. Thus, this study made an examination of education effects in climate change knowledge in terms of actual knowledge, illusion of self-perceived knowledge and illusion of perceived knowledge differential between self and others. A series of independent sample t-test was conducted here. In particular, the respondents were categorized into two groups, which include the group without diploma and the group with diploma or higher degree. Of the respondents in this study ($N=705$), 54.9% have diploma or higher degree ($N=387$), and 45.1% are those who do not have diploma ($N=318$).

Education Difference in Actual Knowledge of Climate Change

With regard to the education difference in actual knowledge of climate change, the results showed that there was a significant difference in the scores for people with higher education ($M= .59$, $SD= .17$) and people without higher education ($M= .50$, $SD= .21$); $t(703)= -6.33$, $p< .001$. In line with previous studies, this study reveals a positive relationship between education and knowledge expertise. Specifically, people with higher education have more knowledge of climate change than those without higher education. The mean difference is presented in Figure 8.

Figure 8. Mean Levels of Actual Knowledge of Climate Change for People without Higher Education and People with Higher Education (Significant Differences Observed)

Education Difference in Illusion of Self-Perceived Knowledge of Climate Change

Also, the analysis of education difference in self-reported perceived knowledge of climate change revealed a significant difference between people with higher education and those without higher education, $t(703) = .07, p < .001$. The sample means are displayed in Figure 9, which shows that people without higher education scored significantly higher on illusion of self-perceived knowledge than did people with higher education (for subjects with higher education, $M = -.01, SD = .21$; for subjects without higher education, $M = .05, SD = .23$).

Figure 9. Mean Levels of Illusion of Self-perceived Knowledge of Climate Change for People without Higher Education and People with Higher Education (Significant Differences Observed)

Education Difference in Illusion of Perceived Knowledge Differential between Self and Others

In terms of illusion of perceived knowledge differential between self and others, the results showed that the difference in the scores for people with higher education ($M = .06, SD = .20$) and people without higher education ($M = .10, SD = .23$) are marginally significant $t(703) = 1.92, p = .056$. These results suggest that education has impact on how people perceive the knowledge differential between self and others. In particular, people with higher education are less likely to have positive illusion as compared to those without higher education. The sample means are presented in Figure 10.

Figure 10. Mean Levels of Illusion in Perceived Knowledge Differential between Self and Others for People without Higher Education and People with Higher Education (Significant Differences Observed)

As the results indicate, education level does have effects on individuals' climate change knowledge levels. Specifically, the highly educated people tend to have more actual knowledge of climate change, which is consistent with prior studies. In terms of self-reported perceived knowledge, the results also reveal positive effects of education level on it. Previous studies that examined the effects of education on perceived knowledge of health issues have reported that people with college education reported significantly more health care knowledge as compared to people with lower levels of education (Finkelstein et al., 2008). This could be explained by the positive relationship between actual knowledge and self-reported perceived knowledge (Brucks, 1985). That is, highly educated people tend to have better understanding of climate change

Moreover, the results suggest that the highly educated people tend to have less positive illusion of knowledge as compared to those with less education. This finding is in line with prior research on optimism bias, which reported a negative relationship between education level and the level of optimism bias level (Eroglu & Croxton, 2010). Besides, in a study on behavioral bias and demographic characteristics, Bashir et al. (2013) reported that people with less education tend to develop a high level of overconfidence. Moreover, people with lower education levels tend to have less life satisfaction. With the motivation of maintaining good self-image, they are

more likely to develop positive illusion. In this case, they are likely to have positive illusion of knowledge, whereas in fact they are not that knowledgeable.

Income Difference

Individuals' household income is another demographic variable that has been extensively examined in environmental studies. However, a majority of these studies focus on the income effects in individuals' willingness to perform pro-environmental behaviors, such as purchase environmental friendly products (e.g., Moon, Florkowski, Brückner, & Schonhof, 2002; Royne, Lvey, & Martinez, 2011). In particular, a strong correlation between environmental behaviors and income was reported (D'Souza, Taghian, Lamb, & Peretiatko, 2007; Harris, 2006). Given the important role of environmental knowledge in promoting environmental behavior, it is imperative to examine income differences in environmental knowledge. Thus, this study conducted a set of independent sample t-test to examine the income effects. Specifically, the sample mean of household income in this study was employed to determine the low and high levels of household income. Of the respondents in this study ($N=705$), 63.5% were low household income groups ($N=448$), and 36.5% were high household income groups ($N=257$).

Income Difference in Actual Knowledge of Climate Change

Regarding the income difference in actual knowledge of climate change, the result reveals a significant difference between lower household income group ($M= .51$, $SD= .20$) and higher household income group ($M= .61$, $SD= .17$), $t(703)= -6.97$, $p< .001$. These results suggest that household income does have an influence on individuals' actual knowledge levels of climate change. Specifically, individuals with higher household income are more knowledgeable of climate change as compared to those with lower household income. The mean difference is displayed in Figure 11.

Figure 11. Mean Levels of Actual Knowledge of Climate Change for People with Lower Household Income and People with Higher Household Income (Significant Differences Observed)

Income Difference in Illusion of Self-perceived Knowledge of Climate Change

Also, the results showed that there was no significant difference in self-reported perceived knowledge between people with lower household income ($M = .02$, $SD = .22$) and people with higher household income ($M = -0.02$, $SD = .21$), $t(703) = 1.52$, $p = .13$. The sample means are displayed in Figure 12.

Figure 12. Mean Levels of Illusion of Self-perceived Knowledge of Climate Change for People with Lower Household Income and People with Higher Household Income (Non-significant Differences Observed)

Income Difference in Illusion of Perceived Knowledge Differential between Self and Others

In terms of income difference in illusion of perceived knowledge differential between self and others, the analysis failed to reveal a significant difference between people with lower household income and those with higher household income, $t(703) = 1.09, p = .28$, which suggests that illusion of perceived knowledge differential among people with lower household income are quite similar with that of people with higher household income (for people with lower household income, $M = .08, SD = .22$; for people with higher household income, $M = .07, SD = .21$). The sample means are presented in Figure 13.

