Exploring pathways to sustainable development: Empirical analyses of wellbeing and cooperative behaviors for current and future generations.

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EXPLORING PATHWAYS TO SUSTAINABLE DEVELOPMENT: EMPIRICAL ANALYSES OF WELLBEING AND COOPERATIVE BEHAVIORS FOR CURRENT AND FUTURE GENERATIONS

ABSTRACT

Sustainability is crucial in protecting our planet and future generations and growing concerns for globalism, capitalism and environmental problems. Sustainable development goals (SDGs) have become common missions for humanity all over the world. Thus, it is crucial to understand what factors facilitate SDGs to suggest the proper mechanism to improve and maintain sustainability. This thesis attempts to find the paths to sustainable development from both aspects of peripersonal (whatever is in your arm's reach directly, such as human relations) and extrapersonal (whatever is beyond your arm's reach directly, such as global climate change) sides of human nature, for example, wellbeing (happiness), generativity, social preferences, perceptions and scientific knowledge). To this purpose, the thesis applies a questionnaire and survey experiments and collects primary data to examine determinants of wellbeing (happiness) at the individual levels, empirically explores the potential factors concerning inquisitive and autonomous people to influence wellbeing (happiness) and generativity in place with different cultures, addresses the relationships between the perception and people's cooperative attitude toward global issues (i.e., climate change).

The first study in this thesis examines relationships between wellbeing (happiness), the concern for inquisitiveness (curiosity & acceptance to something and someone different), generativity and social preferences, along with sociodemographic factors, within a single analytical framework. This study hypothesizes that inquisitiveness is a fundamental determinant of generativity and happiness, posing two research questions (1) Does inquisitiveness play a role in generativity? (2) How does inquisitiveness, along with generativity, affect people's happiness? This study conducts questionnaire surveys

with 400 Japanese subjects, applying quantile regression and structural equation modeling to the data. This study empirically characterizes determinants of wellbeing (happiness) with the data, focussing on generativity and inquisitiveness, controlling for sociodemographic factors. First, the analysis identifies the importance of inquisitiveness in characterizing generativity in that people with high inquisitiveness tend to be generative. Second, people are identified to be happy as they have high generativity and inquisitiveness, demonstrating two influential roles of inquisitiveness as direct and indirect determinants through a mediator of generativity. Overall, the results suggest that inquisitiveness shall be an essential element of people's happiness through intergenerational and intragenerational communication.

The second study considers that generativity and wellbeing shall be necessary and salient indicators that people in societies must enhance for sustainable development, hypothesizing that people with high autonomy (being independent & resisting social pressure) and inquisitiveness (adaptability to new social and/or environmental changes) tend to be generative and happy. To empirically examine the hypothesis, we analyze people's generativity and wellbeing as essential elements of sustainable development and statistically characterize them in relation to autonomy and inquisitiveness with the data from survey experiments of 413 residents in matrilineal Island Palau. We choose Palau as the field, because rapid social and environmental changes are ongoing from traditional to modern societies and a wide variation of people is expected to be observed compared to any field in other nations, even with a small sample size. Two main results are obtained. First, the analysis identifies the importance of inquisitiveness in that people with high inquisitiveness tend to be generative. Second, people's wellbeing is high as they are generative, autonomous and inquisitive, demonstrating two influential roles of inquisitiveness on happiness as direct and indirect determinants through a mediator of generativity. Overall, the results suggest that autonomy and inquisitiveness contribute to people's generativity and wellbeing even in tradition-oriented societies, such as Palau, and their improvements are considered specific paths to sustainable development.

The third study in this thesis analyzes the determinants of human-induced perception and the impact of the gap in perceptions on cooperative behaviors toward climate change by conducting a questionnaire survey and experiments with a climate donation game with 400 Japanese subjects. This study

empirically characterizes determinants of people's cooperative behaviors through the climate donation game with the data, focussing on social value orientation (SVO), scientific literacy and the perception of the cause of climate change, controlling for sociodemographic factors. First, the analysis identifies the importance of people's scientific literacy in explaining the perception gaps in that those with high scientific literacy tend to have the perception of human-induced climate change. Second, people are identified as being cooperative toward climate change, as they have a prosocial value orientation, high scientific literacy and the perception of human-induced climate change, demonstrating two critical roles of scientific literacy as not only a direct determinant but also an indirect one, through a mediator of people's perceptions. Overall, the results suggest that scientific literacy shall be a key to enhancing cooperation toward climate change by promoting the perception of human-induced climate change.

Key Words: Autonomy; inquisitiveness; generativity; wellbeing; perception gaps; scientific literacy; cooperative behavior; climate donation game; sustainable development; Palau

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Chapter 1

Introduction

As Max Weber expects, modernization has been promoted by making everything, including humans, countable and creating a computable world (Weber, 1978; Ann et al., 2005; Bhambra, 2010). Many people have increasingly been pursuing further economic growth and prosperity. Consequently, economic competition stimulates individualism, consumerism and self-maximization behaviors to be a primary source of satisfaction with life, leading to various intergenerational problems against sustainability (Weiss, 2008; Gilovich et al., 2015; Diprose et al., 2019). Nowadays, sustainability is crucial in protecting our planet and future generations and growing concerns for globalism, capitalism and environmental problems (Ostrom, 2009; Sen, 2013; Piketty, 2014). Therefore, sustainable development goals (SDGs) are established and advocated as the missions for humanity, now being a slogan for sustainability all over the world (United Nations, 2015, 2019; WHO, 2019). However, little is known about what types of people or societies are likely to follow the paths for SDGs steadily and what kinds of indicators people in societies must enhance to achieve these goals. Thus, it is crucial to understand what factors facilitate SDGs to suggest the proper mechanism to improve and maintain sustainability.

Several studies have reported that people's brain manages the external world by dividing it into separate spaces, such as the peripersonal (whatever is in your arm's reach) and extrapersonal (whatever is beyond your arm's reach) (Higuchi et al., 2006; Iachini et al., 2017; Lieberman and Long, 2018). Any interaction in the extrapersonal space will occur in the future because the distance is linked to time (Lieberman and Long, 2018). Having experiences in the peripersonal space, such as touching, tasting and holding, will bring people happiness, sadness and joy. By contrast, acquiring something out of your reach may require effort, time and planning. Both peripersonal and extrapersonal spaces are essential for people's collective (or personal) survival strategies or sustainability. As for the peripersonal space, wellbeing (happiness) is reported to positively correlate with materializing sustainable development (Kroll, 2015; De Neve and Sachs, 2020; Kim et al., 2021). Generativity (a concern regarding the establishment and guiding of future generations) is also known to contribute to sustainable development

because it facilitates intergenerational cultural and resource transfers between current and future generations (Aubin and McAdams, 1995; Huta and Zuroff, 2007; Cox et al., 2010; Tabuchi et al., 2015; Shahrier et al., 2017; Timilsina et al., 2019). As for the extrapersonal space, perception, concept and scientific knowledge are essential for tackling global issues, such as international politics, economy and climate change. This thesis attempts to find the paths to sustainable development from both peripersonal and extrapersonal sides of human nature, for example, wellbeing (happiness), generativity, social preferences, perceptions and scientific knowledge.

