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Cultural Factors Influencing Chinese Resident and Student Views on
Solar Photovoltaic Rooftop Adoption

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ABSTRACT

China's adoption rate of solar photovoltaic (PV) is lower than its production rate. This paper investigates cultural factors and their impact on PV adoption. Based on survey data collected from both residents and college students in China, there were differences in the percentages of agreement with the following dimensions between college students who had already installed PV systems and those who had not: power distance, individualism, masculinity, and long term orientation. Data also indicated that there were differences in percentages of agreement with masculinity and uncertainty avoidance between college students who had not already installed solar PV systems and residents.

KEYWORDS: Technology adoption, Customer Behavior, Global Development, Clean Energy, Sustainability

INTRODUCTION

China's Solar Photovoltaic (PV) Industry

China is ranked second in the world for energy consumption (Li & Zhang, 2007) and in great need of developing renewable energy to satisfy the growing energy need. Solar PV technology has been proven to be an effective and efficient way to reduce carbon emissions (Faiers & Neame, 2006); as such, With the UK at their helm, several countries have implemented policies to help promote solar energy systems and reduce carbon emissions (Faiers & Neame, 2005). Since 2012, China's Photovoltaic (PV) application market has been ranked the largest in the world, with the nation's annual PV grid connected installation capacity contributing to a quarter of the world's installation capacity (Fang, Honghua & Sicheng, 2014).

In addition to reducing carbon emissions, solar panels are designed with urban areas in mind (Hernandez, Hoffacker, & Field, 2015), making China's large cities leading areas for installations. This research concentrates on the adoption of distributed solar PV systems. Distributed systems are located at or near the source of where the energy being produced will be consumed (Distributed Solar, n.d.). Most often, residents install distributed solar PV systems on the rooftop of their homes. In contrast, centralized solar systems are commonly solar farms built in centralized locations. The energy produced from the vast number of solar panels is then outsourced to local buyers who purchase it at a standardized price (Utility-Scale Solar Power, n.d.).

However, as the study by Faiers & Neame (2006) indicates, barriers within the adoption and diffusion process do exist, despite the fact that PV systems are affordable and work to improve air quality by reducing the amount of pollution released into the atmosphere. China has a low adoption rate of solar PV systems despite the major beneficial factors this clean energy source can have on a highly-polluted region (Liu, Sun and Kaloustian, 2015). The purpose of this paper is to explore the cultural barriers of solar PV rooftop adoption, particularly among potential college student consumers (Millennial), and residents (Generation X), using first-hand data collected in China.

Generation X and Millennial Consumer Behavior

Generation X consumers have often been looked at as a "hard to reach" population when it comes to marketing new products or services (Richie, 1995). Although these consumers may have "differing social, economic, and cultural backgrounds, they understand the common needs of their peers to be successful, to value their heritage, to be a part of their chosen group" (Richie, 1995, pg 30). However, Generation X consumers do not have the same drive, demand, and hopes that the highly literate millennial Chinese citizens have. Also, Generation X consumers do not appear to be as interested in technology and innovative adoptions that the well-educated younger generation is demanding. They value their heritage and are less accepting of western ideas and products (Inside the Minds of a Chinese Consumer, 2006).

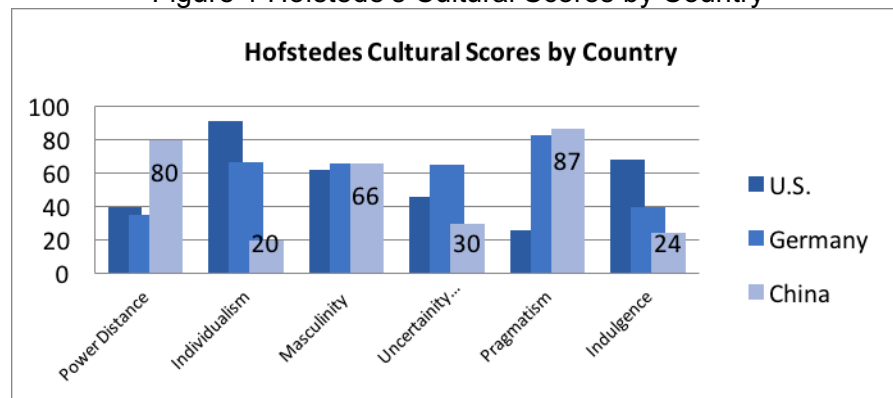
As a result of China's one-child-only policy, especially in urban areas between the late 1970s and 2010, children in China have begun to gain more authority within the household than they have historically had (Goh & Kuczynski, 2009). With many families having just one or two children, these children are becoming more valuable as their parents and grandparents grow older. Today, more respect is given to children because they are expected to support three generations in the future. This newfound sense of importance within the family is allowing children to be more assertive and dominant within the household (Goh & Kuczynski, 2009). The younger generation can now utilize their power to advocate for their own beliefs, which is beneficial if they are adopting the green lifestyle. Younger generations could not only be the future leaders in adopting solar PV systems, but they can also be at an advantage in persuading their elders to switch to a solar PV system – an environmentally-friendly product and a smart financial investment as well.