Figure 13. Mean Levels of Illusion of Perceived Knowledge Differential between Self and Others for People with Lower Household Income and People with Higher Household Income (Non-significant Differences Observed)

The T test analyses reveal household income differences in actual knowledge of climate change. A possible explanation could be that people with high incomes tend to have higher levels of education and are more sensitive to social problems such as climate change (Henion, 1972). Besides, being sensitive to environmental issues would motivate people to pay attention to these issues. In particular, environmental studies have reported that one of the barriers for individuals' engagement with climate change is their attention to more immediate priorities, such as finances and family (Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007). This would be especially true for

people with low household income, as they have more financial pressure compared to those with high household income. In this case, people with less household income are less likely to pay attention to climate change issue, which result in their poor performance in actual knowledge of climate change.

CHAPTER SEVEN RESULTS AND FINDINGS

This chapter reports the results of this research project. Firstly, the results of the replicated information deficit model are reported. Then, this chapter presents the results of proposed model concerning how media attention affect individuals' pro-environmental behavioral intention via actual knowledge and illusion of knowledge.

Descriptive Analysis

In terms of illusion of self-perceived knowledge, the results indicated that among the sample in this study, 365 respondents had positive illusion of self-perceived knowledge; 309 respondents had negative illusion; and 31 respondents had no illusion (Table 2). With regarding to illusion of perceived knowledge differential between self and other, the descriptive statistics analysis showed that among the sample in this research, 444 respondents were found to have positive illusion; 249 respondents had negative illusion; and 12 respondents had no illusion of the perceived knowledge differential between self and other (Table 2).

The results offered evidence for the existence of positive illusion of individuals' knowledge assessment on the topic of climate change. Specifically, this study found that people who had positive illusion outnumbered those who had negative illusion. In other words, a comparatively larger number of people believe that they are more knowledgeable, while they actually have less knowledge. This finding is consistent with the positive illusion model, which asserts that people would develop illusory superiority in comparison with others (Taylor & Brown, 1988).

Besides, prior studies suggest that people are less likely to develop positive illusion of in their knowledge assessment regarding complex issue (Metcalf, 1998). As climate change lies beyond most people's life-world and biographical horizons, it is hard for people to have direct observation of climate change (Lorenzoni et al., 2007). Moreover, the consequences triggered by climate change are mostly determined by the monitoring of the variations of temperature and precipitation data. These physical complexities of climate change make it difficult for people to have a full picture of climate change (Hansen et al., 2003; Solomon et al., 2009). Thus, this study expects a distinctive pattern of illusion of individuals' knowledge assessment regarding climate change, in which people are expected to be less likely to have positive illusion of knowledge. In line with this expectation, the results in this study revealed that some people would develop negative illusion rather than positive illusion of knowledge.

Table 2. Summary Statistics of Illusion of Knowledge

	<i>N</i> of Positive illusion	<i>N</i> of No Illusion	<i>N</i> of Negative illusion	Skewness	Kurtosis
Illusion of Self-Perceived Knowledge	365	31	309	.14	1.02
Illusion of Perceived Knowledge Differential	444	12	249	-0.07	1.02

Table 3. Bivariate Correlations among All Variables ($N = 705$).

	1	2	3	4	5	6	7	8	9	10
1. Age	----									
2. Gender	-.08*									
3. Education	-.45**	-.04								
4. Household Income	-.17**	.01	.43**							
5. Media Attention	-.17**	-.02	.22**	.16**						
6. Actual Knowledge	-.23**	-.08*	.33**	.23**	.26**					
7. Illusion of Self-perceived knowledge	.13**	.03	-.16**	.13**	.07	-.63**				
8. Illusion of Perceived Knowledge Differential between Self and Others	.16**	.06	-.08*	-.05	.08*	-.59**	.76**			
9. Attitude toward Pro-environmental Behaviors	.07	.02	-.02	.02	.39**	.21**	.11**	.07		
10. Private Sphere Pro-environmental Behavioral Intention	.12**	.01	.08*	.10**	.24**	.20**	.06	.06	.47**	
11. Public Sphere Pro-environmental Behavioral Intention	.12**	.02	-.03	-.001	.28**	.13**	.16**	.09*	.52**	.53**

Note. * $p < .05$; ** $p < .01$; *** $p < .001$.

Results

Table 4 shows the descriptive statistics for the measurements and factor loadings for each latent variable in the model. Factor loadings reflect the measurement model. All factor loadings were over .04, and most exceeded .70. The factor loading for all latent variables were significant ($p < .001$). Freely estimating paths among latent variables, all measurement model fit statistics fell within acceptable ranges, demonstrating a good fit to the data (Table 5). Results indicated that the extended model had a better model fit as compared to the original model (Table 5).

Table 4. Summary of Measurement Items.

Variable	<i>Factor loading</i>	<i>M</i>	<i>SD</i>
Media attention			
ma1	.47	4.38	1.64
ma2	.68	4.70	1.59
ma3	.41	4.59	1.72
ma4	.40	4.46	1.84
ma5	.47	4.58	1.70
ma6	.71	4.94	1.52
ma7	.45	4.83	1.74
ma8	.40	4.70	1.86
Attitudes toward pro-environmental behaviors			
att1	.72	4.43	1.55
att2	.72	5.46	1.19
att3	.65	5.70	1.13
att4	.74	5.47	1.21
att5	.52	4.14	1.59
att6	.72	4.57	1.47
att7	.78	5.05	1.39
Private-sphere Pro-environmental behavioral Intention			
Private PEB1	.70	5.05	1.40
Private PEB2	.78	4.99	1.42
Private PEB3	.82	5.05	1.36
Private PEB4	.81	5.02	1.38
Private PEB5	.72	5.30	1.28
Private PEB6	.68	5.47	1.21
Public-sphere Pro-environmental behavioral Intention			
Public PEB1	.81	4.73	1.58

Public PEB2	.88	4.77	1.49
Public PEB3	.81	4.68	1.47
Public PEB4	.68	4.26	1.58

Note: For reference, items appear in this table in the same order as in the Method section.

Table 5. Measurement and Structural Model Fit Indices.