Previous studies have examined several potential determinants of happiness or wellbeing in the last decades (Diener et al., 1999; Kahneman and Deaton, 2010; Meisenberg and Woodley, 2015; Magnani and Zhu, 2018). Other researchers have found the positive relationships between generativity and happiness, often along with social preferences (i.e., prosocial behaviors, such as monetary donation, buying some gifts for friends or volunteering) (Dunn et al., 2008; Hofer et al., 2008; Aknin et al., 2012; Layous et al., 2012; Dunn et al., 2014; Rudd et al., 2014; Aknin et al., 2015; Morselli and Passini, 2015; Timilsina et al., 2019; Shahen et al., 2019). Aknin et al. (2012) conduct survey experiments with Canadian University students, claiming that social preferences are positively associated with happiness and there exists a positive feedback loop between the two. Timilsina et al. (2019) compare prosociality and generativity between rural and urban people by conducting survey experiments in Nepal. They find that rural people are more prosocial and generative than urban ones, and claim that prosocial orientation shall contribute to generativity. Building upon Timilsina et al. (2019), Shahen et al. (2019) conduct similar types of survey experiments in rural and urban areas of Bangladesh, collecting data on happiness and generativity along with prosociality and other variables. They establish that generativity is a robust and consistent predictor of happiness, controlling for prosociality and some other key sociodemographic factors in the analyses. These studies suggest that generativity and prosociality can influence happiness (Aubin and McAdams, 1995; Huta and Zuroff, 2007; Hofer et al., 2008; Cox et al., 2010; Tabuchi et al., 2015).

Past studies have examined that autonomy (being independent & resisting social pressure) and inquisitiveness (adaptability to new social and/or environmental changes) are fundamental personal el-

ements to characterize people's wellbeing and sustainability (Ryan and Deci, 2000; De-Juanas et al., 2020; Xie et al., 2020; Boiman-Meshita and Littman-Ovadia, 2022; Hirose and Kotani, 2022). Other researchers claim that people in tradition-oriented societies are usually reluctant to accept something and someone different or new (low inquisitiveness) and tend to follow indigenous rules without expressing their opinions (low autonomy) for maintaining sustainability in their communities (Savells, 1991; Simon, 1997; Kizilhan, 2014; Dewi and Suyasa, 2019; Watson, 2019). Other studies have empirically examined the relationship between wellbeing, generativity and social preferences, attracting attention in the emergence of problems on sustainability and finding some mixed results for associations among these factors (Layous et al., 2012; Dunn et al., 2014; Rudd et al., 2014; Aknin et al., 2015; Morselli and Passini, 2015; Timilsina et al., 2019; Shahen et al., 2019). Other studies argue that generativity (a concern and commitment for next generations) and wellbeing are highly associated with one another, being essential predictors for sustainability or SDGs (Shahrier et al., 2016, 2017; Timilsina et al., 2019; Shahen et al., 2019; Hirose and Kotani, 2022). That is, people shall be sustainable when they are generative and happy in their daily life. These studies suggest that generativity and wellbeing will be essential elements of sustainable development (Shahrier et al., 2016, 2017; Timilsina et al., 2019; Shahen et al., 2019; Hirose and Kotani, 2022).

Climate change is a serious problem that requires people's cooperation to materialize sustainable development (Pacheco et al., 2014; Bang et al., 2015; Coulibaly et al., 2020; Hirose et al., 2021). There have been several types of research to analyze how people become cooperative against climate change. These studies establish that correct perception and knowledge of climate change are positively associated with cooperative attitudes, whereas a wide variety of gaps in such perceptions exist (Rand et al., 2009; Tobler et al., 2011; Fischer and Charnley, 2012; Islam et al., 2016; Rajapaksa et al., 2018). Past studies have examined people's perceptions of the cause of climate change (Bray, 2010; Cook et al., 2013; Carlton et al., 2015). Some researchers report that climate-change-specific beliefs, particularly whether people believe in the human-induced causes of climate change and/or whether they connect the locally observed impacts to climate change, are the most prominent determinants of risk perception (Saleh Safi et al., 2012; Shealy et al., 2017; Shealy, 2018). Other researchers implement surveys

on people's perceptions and their cooperative attitudes toward climate problems proxied by their willingness to pay (WTP) (O'Connor et al., 1999; Akter and Bennett, 2011; Brechin and Bhandari, 2011; Khanal et al., 2018). O'Connor et al. (1999) examine the relationship between people's risk perceptions and their WTP for climate problems, reporting that an environmental belief is a strong predictor of behavioral intentions for voluntary actions. These studies have demonstrated that people's perceptions generally influence their cooperative attitudes toward climate change.

No previous works have explored the primary paths for sustainable development concerning the peripersonal and extrapersonal factors, such as wellbeing (happiness), generativity and people's perception of global issues. Therefore, in the first stage, this research analyzes determinants of people's wellbeing (happiness) and generativity along with inquisitiveness, social value orientation (SVO) and sociodemographic factors in Japan. In the second stage, this research analyzes determinants of people's wellbeing (happiness) and generativity along with autonomy, inquisitiveness, SVO and sociodemographic factors in matrilineal Island Palau. The author chooses Palau as the field, because rapid social and environmental changes are ongoing from traditional to modern societies, and a wide variation of people is expected to be observed, as compared to any other nation, even with a small sample size. In the third stage, this research addresses the relationships between the perception and people's cooperative attitude toward global issues (i.e., climate change) through survey experiments with actual payment.

The later parts of this thesis are organized as follows: chapter 2, entitled "How does inquisitiveness matter for generativity and happiness?" presents the details of the survey conducted in the urban and nonurban areas in Japan and the main results. Chapter 3, entitled "How do autonomy and inquisitiveness play roles in sustainable development? Implications from matrilineal Island Palau" has approached the essential factors for people to facilitate sustainable development (i.e., wellbeing and generativity) in relation to autonomy and inquisitiveness by considering different societies and providing insight into the age, gender and cultural differences that are presented. Chapter 4, entitled "Is climate change induced by humans? The impact of the gap in perceptions on cooperation." examines the factors that affect people's cooperation against climate change, concerning prosociality, scientific

literacy and perceptions.