Hofstede's Cultural Dimensions

A culture's values can influence an individual's behavior (Hofstede, n.d.). Geert Hofstede defines six cultural factors that distinguish national cultures, factors that can have an impact on individual behavior (Hofstede, n.d.). These six cultural dimensions are power distance,

individualism, masculinity, uncertainty avoidance, and long-term orientation. Hofstede designed a full version score system, which evaluated all these six factors in different nations (Hofstede & Minkov, 2013). These national scores can be used to compare and further analyze similarities and differences between countries; this paper specifically analyzes the cultural factors of China (Refer to Figure 1) with regard to PV adoption behaviors. It is important to note here that these factors are not intended to essentialize and reduce complex webs of relationships into simplistic and static behaviors that are representative of entire nations; however, patterns can be observed from large population samples, and these patterns that Hofstede has identified should be seen as guiding markers of cultural factors, rather than as absolute truths.

Figure 1 Hofstede's Cultural Scores by Country



Data sources: <http://geert-hofstede.com/national-culture.html>

Based on surveys distributed to different international population among 76 different counties and regions in 2010, Table 1 shows the Hofstede's cultural scores of the US, Germany and China. Explanations and breakdowns of China's national score are presented here. Power Distance is defined as the extent to which people accept unequal power distribution. Those who rank high in power distance understand the hierarchical system in place and accept that they have less influence on society. China has a high power-distance, ranked at 80 out of 100.

An individualistic society is defined as one in which the ties between individuals are loose. In contrast, China is a very collective nation which reflects the low score of 20. Generations are raised under the same roof and their main priority is to care for one another, as opposed to other nations, such as the US, which seems to have a more individualistic approach within society.

Masculinity is defined as a society in which gender roles are clearly distinct. In China, men act as the dominant figure and hold a majority of the power, making China a very masculine nation. According to Hofstede's dimensions, China ranks at 66 out of 100 for masculinity.

Uncertainty avoidance is the extent to which the members of institutions and organizations within a society feel threatened by uncertain situations. China ranks low in this category with an overall score of 30. Chinese residents are comfortable with ambiguity and learn to adapt when change is necessary.

Long-term orientation (Pragmatism) refers to a society that fosters virtues, oriented towards future rewards. China is a nation that is always looking toward the future and the advancements that can be made to enrich the nation. This is reflected as the highest-ranking value with an overall score of 87 out of 100.

Indulgence is defined as a society that allows relatively free gratification of some desires and feelings. Historically, China ranks very low overall as a nation in this category with only a score of 24 out of 100. Citizens tend not to indulge in desires that are not necessities.

In sum, Hofstede's research indicates that China, as a whole, ranks high as a power driven, masculine society that focuses on the long-term orientation of actions. Additionally, China is a collective nation that is influenced by family as opposed to individual gains. Furthermore, it ranks low in uncertainty avoidance and indulgence. (See the Figure 1)

In order to understand Chinese occupants' views on solar PV rooftop adoption, it would be beneficial to look at them through Hofstede's cultural dimensions lens. With China experiencing large amounts of pollution in its major cities, the data originates from surveys distributed in Shanghai and Beijing, China. Specifically, this research focuses on the Millennial college student generation, and the Generation X residents.

LITERATURE REVIEW

Factors Influencing Technology Adoption and Solar PV Adoption

When consumers consider adopting a new technology before they fully invest in a new system, they undergo five phases: 1. Knowledge, 2. Persuasion, 3. Decision, 4. Implementation, and 5. Conformation (Faiers & Neame, 2006). The most important stages of the adoption process are educating future consumers (phase 1) and then persuading them (phase 2) to make the conversion to a more technologically advanced PV system. Individuals who are educated and informed about the benefits of the system will be easier to persuade than those who are uninformed.