Model	χ^2	<i>df</i>	χ^2/df	CFI	TLI	RMSEA (<i>p</i> close)
Measurement	759.07	296	2.56	.96	.95	.047 (1.00)
Replicated Model	1294.27	338	3.83	.91	.89	.06 (1.00)
Extended Model	1014.03	366	2.77	.95	.93	.05 (1.00)

Replicated Information Deficit Model

Specifically, media attention was positively associated with actual knowledge ($\beta = .17, p < .001$). Actual knowledge was significantly associated with attitude toward pro-environmental behaviors ($\beta = .28, p < .001$). Finally, attitude toward pro-environmental behaviors was positively associated with pro-environmental behaviors in both private ($\beta = .50, p < .001$) and public ($\beta = .58, p < .001$) spheres. The original information deficit model explained 28% of the variance in pro-environmental behavioral intention in private sphere, and 36% of the variance in pro-environmental behavioral intention in public sphere. Figure 14 summarizes the results.

Extended Information Deficit Model

Regarding the hypothesized relationship between media attention and actual knowledge, the results indicated that individuals' attention to media messages about climate change was positively associated with their actual knowledge of this issue ($\beta = .27, p < .001$), thereby supporting H1.

H2, which hypothesized a positive relationship between attention to media messages about climate change and individuals' illusion of self- perceived knowledge of the issue, was supported ($\beta = .15, p < .01$),

With regard to the hypothesized relationships between individuals' attention to media messages and their illusion of perceived knowledge differential between self and others, the results indicated that individuals' attention to media messages about climate change had effects on their illusion of perceived knowledge differential between self and others. Specifically, when people paid more attention to media

messages about climate change, they would be more likely to develop positive illusion ($\beta = .13, p < .05$), which supported H3.

For the relationship between actual knowledge and attitude toward pro-environmental behavior, the results showed that individuals' actual knowledge of climate change was positively related to their attitude toward engaging pro-environmental behaviors ($\beta = .58, p < .001$). Thus, H4 received supports. Moreover, illusion of self-perceived knowledge of climate change was found to be positively associated with attitude toward pro-environmental behaviors ($\beta = .34, p < .001$), which supported H5. Regarding the relationship between illusion in perceived knowledge differential between self and others and attitude toward pro-environmental behavior, the results showed that positive illusion was positively associated with the attitudes ($\beta = .14, p < .05$), which supported H6.

H7a and H7b, which held that attitude toward pro-environmental behaviors had positive associations with pro-environmental behaviors, received fully support in this research. Specifically, the results showed that attitude was positively related to pro-environmental behavioral intention in both private ($\beta = .46, p < .001$) and public ($\beta = .56, p < .001$) spheres.

For RQ 1, the results indicated that actual knowledge of climate change had direct relationship with pro-environmental behavioral intention in both public sphere ($\beta = .16, p < .01$) and private sphere ($\beta = .12, p < .05$). For RQ2, the results showed a significant relationship between illusion of self-perceived knowledge and pro-environmental behavioral intention in both public sphere ($\beta = .25, p < .001$) and private sphere ($\beta = .18, p < .01$). For RQ3, the results also indicated that there was no direct relationship between illusion of perceived knowledge differential and pro-environmental behavioral intention in public sphere or private sphere. The model explained 30% of the variance in private-sphere behavioral intention and 44% of the variance in public-sphere behavioral intention (see Figure 15).

Moreover, this study used the Bayesian information criterion (BIC) for model comparison. When fitting models, it is possible to increase the likelihood by adding parameters, but it may cause over-fitting. The aim of BIC is to quantify the support for a model over another (Chen & Gopalakrishnan, 1998; Schwarz, 1978). It is a criterion for model selection among a set of models, and the model with the lower BIC is preferred (Van de Schoot, Lugtig, & Hox, 2012; Zucchini, 2000). BIC can measure the efficiency of the model in terms of predicting the data (Neath & Cavanaugh, 2012).

Most importantly, BIC can penalize the complexity of the model where complexity refers to the number of parameters in the model. Differences in BIC of 2 or more provide evidence favoring one model (with the smaller BIC value) over another; 6 or more provide strong evidence; and over 10 is taken to be very strong evidence for model improvement (Dillard & Shen, 2005; Raftery, 1995). Moreover, the literature on BIC indicates that the value difference depends on actual dataset and the model, hence simply chooses the model with the lowest BIC value (Van de Schoot, Lugtig, & Hox, 2012). Thus, I compare the BIC for both the original model and the extended model. The results indicated that the BIC for the extend model is 52427.10, and the BIC for the original model is 54023.55. In this case, the BIC difference between the two models is 1596.45, and the extended model has a lower BIC. Thus, the extended model is better than the original model.

Figure 14. Replicated Information Deficit Model ($N = 705$).

Note: The demographic variables including age, gender, household income, and education were included as control variables in the model testing. They are not shown in the diagram in order to keep it parsimonious.

Figure 15. Extended Information Deficit Model ($N = 705$).

Note: The demographic variables including age, gender, household income, and education were included as control variables in the model testing. They are not shown in the diagram in order to keep it parsimonious

This study has demonstrated some important findings by extending the information deficit model. The results suggested that the extended model performed better in predicting behavior change as compared to the original model. This is in line with the criticism over the original model for its over-emphasis of the simple linear process. Results showed that individuals' attention to media messages about climate change contributes to both actual knowledge and illusion of knowledge, which promotes their positive attitude toward pro-environmental behaviors, and in turn translates in to pro-environmental behavioral intention. In particular, how people evaluate their own knowledge levels could influence their attitude and behavior changes, as the findings suggested that the more positive illusion of knowledge people have, the more positive attitude they would develop toward pro-environmental behaviors, which in turn promote their intention of performing the behaviors.

This chapter makes a conclusion of this dissertation project. The first section of this chapter discusses the findings. The second section assesses the theoretical and practical implications of this dissertation project. The last section presents the limitation of this study and provides recommendation for future studies.

