UNDERSTANDING SUSTAINABILITY IN AN EMERGING CHINA

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Table of Contents

Abstract

Resource depletion from human activity is placing tremendous pressure on the planet. Global climate change is taxing both environmentally and economically, and is arguably the most pressing issue in public health today. Individual environmental impact is largely based on lifestyle choices on housing, transportation, and food. These choices are more than a matter of taste; they are the embodiment of one's values. Identifying these values is essential to finding motivators for societal behavior change. The first half of this paper uses a literature review to assess the current effects of global climate change in China and societal barriers towards sustainability. Using survey data, the second half of this paper discusses trends between Chinese and American lifestyle preferences to explore if there are significant cultural differences embodied in everyday choices. Prioritizing behavioral, infrastructural, and policy changes in China based on their preferences will streamline implementing sustainability initiatives in high impact sectors.

Keywords: sustainability, China, lifestyle preferences, housing, transportation, food

Understanding Sustainability in an Emerging China

Part I: The Current State of Affairs

A Wicked Problem

Global climate change is arguably the most pressing challenge that our generation will have to face – not only for the environment, but also for the economy and public health. Worldwide, awareness on the impacts of climate change is increasing, but not enough is being done to ensure a sustainable future. Climate change is a multifaceted problem that affects everyone to varying degrees, but is extremely difficult to tackle. China is a crucial player in influencing global climate change, both positively and negatively, and its actions have ramifications worldwide.

In this paper, I will provide a sweeping overview of climate change and its effects in China. Using a literature review, I will offer a few reasons explaining why climate change has not been effectively addressed thus far, and argue that China is at the perfect crossroads to play a leading role in reducing carbon emissions and in creating more sustainable lifestyles. Following understanding a broad view of sustainability in China today, I then move on to address how societal behavior change coupled with infrastructure and policy changes is a powerful tool towards sustainability. Finally, I will describe a survey I conducted with Chinese and American participants on lifestyle preferences. The data will allow me to examine specific areas that may be targeted by behavioral modification, new legislation, and structural changes to create high impact transformations for lower impact on the earth.

Before discussing strategies to mitigate and adapt to climate change, it is important to define global climate change and some of its effects. Global warming is an increase in the average temperature of the earth's atmosphere, which contributes to long-term changes in

weather patterns such as temperature, precipitation, or wind; this is global climate change. As earth's overall temperature rises, there are increased risks of extreme weather events such as heat waves, floods, or hurricanes. "Rare" weather events are becoming increasingly common, causing direct physical harm and requiring many resources for recovery. However, global climate change also causes less conspicuous but potentially more damaging effects, such as changes in infectious disease dynamics, long-term drought conditions, or increasing salinization of drinking water from rising sea levels (Campbell-Lendrum, Corvalán, & Neira, 2007). Once recognized, these gradual shifts are often seen as unfortunate but isolated problems, and the immensity of the problem is not fully realized until viewed from the macro-level.

Although some climate change may be due to natural factors, CO_2 emissions from industrialization have accelerated rising temperatures at unprecedented rates. Human activities including burning fossil fuels, deforestation, and urbanization change both the earth's surface and its atmospheric composition. When fossil fuels are burned, CO_2 is released and more heat is trapped within the atmosphere. In China, energy consumption and CO_2 emissions have nearly doubled every 5 years over the last 2 decades, leading China to surpass the United States as the top CO_2 emitter worldwide in 2007 (Hubacek, Feng, & Chen, 2011). China's large impact on the environment is what first peaked my interest in studying methods to mplement sustainability in China. If creative solutions are successfully applied there, the impacts will be felt worldwide.

Even though China is a very large contributor to climate change, it also suffers from many of its negative consequences with the environmental ramifications closely tied in with economic consequences. It has been estimated that coping with the damages from extreme weather alone could cost China $1.2 trillion by 2030 (Harvey, 2012). This price tag does not account for other effects of climate change. For example, China has been experiencing more

extreme temperatures in conjunction with its industrialization. In the last 100 years, China has experienced higher temperatures overall, especially in the last 50 years (Li, 2013). With longer summers and higher temperatures, energy use with cooling appliances such as refrigerators and air conditioning has increased (Li, 2013). Ironically, this energy use leads to more global warming, which creates a cycle that distances humans from their physical environments and the effects of their collective actions. Furthermore, higher temperatures increase demand for water. In a study of urban water usage in Xi'an from 1978 to 2007, researchers found that every 1°C increase in average urban temperature led to a 1.093 m^3 increase in water consumption per person per year (Zhang, Dong, Yan, & Yan, 2009). China has only about 1/5 of the water per capita as the United States, and heat will cause more water losses from evaporation (Jacques, 2009). Increased demand on limited resources puts a strain on those who provide access to energy and water to the public.

Rising global temperatures also causes sea levels to rise, which is dangerous considering many of China's largest cities are on the coast. Between 1980 and 2014, China's coastal regions have had an annual sea level increase of 3 mm, which is a higher rate than the world average (China's sea level, 2015). This may cause salinization of drinking water, requiring financial and material resources to reverse. Moreover, massive cultural and economic centers such as Tianjin, Shanghai, Hangzhou, Guangzhou, and Shenzhen are all near the coast (Li, 2013). Coastal access has allowed for a high influx of resources and the foreign interaction required for economic growth, but also puts these cities at a higher risk for storm surges, flooding, and potentially eventually being erased by rising sea levels. China's economy would suffer greatly if these commercial centers deteriorated or had to divert considerable resources to mitigate damages from flooding.

Food cultivation for a growing population has contributed heavily to environmental degradation, but is also endangered by changes in precipitation from climate change. China is not rich in most natural resources; it has 8% of the world's cultivated land, but must sustain 22% of the world's population (Jacques, 2009). In an effort to boost the amount of arable land, half of China's forests have been destroyed over the last 40 years (Jacques, 2009). Similarly, overgrazing has caused deserts to expand in the north and the west. Although deforestation and overgrazing allow for short-term gains for agriculture, in the long term the resulting desertification and soil degradation forces ranchers to move to less fertile lands. Also, farmers must reduce the fallow period where land is left untouched to regain nutrients because there is not enough arable land to produce enough food. Annually, China loses $6.5 billion as a result of desertification because of reductions in food supply and people's well-being (Withgott & Laposata, 2014). Furthermore, increasingly concentrated precipitation has led to changes in food and water availability. The Northern provinces are more likely to suffer from droughts and the Southern provinces are more likely to suffer from floods. However, there are deviations to this trend. In 2010, southwest China experienced the worst drought it had seen in over a century (Jacques, 2009). Changes in precipitation affect the types of plants that can be cultivated and endanger both food supply and people's well-being. Overextending the capabilities of the land used to produce food reduces the total amount of arable land, but it is difficult to allow the land to regenerate nutrients against the pressing urgency to grow enough food. This is further complicated by changes in precipitation from global climate change affecting the water supply for agriculture.

While there are economic losses in mitigating the effects of climate change on extreme temperatures, rising sea levels, and changes in precipitation, global climate change may have an

even more severe cost on public health. According to the United Nations, health is the most direct component linking climate change and individual lives. Extreme weather events create instant harm, but there are more subtle problems that affect public health. Climate has many influences on health including altering physical activity patterns, the spread of infectious diseases, and food availability (Nilsson, Evengard, Sauerborn, & Byass, 2012). As discussed earlier, drought will reduce food and water supplies. Productivity losses in farming will have economic costs, but may also lead to malnutrition, suppressing immune systems and leaving populations susceptible to infectious diseases. Additionally, many diseases such as malaria are tied to weather conditions such as humidity and temperature. Changes in climate may affect the distribution and longevity of diseases, although the exact effects are not yet known (Longstreth, 1991). Global warming will also likely affect forests, farmland, and wetlands, all of which in turn will influence the airborne concentration of allergens such as mold and pollen. This could increase the prevalence or intensity of asthma and hay fever (Longstreth, 1991). Individually, these problems may seem to result from speculation rather than scientific assessment, but together, global climate change poses a formidable threat to everyday life. Working to reduce CO_2 emissions and global climate change will mitigate future costs to individual health.

Another stress on health comes from increased heat. Heat waves lead to increased mortality, but simply having higher temperatures in general puts heat stress on the thermoregulatory system, which is tied to the circulatory system. Susceptible populations to heat stress include the very young, the very old, and those who already have heart, respiratory, or vascular problems (Longstreth, 1991). Moreover, air pollution increases with heat, especially in industrialized and urban areas. Similar to New Delhi or Los Angeles, Beijing is notorious for its problems with smog. In January 2013, the smog in Beijing classified as “beyond index,” with an

air particulate concentration of 755 on a scale of 0-500 (Withgott & Laposata, 2014). Residents were cautioned against any outdoor activities and were unable to safely leave their homes without a mask. Every year, outdoor air pollution is blamed for 1.2 million premature deaths in China (Withgott & Laposata, 2014). Climate change has extreme costs to human well-being that we cannot adapt to easily.

Furthermore, urban areas are at the highest risk for many public health crises. One mechanism that exacerbates rising temperatures is the heat island effect. Because urbanization replaces permeable and moist surfaces with dry infrastructure, cities on the whole have been found to have higher temperatures than surrounding rural areas (Wong & Hogen, 2011). In Shanghai, the heat island effect was found to be directly responsible for increased summer mortality rates from 1975-2004 in comparison to nearby rural areas (Tan et al., 2010). High rates of economic and population growth from urbanization also put residents at risk for serious water shortages (Dong, Tao, Yang, Li, & Li, 2011). Combined with the heat, an urban water deficit is very dangerous to sustaining citizens' well-being. Any problems with infectious diseases or resource loss are also amplified by the effects of crowding. High population density contributes to spreading infectious diseases, which could lead to an epidemic in major economic zones. Urbanization is only expected to continue at a fast rate, with another 400 million rural residents expected to move to China's metropolises over the next 15-20 years (Brubaker, 2014). These new residents will consume large amounts of resources once settled and add to the strain on ecological and infrastructural systems.

Global climate change is a wicked problem. These are defined as problems that are difficult or impossible to solve because of "incomplete or contradictory knowledge, the number of people and opinions involved, the large economic burden, and the interconnected nature of

these problems with other problems" (Kolko, 2012). Climate change fits these stipulations because it involves many areas of society with no easy answers. It is multifaceted with high costs to the natural environment, food and water availability, public health, and a large economic burden is required to mitigate its effects. Since climate change is interconnected with so many areas of human experience and involves a wide variety of stakeholders, it is extremely difficult to agree on a plan of action.