Chapter 2

How does inquisitiveness matter for generativity and happiness?

2.1 Introduction

Curiosity and acceptance are important elements for one person to gain creativity, fulfillment and views (Kashdan et al., 2009; Silvia and Kashdan, 2009; Kashdan et al., 2011; Hagtvedt et al., 2019). A child's tendency to ask a question shall be an initial step of building human relations and learning various things. In the literature, such a tendency is conceptualized as "inquisitiveness" representing curiosity & acceptance to something and someone different (Lagattuta and Wellman, 2002; Fusaro and Smith, 2018). Frazier et al. (2009) examine adult-child conversational exchanges by focusing on young children's questions and adult's answers, claiming that such communications provide important bases for children's future life, especially regarding how they are able to grow through human interactions. Moreover, it is established that having and keeping nice relationships with family, friends and general others contribute to generativity and happiness (McAdams and Aubin, 1992; Huta and Zuroff, 2007; Hofer et al., 2008; Schoklitsch and Baumann, 2012; Villar, 2012). Given this state of affairs, individual tendencies to be curious about and/or accept something and someone different (or new) may be a main engine for one person to be not only interactive with people in different generations but also happy. Therefore, this research addresses the role of inquisitiveness for generativity and happiness.

Erikson (1963) introduces the concept of generativity and defines it as a concern regarding the establishing and guiding of future generations in the life-span theory of personality development. Generativity is expressed in bearing and raising children but is by no means limited to the domain of parenthood (McAdams and Aubin, 1992). Various activities and behaviors concerning future generations for helping and teaching something useful and interesting to young generations, are also considered expressions of generativity (McAdams and Logan, 2004; Timilsina et al., 2019). Some scales of gen-

erativity have been developed to quantify such people's activities, behaviors and concerns, e.g., the Loyola generativity scale (LGS) and the generative behavior checklist (GBC) (McAdams and Aubin, 1992; McAdams et al., 1993; McAdams, 2001; Hofer et al., 2008). Utilizing these scales, previous studies have characterized generativity concerning psychological and sociodemographic factors, such as aging, education, gender, health, income, marital status, political view, type of societies and value orientation (Peterson and Duncan, 1999; Pratt et al., 2001; Lawford et al., 2005; Rittenour and Colaner, 2012; Jones and McAdams, 2013; Schoklitsch and Baumann, 2012; Timilsina et al., 2019). Overall, it is established that age, marital status and type of societies are main determinants of generativity.

Happiness is taken to be a term to represent an outcome of a "good life," where people act and behave to seek happiness (Mentzakis and Moro, 2009; Jorgensen et al., 2010; Luhmann et al., 2011; Gilbert et al., 2016).[1] Maslow proposes a theory based on psychological needs and gratification processes, suggesting that people are happy as they become wealthy, i.e., Maslow's hypothesis (Maslow, 1954). To examine this hypothesis, several researchers have developed and refined the measurements, such as the subjective happiness scale (SHS) and satisfaction with life scale (SWLS) (Diener et al., 1985, 2003; Lyubomirsky and Lepper, 1999). Veenhoven (1991) and Diener and Diener (1995) examine the hypothesis with cross-country level data utilizing happiness scales and conclude that wealth can account for variation in happiness across countries to a certain extent; however, there should be some other important predictors. Following these works, the literature has focused on how happiness is associated with cultural, sociodemographic and personal factors, other than wealth or income, including education, gender, marital status, self-esteem, human relations, optimism and extraversion (Diener et al., 1998, 1999; Kahneman et al., 1999; Lee et al., 2000; Jan and Masood, 2008; Oishi and Diener, 2009; Diener and Ryan, 2009; Chitchai et al., 2018). Overall, it is established that aging, income, human relationships, personality traits and value orientations matter for characterizing happiness (Welsch, 2006; Zidansek, 2007; Leung et al., 2011; Bibi et al., 2015; Meisenberg and Woodley, 2015; Magnani and Zhu, 2018; Au et al., 2020).

Previous studies have examined the relationship between generativity and happiness, often along

[1] In this paper, we interchangeably use the term "wellbeing" to refer to "happiness."

with social preferences (Dunn et al., 2008; Hofer et al., 2008; Aknin et al., 2012; Layous et al., 2012; Dunn et al., 2014; Rudd et al., 2014; Aknin et al., 2015; Morselli and Passini, 2015; Timilsina et al., 2019; Shahen et al., 2019). Aknin et al. (2012) conduct survey experiments with 51 students of the University of British Columbia, claiming that social preferences are positively associated with happiness and there exists a positive feedback loop between the two. Timilsina et al. (2019) compare prosociality and generativity between rural and urban people by conducting survey experiments in Nepal. They find that rural people are more prosocial and generative than urban ones, and claim that prosocial orientation shall contribute to generativity. Building upon Timilsina et al. (2019), Shahen et al. (2019) conduct similar types of survey experiments in rural and urban areas of Bangladesh, collecting data on happiness and generativity along with prosociality and other variables. They establish that generativity is a robust and consistent predictor of happiness, controlling for prosociality and some other key sociodemographic factors in the analyses. Overall, these studies suggest that generativity and prosociality can influence happiness (Aubin and McAdams, 1995; Huta and Zuroff, 2007; Hofer et al., 2008; Cox et al., 2010; Tabuchi et al., 2015).

Inquisitiveness is a concept to represent curiosity & acceptance of something and someone different and/or new, and those with such inquisitiveness tend to start communications with others by asking questions (Hirayama and Kusumi, 2004; Black, 2005; Bardone and Secchi, 2017; Watson, 2019). After some development of the scales for inquisitiveness by Facione et al. (1992), Hirayama and Kusumi (2004) and Hogan and Hogan (2007), some studies have been conducted to address how an inquisitive person behaves in terms of learning from and engaging with people regardless of their backgrounds, positions and roles as well as how such behaviors may lead to creative problem solving for nursing and schooling (Yeh, 2002; Kawashima and Petrini, 2004; Hogan and Hogan, 2007; Bardone and Secchi, 2017; Secchi and Adamsen, 2017). Hirayama and Kusumi (2004) conduct questionnaire surveys with 426 Japanese university students and analyze the critical thinking attitudes on the process of drawing a conclusion. They find that inquisitiveness is an essential factor in reaching a conclusion not bounded by people's beliefs.[2] Overall, inquisitiveness is a powerful source of engines that increases the motivation

[2]Nakagawa (2016) also demonstrates that inquisitiveness is positively correlated with how people

and behaviors in some situations, triggering people's communications with others and their interactions with unfamiliar environments (Blank and Covington, 1965; Baldwin and Moses, 1996; Black, 2005; Cluver, 2010).