Research in the field has considered various factors to be influential in shaping potential consumers' decision processes in solar PV adoption. Kaplan (1999) conducted an empirical analysis on how government policies impacted a consumer's willingness to adopt solar PV panels. The study went on to discuss that potential consumers are skeptical to convert to solar PV systems due to a lack of confidence in the systems, as well as their poor aesthetic appeal (Faiers & Neame, 2005). Recently, more studies conducted looked at individuals' attitudes toward adoption in comparison to their social, educational, and economic backgrounds, as well as lifestyle choices. Fraj and Martinez's (2006) empirical study concluded that those who are striving to fulfill an ecological lifestyle are more apt to installing a solar PV system in their home. Yuan, Zuo and Ma (2010) collaborated on a survey questioning residents in Jinan City, Shandong province China about various solar energy systems and their viewpoints on adoption. The research concluded that while the idea of implementing solar energy systems is accepted, solar water heaters are favored over solar photovoltaic systems due to.... Furthermore, income, age, and education were discovered to play a large role in explaining why solar PV systems are not being implemented, despite the levels of awareness the public has about the system. A

study by Islam (2014) further claimed that “younger households who have a higher awareness level and are less sensitive to cost-related factors are prone to higher early adoption rates” (p. 348). Apart from these few studies, there is very limited research studying the relationship between cultural factors and solar PV adoption.

Cultural Factors Influencing Adoption

Hofstede examined employee survey and interview responses in the workplace to see how their values were influenced by culture (Hofstede & Minkov, 2013). He provided national rankings for each country for each of his six established cultural dimensions. To date, there are rankings for 73 countries. Liu, Sun and Kaloustian (2015) followed the framework of Hofstede (Hofstede & Minkov, 2013) and elaborated on all the cultural factors and potential influences on the solar PV adoption based on the context of China. This paper aims to explore the potential influences identified through a survey modeled off of Hofstede and Minkov’s published Values Survey Module 2013 Questionnaire.

Chinese Millennial Generation

There is a general belief that the younger generations are more likely to adopt solar PV systems. Labay and Kinnear’s work (1981) established that the most likely adopters of a solar PV system are young, educated people. By dividing potential adopters into various categories, results concluded that education, income level, and being a younger member of the family are characteristics of those most likely to adapt to a solar PV system. Younger generations categorize the benefits of solar energy to fall more in line with their personal values and consciousness for the environment. Millennials are usually believed to be more likely to adopt because of their knowledge and education about solar energy and the benefits it has on the environment. Still, low adoption rates persist, which Islam (2014) attributes to the lack of knowledge potential consumers may have regarding the new technology. Also, older generations could potentially be hesitant to invest in a more technologically advanced heating system when they have been using a familiar and traditional source their entire life. Moreover, older generations of Chinese residents have not been found to possess the same ecological behavior traits that younger generations are being introduced to (Fraj & Martinez, 2006). In fact, a study conducted by Chen (2014) in Taiwan supports the idea that younger residents are being raised in a culture where there is a strong push to live an environmentally conscious life. Furthermore, consumer innovativeness and the willingness to experiment with new things are key characteristics in young adults willing to adopt solar photovoltaic products.

Our Contribution

Our research complements previous research with an empirical study that collected and investigated first-hand data in China. More specifically, our research addresses a gap in the research by shedding light on the viewpoints and opinions of young Chinese citizens, namely the Millennial generation with higher education (college students) that is being raised in a world centered on global warming and pollution debates. This paper researches current Chinese college students’ and residents’ attitudes to these fundamental cultural factors and further investigates how these factors influence different generations’ willingness to adopt solar PV systems. Unlike in previous studies, the survey for this study was designed for and distributed to

a large variety of Chinese occupants who reside in both urban and rural areas and have varying demographic backgrounds.

METHODOLOGY

The data for this project was collected during a three-week research trip in China in the summer of 2016 through surveys distributed to college students and residents. Data were collected from students at two Universities: Shanghai Normal University and Beijing Jiaotong University. By visiting undergraduate and graduate student classrooms, our research team was able to collect 453 completed surveys. This survey consisted of 51 questions with a majority of them relating to Hofstede's cultural dimensions. There was also a section focused on demographics such as age, income, and education. A shorter version of the survey was distributed to residents at local tourist attractions in Shanghai and Beijing. The survey consisted of 24 questions, all of which were also asked on the college student survey. Residents were approached in busy areas of the city such as shopping centers and tourist locations and were asked to participate by taking the survey.

We strategically chose to visit universities and tourist attractions to ensure a variety in the demographics of participants. Many of the surveyed college students have traveled from all over the nation to attend these two major universities, which provides for a wide array of geographic backgrounds. Moreover, many of the residents surveyed at the tourist attractions were visiting the sites from other areas in the country, further expanding our range of responses. These locations ensured that not everyone surveyed lived locally in Shanghai and Beijing, but instead created a mix of rural, suburban, and urban upbringings.

The college student survey was distributed in English since many of the students have had over ten years of experience learning the language. However, since many of the Generation X respondents are not fluent enough in English to comprehend the survey, they were given surveys in Mandarin and the results were later translated into English. Prior to the completion of the survey, all participants received a brief explanation of the purpose of the survey and agreed to participate. In total, 452 college students and 63 residents filled out the questionnaire. The results of both generations were compared to show any significant differences between the two.