Barriers to Sustainability

Identifying climate change as an anthropogenic and pressing concern makes it evident that we cannot continue "business as usual" and must move towards a more sustainable future. For the purposes of this discussion, sustainability is defined as creating systems in which humanity can live in a long-term, sustained balance with the environment at a reasonable quality of life. Our lifestyles cannot use more resources than the world can provide so that we do not compromise the ability of future generations to enjoy the same standard of living. Sustainability is necessary, but because climate change is such a wicked problem, there are many obstacles to achieving it.

Many experts look towards improving technology as the main barrier to sustainability, but social and behavioral barriers are important as well. According to Jevon's Paradox, technology that increases the efficiency of resource use actually increases, rather than decreases, the rate of consumption of that resource (Robbins et al., 2011). For example, as LED video screens have become more efficient and more affordable, stores can afford to replace paper advertisements with commercials on fixed screens. People can have a TV in every room of the house instead of only having one. Similarly, lowering heating costs allows more people to leave

the heat on for longer periods of time. Advances in technology are extremely important, but we must also pay attention to the human side of the equation alongside technological improvements. Ouyang and Hokao (2009) conducted a study in Hangzhou on urban behavior and electrical consumption from 2007-2008 and found that behavior is one of the most important components to energy efficiency in households besides technological improvements. Their research concluded that residential electricity consumption will increase continuously in China because of higher standards of living and dependency on electrical appliances, but is also insinuates that education on energy savings can save more than 10% of domestic electricity use. Shifting some investment from improving technologies to improving behavior for energy consumption in everyday life can yield great benefits. Social barriers to sustainability are very important to identify so that we can implement human-centered sustainability initiatives, which is why I will focus on the social and cultural barriers to sustainability rather than structural or technological ones.

Methods currently used to advocate sustainability often evoke negative emotions as motivators for action. When people are asked to describe environmentalism, they often conjure up images of hippie protesters, Armageddon, and drowning polar bears. Sustainability is often promoted as an opportunity to do what is morally correct in order to prevent the world from ending. These methods make people feel guilty if they are not doing their part, while scaring them of the consequences of inaction at the same time. Industrial ecologist Robert Frosch stated, “environmental activists will have to drop their subscriptions to the ‘horror-of-the-month-club’ and start thinking seriously about systems ecology in the natural and industrial worlds” (Frosch, 1992). In suggesting radical and revolutionary changes as the only option instead of thinking of ways that we can adjust existing systems, people do not feel a desire to invest in these changes,

especially when the unfamiliarity is combined with fear and guilt. While these negative emotions have the shock potential to effectively raise concern about the environment, they may also make people feel unable to help. Helplessness, anxiety, and shame create a sense of discomfort that drives people away from taking action.

Awareness is the first step towards action, but those who are aware of climate change and its implications often do not do more than talk about their concerns. For example, many in the global North reported being concerned about climate change but have ignored it in their daily and political actions, creating a large discrepancy between desiring change and creating change themselves (Poland, Dooris, & Haluza-Dela, 2011). As discussed by Milbrath (1995), awareness and concern about a certain topic is not necessarily correlated with understanding the subject itself. Concern in itself does not lead to action. Even though awareness is spreading on the problems surrounding climate change, people may lack knowledge on the specific actions in their daily lives that contribute to it or what policies may help the situation. There is a clear lack in environmental education around the world. Without a clear understanding of the nuances behind the contributors to climate change, people are unable to critically evaluate modes of action and do not know how to begin tackling the problem. This uncertainty leads to apathy instead of action.

Another difficulty in implementing sustainability is that the pervasive nature of capitalism makes it difficult to think outside of market logic. Integral aspects of society including education, health, and the environment become externalities because success is measured using national GDP instead of national well-being. However, just because something is difficult to measure or to label with a price tag does not mean that it is unimportant to our daily lives and to society as a whole. We need to figure out ways to either internalize these externalities, or to

emphasize an alternative system of value to bring focus to sectors outside of the market such as the environment.

In China, there is also disagreement over whose responsibility it is to address global climate change. From a citizen's perspective, climate change is too big of a problem for an individual to make a difference. The government needs to take care of its people by alleviating the effects of climate change, such as in reducing air pollution. On the other hand, industrializing countries such as China feel as if other countries should take the lead. Although China is now the largest carbon emitter worldwide, other countries have had the opportunity to develop and to pollute earlier. To the Chinese government, working on the environment is a luxury for those who have already industrialized. Western countries have historically polluted the most so it is their responsibility to begin cleaning it up.

Furthermore, the Chinese government is unsure of how long it has to act, and is unwilling to put economic goals aside out of fear of social unrest. Environmental degradation is a "creeping" problem that slowly looms in the background as opposed to a "competing" problem demanding immediate attention (Milbrath, 1995). This leads to apathy and procrastination because it is uncertain when we have reached a tipping point where immediate action is necessary. Furthermore, since there is no precedent for what will happen with climate change, it is extremely difficult to internalize the urgency behind the possibilities of what will happen. This long-term problem is balanced against the priority of economic growth. Starting in 1978, Deng Xiaoping created economic reforms that transformed the world. China's economic growth exploded from an annual GDP growth of 4-5% to 9.5% for nearly two decades (Jacques, 2009). The state's goals with these reforms were to restore Party legitimacy and to achieve political

stability through economic growth. One fear is that focusing on something other than the economy may lead to civil unrest, especially since so many still live in poverty.

Governments have begun to address sustainability by setting carbon emission reduction goals, but it is unlikely that setting these goals will create real change. In the fall of 2014, President Obama and President Xi Jinping jointly announced their targets for reducing greenhouse gas emissions. However, according to experts, neither target is expected to significantly improve conditions even if the targets are met (Tucker, 2014). One structural barrier for China in meeting these targets is its dependence on coal. Nearly 70% of China's energy is produced from coal, which is a "dirty" form of energy that creates more carbon emissions than oil and natural gas (Jacques, 2009). It will take a significant amount of effort and financial input to change existing infrastructure to "cleaner" forms of energy. The unreliability of governmental efficiency may mean that finding ways for individuals to understand and desire changes will be the best way to institutionalize change.

Part II: Creating the Future

Mechanisms for Societal Behavior Change

Now that the context on global climate change in China and the problems with implementing sustainability has been established, the next step is to discuss what needs to be done to move forward. Individuals cannot regulate their lives independent from the societies and institutions around them. To effectively change our physical environment, sociology suggests that we should pay more attention to the social conditions of transformative learning and culture change (Poland et al., 2011). These techniques range from changing how sustainability is presented to ways of creating and institutionalizing new habits.

Sustainability needs to be framed as something that can increase one's quality of life instead of a moral responsibility towards voluntary deprivation. People are told to have less impact – to use fewer resources, to have fewer emissions, to take up less space – and what they are hearing is to give up their material goods and to have less fun (Milbrath, 1995). The dominant dialogue needs to change from prescribing what *not* to do to a discussion on what we need to do and where we need to go. Framing sustainability in terms of creating new lifestyles is a very different motivator than avoiding environmental consequences. Previously, it was always assumed that our actions would be sustainable, so sustainability was not something that people consciously thought about. Having to carve a new path makes it extremely difficult to imagine what a sustainable world looks like in practice. Without a direction to work towards, people do not know what they are trying to achieve. Creating a vision of a world where success is defined by the health of the people, their environment, their relationships, and an interconnected sense of belonging and fulfillment is more compelling than a barren world where the goal is ascetic restraint. This turns the dialogue from avoiding and managing risks to "engaging emergence" (Poland et al., 2011). Connecting a compelling vision of the future with concrete actions that individuals can take is much more effective than only dictating what actions to avoid.

Stakeholders in all areas of society need to be involved to create a paradigm shift towards sustainability instead of demonizing big businesses and the government. Instead of blaming and marginalizing those who hold political and financial power, we need to consider how minimizing waste and environmentalism can benefit all stakeholders in different ways. Parallel action is required on many fronts to achieve sustainability, including large corporations, the government, other countries, and the general public. One potential limitation to this inclusivity is an inherent conflict of interests. For example, businesses want to expand, but reducing consumption is

necessary for curbing resource depletion. However, bringing all stakeholders into the discussion will be more productive than trying to exclude those who typically have a lot of power in society. Bringing everyone to a common ground will assist in finding the creative solutions needed to move forwards.

Furthermore, we need to identify what people value so that we can invoke changes and create new habits based on those values. Many fear that a paradigm shift threatens present values and lifestyles (Milbrath, 1995). If we align the paradigm shift towards sustainability with prioritized values, particularly with desires that are currently unfulfilled, people will naturally gravitate towards changing their lifestyles. New habits can then be solidified by changing infrastructure and legislation to institutionalize what people already want.

Examining the Tangible

The survey I conducted approaches understanding sustainability through looking at what is tangible to individuals. This breaks down the wicked problem of global climate change from a large and intimidating abstraction into parts of our daily lives that are familiar and approachable. Familiarity with these concrete areas will help to create solutions with small, actionable steps. In the survey, I examined lifestyles, preferences, and values surrounding sustainability. Within lifestyle preferences, there are three main areas of assessment: housing, transportation and travel, and food. These areas are mundane enough to be visualized, are more or less under direct personal control, and dictate much of an individual's environmental impact. Although there are structural and financial constraints towards fulfilling one's preferences in these areas, identifying consumers' priorities will enable us to target specific areas for high impact behavioral and structural changes in the future. In assessing personal values and perceptions on sustainability,

we can recognize values that we can capitalize and build upon in trying to influence behavior change. Furthermore, we can pinpoint misconceptions or other barriers to prioritizing sustainability and address them with environmental education and the media. Together, all of these form a brief but comprehensive overview on the social side of sustainability today.

In this study, I compared Chinese and American lifestyle preferences to see if there are cultural differences between the two groups. Some hold the perception that industrialization is a linear path, with the ultimate goal of living a Western lifestyle. However, even though people may have similar desires, the way that their wants are embodied in the materiality of their lives can be very different and lead to differences in environmental impact. Obviously there is diversity in socioeconomic classes, region, and other contextual differences within each country, but perhaps there are overarching themes that are connected to culture. Sustainability solutions are not one size fits all, so identifying priorities will help to determine if existing practices in China or the United States can easily transfer to the other country, and which solutions will need to be greatly modified before implementation. Beyond looking for cultural differences, comparing Chinese and American preferences will also help me to contextualize my own perspective as an American, and allow me to draw from a pool of relatively available participants.