No previous works have addressed how generativity and happiness are characterized by inquisitiveness, while both of these concepts are known to be highly concerned with how people build and keep relationships with family, friends and general others. Inquisitiveness is considered an important factor to trigger communications, being conjectured to contribute to maintaining nice human relations. Therefore, we hypothesize that inquisitiveness is an important determinant of generativity and happiness, empirically examining the relationships along with noncognitive, cognitive and sociodemographic factors in a single analytical framework. To this end, we conduct questionnaire surveys with 400 Japanese subjects to collect data, following previous studies that analyze the relationship between behaviors and happiness with cross-sectional data (Tkach and Lyubomirsky, 2006; Warner and Vroman, 2011; Lee and Kawachi, 2019; Pluut and Wonders, 2020; Salavera et al., 2020).[3] With this data, our research addresses the following two open questions. (1) Does inquisitiveness play a role in generativity? (2) How does inquisitiveness, along with generativity, affect people's happiness?

2.2 Materials and methods

2.2.1 Materials

We conduct questionnaire surveys with 400 subjects sourced from the registered participant pool of a web-based survey research organization, Cross Marketing Inc., in Japan.[4] Subjects' mean age is 47.79 years with a standard deviation $= 16.74$, ranging between 20 and 88 years. The survey area

are well prepared for possible future disasters by conducting questionnaire surveys in Japan. Another group of studies analyze the role of inquisitiveness in leadership studies at schools and workplaces, generally confirming its importance in experiments and the fields (Harris, 2011; Blickle et al., 2014; Bardone and Secchi, 2017; Watson, 2019).

[3]There are several studies that apply cross-sectional data analyses, such as mediation analysis and regressions, to examine the relationships among personality traits, behaviors and happiness (Tkach and Lyubomirsky, 2006; Warner and Vroman, 2011; Salavera et al., 2020).

[4]The sample size is partly determined by the budget and time constraints facing us.

is divided into urban and nonurban ones according to a population density of 500 people km^{-2}. If the population density at the place where a subject lives is above the threshold, it is urban. Otherwise, it is nonurban. Literature establishes that prosociality differs between rural and urban areas in some developing countries (Shahrier et al., 2016, 2017; Shahen et al., 2019). Therefore, we take the samples from urban and nonurban areas, considering and controlling for such possibility in statistical analyses. This survey collects a sample of 200 participants each in urban and nonurban areas (400 subjects in total) with information about (i) sociodemographic factors, such as age, gender, household income, marital status, educational background, family characteristics, (ii) generativity (a concern in guiding the next generation), (iii) subjective wellbeing (SWB) as happiness, (iv) inquisitiveness (curiosity & acceptance to something and someone different and/or new) and (v) social value orientation (as a proxy for social preferences). The variables we collect in this survey can be categorized into cognitive, noncognitive and sociodemographic factors in relation to SWB, as described in figure 2.1.

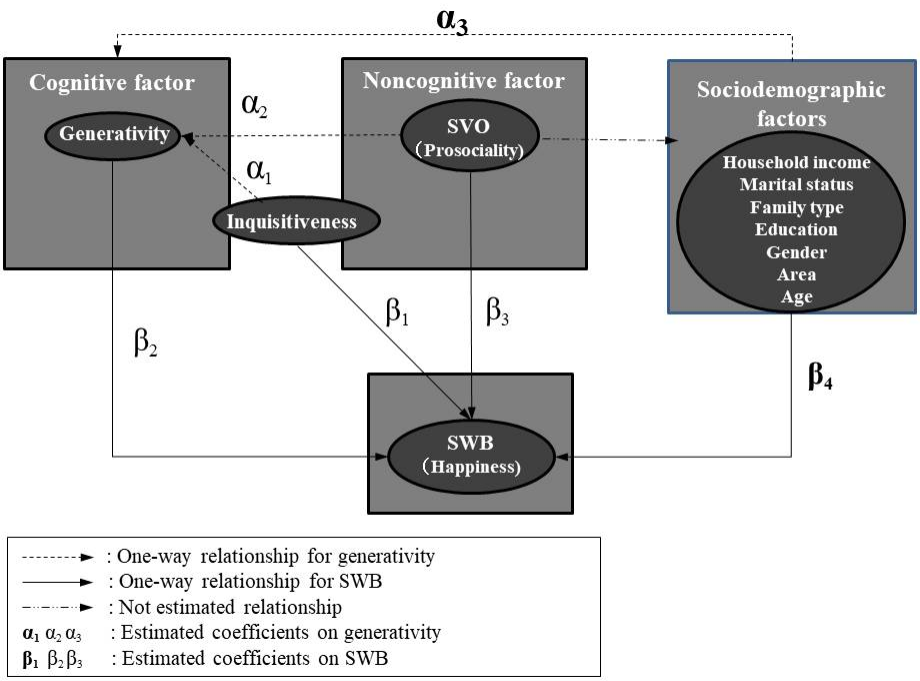


Figure 2.1: Conceptual framework describing the relationships concerning SWB among cognitive, noncognitive and sociodemographic factors.

2.2.2 Methods

The satisfaction with life scale (SWLS)

We employ the satisfaction with life scale (SWLS) to measure participants' life satisfaction in our survey, wellbeing is a part of happiness (Bibi et al., 2015). The SWLS is an established measure of life satisfaction and is known as a concept that is central to the research area of subjective wellbeing (SWB) (see, e.g., (Diener et al., 1985; Hayes and Joseph, 2003; Rittenour and Colaner, 2012; Grossman and Gruenewald, 2020)). Validation is carried out across ages, countries and genders (Diener et al., 1985; Jan and Masood, 2008; Esnaola et al., 2017) and the components consist of several aspects (i.e., affective, intrinsic and extrinsic ones) (Diener et al., 1985; Lucas et al., 1996). The affective aspect of life satisfaction refers to emotional elements, whereby levels of positive and negative ones are used to indicate the status of SWB (Lucas et al., 1996). In this case, the level of SWB is measured by psychological instruments, such as Ryff's psychological wellbeing scale (Ryff, 1989). The extrinsic aspect of life satisfaction refers to a relativistic judgment, whereby comparing oneself with others is used to indicate the status of SWB. In this case, the level of people's SWB is measured by instruments, such as the subjective happiness scale (SHS), as compared to that of their peers by stating "Compared to my peers, I consider myself," and its anchor is "less happy" and/or "more happy" (Lyubomirsky and Lepper, 1999).