All of the collected data were entered into an Excel data sheet and imported into SPSS. Conducting basic cross-tab analysis on each cultural factor, as well as hypothesis tests, this research compares and contrasts Chinese college students' and residents' viewpoints about solar PV adoption based on cultural factors.

HYPOTHESES

As there is a lack of studies that investigate cultural factors in the solar PV industry, this paper focuses on the influence that cultural factors may have on adoption for both college students and the residents surveyed. The following two sets of null hypotheses were proposed for each cultural factor and were tested for accuracy:

H0: Comparing the group of college students who installed solar PV systems with the group who did not, there is no percentage difference in level of agreement with the given statement.

H0': Comparing the group of college students who did not install solar PV systems with the group of *residents* who did not install, there is no percentage difference in the level of agreement with the given statement.

SURVEY DESIGN

The surveys distributed were designed to assess how significant Hofstede's cultural dimensions were in influencing participants' viewpoints on solar rooftop PV adoption. The survey had three parts: questions about current solar PV adoption, cultural dimensions, and demographics. The cultural factor questions were adopted from Hofstede's cultural dimensions' framework (Hofstede & Minkov, 2013). Every question has a 1-5 likert value scale. In most questions, participants were asked on a 1-5 scale how much they agreed or disagreed with a given statement. Other questions aimed to evaluate the importance of statements with the response of 5 signifying utmost importance and a response of 1 signifying lowest importance.

RESULTS

Demographics of College Students

In total, there were 453 college students who answered the survey at both universities. There was an equal representation of gender with 48% of respondents being female and 52% male. All participants have had K-12 schooling and are currently in the process of earning either a graduate or undergraduate degree. The most popular major was Engineering with approximately 57% of all students studying this field, followed by Business and Humanities. Almost 93% of students stated they do not work while in school and are instead supported by their families; a common societal norm for Chinese students.

Table 1 indicates the demographics of the college student respondents.

Table 1: Demographics of College Student Participants

Characteristic	Range	Percentages(%) (N= 453)
Age	Under 20	40.13
	20-30	59.42
	31-40	01.11
Gender	Male	48.00
	Female	52.00
Main Occupation	Do Not Work	92.87
	Part Time Job	07.13
Major	Science	14.21
	Engineering	56.76
	Humanities	39.98
	Business	16.85
	Other (Law, Medical)	12.20
Geographic	North China	28.86
	Northeast China	06.26
	East China	31.10
	Southwest China	06.26
	Northwest China	06.49
	South Central China	21.93

Sixty-three residents were surveyed on the streets of Beijing and Shanghai, China. There was an even ratio of male to female participants and approximately 75% of them had at least some level of college education. The average income for those surveyed was between 60,000-200,000 RMB (\$8,700- \$29,000 USD) and 46% reported living with family members. Overall, a variety of geographic locations was covered, with 24% reporting living in North China, 36% living in East China and 22% living in South China.

Table 2 below indicates the demographic characteristics of the resident-respondents.

Table 2: Demographics of Resident Participants

Characteristics	Range	Percentage from Residents % (N=63)
Age	Under 20	03.51
	20-30	63.16
	31-40	15.79
	41-50	08.77
	51-60	03.51
	61 and over	05.26
Gender	Male	49.20
	Female	50.80
Highest Education	Primary School	03.33
	High School	25.00
	Some College	26.67
	Bachelor Degree	31.67
	Graduate Degree (Masters and Above)	11.67
Main Occupation	Have no work	05.00
	Unskilled or semi-skilled manual worker	18.33
	Professional	11.67
	Management	30.00
	Other	35.00
Income Range	0-60,000 RMB	42.86
	60,000-200,000 RMB	37.50
	200,000-400,000 RMB	08.93
	Above 400,000 RMB	07.14
Living Arrangement	Own a detached home	08.47
	Own an apartment/condo	23.73
	Renting	18.64
	Living with family	49.15
Geographic	North China	25.00
	Northeast China	06.67
	East China	38.33
	Southwest China	00.00

	Northwest China	05.00
	South Central China	23.33
	Other	01.67

Cross-tab Analysis Results

Cross-tab analyses were applied to establish which cultural factors had an impact on respondents' viewpoints of solar rooftop PV adoption. These cross-tab analyses were conducted for each group surveyed and broken down by cultural dimensions. They were then compared to identify significant differences in the results. Refer to Tables 3 through 14 for breakdowns of each factor and the influence they had or did not have on solar PV adoption.