Young adults were the targeted participant age group because their lifestyle preferences will put be enacted in the very near future. According to Wu (2010), young adults from 20-30 years of age form lasting preferences that greatly influence their lives in the future. The persistence of their preferences and the enduring nature of choices in areas such as housing make this age group extremely important to study. Furthermore, international Chinese and American college students are at similar points in their life transitions. This will act as a control so that the

main differences between the two groups should reflect cultural rather than generational variances.

Participants & Materials

A survey made with Google Forms was distributed via email, flyers in the Ann Arbor area, and social media. Using a survey allowed for a larger sample size and encouraged honesty through anonymity so people did not feel pressured to select the most sustainable choices as their ideal lifestyles. This survey was intended to capture adult attitudes and lifestyle preferences at similar points in life before many long-term habits and choices are made. Furthermore, surveying young adults would help control for generational differences. There were 122 adult participants between the ages of 18 and 52, with an average age of 21.80 years (see Table 1). Although the range of participant age is fairly large, the majority of the participants are between 18 and 28, with the Chinese participants slightly older than the American ones (see Figure 1). For the purposes of this study, subjects were asked to self-identify as Chinese or American in response to the question “are you from China or the United States?” under the premise that anyone who held both identities would have attitudes and lifestyle preferences that are more representative of his or her more dominant identity. Twenty participants were from China and 102 participants were from the United States.

As shown in the Appendix, the survey was broken up into five sections and meant to be brief yet comprehensive. These sections were the following: demographics, housing, transportation & travel, food, and values & perceptions. Participants answered questions about their current and preferred lifestyles in housing, transportation, and food, then ranked different factors involved in consumer decision making in those areas in order of importance. For the

section on values and perceptions, subjects selected perceptions that they associated with sustainability and values that fit in with their personal definitions of success.

Results

Data was analyzed in SPSS 22 using an independent samples t-test for numerical data and a chi-squared test for independence for categorical data. Statistical significance was set at $P \leq 0.05$. The between-subject factor was nationality (Chinese, American) but very few variables were found to be statistically significant, which will be discussed further in the limitations. I will describe my findings on the Chinese participants between their current and preferred lifestyles, and in relation to the American participants. Any specific variables that were statistically significantly different from the American participants' responses will be indicated.

Housing

Housing has the potential to determine much of one's individual environmental impact. Location determines the length and mode of one's daily commute. Larger homes involve increased energy use, the space to own more stuff, and are built using land that could be used for other purposes such as farming. The more sprawl there is, the more money is needed for the government to facilitate the same number of people.

In terms of preferred housing, Chinese participants were roughly evenly distributed between preferring a high-rise apartment with many units (30%), an apartment with 2-4 other units (35%), and a house (30%). This distribution was very different from the American participants' preferences, which was skewed towards living in a house in comparison to the Chinese (55%). Although China is striving for industrialization, this data supports my hypothesis

that China's idea of modernity is not the same as preferring a Western lifestyle. Culture and region matter in shaping preferences for day-to- day functionality. Despite preferring less space per person in comparison to the American participants (see Figure 2), the Chinese participants' preferences may still be far larger homes than what an urbanizing China can offer. A desire for more space is also reflected in rebuilding and extending housing in China. For example, Hubacek et al. (2011) found that the average living space per capita for rural households expanded from 8.1 to 32.4 square meters between 1978 and 2008. Similarly, before 1978 the per capita living space in urban areas was only 3.6 square meters. Developing housing has expanded considerably since then to expand per capita living space, and continues to grow in China today.

Even though there is a trend towards desiring more space per person, housing size is not the most important factor in selecting housing. In order of importance, the factors in selecting housing are as follows: price, distance to work, school, and stores, availability of public transportation, air quality, size, a strong community, and being close to nature (see Table 2). The importance of price may be because most of the subjects were young adults, but the data suggests that affordable housing in a good location with effective public transportation would be preferred over larger housing. This means that a potential direction towards sustainability would be to design space-efficient housing in central areas; these would be both preferred by the public and have lower environmental impact. Additionally, the only factor that was significantly different from the American population was the availability of public transportation, which the Chinese participants valued much more. An independent samples t-test showed that this was a significant difference, $t(120) = 2.28$, $p = .024$. Continuing to develop and maintain public transportation such as subway lines instead of building more parking structures or roads could be valued by the Chinese and create fewer carbon emissions at the same time.

Transportation & Travel

Housing infrastructure and location will determine the distances that people will have to commute, but there is still a fair amount of flexibility in choosing a mode of transportation. Walking and biking have negligible effects on the environment, and public transportation instead of driving cars reduces car emissions, congestion, and air pollution, but the current trend in China is moving towards increasing rates of car ownership at alarming rates. In Beijing, 1,500 new cars are hitting the streets every day, accumulating to the existing traffic and smog (Withgott & Laposata, 2014). If rates of car ownership eventually match the United States' per capita car ownership, China would have 1.1 billion cars compared to the current global total of 800 million cars (Jacques, 2009). Identifying underlying factors in choosing differing modes of transportation may help to reduce the rates of new car ownership while still helping to actualize what people value and desire.

I asked participants for their current most frequently used mode of transport (see Figure 3). Around 50% of both groups walked most frequently and around 10% biked. More Chinese participants used busses and subways (40%) than American participants (13%), but the higher frequency of American car usage is likely due to the Chinese participants lacking access to their cars from being international students.

Despite the discrepancies in current transport, Chinese and American preferences for preferred transportation were much more similar (see Figure 4). Around 35% of both groups preferred driving cars and only about half of the people who currently walk the most frequently preferred that mode of transport. However, one stark difference was that the preference for public transportation in China was double that of America (30% compared to 15%).

These preferences are contextualized by the relative importance of different factors in selecting a mode of transportation. Convenience and distance to destination tied for the most important variable, followed by expense, weather, environmental impact, and exercise gained (see Table 3). To me, it made sense that weather would not heavily impact preferred transportation over time because most people have fairly routinized lives and would not adjust transportation time and expense daily in response to the weather. Exercise gained would only factor in to those who chose to walk or bike, and environmental impact is generally a secondary consideration of consumer choices. However, it did surprise me that expense was not the first or second most important factor. This could be because people see mobility as a fixed expense because it is a necessity for work and school, so they are willing to spend more in exchange for convenience in their daily lives. One way that the importance of car ownership can be reduced is in finding ways to make public transportation or walking the most convenient choice. When building new cities, increasing walkability and reducing the distance to amenities will align with what people value most, thereby making the sustainable choice the convenient one.

Travel was also included in the section on transportation because of the vast carbon emissions stemming from recreational transit, especially airplane use. When participants were asked the question “given a free week, would you prefer to relax at home or to travel somewhere?” American participants were pretty evenly split between the three options of relaxing at home, traveling somewhere nearby, and traveling somewhere far away (see Figure 5). On the other hand, only 15% of the Chinese participants preferred to relax at home and were split between traveling nearby (40%) and traveling far away (45%). While it is possible that Chinese people have a greater propensity for travel, a potential confound is that most of the Chinese

participants are international students who needed to fly to the United States and already have more exposure to traveling.

Participants' long-distance travel was assessed through asking for an estimate on hours flown annually. Based on the survey data, the Chinese participants flew significantly more hours a year than the American participants (see Figure 6). This was shown using an independent samples t-test, $t(120) = 3.44$, $p = .002$. On average, Chinese participants flew 28.5 hours annually in comparison to the American participants, who flew 13.4 hours a year. An increased amount of air travel is very likely to be specific to the Chinese international students instead of representing a random sample of Chinese people, so more research is needed to determine the prevalence and importance of travel in China.

Food

Food systems involve some of the most complex interactions we have with the environment. Environmental impact includes production, processing, transport, and consumption of food. Within production, we must consider the land and water used for the animals and their feed, as well as any energy put into producing fertilizers and pesticides. All of these use up many resources and create wastes that degrade the environment, especially when there is increased demand for food from a growing population. For example, in China food cultivation has contributed to deforestation and desertification in areas where too much pressure is put on the environment.

One crucial factor in how much environmental impact is generated from food production is how many animal products are consumed. Research by Jiang and Davis (2007) projected substantial future growth in China in household demand for fine grains such as rice and wheat as

income grows. However, the largest projected increase is for animal products, particularly meat, which increased in demand nearly proportionately to income growth. The emphasis on income as the largest factor in ongoing changes in food consumption is supported by more recent research by Zhou, Liu, & Cao (2014). They found that income is the most important factor affecting animal product consumption. Rural residents have less food access than urban residents in general, which is reflected by a much lower rate of rural meat consumption. Within urban residents, as their incomes rose, the more animal products they consumed. These demands on animal production will continue to put strains on grains and other inputs in the meat industry, leading to even more increases in atmospheric CO_2 concentrations.

My first objective was to identify how often people eat any animal products, and asked participants to classify themselves as vegan, vegetarian, an occasional animal product consumer, an average consumer, or a meat lover. Eating lower on the food chain reduces environmental costs. Between China and the United States, the rates of consumption of animal products were roughly the same (see Figure 7).

Despite this similarity, it was important to identify which animals are consumed most frequently because the kind of animal greatly affects environmental impact. In an infographic published by National Geographic, 6.8 pounds of feed were needed to produce one pound of beef, which contrasts greatly with the 2.9 pounds of feed needed to produce pork, the 1.7 pounds for chicken, and the 1.1 pounds for fish (Mason, Treat, & Twombly, 2014). Participants were asked which meat or seafood they ate most frequently if they consumed animal products (see Figure 8). Here we can see that China consumes much more pork than the United States (20% compared to 6%), while the United States eats much more chicken (61% compared to 35%). Also, China consumes almost double the seafood of the United States (15% compared to 8%). It

may be beneficial to try to shift beef and pork consumption to increase existing preferences for seafood and chicken, or even towards vegetarianism.