Discussion

The findings of this study suggest that the extended information deficit model works better than the original model in predicting behavioral change. By taking individuals' illusion of knowledge into account, the extended model offers a more comprehensive framework for the examination of media effects. Specifically, this research demonstrated that attention to media messages about climate change was positively associated with individuals' actual knowledge of this topic. This result is consistent with previous studies (Eveland & Cortese, 2004; van Aelst & Walgrave, 2011). Media, as an important source of information, is considered a useful tool in cultivating public understanding of public agendas. The findings of this study confirmed the role of media in cultivating public knowledge about climate change. Meanwhile, findings from this study have confirmed that individuals' attention to

media messages about climate change could influence their perceived knowledge levels.

Compared with prior media effects research, this study investigated the effects of media attention on individuals' illusion of knowledge level in addition to objective understanding. Most previous communication research focuses on the examination of the substantial effects of media on cultivating public awareness, changing their attitude, and promoting their behavior. These studies are in line with the original information deficit model, which assumes that people behave in a rational manner. On the basis of this assumption, people make decisions based on objective analysis of the surroundings. However, people not only use objective analysis in their decision-making, but also employ subjective perception in this process (Ladwig et al., 2012; Majid et al., 2011; Reyna & Lloyd, 2006).

Thus, this study suggests that future media effects research should not only examine how media contribute to individuals' objective understanding, but also investigate how media shape their subjective evaluation of their own knowledge levels.

Moreover, the findings of this research confirmed that media attention could affect individuals' illusion of knowledge. The results revealed that individuals' attention to media messages could increase their positive illusion of self-perceived knowledge. This is consistent with previous studies, which reported that media exposure had a stronger relationship with individuals' feeling of knowing than with their actual knowledge (Holland, 1995; Park, 2001). Also, the results indicated that media attention could increase individuals' positive illusion of perceived knowledge differential between self and others. Specifically, when people paid more attention to media, they tended to perceive that they know much more about climate change, whereas this was not the real situation. That is, paying attention to media messages could increase the illusory superiority of self over others in terms of knowledge assessment. This result is consistent with what is suggested by self-enhancement bias (Alicke, 1985; Wood, 1989). To maintain good feelings of the self, an individual tends to develop illusory superiority over others. Paying attention to media coverage about environmental issues, such as climate change, is regarded as a positive behavior. With the motivation of maintain a positive self-image, people tend to believe that they are influenced by positive events. In this case, they tend to amplify the effects of these media messages in increasing their knowledge than in increasing the knowledge of

others. The more attention an individual pays to media messages, the more this amplification effects will be developed in the perception. Therefore, an increasing attention to media can contribute to positive illusion of perceived knowledge differential between self and others.

More importantly, by comparing the perceived knowledge differential with the actual knowledge differential, this study offered an in-depth examination of media effects on individuals' perception. Prior media effects research has indicated that media could exert effects upon individuals' perception (Ladwig et al., 2012). In particular, the third person perception is a prominent theory to examine how media influence self and others. This theory postulates that people tend to perceive others are more influenced by socially undesirable media messages as compared to themselves (Gunther, 1995; Stavrosit & Kim, 2014; Wei, Lo, & Lu, 2008). It could be true that others are more influenced by social undesirable messages. Also, it is possible that individuals are actually influenced more by the social undesirable media messages than others, while they perceive that others are influenced more by the messages. However, very few of these studies on third person perception have examined whether such perceptions reflect the reality in an accurate manner or not. Unlike those studies, the present research provided an in-depth examination of how individuals' attention to media influenced the distinction between their perception and the reality in terms of knowledge assessment. The results of this study showed that media indeed had effects on illusion, in which media attention could increase individuals' positive illusion of perceived knowledge differential between self and others. That is, after paying attention to media messages about climate change, people tend to believe that they are more knowledgeable than others, while they actually are not that knowledgeable. Accordingly, both third person perception and illusion focus on how media affect individuals' perception of self and others, while illusion makes a further concern over the accuracy of individuals' perception, and to what extent the perception is different from the reality. Besides, unlike third person perception that merely focuses on differences in perceived media influence on self and others, the focus of illusion is broader, as it can be operationalized in terms of knowledge and other factors, such as individuals' emotional attributes. Thus, by introducing the concept of illusion, this study offered a new angle to examine media effects on individuals' perception.

As the results suggested, paying attention to media messages about climate change could contribute to both actual knowledge and illusion of knowledge. Meanwhile, the results showed a negative relationship between actual knowledge and illusion of knowledge. This finding suggests that people who possess more actual knowledge about climate change are less likely to develop unrealistic positively view toward self. This finding is consistent with prior research. For example, Radcliffe and Klein (2002) reported a negative relationship between actual knowledge and individuals' unrealistic optimism. This suggests that the more factual knowledge people have, the more likely they will develop accurate perception.

The negative relationship between actual knowledge and positive illusion of knowledge could be explained by the attributes of those who have more actual knowledge of climate change. The analyses of demographic differences in this study had shown that people who have more actual knowledge of climate change tend to be those who are highly educated. Prior studies on overconfidence reported that people with a higher level of education tend to have a lower level of overconfidence (Bashir et al., 2013; Eroglu & Croxton, 2010). In line with these studies, it is possible that people who have more actual knowledge of climate change tend to have less overconfidence as compared to those who have less actual knowledge. In this case, people with more actual knowledge may have less positive illusion I, while people who have less actual knowledge may have more positive illusion. Besides, another possible explanation for this finding could be the nature of media as a public information source for climate change. Media is a public information source with extensive capability to reach the general public (van Aelst & Walgrave, 2011). In this case, when people learn from media about climate change, they may perceive that others also learn about this issue from media as well. Thus, the perceived knowledge differential between self and others may be decreased. Meanwhile, the results showed that paying attention to media messages could increase actual knowledge for all the respondents. Consequently, the actual knowledge differential may be decreased in the meantime. In this case, one's perceived knowledge differential between self and others could possibly reflect the actual knowledge differential, which results in a decrease in their positive illusion.

Regarding the effects of illusion of knowledge on people's attitudes toward pro-environmental behaviors, the findings of this study suggest that the more positive

illusion people have, the more positive attitudes they will develop toward performing pro-environmental behaviors. Prior research has indicated that the perception of being better than others is an important indicator of self-confidence (Lenney, 1981).