Power Distance

In terms of Power Distance, the following question was selected for analysis: "Be consulted by your boss in the decision involving your work". The questions on the survey relevant to this value asked participants to rate on a scale of 1-5 how important certain personal issues were to them. If they believed it is important, it means they do not agree with power distance, and instead are looking for some equality in the division of power. Those who answered with disagree or strongly disagree were deemed to be more accepting of inequality.

Table 3: Cross-tabulation on Power Distance: College Students

College Students	Be consulted by your boss in decision involving your work					
Response	Of little or no importance	Of little importance	Of moderate importance	Very Important	Of utmost importance	Total
No	1.67%	10.12%	39.94%	38.29%	9.92%	100.00%
Yes	3.53%	43.53%	40%	7.1%	4.71%	100.00%

Data indicated that a majority of college students who had already installed solar PV systems agreed with this statement and, in turn, disagreed with power distance. In total, 26.32% of students who had already adopted a solar PV system responded to this question with "very important" or "of utmost importance," suggesting that they found power distance to be of little importance. Of those who answered "no" to having solar PV systems installed on their homes, 29.63% agree with this statement, showing that they do not agree with power distance.

Table 4: Cross-tabulation on Power Distance: Residents

Residents	Be consulted by your boss in decision involving your work					
Response	Of little or no importance	Of little importance	Of moderate importance	Very Important	Of utmost importance	Total

No	5.56%	12.96%	37.03%	29.63%	14.82%	100.00%
Yes	0.00%	40.00%	0.00%	20.00%	40.00%	100.00%

Data indicated that residents who had already installed solar PV systems in their own living situation agreed with this statement, opposing the idea of power distance. In total, 40% of those who answered “yes” found this to be of little importance, while 60% found it important, indicating they do not agree with power distance. Of those who had not already installed a solar PV system on their home, nearly 70% found this to be important, also indicating that they disagree with power distance.

6.2.2 Individualism

In terms of individualism or collectivism, the responses for the question “If a coworker gets a prize, I would feel proud” were analyzed. Participants were asked on a 1-5 scale how much they agreed or disagreed with the statement, “If a coworker gets a prize, I would feel proud.” If participants strongly agreed with this statement, it indicates that they have collectivist views as opposed to individualistic ones. If they agreed or strongly agreed, they are collectivists; otherwise, they would be individualists.

Table 5: Cross-tabulation on Individualism: College Students

College Students	If a coworker gets a prize, I would feel proud					
Response	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
No	2.45%	10.08%	19.35%	52.04%	15.80%	100.00%
Yes	1.18%	7.06%	9.41%	63.35%	20.00%	100.00%

The results of the individualism question show that a majority of the college students surveyed have a collectivist viewpoint. This result was expected when considering China’s high overall ranking as a collectivist nation. Eighty-three point thirty-five percent of students who had already installed solar PV panels agreed with this statement, signifying that they have a collectivist perspective. Those who had not already adopted a solar PV system also agreed with this statement. In total, 67.84% agreed with the statement.

Table 6: Cross-tabulation on Individualism: Residents

Residents	If a coworker gets a prize, I would feel proud					
Response	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
No	1.82%	3.64%	23.64%	52.73%	18.18%	100.00%
Yes	0.00%	0.00%	25.00%	75.00%	0.00%	100.00%

Similar to the college students, the residents' responses indicated a collectivist viewpoint, which was expected considering the national ranking for the country. In total, 75% of all respondents who had already adopted a solar PV system agreed with this statement. It is also important to note that of the participants who had adopted solar PV systems, none disagreed with the statement, but 25% of respondents remained undecided. Of those who had not adopted a solar PV system, 70.91% agreed with the given statement and 5.46% disagreed. Overall, roughly 75% of residents agreed with this statement, strongly suggesting that they have collectivist viewpoints.

6.2.3 Masculinity

In order to understand if participants have masculine viewpoints, survey participants were asked how important a variety of questions were to them. The question that was the same on both surveys and specifically focused on masculinity asked participants to rate how important they viewed the phrase: "have chances for promotion." Those who answered that this statement was important to them are more apt to have the same masculine outlook on life as Hofstede determined in his high masculine rating for China.

Table 7: Cross-tabulation on Masculinity: College Students

College Students	Have Chances for Promotion					
Response	Of little or no importance	Of little importance	Of moderate importance	Very Important	Of utmost importance	Total
No	3.54%	5.45%	12.81%	43.33%	34.88%	100.00%
Yes	0.00%	4.71%	8.34%	48.24%	38.82%	100.00%

When considering China's high ranking as a masculine nation, it was expected that a majority of students would agree with the aforementioned statement and the idea of a masculine society. Of the students who had already adopted solar PV panels, 87.06% agreed with the given statement, representing a masculine viewpoint. Similarly, 78.21% of students who had not adopted solar PV systems also found this statement to be important signifying they strongly agreed with a masculine society.