Among housing, transportation, and food, ranking the relative importance of factors in food selection in China was statistically the sector that had the most differences from American preferences. Health was the number one factor, followed by freshness, price, taste, chemical additives, and organic foods. Independent samples t-tests showed that health and freshness were valued more in China than in the United States, at $t(120) = -2.71$, $p = .032$ for health and $t(120) = -2.93$, $p = .004$ for freshness. On the other hand, price and taste were valued less in China, at $t(120) = 2.50$, $p = .014$ for price and $t(120) = 3.04$, $p = .006$ for taste. Organic food was valued more in China than the United States at an almost statistically significant value of $t(119) = -1.93$, $p = .056$. Using health may be the most effective motivator for changing the types of meat or even in reducing the total amount of meat consumed in China. For example, health benefits such as improving cardiovascular health and reducing obesity may be emphasized. Furthermore, ensuring fresh produce is accessible to all socioeconomic statuses, even at higher prices, may encourage a steady percentage of plants in Chinese diets because freshness is valued over price. These are all possible shifts to focus on in future food sustainability efforts.

Values & Perceptions

Recognizing values that drive individuals' actions and investigating current perceptions about sustainability will help to determine motivators that can be aligned with sustainability efforts and to identify misconceptions to be addressed with environmental education. The questions in this section asked for choosing between investing in the economy or the

environment, associations with sustainability and success, and agreement with statements surrounding sustainability.

Economic development does not necessarily align with environmental preservation even though it has the potential to do so; this is why it is important to study how the public balances prioritizing between the economy and the environment. In response to the question "If you had to choose, would you invest in your community's economy or in its environment?" 35% of Chinese subjects chose the economy and 65% of them chose the environment (see Figure 9). This question specifically asked about investing in their community as opposed to investing in general in an effort to make the choice seem more real. A potential confound is that many university students may come from more prosperous areas where the economy is already well-developed, but making the choice as tangible as possible was the first concern. There was no significant difference between the Chinese and American preferences between the economy and the environment. Other researchers have found similar percentages favoring prioritizing the environment over economic growth. In 2007, 70% of Chinese citizens named environmental problems as a major global threat (Jacques, 2012). Perceiving these problems as a major threat is the first step to prioritizing addressing these issues over other investments. A Gallup poll studying prioritization of environmental protection versus economic growth in 2011 found that 57% of Chinese adults out of the 4,200 surveyed prioritized protecting the environment over economic growth, while only 21% prioritized the economy over the environment. Additionally, urban residents are significantly less satisfied than those in rural areas, with 77% of Beijing residents prioritizing the environment over development at the risk of curbing economic growth (Yu & Pugliese, 2012). The theme of a rural-urban divide for both environmental problems and public perceptions may be something to continue researching in future studies.

Sustainability involves creating an environmental, economic, and social balance so that all resources are fairly and efficiently allocated, our planet is not exploited or neglected, and human well-being and social equity are cared for. Despite all three pillars being essential to sustainability, the environmental pillar is often emphasized and people do not realize that the economic and social pillars are just as important for creating a sustainable world. I asked participants to select what they associated with sustainability from the following options: only about the environment, minimizes waste, expensive, cost-saving, bad for businesses, creates jobs, convenient, hard to address, not prioritized, necessary, inclusive, preserves cultures, and improves health. From those options, the highest rated associations for China were "minimizes waste," "improves health," "cost-saving," "creates jobs," and "necessary" (see Figure 10). Chinese participants perceived sustainability as a convenient and cost-saving measure more frequently than American participants did, as well as associating sustainability with creating jobs. Conversely, Chinese participants did not perceive sustainability as "hard to address" or something that is "not prioritized" or even something "necessary" as highly as the American participants. It is unclear why the Chinese participants felt that sustainability was much easier and convenient to implement than the American participants. Ethnographic research and interviews would be very interesting to conduct in order to dig deeper into these perceptions.

A similar question asked participants to select statements that they agreed with around sustainability. For both China and the United States, the highest rated statements were that "we need to do more for the environment to lead happy and healthy lives for ourselves," "investing in the environment will help the economy," and "people have an obligation to think of the impacts of their consumer choices" (see Figure 11). However, the Chinese participants did not feel as strongly as the American participants that people have an obligation to think of the impacts of

their consumer choices. Cause marketing may bring awareness to the impacts of consumer choices, but another route may be to simply promote sustainability as a means towards personal health and happiness.

One statement that only 40% of Chinese participants agreed with was that "companies that find ways to reduce pollution and waste make more money." A common sentiment around the world is that sustainability is expensive. For example, "greener" goods that advertise fair trade, organic origins, or local producers often cost more than the standard products. On the other hand, recycling and composting, installing energy-efficient appliances, and streamlining production processes are all sustainability measures that save money. Many businesses view sustainability as an expensive project that will be handled as time and resources allow, and do not consider how greener production methods can actually reduce costs. An example of cost-effective sustainability is with DuPont, an American chemical company. DuPont has reduced heat-trapping greenhouse gas emissions by 72% since 1990 while saving 3 billion dollars in the process (Cortese, 2012). DuPont was able to avoid costs because of their zero-tolerance for waste, which was both profitable and sustainable. This is extremely significant; in most manufacturing processes, less than 1% of raw materials processed are actually embodied in the final product and the rest is all waste (Lovins, 2008). If companies are able to improve their supply chains to use fewer resources, they will become more efficient; this will decrease costs and allow them to be more competitive.

Furthermore, sustainability can also serve to help businesses with marketing because customers want to buy from companies who are trying to do the right thing. In a search for a greater purpose, customers prefer to align themselves with companies that seem to be working towards something bigger than just profit. Marketing campaigns, products, and services that

reflect sustainable lifestyles double as branding opportunities by associating companies with the idea of living meaningful and prosperous lives. A recent report from Goldman Sachs found that "companies that are good leaders in environment, social, and good governance policies have outperformed the MSCI world index of stocks by 25% since 2005," with 72% of the listed companies outperforming their industry peers (Lovins, 2008). Without changing how products are produced, companies can also sponsor promotions or services that enable people to take meaningful actions and to build sustainable habits. These can services range from offering multi-use public transit cards to building recycling centers or organizing clothing swaps (JUCCCE, 2012). Companies with a triple bottom line of achieving profit while protecting people and the planet have reduced material cost savings, the ability to drive innovation and retain competitive advantage, enhanced reputation and brand development, increased employee productivity and health, and better stakeholder relations. It is difficult to transition from existing infrastructure to something that is more environmentally sustainable and companies would need to analyze ways to reduce waste or to renovate existing processes, but sustainability is not necessarily contradictory to business growth. Educating citizens and businesses alike will help to change perceptions on sustainable development and hopefully remove some of the barriers to sustainability.

Finally, participants were asked to pick up to 5 values that fit in best with their definitions of success. Similar to the ranking questions on decision making in specific sectors, recognizing values is a way of identifying the factors that influence daily lifestyle choices. Chinese and American participants ranked happiness as the ultimate measure of success. For Chinese participants, the next priorities were family and health, which were equally valued. This is followed by work-life balance, then knowledge (see Figure 12). Some differences from the

American participants' values were that meaningful impact was the second most important value and that work-life balance was not as important. Based on this data, sustainability should be framed as a gateway to achieving happiness and a better quality of life. Furthermore, in China specifically, family and health can act as potent motivators to work towards sustainability. From a social perspective aligning sustainability with the values that people already hold will be the most effective way to streamline change.

Limitations

Although there are some trends that can be extrapolated from the survey results, the most significant limitation in this study was in acquiring study participants. There are a much smaller percentage of Chinese students on campus than there are American students, and it was very difficult reaching out to enough of them to fill out the survey, particularly since there were not any incentives to complete it. Another problem was that the survey was created on Google Forms for a more approachable survey interface, but Qualtrics should have been used so that the survey could have been sent to students currently living in China. Moreover, the survey was only conducted in English, so language barriers may have deterred Chinese students from participating even though the survey was relatively short.

With this shortage in Chinese participants, the data was insufficient for meeting the sample size requirement for the chi-squared test of independence, and also affected the significance level of the independent samples t-test. The chi-squared test could not be performed so analysis of categorical data was not statistically significant. Although general trends can still be identified from the data overall, there is little statistically significant distinction between Chinese and American responses because of the small sample size for China. Results from this

study obviously cannot be generalized from 20 participants to all Chinese adults because China is such a diverse and large country. For any definitive conclusions specific to China, the survey would have to be conducted again, ideally with a minimum of 100 respondents per group.

Another limitation in using a survey is that its brief nature prevents participants from elaborating on their reasoning for each choice. Although there was a comment box after each section, having the time and the resources to conduct interviews would have provided a more complete picture of the intricacies in selecting different alternatives.

Conclusions & Future Directions

Sustainability is as much of a societal problem as it is an environmental one, because we are dependent upon the earth to sustain us. Global climate change is an anthropogenic problem that has far-reaching implications in human lives, including heavy costs for the economy and for public health. Novelist and environmental activist Wendell Berry (2012) states:

> We have lived our lives by the assumption that what was good for us would be good for the world. We have been wrong. We must change our lives so that it will be possible to live by the contrary assumption, that what is good for the world will be good for us. (p. 220)

Particularly with China's breakneck economic growth and emerging middle class, it is no longer plausible to continue "business as usual." China needs to work towards sustainability not only because it is a large contributor to global climate change, but also because it is suffering from many of its devastating consequences.

Instead of only focusing on technological improvements as the answer to sustainability, we need to find ways to create a paradigm shift towards sustainability. Externalities such as environmental degradation and social inequities need to be brought into the conversation and

accounted for. A key component to creating informed dialogue is developing environmental education instead of only formulating concern for the consequences of industrialization and global climate change. Furthermore, success must be able to be measured beyond GDP. We must look beyond market logic and find ways to recognize the interconnectedness between the people and the planet, and measure success based on improving well-being rather than accumulating material wealth. All stakeholders must collaborate for this fundamental shift to occur. Businesses should find ways to streamline their production processes, which will both cut down on costs and help to reduce waste. Citizens should strive for healthy consumption patterns and low-footprint lifestyles. The government should create policies to cut carbon emissions and build infrastructure that promotes sustainable lifestyles. These diverse stakeholders need to collaborate in order to building a vision for a sustainable future.

However, there are specific values that can help to incite these changes. Throughout the data analysis, one factor that was highly prioritized by Chinese participants in many different sections was health. Health was the most influential factor in consumer choices on food, and was second in creating a definition of success. Furthermore, Chinese participants agreed strongly with the perception that sustainable lifestyles are essential to their health. Personal health and wellness may be the primary motivator towards sustainability in China. If individuals and their health is linked to the consequences of climate change and the benefits of sustainable lifestyles, high impact change may be created. Another prominent factor is convenience. By making the sustainable choice the default option, a shift in everyday norms may be institutionalized quickly. Aligning policies, infrastructure, and behavior change using what people already value and prefer will allow us to create a model of sustainability unique to China.