This research focuses on intrinsic happiness, not limited to positive and negative emotions, employing the SWLS, which is designed to measure self-recognition of SWB (Diener et al., 1985; Diener, 2009; Esnaola et al., 2017). The items of the SWLS include five short statements: (1) "In most ways, my life is close to my ideal," (2) "The conditions of my life are excellent," (3) "I am satisfied with my life," (4) "So far, I have gotten the important things I want in life" and (5) "If I could live my life over, I would change almost nothing." Each item scores on a 7-point Likert scale, ranging from $1 =$ "Strongly disagree" to $7 =$ "Strongly agree," and the total scale scores are the sum of the five-item scores, ranging between 5 and 35. The higher the scores are, the greater life satisfaction is. The scores are categorized as extremely satisfied ($31 \sim 35$), satisfied ($26 \sim 30$), slightly satisfied ($21 \sim 25$),

neutral (20), slightly dissatisfied ($15 \sim 19$), dissatisfied ($10 \sim 14$) and extremely dissatisfied ($5 \sim 9$).

The Loyola generativity scale (LGS)

For generativity, researchers have developed several measurements to assess individual differences in consideration of its various aspects (Schoklitsch and Baumann, 2012). The Loyola generativity scale (LGS), which shall be considered a cognitive factor, is employed to measure "generative concern," as it is the most commonly used one in the literature (see, e.g., (McAdams and Aubin, 1992; Peterson and Duncan, 1999; McAdams et al., 2001; Lawford et al., 2005; Schoklitsch and Baumann, 2012; Jones and McAdams, 2013; Newton et al., 2014; De Espanés et al., 2015). The LGS scale contains a list of 20 questions, of which 6 questions are reverse questions. Another popular scale for generativity is the generative behavior checklist (GBC) that scores on "generative behaviors" in the past two months (McAdams et al., 1993; Schoklitsch and Baumann, 2012). Both the LGS and GBC are established to display positive associations, demonstrating consistency between generative concerns and behaviors (McAdams et al., 1993). We decide to use the LGS rather than the GBC because we realize that some questions in the GBC shall be difficult for many Japanese people to answer because of the absence of such opportunities and experiences (e.g.,"Babysat for somebody else's children," "Taught Sunday school or provided similar religious instruction").

The items of the LGS include statements, such as (1) "I try to pass along the knowledge I have gained through my experiences," (2) "I have important skills that I try to teach others," (3) "I feel as though I have made a difference to many people," (4) "I have made and created things that have had an impact on other people," (5) "I have made many commitments to many different kinds of people, groups and activities in my life" and (6) "I do not volunteer to work for a charity." Here, question (6) is considered the reverse one. Participants need to choose one of four options for each statement. "Zero," "one," "two" or "three" scores indicate how often the statement applies to subjects (Mark "zero" if a statement never applies, mark "three" if the statement applies very often or nearly always). In the case of reverse questions, we calculate the reverse score (i.e., zero becomes three, one becomes two, two becomes three and three becomes zero). The generativity score for each participant is computed as the

sum of the scores for all 20 items. The theoretical range is between 0 and 60, being calculated as the sum of the scores from the LGS questions, and Cronbach's alpha for this measure is 0.90 in our sample.

The inquisitiveness subscale

We employ the inquisitiveness scale in our survey, which is a subscale of the critical thinking disposition scale developed by Hirayama and Kusumi (2004). This instrument is used to measure one's disposition for curiosity & acceptance of something and someone different and/or new (Hirayama and Kusumi, 2004; Nakagawa, 2016; Futami et al., 2020). This subscale consists of ten items, including (1) "I want to interact with people with various ways of thinking and learn a lot from them," (2) "I want to keep learning new things throughout my life," (3) "I like to challenge new things," (4) "I want to learn about various cultures," (5) "Learning how foreigners think is meaningful to me," (6) "I am interested in people who have a different way of thinking," (7) "I want to know more about any topic," (8) "I want to learn as much as possible, even if I do not know if it is useful," (9) "It is interesting to discuss with people who have different ideas than me" and (10) "I want to ask someone if I do not know." The items are rated from $1 =$ "Strongly disagree" to $5 =$ "Strongly agree." The theoretical range is between 10 and 50. This subscale is established as a reliable measure for influencing people's behaviors and attitudes in many important contexts, such as disaster management (Nakagawa, 2016).

Social value orientation (SVO) with the slider method

We use the SVO game with the "slider method" to identify participants' social preferences as prosocial or proself (Murphy et al., 2011). Figure 2.2 shows the six items of the slider measure that gives numbers to represent outcomes for oneself and the other in a pair of people where the other is unknown to the participant. Participants are asked to choose among the nine options for each item. Each participant chooses her allocation by marking a line that defines her most preferred distribution between herself and the other person. The mean allocation for herself $\overline{A}_s$ and that for the other person $\overline{A}_o$ are calculated from all six items (see Figure 2.2). Then, 50 is subtracted from $\overline{A}_s$ and $\overline{A}_o$ to shift the base of the resulting angle to the center of the circle $(50, 50)$. The index of a participant's SVO is given by

SVO $= \arctan \frac{(\overline{A}_o)-50}{(\overline{A}_s)-50}$. Depending on the values generated from the test, social preferences are categorized as follows: 1. altruist: SVO $> 57.15°$, 2. prosocial: $22.45° <$ SVO $< 57.15°$, 3. individualist: $-12.04° <$ SVO $< 22.45°$ and 4. competitive: SVO $< -12.04°$.