Table 8: Cross-tabulation on Masculinity: Residents

Residents	Have Chances for Promotion					
Response	Of little or no importance	Of little importance	Of moderate importance	Very Important	Of utmost importance	Total
No	10.87%	13.04%	18.48%	36.96%	20.65%	100.00%
Yes	0.00%	0.00%	25.00%	87.50%	0.00%	100.00%

As expected, many of the survey residents found the statement, “have chances for promotion” to be important, showing their acceptance for a masculine society. Of those who had already adopted solar PV panels, 87.5% of participants agreed with the statement and approximately 57% of those who had not adopted agreed as well. These responses support Hofstede’s ranking of China’s high masculine values.

Uncertainty Avoidance

The question relevant to Uncertainty Avoidance asks how much participants agree or disagree with the statement: “One can be a good manager without having a precise answer to every question that a subordinate may raise about his or her work.” If participants strongly disagreed with this statement, it shows they strongly avoid uncertainty because they believe that a good manager needs to have a precise answer to every question so that the system functions well, and vice versa if they did agree with the statement.

Table 9: Cross-tabulation on Uncertainty Avoidance: College Students

College Students	One can be a good manager without having a precise answer to every question that a subordinate may raise about his or her work					
Response	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
No	4.96%	23.97%	33.06%	33.61%	4.41%	100.00%
Yes	4.82%	31.58%	33.73%	31.33%	6.02%	100.00%

When answering the questions on uncertainty avoidance, about one third of all students were undecided on this topic. However, 28.93% of students who had already adopted and 36.40% of those who had not adopted disagreed with this statement strongly or somewhat. However, when comparing these percentages to those who agreed with the statement, those who had not adopted a solar PV system and those who had had agreement rated 38.02% and 37.35% respectively. These percentages are fairly even and the remaining one third of participants answered “undecided”, making it difficult to argue a strong favor one way or another.

Table 10: Cross-tabulation on Uncertainty Avoidance: Residents

Residents	One can be a good manager without having a precise answer to every question that a subordinate may raise about his or her work					
Response	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
No	10.91%	5.45%	32.73%	38.18%	12.73%	100.00%
Yes	0.00%	20.00%	40.00%	40.00%	0.00%	100.00%

Approximately 50% who had not adopted a solar PV system on their home agreed with the statement, “One can be a good manager without having a precise answer to every question that a subordinate may raise about his or her work.” Of the residents who had adopted a solar PV

system, only 20% disagreed with the statement and 40% agreed, while another 40% answered “undecided.”

Long Term Orientation

When looking at long-term orientation, the statement, “Frugal (not spending more than needed)” was analyzed. By answering with a one, the participant indicated they are not frugal, and with a five they are very cautious with their spending habits. Those who agreed with this statement are focused on long-term orientation; are always thinking about the future; and are always considering how to be prepared for any situation.

Table 11: Cross-tabulation on Long-term Orientation: College Students

College Students	Frugal (not spending more than needed)					
Response	Not Important	Of Little Importance	Of Moderate Importance	Very Important	Of Utmost Importance	Total
No	2.18%	14.71%	45.23%	28.24%	9.54%	100%
Yes	7.14%	10.71%	36.90%	34.52%	10.71%	100%

When answering the question regarding frugality, 45.23% of students who had adopted and 37.78% of those who had not believed that being frugal is important. This reflects the nation’s viewpoint about long-term orientation. The future needs to be considered and individuals need to be prepared for a future event that may cause unforeseen costs.

Table 12: Cross-tabulation on Long-term Orientation: Residents

Residents	Frugal (not spending more than needed)					
Response	Not Important	Of Little Importance	Of Moderate Importance	Very Important	Of Utmost Importance	Total
No	3.77%	11.32%	43.40%	22.64%	18.87%	100.00%
Yes	0.00%	0.00%	50.00%	50.00%	0.00%	100.00%

Half of the residents surveyed who had adopted, agreed with the idea of being frugal and living a modest lifestyle. This percentage is slightly higher in comparison to the participants who had not adopted a solar PV system. Of those who had not adopted, 41.51% agreed and 43.4% remained undecided on their opinion regarding this concept. These results were expected when taking into consideration China’s very low ranking for the indulgence factor (results below). Chinese residents are used to living modestly and not indulging on items they do not need or cannot afford.

Indulgence

Indulgence is defined as a society that allows some desires and feelings. The question selected on the survey relevant to the value of indulgence asked participants to rate on a scale of 1-5 how much they agreed with the statement: “Moderation: having few desires.” If they agreed or

strongly agreed, it means they show some restraint and do not indulge on all of their desires and feelings. Those who did not agree with the statement agreed with the indulgence factor.