In the future, I would like to focus on urban Chinese citizens and conduct both surveys and extensive interviews. Much of the research has shown a divide between urban and rural consumption patterns, and studying the areas that creates the most environmental impact will lead to focused changes. Moreover, understanding the motivations behind everyday choices will identify gaps in education and potential triggers of societal change. Another future direction is to create a pilot program to change behavioral norms in a specific city, and then study the program's effectiveness in changing both perceptions of sustainability and individual behaviors.

If "the best citizen is the one who least needs governing," finding what people desire and coupling their aspirations with sustainable measures will allow China to create new social norms, which can then be reinforced by governmental policies to make behavior changes permanent (Berry, 2012). This way, education, the public, and the government can work together to bring about rapid, widespread changes towards sustainable lifestyles – an equitable, viable, and beautiful future.

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Appendix: Survey Questions

Lifestyle Preferences Survey

1. Demographics

What is your age?

Are you from China or the United States?

- China
- United States

How many years have you lived in China?

How many years have you lived in the United States?

2. Housing

Including yourself, how many people currently live in your household? This is referring to people that you live with now (instead of back at home if you are a student).

Would you prefer to share a living space or would you rather live on your own?

- Share with extended family
- Share with nuclear family
- Share with roommate(s)
- Independent living

What setting would you prefer to live in?

- Mansion
- House
- Apartment with 2-4 other units
- High rise apartment with many units

Please rank the following in order of importance for selecting the ideal home:

- Price
- Size of home
- Close to work/school/stores
- Air quality
- Availability of public transportation
- Strong community
- Close to nature

Comments?

3. Travel and Transportation

How do you most often go from place to place?

- Walking
- Biking
- Motorcycle
- Car
- Bus
- Subway

How would you prefer to go from place to place?

- Walking
- Biking
- Motorcycle

- Car
- Bus
- Subway

Given a free week, would you prefer to relax at home or to travel somewhere?

- Relax at home
- Travel somewhere nearby
- Travel somewhere far away

Approximately how many hours do you fly each year?

Please rank the following in order of importance for choosing which mode of transportation you use:

- Expense
- Convenience
- Distance to destination
- Exercise gained
- Environmental impact
- Weather

Comments?

4. Food and Consumer Choices

How often do you eat animal-based products? Ex. beef, pork, chicken, fish, eggs, dairy

- Meat lover
- Average
- Occasional
- Vegetarian
- Vegan

If you eat meat or seafood, which of the following do you eat most often?

- Beef
- Lamb
- Pork
- Chicken
- Seafood
- Other

When eating out, do you generally bring the leftover food home or do you leave it in the restaurant?

- Bring the leftovers home and eat it later
- Bring the leftovers home but rarely eat it later
- Leave it in the restaurant

Please rank how much the following aspects factor into the foods you buy:

- Price
- Taste
- Freshness
- Organic
- How healthy the food is
- Chemical use in food production

Comments?

5. Values and Perceptions

If you had to choose, would you invest in your community's economy or in its environment?

- Economy
- Environment

Which of the following do you associate with sustainability?

- Only about the environment
- Minimizes waste
- Expensive
- Cost-saving
- Bad for businesses
- Creates jobs
- Convenient
- Hard to address
- Not prioritized
- Necessary
- Inclusive
- Preserve cultures
- Improves health

Which of the following fits in best with your definition of success? Please pick up to 5.

- Prestige
- Money
- Family
- Knowledge
- Meaningful impact
- Luxury
- Happiness
- Work-life balance
- Community
- Health
- Other

Please put a check next to statements that you agree with.

- Current lifestyles are sustainable for future generations
- Using fewer material resources will lead to a decline in quality of life
- We need to do more for the environment to lead happy and healthy lives for ourselves
- Individuals are powerless to help the environment
- Sustainable and socially responsible investments have lower returns
- Companies that find ways to reduce pollution and waste make more money
- People have an obligation to think of the impacts of their consumer choices
- Investing in the economy will help the environment
- Investing in the environment will help the economy

Comments?

The Lifestyle Preferences survey can also be found at http://goo.gl/uqsZZR

Tables & Figures

Table 1

Participant Age by Nationality

Nationality	Minimum	Maximum	Mean	N	Std. Deviation
China	18	46	23.95	20	5.835
United States	18	52	21.37	102	4.259
Total	18	52	21.80	122	4.626

Figure 1

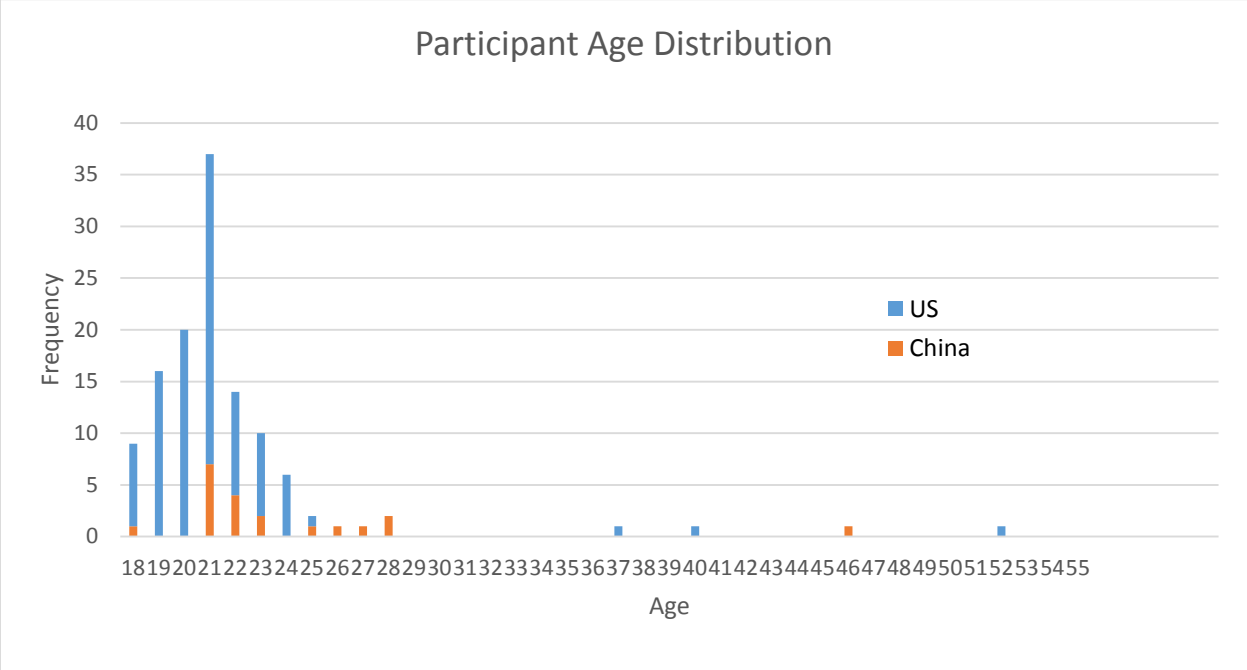


Figure 2

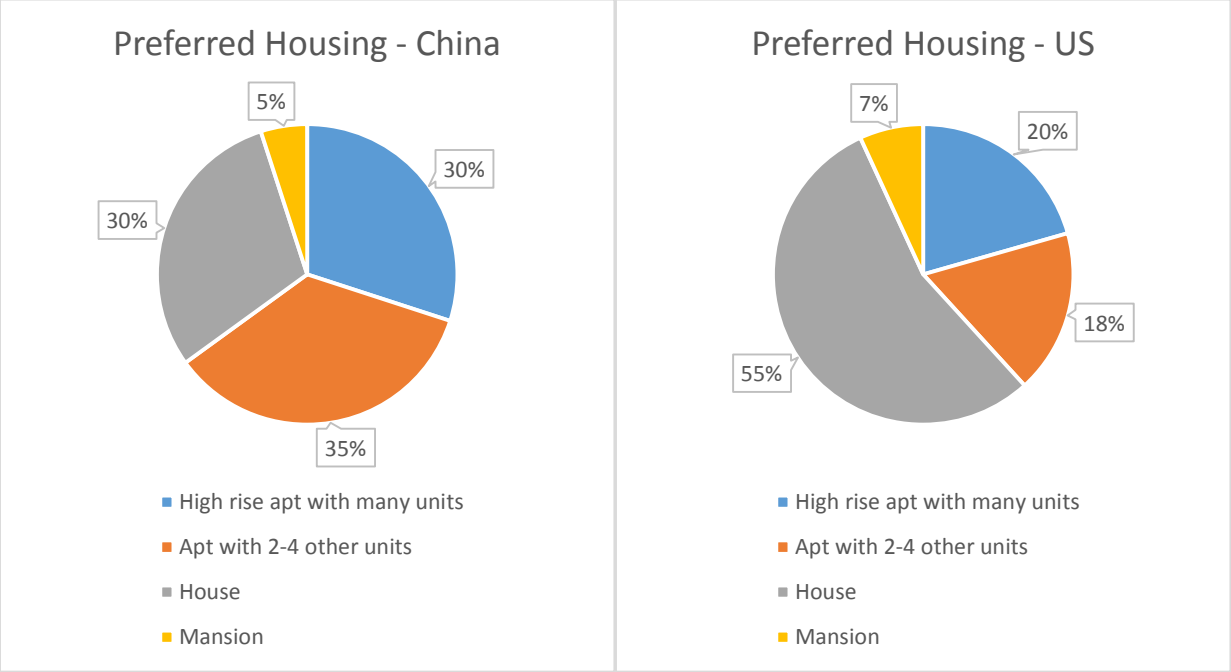

Preferred Housing - China
5%
30%
30%
35%
High rise apt with many units
Apt with 2-4 other units
House
Mansion
Preferred Housing - US
7%
20%
18%
55%
High rise apt with many units
Apt with 2-4 other units
House
Mansion