Moreover, individuals' self-confidence is positively associated with their positive attitude (Davies, 2000; Rohaan, Taconis, & Jochems, 2010). Accordingly, people who exhibit illusory superiority in the perceived knowledge differential between self and others are likely to have an overly high level of self-confidence. Such self-confidence in terms of knowledge assessment may make people believe that behaviors in mitigating climate change are easy to perform. Moreover, prior research has indicated the feeling of knowing would increase one's internal attribution of responsibility (Aertsens et al., 2011; Bamberg & Moser, 2007). Accordingly, the feeling of having more knowledge than others may exert considerably more effects on increasing consciousness for responsibility. Furthermore, prior research has suggested that people with a consciousness for responsibility in addressing environmental issues are those who tend to exhibit positive attitudes toward performing pro-environmental behaviors (Cordano & Frieze, 2000). Thus, positive illusion of climate change knowledge may increase individual positive attitude toward performing pro-environmental behavior.

Furthermore, consistent with prior research, this study confirmed the important role of attitude in shaping behaviors. In particular, attitude is positively related to intention to perform pro-environmental behaviors in both private and public spheres. Those who perceive pro-environmental behaviors to be beneficial, important, and easy, tend to have more initiatives to perform the behaviors (Clark, Kotchen, & Moore, 2003; Fujii, 2006).

Besides, unlike prior behavioral studies in environmental communication, this study highlighted the collective nature of the actions in addressing climate change. Consistent with the collective interest model, this study confirmed that the perceptual difference between self and others would play a role in the mechanism. This finding suggests that future study should address the collective nature of pro-environmental behaviors in their examination, instead of treating environmental behavior the same as other personal behaviors (e.g. health behavior).

Theoretical and Practical Implications

This dissertation has several theoretical contributions. First of all, this study reevaluates the information deficit model and makes extension to this model by including illusion of knowledge into the original model. The findings reveal that the extended model works better in predicting pro-environmental behavioral intention. This suggests that future studies that employ the information deficit model should take actual knowledge and illusion of knowledge into consideration to understand individuals' behavior change. This may give a more comprehensive understanding of the mechanism underlying individuals' behavior change. Moreover, prior research mostly emphasized the role of actual knowledge in fostering pro-environmental behavioral intention (Finger, 1994; Jensen, 2002). However, people's decision-making is not merely shaped by their factual understanding, but also by their subjective perception and how they evaluate their own level of knowledge (Ladwig et al., 2012; Majid et al., 2011; Reyna & Lloyd, 2006). Thus, this dissertation offers a new angle in understanding pro-environmental behavior by making an examination of individuals' perception.

Secondly, this dissertation highlights the collective nature of pro-environmental behaviors, which has been mostly overlooked in prior studies. The collective interest model indicates that people would compare themselves with others when making decisions that involves engaging in collective action. On the basis of this model, perceived climate change knowledge differential between self and others is taken account into the examination of individuals' intention in performing pro-environmental behavior. By demonstrating that perceived knowledge differential would affect individuals' intention to pro-environmental behaviors, the finding of this study confirms the collective nature of pro-environmental behavior. Given the finding of this study, future studies are suggested to consider the collective nature of environmental behavior in identifying its predictors.

Thirdly, this dissertation made a theoretical contribution to the literature on media effects. More work needs to look into collective aspects of media effects, but prior studies on media effects have a long history of going past mere knowledge acquisition. Nonetheless, how media affects the perceived knowledge differential between self and others still requires further study. Prior research has indicated that people tend to develop illusory superiority when comparing with others in terms of

personal attributes evaluation (Brown, 1986; Taylor & Brown, 1988). However, how media affect illusion in the comparison between self and others remains largely unexamined. By examining media effects on illusion of perceived knowledge differential between self and others, this study contributes to the understanding of media effects on illusion, which offers a new angle to look at the mechanism underlying media effects. In particular, this study found that media affect its audiences not only through exerting influence to their actual knowledge, but also through triggering their illusion in perception. This suggests that how media influence individual perception or feelings should be taken into account in studying media effects.

Besides, findings in this study reveal that media attention could increase individuals' positive illusion of perceived knowledge differential between self and others. Previous studies have illustrated that media could influence the perceptual difference between self and others (Cohen & Davis, 1991; Davison, 1983). However, these studies have not examined whether such perceptual differences between self and others were accurate reflections of the reality. By comparing perceived knowledge differential with actual knowledge differential, this study provided insights into whether such perception accurately reflects the reality or not.

In addition, this dissertation enhances understanding of the positive illusion model. Although Taylor and Brown (1988) indicated that positive illusion could enhance individuals' motivation, persistence, and performance, only a few studies have made empirical examination of the underlying mechanisms. This dissertation provides empirical evidence for the positive illusion model by studying the effects of illusion of knowledge on individual pro-environmental behavior intention. Through reintroducing positive illusion to the literature of media studies, this dissertation may rejuvenate research on positive illusion and offer a new direction for media research. For example, future studies may examine how media influence individuals' illusion in terms of other factors in addition to knowledge.

This dissertation has also yielded several practical implications. Specifically, it provides empirical evidence for the positive illusion model by studying the effects of illusion of knowledge on individual pro-environmental behavior intention. The findings revealed that media could not only influence individuals' pro-environmental behavioral intention through increasing their actual knowledge of climate change, but

also through triggering the illusion in their perception. In light of these findings, communication practitioners should take note that individuals' perception will play a role in influencing their behavioral intention in addition to their actual knowledge. Moreover, the findings of this study suggest that media attention can foster individuals' self-confidence, which in turn, promotes their behavioral intention. Thus, in environmental campaigns, communication practitioners should not only concentrate on increasing public understanding, they should also make efforts to foster individuals' self-confidence in comprehending this issue.

Consistent with the collective interest model, this study confirms that how people perceive the difference between self and others will influence their intention to perform pro-environmental behavior. This finding suggests that how people perceive the difference between self and others should be taken account into designing environmental campaigns.