Table 13: Cross-tabulation on Indulgence: College Students

College Students	Moderation: having few desires					
Response	Not Important	Of Little Importance	Of Moderate Importance	Very Important	Of Utmost Importance	Total
No	2.19%	13.11%	39.89%	37.43%	7.38%	100.00%
Yes	5.95%	10.71%	39.29%	38.10%	5.95%	100.00%

Less than half of all students surveyed agreed with this statement, thus representing an approach of restraint. This is consistent with China's low ranking of 30 on the indulgence scale. In total, 44.05% of students who had adopted solar PV panels and 44.81% of those who had not adopted agreed with this statement, thus suggesting restraint as opposed to indulgence.

Table 14: Cross-tabulation on Indulgence: Residents

Residents	Moderation: having few desires					
Response	Not Important	Of Little Importance	Of Moderate Importance	Very Important	Of Utmost Importance	Total
No	1.85%	9.26%	50.00%	22.22%	16.67%	100.00%
Yes	0.00%	40.00%	40.00%	20.00%	0.00%	100.00%

Of those who had not installed a solar PV system, 50% found this statement to be moderately important and 38.89% found it to be important. Of those who had adopted, 40% stated that this statement was moderately important to them and 20% found it important. When compared to college students, college students who had adopted showed more restraint than the residents.

Summary of Results

Table 15: Summary of Results Regarding Cultural Factors

	Residents N=63		College Students N=453	
	Install	Not Install	Install	Not Install
Power Distance	60.00%	44.45%	11.81%	48.21%
Individualism	75.00%	70.91%	83.35%	67.87%
Masculinity	87.50%	57.61%	88.06%	78.21%
Uncertainty Avoidance	40.00%	50.91%	37.35%	38.02%

Long Term Orientation	50.00%	41.51%	44.93%	37.78%
Indulgence	20%	38.89%	44.05%	44.81%

Hypotheses Testing

Based on the summary results as presented in Table 15, we conducted the two-tail hypotheses tests to see 1) whether there is a difference in percentages of agreement with each cultural dimension between college students who had already installed solar PV systems with those who had not; and 2) whether there is a difference in percentages of agreement with each cultural dimension between college students who had not already installed solar PV systems and the group of residents who had. The p-value results are listed in Table 16.

Table 16: Results of Two-tail P-Values by Factor

	Students Installed vs. Students Not Installed	Students Not Installed vs. Residents Not Installed
Power Distance	<.0002**	.5837
Individualism	<.0002**	.7414
Masculinity	<.0002**	.0003**
Uncertainty Avoidance	.8368	.0394*
Long Term Orientation	.0309*	.5899
Indulgence	.8407	.9623

Power Distance

In the first null hypothesis test, we compared the percentage of agreement with the power distance factor of the college students who had already installed solar PV systems (11.81%, see Table 15) with the group that had not installed solar PV systems (48.21%, see Table 15). Since the p-value is less than 0.0002 (See Table 16), the null hypothesis is rejected; what is more, the difference is significant.

In the second hypothesis test, the percentage (48.21%, see Table 15) of the group of college students who had not installed solar PV systems was compared to the percentage (44.45%, see Table 15) of the group of residents who had installed solar PV systems; our objective was to see whether or not there was a difference in the percentage of each group regarding the power distance statement. Since the p-value was 0.583 (See Table 16), we cannot reject the hypothesis. The two groups have no difference in agreement with the statement. Based on this, we can conclude that there is no difference in perceptions of power distance between these two groups.

Individualism

In the first null hypothesis test, the percentage of the group of college students who had installed solar PV systems (83.35, see Table 15) was compared with the percentage of the group who had not installed solar PV systems (67.87%, see Table 15) with regards to the individualism statement. Since the p-value was less than 0.0002 (see Table 16), the null hypothesis was rejected; there is a significant difference between the two groups. A further analysis was done to determine whether the percentage of agreement of college students who had already installed solar PV is higher than that of the college students who had not installed.

In the second hypothesis test, we compared the percentage of agreement of college students who had not already installed solar PV (67.87%, see Table 15) with the percentage of disagreement of the group of residents (70.91%, see Table 15) with regards to the individualism statement. Since the p-value is 0.7414 (see Table 16), we could not reject the null hypothesis. Based on this, we can conclude that there is no difference in perceptions of individualism between these two groups.

Masculinity

When comparing the percentages of the group of college students who had already installed solar PV systems (88.06%, see Table 15) with the percentage of college students who had not (78.21%, see Table 15) to see whether there was a difference regarding the statement on individualism, we found that the p-value is less than 0.0002 (see Table 16) and the null hypothesis was therefore rejected. The difference between the two is significant.