Table 2

Mean Rankings for Importance of Factors in Selecting Housing

	Nationality	N	Mean	Std. Deviation	Std. Error Mean
Price	China	20	2.10	1.483	.332
	United States	102	2.33	1.607	.159
Size	China	20	4.75	1.618	.362
	United States	102	4.60	1.690	.167
Distance to work/school/stores	China	20	2.75	1.682	.376
	United States	102	2.24	1.321	.131
Air quality	China	20	4.45	1.572	.352
	United States	101	4.49	1.775	.177
Public transportation	China	20	3.55	1.849	.413
	United States	102	4.60	1.884	.187
Strong community	China	19	4.95	1.715	.393
	United States	102	4.55	1.681	.166
Natural environment	China	20	5.40	1.875	.419
	United States	102	5.18	1.703	.169

*The lower the number is, the more important it is considered

Figure 3

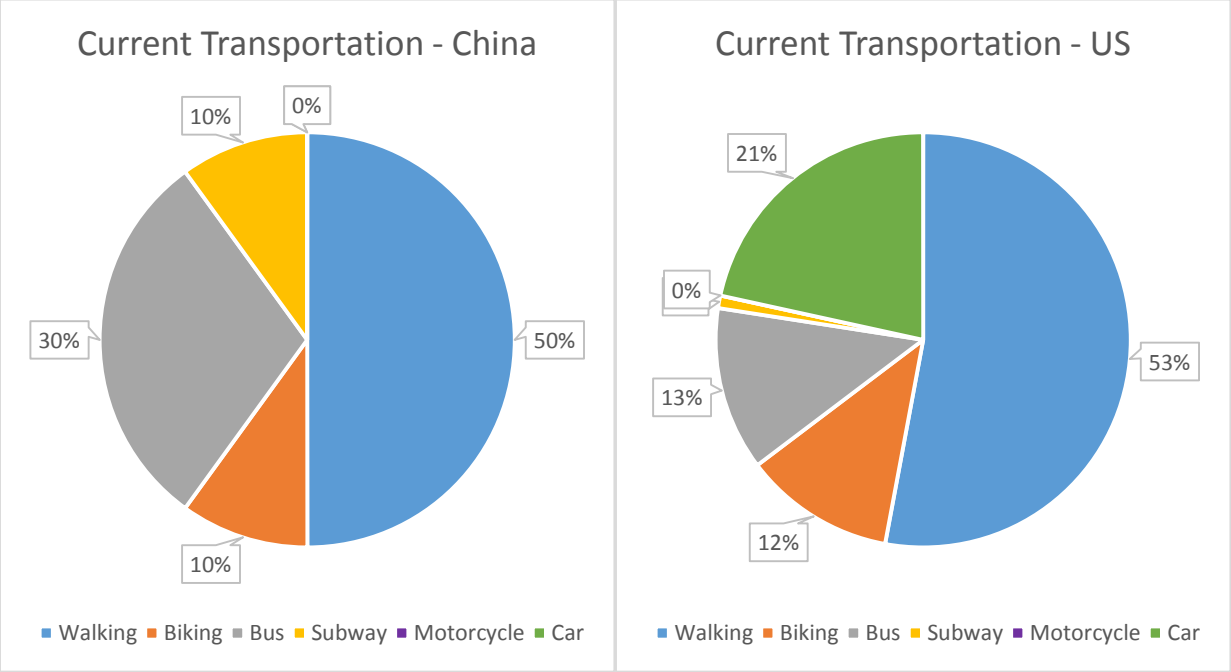


Figure 4

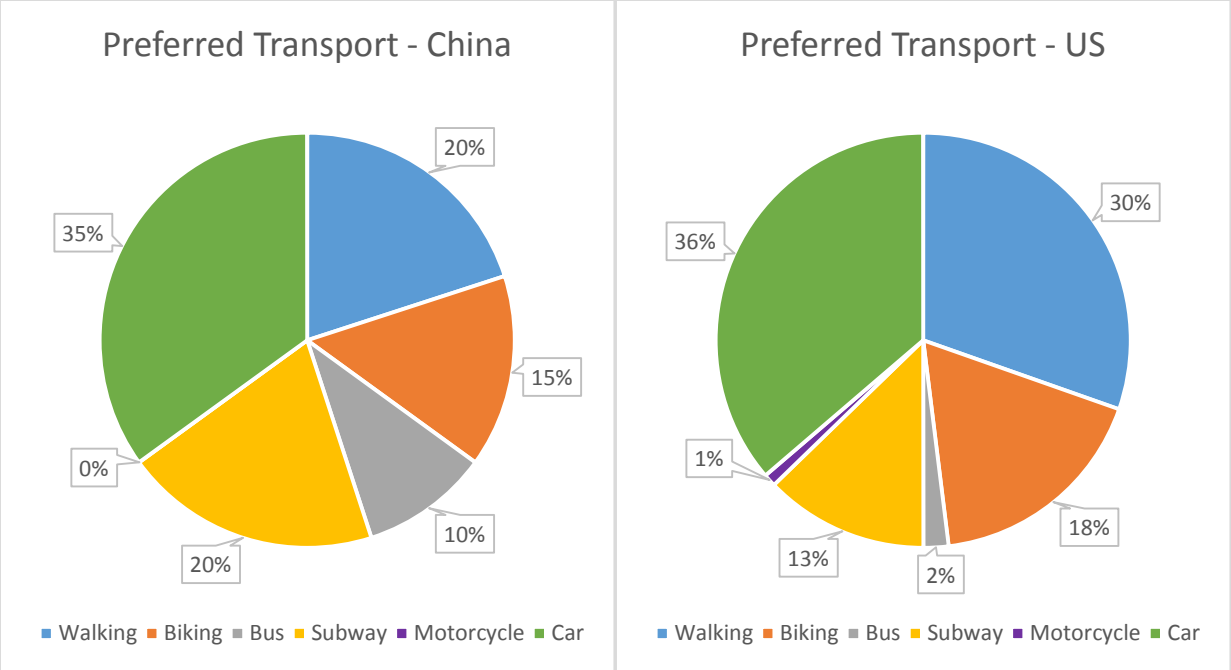


Table 3

Mean Rankings for Importance of Factors in Selecting Transportation

	Nationality	N	Mean	Std. Deviation	Std. Error Mean
Expense	China	20	2.80	1.005	.225
	United States	102	3.17	1.529	.151
Convenience	China	20	2.15	1.387	.310
	United States	102	2.25	1.214	.120
Distance to destination	China	20	2.15	1.348	.302
	United States	102	2.13	1.347	.133
Exercise gained	China	20	5.30	.923	.206
	United States	100	5.11	1.109	.111
Environmental impact	China	19	4.79	1.134	.260
	United States	102	4.68	1.064	.105
Weather	China	20	4.00	1.257	.281
	United States	101	3.66	1.416	.141

*The lower the number is, the more important it is considered

Figure 5

Response to “Given a free week, would you prefer to relax at home or to travel somewhere?”

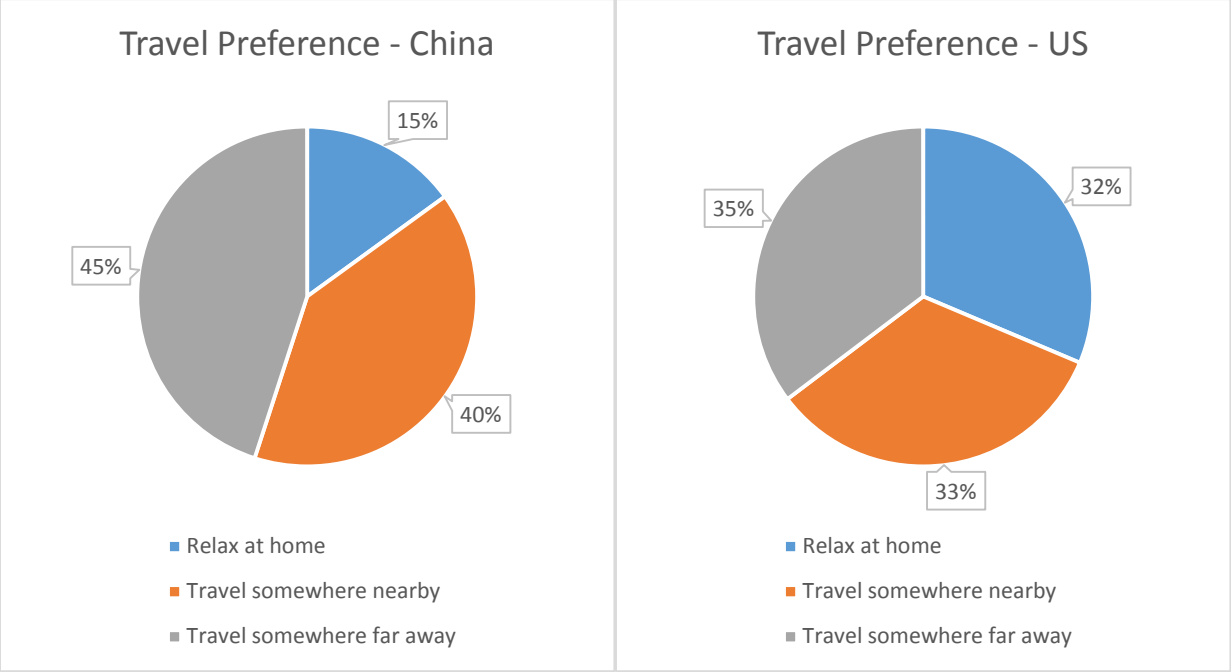


Figure 6

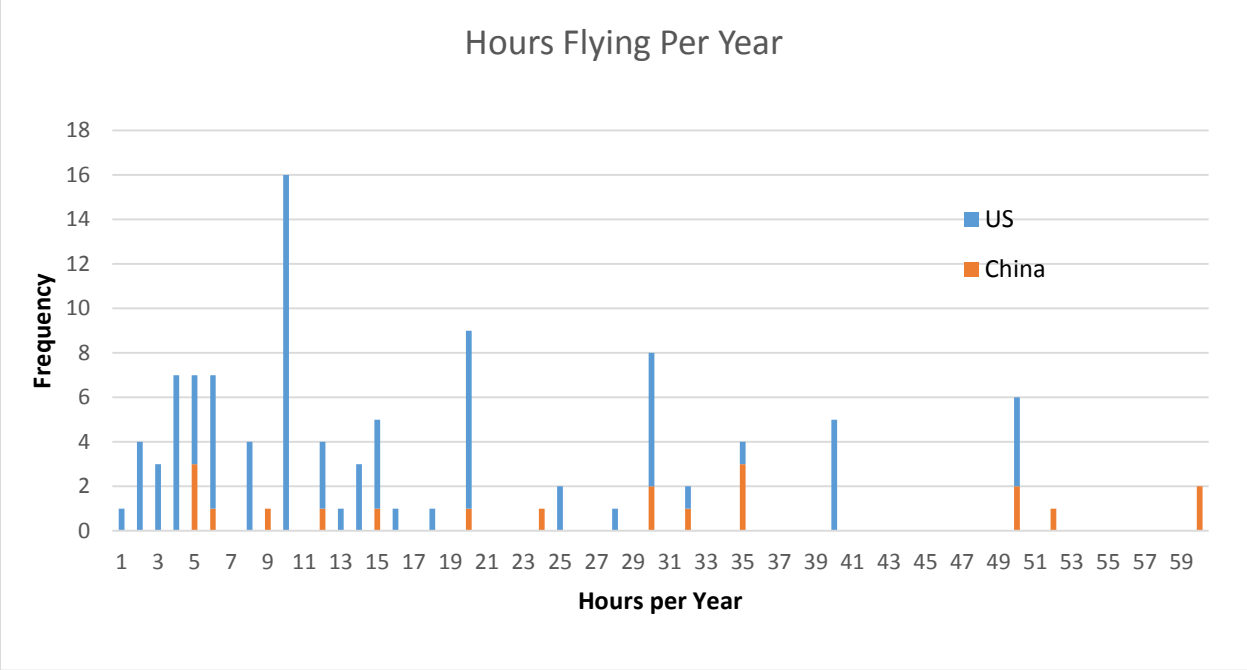


Figure 7

Response to “How often do you eat animal-based products?”