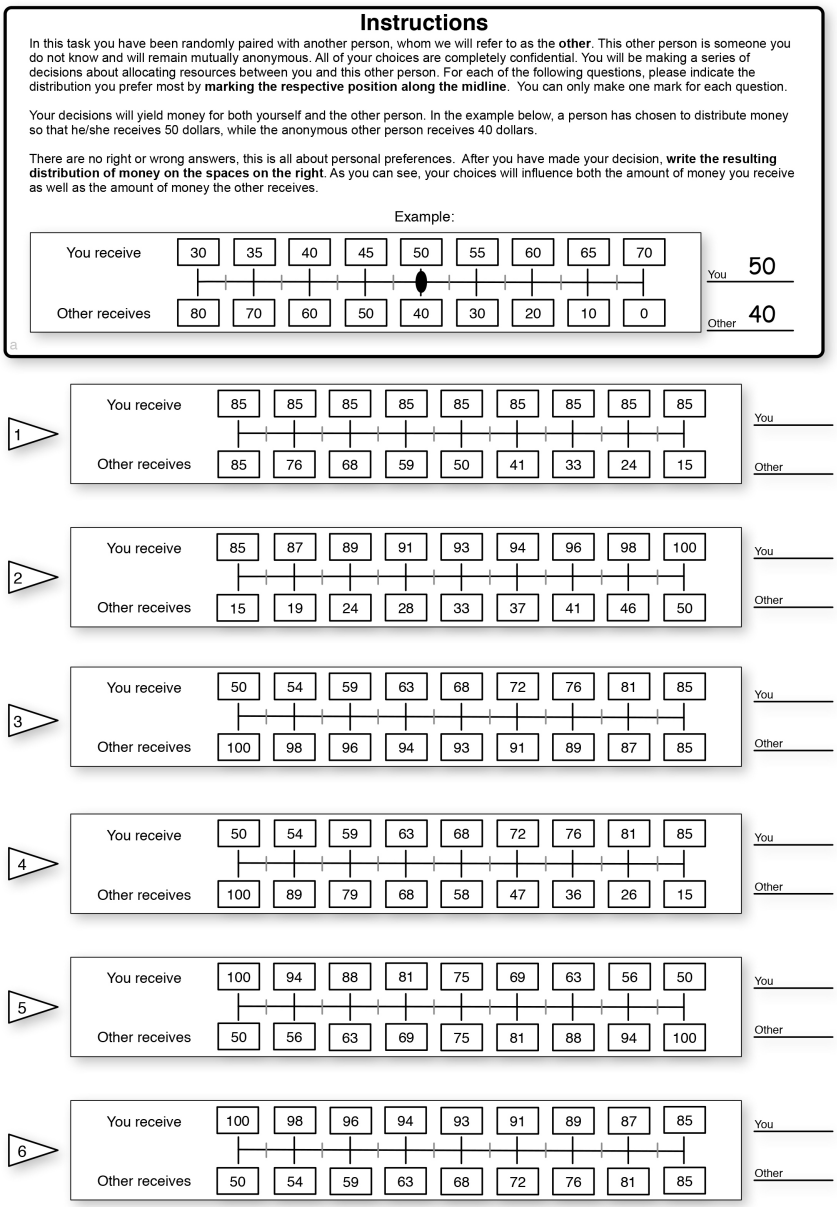


Figure 2.2: Instructions of the "slider method" for measuring the social value orientation (Murphy et al., 2011)

The SVO framework assumes that people have different motivations and goals for evaluating re-

source allocations between themselves and others. Also, the SVOs are established to be stable for a long time (see, e.g., (Van Lange et al., 2007; Brosig-Koch et al., 2011)). Participants that go through the six primary items in the slider method are known to give complete categories of social preferences (Murphy et al., 2011). As has been done in the research of psychology, we simplify the four categories of social preferences into two categories of prosocial and proself types; "altruist" and "prosocial" types are categorized as prosocial subjects, while "individualist" and "competitive" types are categorized as "proself" participant (see (Murphy et al., 2011)). Participants are informed that the units in this game are points, meaning that the more points they get, the more real money they will earn.[5] Our survey experiments are conducted with real monetary payments in the SVO game. This game is designed to motivate participants to seriously perform in the survey experiment, considering their opportunity costs of time and their true revelation of social preferences.

One session takes 5 to 8 minutes. An exchange rate is applied to the points in the games to determine the monetary reward, and participants receive a maximum of 150 JPY ($\approx$ 1.37 USD) and an average of 104 JPY ($\approx$ 0.95 USD) in the game. The decisions in this game are conducted in complete privacy. To compute the payoffs of participants, we randomly match one participant with another to form a pair. The payoff for each participant in the game is the summation of the points from 6 selections by an individual, as "You," and 6 selections by the partner, as "Other." We explain the methods of random matching and payoff calculation with information on the exchange rate (1 point is converted to 1 JPY) for the real monetary incentive for participants before starting the game. Participants who finish the questionnaire receive payments from the game and are paid 96.33 JPY on average.

2.2.3 Regression analyses

With the cross-sectional data of the aforementioned variables, we first characterize generativity in relation to inquisitiveness, and second, characterize happiness in relation to inquisitiveness and generativity along with other factors. We decided to rely on cross-sectional data following some previous

[5]For details, see the instructions in Figure 2.2.

researches in that the effectiveness of cross-sectional data analyses is argued for identifying correlation and causal relation among psychometric and sociodemographic variables, especially when the causal direction is somewhat obvious or intuitively straightforward (Tkach and Lyubomirsky, 2006; Warner and Vroman, 2011; Salavera et al., 2020). Specifically, we use mean-based and median regressions to address the two open questions posed in this chapter. Question 1: "Does inquisitiveness play a role in generativity?" Question 2: "How does inquisitiveness, along with generativity, affect people's happiness?" To answer questions (1) and (2), regression models are applied to characterize generativity and happiness as dependent variables, respectively, in relation to other key independent variables as described in figure 2.1, enabling to identify of important determinants. For empirically characterizing the generativity of participant i, the model is specified as

$$\text{generativity}_i = \alpha_0 + \alpha_1 \cdot \text{inquisitiveness}_i + \alpha_2 \cdot \text{SVO}_i + \boldsymbol{\alpha}_3 \cdot \mathbf{x}_i' + \epsilon_i, \tag{2.1}$$

where $\mathbf{x}_i$ is a vector of sociodemographic independent variables including household income, marital status, family type, education, gender, etc. The associated coefficients of $\alpha_0, \alpha_1, , \alpha_2, \boldsymbol{\alpha}_3$ are the parameters to be estimated, and ϵ_i is a disturbance term. In equation (2.1), parameter α_1 is of particular interest to statistically examine question (1).

For the happiness of participant i, the model is

$$\text{SWB}_i = \beta_0 + \beta_1 \cdot \text{inquisitiveness}_i + \beta_2 \cdot \text{generativity}_i + \beta_3 \cdot \text{SVO}_i + \boldsymbol{\beta}_4 \cdot \mathbf{x}_i' + \varepsilon_i \tag{2.2}$$

where SWB_i stands for participant i's happiness. The coefficients, $\beta_0, \beta_1, \beta_2, \beta_3, \boldsymbol{\beta}_4$, are parameters to be estimated and ε_i is a disturbance term. In equation (2.2), parameters β_1 and β_2 are of particular interest to statistically test question (2)[6].