The second hypothesis test compared the percentage of agreement of college students who had not installed solar PV systems (78.21%, see Table 15) with the percentage of residents who had (88.06%, see Table 15) to determine whether or not there is a difference with regards to individualism. Since the p-value is 0.0003 (see Table 16), and as such considered significant, the null hypothesis was rejected.

Uncertainty Avoidance

When the percentage of agreement with the uncertainty avoidance statement between college students who had already installed solar PV systems (37.35%, see Table 15) was compared to those who had not (38.02%, see Table 15), it was determined that the p-value is 0.8368 (see Table 16). The hypothesis was not rejected; Therefore, there is no difference for the two groups regarding uncertainty avoidance.

The second hypothesis test compared agreement with the uncertainty avoidance statement between the college students who had not installed solar PV systems (38.02%, see Table 15) with the residents who had (50.19%, see Table 15). Since the p-value is 0.0394 (see Table 16), and as such considered significant, the null hypothesis was rejected.

Long Term Orientation

The first null hypothesis test compared the percentage of agreement with the long-term orientation statement between the college students who had already installed solar PV systems (44.93%, see Table 15) with the group who had not (37.78%, see Table 15). Since the p-value is 0.0309 (see Table 16), and as such considered significant, the null hypothesis was rejected. A further analysis was done to determine the difference between the two. The p-value is 0.013, suggesting that the students who had installed solar PV showed significant long-term orientation compared with the students who had not.

In the second hypothesis test, regarding long-term orientation, the percentage of college students who had not installed solar PV systems (37.78%, see Table 15) was compared with the percentage of the residents who had not (41.51%, see Table 15). Since the p-value is 0.5899 (see Table 16), the hypothesis was not rejected. The two groups have no difference in agreeing with this statement, suggesting that there is no difference in the long-term orientation.

For people who had not installed solar PV systems, whether college students or residents, there was no difference regarding long-term orientation.

Indulgence

The first null hypothesis test compared the percentage of agreement with the indulgence statement between the college students who installed solar PV systems (44.05%, see Table 15) with the group who had not (44.81%, see Table 15). Since the p-value is 0.8407 (see Table 16), the null hypothesis was not rejected. There was no significant difference.

In the second hypothesis test, the percentage of agreement with the indulgence statement between the college students who had not installed solar PV systems (44.81%, see Table 15) was compared with the percentage of the residents who had not (38.89%, see Table 15). Since the p-value is 0.9623 (see Table 16), the null hypothesis was not rejected. The two groups had no difference in agreeing with indulgence.

CONCLUSION

There is a limited percentage of installation of solar PV rooftop systems among residents and college students. When comparing college students who installed solar PV systems with those who had not, there were differences in perceptions of four of the six investigated cultural dimensions: power distance, individualism, masculinity, and long-term orientation. It was expected that there would be a difference in masculinity because our assumption was that college students who are more competitive are more likely to install solar PV panels. Further, college students who have long-term orientations would be more focused on saving money in the future and would be more willing to make the investment now to install a PV system. In terms of power distance, the difference in percentage indicated that of those who have adopted a solar PV system are more likely to have democratic viewpoints as opposed to the viewpoints that have traditionally been prevalent in China.

When comparing the group of college students who had not installed solar PV systems with the group of residents who had not installed, there were differences in perceptions of two of the six investigated cultural dimensions: masculinity and uncertainty avoidance. It was expected that college students who are well-educated might be more ambitious and open to new technologies that may help them succeed later in life. However, it was the residents who agreed more with the idea of uncertainty avoidance. This indicated that they are more likely to take risks than are college students. This could be because they are more established in life, have more money, or are less aware/knowledgeable on the impact of the transition.

LIMITATIONS AND FUTURE RESEARCH

There were several limitations to this research. The Chinese college students' survey was distributed in English. Despite the students' extensive knowledge and understanding of this language, there were still some sentences or words the students may not have fully understood. Although we discouraged it, we still noticed some students working together to translate and interpret the survey, resulting in a few surveys with identical answers. Further, there were a limited number of resident surveys completed. The low number of participants cannot fully represent the entire Chinese X generation or population. Finally, there was only one question for each factor that appeared on both the college students' and residents' surveys. Obviously, the one question was just one indicator of the participants' cultural viewpoints.

For future research, more in-depth linear regression could be done. Preliminary analysis showed no interesting or noteworthy results, but a more detailed analysis could provide more insightful results. Also, other relevant questions from Hofstede's survey (?) could be asked to obtain a more accurate representation of each cultural factor.

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