Moreover, this study reveals that people from different social groups tend to have different levels of actual knowledge and illusion of perceived knowledge differential. For example, compared to young people, the middle-aged and the elderly are more likely to have positive illusion of perceived knowledge differential and less likely to have actual knowledge of climate change. Given the complexity of climate change issue, the elderly may find it difficult to learn the mechanism behind climate change as compared to young people. Conversely, positive illusion may be easier to achieve than actual knowledge gain for the elderly. In this case, the group differences should be taken into account in designing effective communication campaigns. This suggests that specialized campaign should be designed for the targeted population. In particular, more effort should be made to design communication campaigns that focus on promoting the elderly's pro-environmental behaviors through raising their positive illusion of perceived knowledge differential between self and others.

In line with positive illusion model, this study has provided support for the positive effects of positive illusion of perceived differential between self and others in changing individuals' attitude and behavior, as people with more positive illusion in terms of knowledge comparison with others are more likely to develop positive attitude and perform pro-environmental behaviors. The positive effects of positive illusion could be applied in other pro-social contexts, such as health campaigns. Specifically, people with more positive illusion in the comparison with others are

expected to be more likely to develop positive attitude and engage in healthy behaviors in fighting illness. For instance, people with positive illusion in terms of their abilities to fighting cancer may be more likely to develop positive attitude toward the therapy, which may increase the chance for the cure. In this case, communication practitioners may develop health campaigns that focus on decreasing individuals' pessimist feeling of being worse than others and increasing their confidence of performing the healthy behaviors. Meanwhile, the regulatory agencies should enact relevant regulations to prevent media organizations from using positive illusion media messages in potentially unethical manners.

Limitations and Directions for Future Research

This dissertation contains several limitations. First, this research was conducted in Singapore, an Asian country that appreciates the value of collectivism. In this case, the findings generated from the sample may not be generalized to population from other cultural background. Prior research examined the possible differences in social comparison choices between individualistic and collectivistic cultures, and reported that higher collectivism scores were associated with an increased desire to engage in comparison in general, an increased desire to make upward comparisons, and a decreased desire to make downward comparisons (Chung & Mallery, 1999). In line with this finding, it is possible that people in the collectivist culture are more likely to engage in the knowledge comparison with others, while they may be less likely to have positive illusion of perceived knowledge differential. Conversely, people in the individualistic culture may be more likely to develop positive illusion, although they may not so engaged in social comparison. Given the cultural differences, future studies should examine the proposed model in other countries with different cultural backgrounds to test the external validity of the findings.

Second, the mean value of the actual knowledge scores of all the respondents in the sample was used to determine others' actual knowledge level. However, the score may not truly represent the climate change knowledge of the general public because of the limited sample size. One future direction is to conduct a national survey on public knowledge of climate change with a larger sample size.

Third, perceived knowledge differential and actual knowledge differential were measured using different scales in the survey. To make the subtraction, the

measurement for actual knowledge differential and perceived knowledge differential should be on the same scale. Thus, this study made a transformation of these measurements. In particular, the percentage of perceived knowledge was calculated. Also, by averaging the responses to 12 items, the score for actual knowledge in this study was transformed into percentage. In this manner, the measurements for perceived knowledge and actual knowledge are on the same scale. However, the transformation of the scales might present some issues, given that the variables were scored on different scales.

Forth, as the aforementioned, positive illusion is a broad concept, which can be operationalized in terms of other factors in addition to knowledge. Future studies could make a thorough examination of positive illusion in terms of different personal attributes. To operationalize positive illusion, both actual and perceived scores of the factor should be obtained. However, it is difficult to get an actual score for some factors. Taking attitude as an example, it would be hard to get an actual score of it, as its measurement is mostly based on respondents' perceptions. Thus, future studies on positive illusion should operationalize it in terms of factors that have both actual and perceived scores.

With regarding to the effects of positive illusion, this study employed Taylor and Brown's positive illusion model as a basis to examine its effects in promoting pro-environmental behavioral intention. However, it is also possible that positive illusion could bring about negative outcomes in certain contexts. For example, it is possible that positive illusion of knowledge may reduce individuals' willingness of continuous learning. Thus, to obtain a full picture of positive illusion phenomenon, future studies are suggested to make an examination of the possible negative effects. Also, findings from this study suggested that people would develop negative illusion in self-knowledge assessment regarding climate change. However, this study treated illusion as a linear function, instead of focusing on the categorical difference between positive illusion and negative illusion. As thus, future studies are encouraged to make a thorough examination of the categorical difference between positive illusion and negative illusion.

Moreover, there are several limitations in terms of the measurement of variables. First, this study has conceptualized media attention as a one-dimensional construct by using a singular composite measure—attention to media—where items

are averaged to form attention to media without accounting for differences in media platforms. Despite the high reliability of a single media attention construct (e.g. Ho, Peh, & Soh, 2013), collapsing all the items into a single dimension poses a challenge, in which researchers are not able to understand if there are different effects of attention on these media platforms. Given that each type of media has its own characteristics, it is suggested that future research should make an in-depth examination and identify how individuals' attention to different types of media platforms related to variations in knowledge, attitude, and behavior. Besides, the measurement of media attention in this study was based on self-reported score, which may not be an accurate reflection of the actual amount of attention that people pay to media messages about climate change. Thus, future studies should employ a more accurate measurement of media attention. Second, this study used single-items to measure certain variables, such as self-reported perceived knowledge. Future research is suggested to develop multiple items to measure the variables, which would improve both the measurement validity and reliability.

Another direction for future study could exist in how people conceptualize others in the comparison. It is possible that people may perform distinctively when they were asked to compare themselves with other people from the same neighborhoods and from different neighborhoods. Moreover, as climate change is a global issue, how people compare themselves with people from other countries may have effects on their willingness to mitigate and adapt to climate change. Thus, future studies are suggested to gain an insight into the structural context of social comparison.

In terms of the sample, this study merely focused on HDB residents, whereas the residents in other types of housing were not included in the sample. Future studies are suggested to get a representative sample by including residents in all types of housing in Singapore. This study had not asked the respondents' races. Thus, future studies should ask the respondents regarding their races, which would enable a more accurate estimation of how closely the sample matches the population demographics. Moreover, the surveys were conducted in English and Mandarin. The failing of using other languages, such as Malay or Tamil, may cause the lack of national representativeness. Future studies should address this issue by using all the possible languages in Singapore.