[6]The regression analysis (2.1) assesses the hypothesis that individuals with high generativity are also those with high inquisitiveness; the second one (2.2) aims to evaluate the hypothesis that individuals with high generativity possess high levels of subjective wellbeing (SWB). We incorporate inquisitiveness and generativity as independent variables in the same regression analysis on SWB (2.2) because we judge that the regression models are accounted for after the effects of residuals have been partialled out or netted out. The regression analysis (2.2) quantifies the alteration in SWB resulting from a one-unit increase in an independent variable withholding the other independent variables fixed. Thus, the partial

The median regression is used to statistically analyze the determinants of subjactive wellbeing (SWB) in place of parametric mean-based regressions, when observations of SWB in the sample are considered to be non-normally distributed and/or skewed. The literature claims that median or quantile regressions are more appropriate than parametric mean-based ones, such as ordinary least squares (OLS) regression, yielding robust estimations against the boundary values and/or outliers, especially when the dependent variable is bounded on a certain support range, non-normally distributed and skewed (Hao and Naiman, 2007; Wooldridge, 2019). In fact, we have run Shapiro-Wilk tests for the two dependent variables of generativity and happiness to check their normality with a null hypothesis that the variable is normally distributed. The results do not reject the null hypothesis ($z = 0.630, P = 0.264$) for generativity but reject it ($z = 3.621, P < 0.01$) for happiness. Therefore, we use the mean-based OLS and median regressions for generativity and SWB with the specifications of Eq 2.1 and 2.2, respectively.

To further confirm the regression results, we apply structural equation modeling (SEM) to analyze whether or not the relationships, i.e., "paths," exist: (1) inquisitiveness $\rightarrow$ generativity, (2) inquisitiveness $\rightarrow$ SWB and (3) generativity $\rightarrow$ SWB. Specifically, the existence of these three paths is examined to establish whether or not generativity is a mediator in the relationship between inquisitiveness and SWB, as graphically conceptualized in figure 2.3. To this end, the SEM is one of the effective approaches and enables us to test the paths among the three variables together with the direct and indirect effects of inquisitiveness, following the procedures Gunzler et al. (2013, 2014); Venturini and Mehmetoglu (2019). The SEM analysis computes a beta weight as a standardized coefficient, (β), along with the associated statistical significance for each path. The magnitudes of standardized coefficients can be directly compared for the purpose of estimating the relationships' relative strength, and the standardization is a necessary step to compare indirect and direct effects among different sets of paths in the

regression reveals the impact of solely the explanatory variable on the dependent variable of SWB, with the effects (i.e., indirect effect) of the other explanatory variables being irrelevant (Wooldridge, 2019). Therefore, we employ structural equation modeling (SEM) to test hypotheses about mediating effect between variables. Partial regression analysis is a simple form of the partial regression coefficient, but SEM provides more advanced capabilities for complex modeling relationships between variables.

same model, i.e., comparison between direct and indirect pathways in a mediation model (Fox, 1997; Cheung, 2009; Kwan and Chan, 2011).

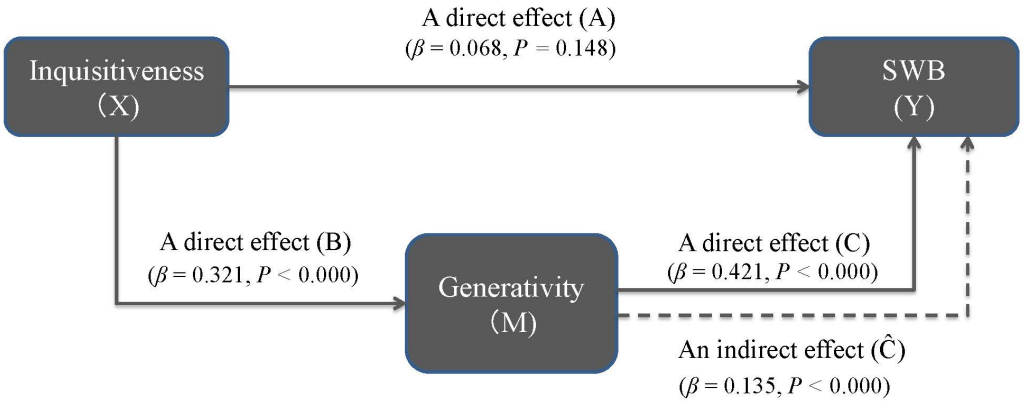


Figure 2.3: The mediating effects among inquisitiveness, generativity and SWB

2.3 Results

Tables 2.1 and 2.2 present the definitions of all variables used in the analysis and the summary statistics for urban, nonurban and overall areas. The percentage of female participants and the mean age are similar between urban and nonurban areas (45 % and 49 % as well as 50.29 years and 49.30 years). Concerning marital status, the percentage of married participants in urban areas (nonurban areas) is 70 % (64 %). The percentage of participants with extended families in urban areas (nonurban areas) is 11 % (20 %). Participants in urban and nonurban areas possess a college degree and a high school diploma as the median education level, respectively. The median household income in urban areas is the same as that in nonurban areas. Contrary to our expectations, nonurban areas have a slightly higher

percentage of unmarried individuals than do urban areas in our survey. This suggests that currently, in Japan, urban and nonurban people's lives are similar except regarding family type. Table 2.2 shows the summary statistics of participants' generativity in urban, nonurban and overall areas. We have computed Cronbach's alpha for this scale to be 0.90, illustrating that the generativity scale possesses acceptable internal consistency in our sample. The median generativity score is 26 points in both urban and nonurban areas, while the average generativity scores are 25.87 and 24.63 points, respectively. This finding suggests that generativity between urban and nonurban participants is similar; however, mean generativity in urban subjects is slightly higher than that in nonurban participants.

Table 2.2 shows the summary statistics of subjective wellbeing (see the "SWB" row in table 2.2) in urban, nonurban and overall areas. We have computed Cronbach's alpha for this scale to be 0.93, illustrating that the satisfaction with life scale (SWLS) possesses acceptable internal consistency in our sample. The median scores of the SWLS are 19 and 18 points in urban and nonurban areas, while the average scores of the SWLS are 17.82 and 17.53 points, respectively. This finding suggests that SWB between urban and nonurban participants is not distinct. Table 2.2 also shows the summary statistics of participant' inquisitiveness in urban, nonurban and overall areas. We have computed Cronbach's alpha for this scale to be 0.94, illustrating that the inquisitiveness scale possesses acceptable internal consistency in our sample. The median score of inquisitiveness is 32 points in both urban and nonurban areas, while the average scores of inquisitiveness are 32.20 and 32.30 points, respectively. This finding suggests that inquisitiveness between urban and nonurban participants is not different.