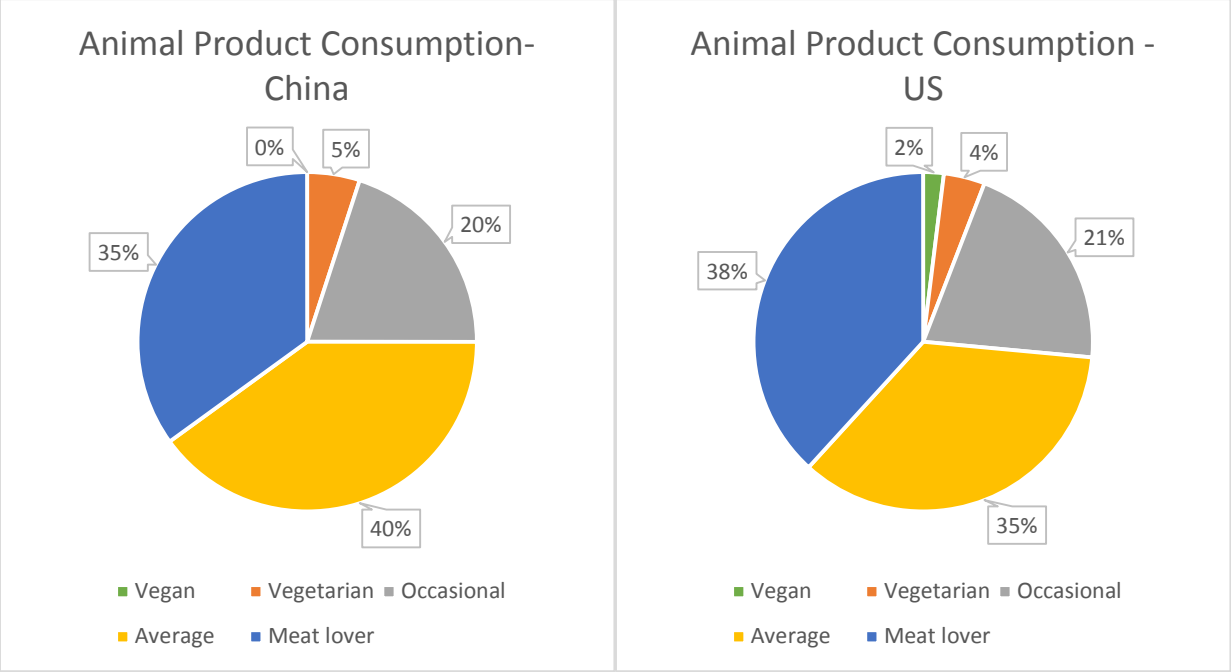


Figure 8

Response to “If you eat meat or seafood, which of the following do you eat most often?”

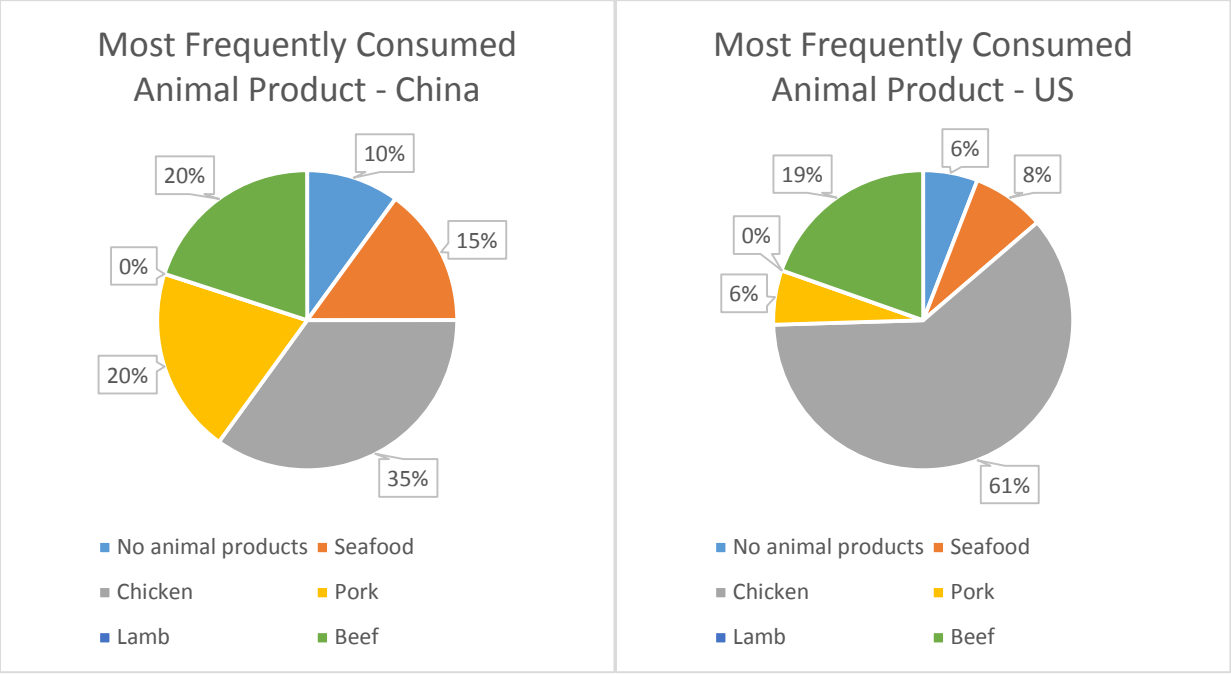


Table 4

Mean Rankings for Importance of Factors in Selecting Food

	Nationality	N	Mean	Std. Deviation	Std. Error Mean
Price	China	20	3.45	1.538	.344
	United States	102	2.52	1.520	.151
Taste	China	20	3.65	1.814	.406
	United States	102	2.35	1.347	.133
Freshness	China	20	2.25	.967	.216
	United States	102	3.09	1.203	.119
Organic	China	20	4.85	1.348	.302
	United States	101	5.35	.984	.098
Health	China	20	2.15	1.182	.264
	United States	102	2.76	1.153	.114
Processed foods	China	20	4.65	1.309	.293
	United States	100	4.93	1.121	.112

*The lower the number is, the more important it is considered

Figure 9

Response to “If you had to choose, would you invest in your community’s economy or in its environment?”

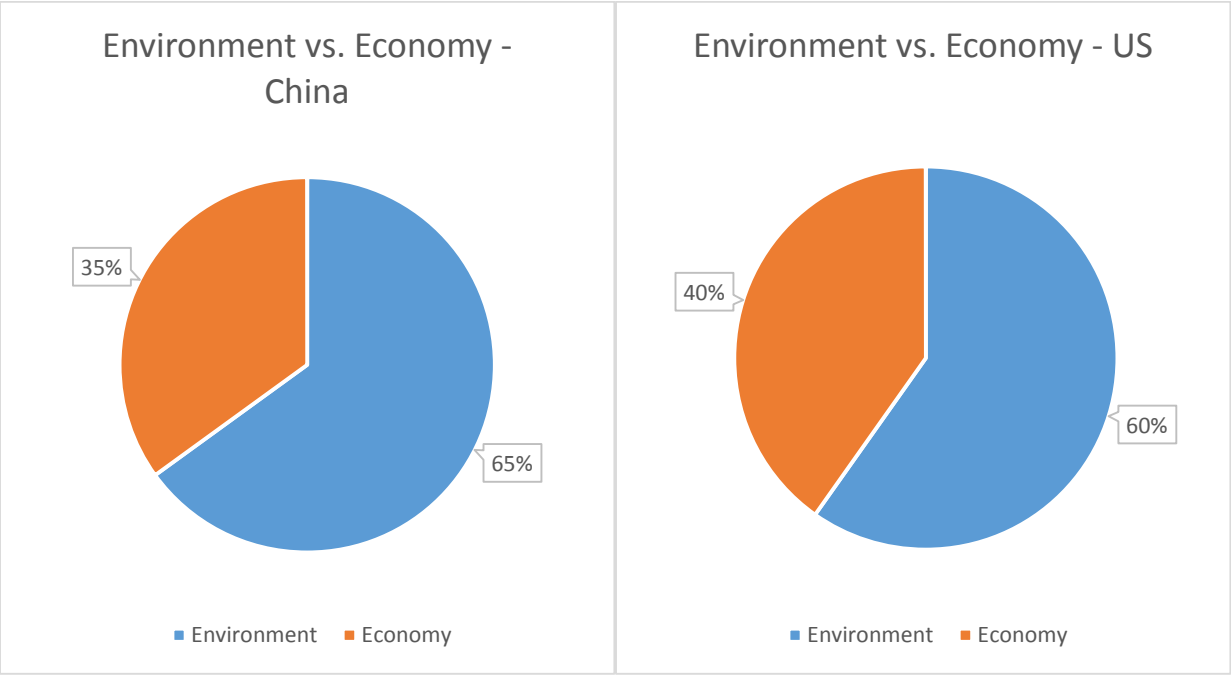
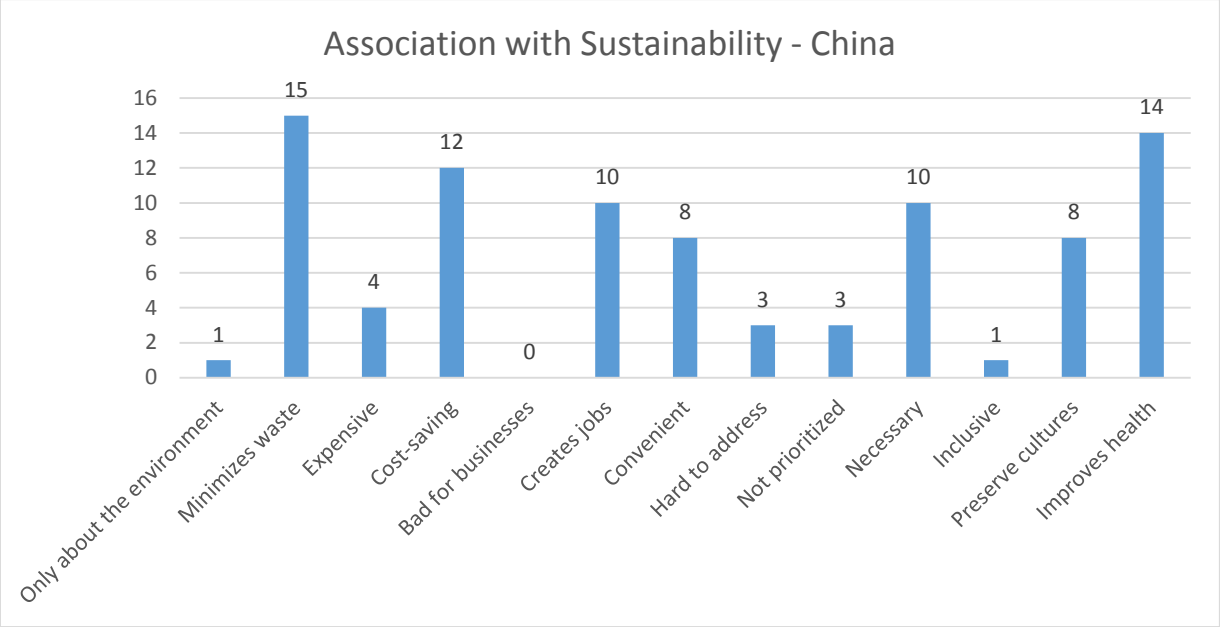