Besides, this study examined respondents' pro-environmental behavioral intentions rather than their actual pro-environmental behaviors. Although prior research has provided evidence for the likely translation of pro-environmental behavioral intentions into actual behavior (Ajzen & Fishbein, 2005), future research can examine the extent to which pro-environmental behavior intention is translated into actual pro-environmental behavior. Additionally, this research used a cross-sectional data, which might preclude the causality statement. Future research can consider using more datasets or longitudinal data to verify the findings of this study.

As a final remark, I believe that the findings of this dissertation have shed light on the mechanism underlying the association between media attention and behavioral intention. Given the recognition of the collective nature of pro-environmental behavior, this study offer insights into the role of perceived difference between self and others in determining individual intention of engaging in the relevant behaviors.

The findings of this dissertation project have confirmed the important role of media in promoting individuals' pro-environmental behavioral intention. In particular, the findings suggest that media attention on climate change issue can promote individuals' pro-environmental behavioral intention not only by increasing their actual knowledge and self-reported perceived knowledge of climate change, but also by triggering their positive illusion of knowledge.

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APPENDIX A. INFORMATION SHEET AND INFORMED CONSENT FOR PARTICIPANTS

Purpose of research:

This study aims to look at Singaporean's awareness and attitude toward climate change. This is an academic study conducted by Prof. Hao Xiaoming from the Wee Kim Wee School of Communication and Information, Nanyang Technological University.

What you will do in this study:

If you consent to participate in this study, you will be asked to sign a consent form at the end of this information sheet and answer a face-to-face survey conducted by our interviewer. The survey will take approximately 30 minutes to complete. At the end of study, you will receive a voucher of S\$10 for the appreciation of your kindly participation.

Confidentiality:

Your participation in this study will remain confidential. The survey will be labelled using numbers, and not personal names. As such, no information that could personally identify you will be used in any reports or future publications on this study. The data will be stored securely in a locked facility, and only researchers conducting this study will have access to the information. Results from this study may be presented at conferences, and/or reported in books and/or academic journals in future.

Benefits/Risks:

Your participation in this study will contribute to research on climate change among the general Singapore population. You will also receive a small token of appreciation for your participation. There are no anticipated risks associated with participating in this study.

Voluntary withdrawal:

Please remember that your participation in this study is completely voluntary and that you are free to withdraw at any time during the study without penalty. However, we will appreciate it if you can answer ALL the questions. Your decision to participate, decline, or withdraw participation will have no effect on you or your family's current or future status or relationship with Nanyang Technological University.

Further Information:

If you have any questions about the study, please feel free to contact:

Prof. Hao Xiaoming
Wee Kim Wee School of Communication & Information
Nanyang Technological University^[1]_[SEP]
Phone: +65-6790-5012
E-mail: TXMHAO@ntu.edu.sg

Should you have any further questions or concerns regarding the survey, please contact Nanyang Technological University's Institutional Review Board at Email: irb@ntu.edu.sg, Tel: +65 65922495

CONSENT FORM

I have been informed about the purpose of the study.

I understand that my participation in this study is voluntary, and that I may withdraw from the study at any time.

I understand that the information obtained from this study will be kept confidential. No information that could identify me will be used in any reports coming from this study.

I understand that if I have any questions or require further information about his study, I can contact the Prof. Hao Xiaoming, at TXMHAO@ntu.edu.sg

I have understood the information listed in this information sheet and DO / DO NOT give my consent to participate in the above study.

Sign: _____

Date: _____

APPENDIX B. QUESTIONNAIRE

SECTION A

1. How much attention do **you** pay to information about **pro-environmental messages related to climate change** (e.g. recycling, low-carbon lifestyle, energy conservation, etc.)

	no attention at all					a lot of attention	
a) ...in newspapers (including print and digital edition)?	1	2	3	4	5	6	7
b) ...on television?	1	2	3	4	5	6	7
c) ...on the Internet?	1	2	3	4	5	6	7
d) ...on social media (e.g. Twitter, Facebook, etc.)?	1	2	3	4	5	6	7

2. How much attention do you think **other people** pay to information about **pro-environmental messages related to climate change** (e.g. recycling, low-carbon lifestyle, energy conservation, etc.)

	no attention at all					a lot of attention	
a) ...in newspapers (including print and digital edition)?	1	2	3	4	5	6	7
b) ...on television?	1	2	3	4	5	6	7
c) ...on the Internet?	1	2	3	4	5	6	7
d) ...on social media (e.g. Twitter, Facebook, etc.)?	1	2	3	4	5	6	7

3. Media coverage of **pro-environmental messages related to climate change...**

	strongly disagree					strongly agree	
a) had an influence on me .	1	2	3	4	5	6	7
b) had an influence on other people .	1	2	3	4	5	6	7

4. How much attention do **you** pay to information about **environmental crisis messages related to climate change** (e.g. the rising sea-level, haze, heat-wave, etc.)

	no attention at all					a lot of attention	
a) ...in newspapers (including print and digital edition)?	1	2	3	4	5	6	7
b) ...on television?	1	2	3	4	5	6	7

c) ...on the Internet?	1	2	3	4	5	6	7
d) ...on social media (e.g. Twitter, Facebook, etc.)?	1	2	3	4	5	6	7

5. How much attention do you think **other people** pay to information about **environmental crisis messages related to climate change**

	no attention at all					a lot of attention	
a) ...in newspapers (including print and digital edition)?	1	2	3	4	5	6	7
b) ...on television?	1	2	3	4	5	6	7
c) ...on the Internet?	1	2	3	4	5	6	7
d) ...on social media (e.g. Twitter, Facebook, etc.)?	1	2	3	4	5	6	7

6. Media coverage of **environmental crisis messages related to climate change...**

	strongly disagree					strongly agree	
a) had an influence on me .	1	2	3	4	5	6	7
b) had an influence on other people .	1	2	3	4	5	6	7

7. How much attention do **you** pay to information about **general environmental issues** (e.g. animal extinction, air pollution, water pollution, etc.)

	no attention at all					a lot of attention	
a) ...in newspapers (including print and digital edition)?	1	2	3	4	5	6	7
b) ...on television?	1	2	3	4	5	6	7
c) ...on the Internet?	1	2	3	4	5	6	7
d) ...on social media (e.g. Twitter, Facebook, etc.)?	1	2	3	4	5	6	7