Figure 10

Response to “Which of the following do you associate with sustainability?”



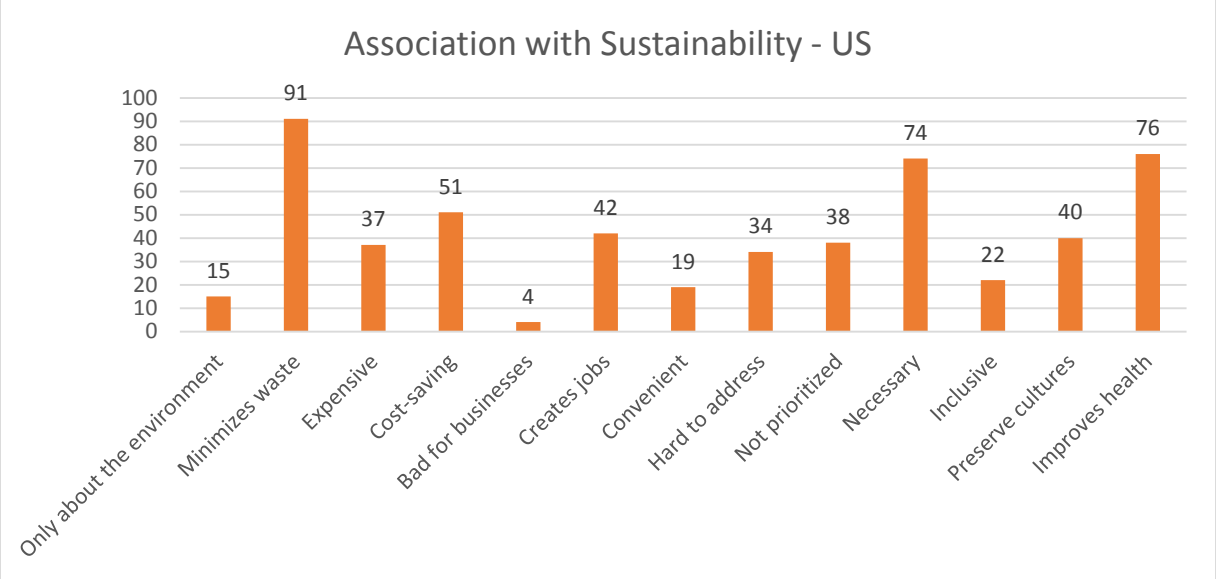
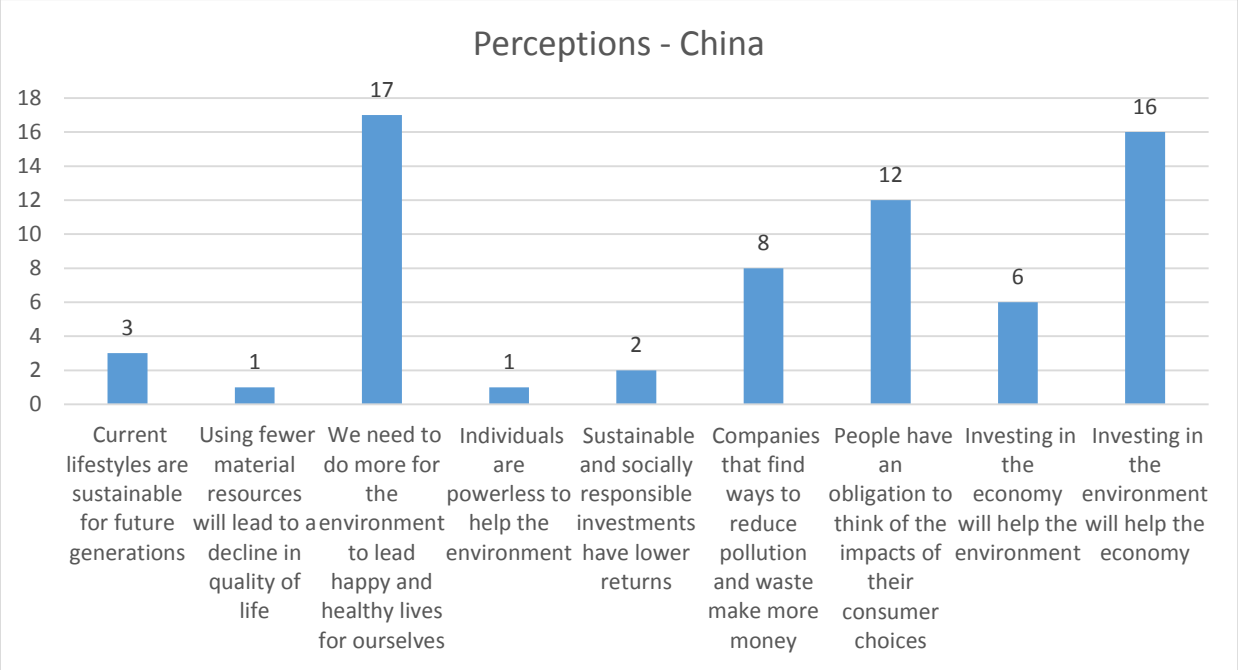


Figure 11

Response to “Please put a check next to statements that you agree with.”



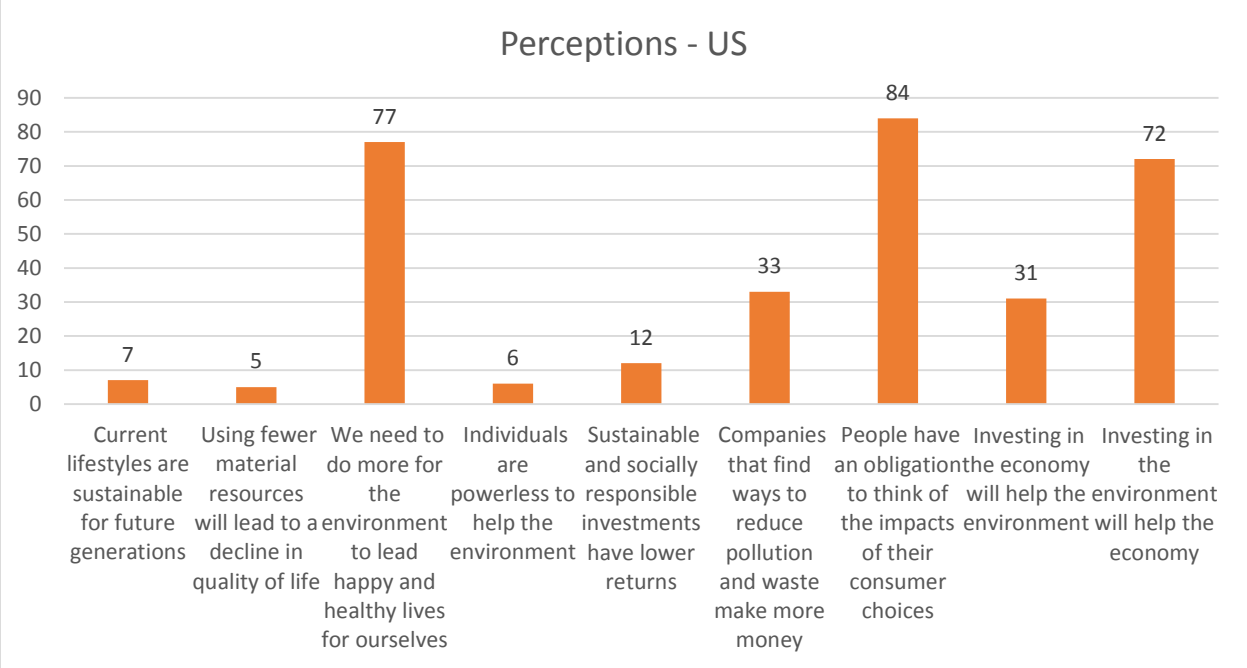


Figure 12

Response to “Which of the following fits in best with your definition of success? Please pick up to 5.”