8. How much attention do you think **other people** pay to information about **general environmental issues**

	no attention at all					a lot of attention	
a) ...in newspapers (including print and digital edition)?	1	2	3	4	5	6	7
b) ...on television?	1	2	3	4	5	6	7
c) ...on the Internet?	1	2	3	4	5	6	7
d) ...on social media (e.g. Twitter, Facebook, etc.)?	1	2	3	4	5	6	7

9. Media coverage of **general environmental issues**

strongly disagree strongly agree

a) had an influence on me .	1	2	3	4	5	6	7
b) had an influence on other people .	1	2	3	4	5	6	7

10. After I encounter information about **climate change**,

	strongly disagree					strongly agree	
a) I am likely to stop and think about it.	1	2	3	4	5	6	7
b) I carefully analyze the information to understand it better.	1	2	3	4	5	6	7
c) I often relate what I learnt from the information to other things I know.	1	2	3	4	5	6	7

11. I think that engaging in pro-environmental behavior is...

	strongly disagree					strongly agree	
a) enjoyable	1	2	3	4	5	6	7
b) beneficial	1	2	3	4	5	6	7
c) important	1	2	3	4	5	6	7
d) worthwhile	1	2	3	4	5	6	7
e) easy	1	2	3	4	5	6	7
f) compatible with my lifestyle	1	2	3	4	5	6	7
g) satisfying	1	2	3	4	5	6	7

SECTION B

12. Please rate your knowledge of climate change on a 0 to 10 scale, where 0 means knowing nothing and 10 means knowing everything that one could possibly know about this topic. How much do you think you currently know about climate change?

a) The hole in the ozone layer is the primary cause of global warming.	True	False	Don't know
b) The average temperature of the earth has increased significantly in the last 100 years.	True	False	Don't know
c) China is the largest emitter of carbon dioxide (the greenhouse gas that has been linked to global warming) in the world.	True	False	Don't know
d) The output from the Sun contributes to global warming more than greenhouse gases produced by people.	True	False	Don't know
e) Reducing human emissions of greenhouse gases will have an immediate effect on global warming with average global temperatures dropping in just a few years.	True	False	Don't know
f) Climate change is happening, and is mostly caused by human activities.	True	False	Don't know
g) Climate change is only defined as the rising of	True	False	Don't know

temperature of the earth's surface.

h) Climate change is partly caused by the increase in the emission of heavy metals.	True	False	Don't know
i) Rise in sea level and drought are some of the consequences of climate change.	True	False	Don't know
j) The ocean can absorb CO2 emitted by humans.	True	False	Don't know
k) Because of climate change, the water in sea and oceans will expand.	True	False	Don't know
l) Because of climate change, certain plants and animals may become extinct.	True	False	Don't know

13. Using that same scale from 0 to 10, please rate how much do you think the other people know about climate change? _____

14. For each of the following statements, please indicate if it is true or false.

15. How much do you agree with the following statements?

	strongly disagree					strongly agree	
a) When possible I would ride a bicycle or take public transportation to work or school in the next six months.	1	2	3	4	5	6	7
b) I intent to buy products in a refillable packages in the next six months.	1	2	3	4	5	6	7
c) Because of air pollution caused by auto-cars, I would avoid staying long on roads with a lot of traffic.	1	2	3	4	5	6	7
d) When cooking I would use a lid to cover the pot or pan to avoid wasting energy in the next six months.	1	2	3	4	5	6	7
e) I would buy products which come with minimal packaging in the next six months.	1	2	3	4	5	6	7
f) I would buy paper and plastic products that are made from recycled materials in the next six months.	1	2	3	4	5	6	7
g) I would use energy-efficient household devices in the next six months.	1	2	3	4	5	6	7
h) When there is haze, I would cut down my outdoor activities.	1	2	3	4	5	6	7
i) I would recycle used paper and plastic in the next six months.	1	2	3	4	5	6	7
j) When doing the laundry I would use more detergent than it says on the packing, to make sure that everything gets really clean in the next six months.	1	2	3	4	5	6	7
k) I intend to use less air-conditioning in the next six months.	1	2	3	4	5	6	7
l) I would avoid physical outdoor activity when the ozone concentration in the air is high.	1	2	3	4	5	6	7

m) I would take part in events run by environmental organizations, such as planting trees, picking up litter in the beach, etc., in the next six months.	1	2	3	4	5	6	7
n) I would sign a petition in support of promoting the environment in the next six months.	1	2	3	4	5	6	7
o) I would try to convince others of the importance of environmental protection in the next six months.	1	2	3	4	5	6	7
p) I intend to consider together with others how we can protect environment in the next six months.	1	2	3	4	5	6	7
q) I would contribute money to support an environmental group or organization in the next six months.	1	2	3	4	5	6	7

SECTION C

16. How much do you agree with the following statements?

	strongly disagree					strongly agree	
a) I know how to protect the environment, so that climate change can be mitigated.	1	2	3	4	5	6	7
b) I believe I can cope with the environmental problems related to climate change.	1	2	3	4	5	6	7
c) I am able to find ways to deal with problems caused by climate change, if I make an effort.	1	2	3	4	5	6	7

SECTION D: DEMOGRAPHICS

17. What is your age? _____

18. What is your gender? a) Male b) Female

19. What is your highest level of education completed?

- a) No formal education
- b) Primary 6 or below
- c) Some secondary
- d) N-level/ITE
- e) O-level
- f) A-level
- g) Diploma
- h) Degree
- i) Postgraduate

20. What is your marital status?

- a) Married
- b) Single
- c) Others

21. May I know your average monthly household income?

- a) \$1,000 or less
- b) \$1,001 to \$2,000
- c) \$2,001 to \$3,000
- d) \$3,001 to \$4,000
- e) \$4,001 to \$5,000
- f) \$5,001 to \$6,000
- g) \$6,001 to \$7,000
- h) \$7,001 to \$8,000
- i) \$8,001 to \$9,000
- j) \$9,001 to \$10,000
- k) \$10,001 to \$11,000
- l) \$11,001 to \$12,000
- m) Above \$12,000