Next, we report the summary statistics of participants' SVOs, focusing on the percentages of prosocial participants in urban, nonurban and overall areas (see the last row of "SVO (prosocial)" in table 2.2). While 63 % of subjects in the overall are prosocial, 62 % (64 %) of urban (nonurban) participants are prosocial. This result is in sharp contrast with similar studies in developing countries showing that the percentages of prosocial participants between urban and rural areas are quite different, and the percentage of prosocial participants in rural areas is higher than that in urban ones (Shahrier et al., 2016, 2017; Timilsina et al., 2019). This finding suggests that the degree of prosociality among people is similar between urban and nonurban areas in Japan, compared to other developing countries.

Table 2.1: Variable definitions

Variables	Descriptions
Gender	Gender is a dummy variable that takes 1 when the participant is female, otherwise 0.
Age	Age is defined as years of age.
Marital status	Marital status is a dummy valuable that categorical variable of 0 and 1 where nonmarried (i.e.,single, divorce or bereavement) and married are coded as 0 and 1, respectively.
Family type	Family type is that categorical variable of 0 and 1 where family type, nuclear family, extended family are coded as 0 and 1 respectively.
Area	Area is that categorical variable of 0 and 1 where residential area, nonurban areas, urban areas are coded as 0 and 1, respectively.
Education	Education is categorical variables of $1, 2, 3, 4$ and 5 where educational background, No scholastic, Junior high school, high school, undergraduate and graduate are coded as $1, 2, 3, 4$ and 5, respectively.
Household income	Household is categorical variables of $1, 2, 3, 4, 5$ and 6 where household income per year in JPY, $0 <$ 1M, $1 <$ 2.5M, $2.5 <$ 4M, $4 <$ 7M, $7 <$ 10M and more than 10M, respecively.
Generatitity	Generativity is defined as the measurement of the Loyola generative scale (Range is between 0 and 60)
SWB	Subjective wellbeing (SWB) is defined as the measurement of the satisfaction with life scale (SWLS) (Range is between 5 and 35)
Inquisitiveness	Inquisitiveness is defined as the measurement by a subscale of the critical thinking disposition scale (Range is between 10 and 50)
SVO	The “SVO” represents a dummy valuable taking 1 when the participant is prosocial. and otherwise 0, based on SVO games.

Table 2.2: Summary statistics of participants' sociodemographic information and major variables

	Urban areas					Nonurban areas					Overall				
	Mean	Median	SD[1]	Min	Max	Mean	Median	SD	Min	Max	Mean	Median	SD	Min	Max
Gender (female)	0.45	0	0.50	0	1	0.49	0	0.50	0	1	0.47	0	0.50	0	1
Age	50.29	51	17.40	20	88	49.30	49	16.10	20	88	49.79	50	16.74	20	88
Marital status (experienced)	0.70	1	0.46	0	1	0.64	1	0.48	0	1	0.67	1	0.47	0	1
Family type (extended)	0.11	0	0.31	0	1	0.20	0	0.40	0	1	0.15	0	0.36	0	1
Education	3.73	4	0.58	1	5	3.46	3	0.64	1	5	3.61	4	0.62	1	5
Household income	3.86	4	1.40	1	6	3.59	4	1.33	1	6	3.72	4	1.37	1	6
Generativity	25.87	26	10.33	3	51	24.63	26	9.38	2	47	25.25	26	9.87	2	51
SWB	17.82	19	6.84	5	35	17.53	18	6.46	5	33	17.67	19	6.65	5	35
Inquisitiveness	32.20	32	7.39	10	50	32.30	32	7.23	10	50	32.25	32	7.30	10	50
SVO (Prosocial)	0.62	1	0.49	0	1	0.64	1	0.48	0	1	0.63	1	0.48	0	1
Sample size			n = 200					n = 200					n = 400		

[1] SD stands for standard deviation.

To empirically characterize open question (1), we perform ordinary least squares (OLS) regression in which generativity is taken as a dependent variable, and inquisitiveness is taken as an independent one along with other factors, as described in equation (2.1). Table 2.3 reports the estimated coefficients $(\alpha_1, \alpha_2, \boldsymbol{\alpha}_3)$ and their respective standard errors of the independent variables on generativity, along with statistical significance. Model 1 in table 2.3 contains inquisitiveness and age as independent variables. Next, we gradually add marital status, the gender dummy and other factors as independent variables in models 2 to 4, building upon model 1. We first find that inquisitiveness is statistically significant with a positive sign at 1 % in a robust manner, irrespective of the models. The estimated coefficients of inquisitiveness on participants' generativity range between 0.390 and 0.395 in models 1 to 4, implying that a subject is likely to have an increase in generativity by the range, when one unit in her inquisitiveness rises.

Second, age has a positive effect on the participants' generativity at 1 % significance in models 1 to 4. The estimated coefficients of age in models 1 to 4 indicate that a subject is likely to increase generativity by $0.086 \sim 0.110$ when she ages by one year. Marital status also exhibits 1 % and 5 % statistical significance with a positive sign in models 2 to 4, implying that a married participant tends to enhance her generativity by $2.259 \sim 2.471$, as compared with a nonmarried subject. The other independent variables, such as gender, prosociality, education, household income and area, are identified as statistically insignificant, as shown in models 2 to 4 in table 2.3. We confirm that the main results qualitatively remain the same, irrespective of the various specifications of models other than models 1 to 4, such as the inclusion of age squared and/or interaction terms among the variables. Overall, inquisitiveness, age and marital status are confirmed to be the main determinants of participants' generativity.

To empirically characterize open question (2), we perform the median regression in which SWB is taken as a dependent variable, and generativity and inquisitiveness are taken as an independent one along with other factors, as described in equation (2.2). Table 2.4 reports the estimated coefficients $(\beta_1, \beta_2, \beta_3, \boldsymbol{\beta}_4)$ and their respective standard errors of the independent variables on SWB, along with statistical significance. Model 1 of table 2.4 contains generativity and inquisitiveness as independent variables, and next, we gradually add marital status, age, household income and other factors as in-

Table 2.3: Estimation results of OLS regression on generativity

Variable	Marginal effects on generativity			
	Model 1	Model 2	Model 3	Model 4
Inquisitiveness	0.395***	0.390***	0.391***	0.391***
	(0.064)	(0.063)	(0.064)	(0.064)
Age	0.110***	0.086***	0.088***	0.090***
	(0.028)	(0.029)	(0.029)	(0.030)
Marital status (base group = non married)		2.458***	2.471***	2.259**
		(0.978)	(0.984)	(1.047)
Gender (base group = male)			−0.632	−0.570
			(0.923)	(0.936)
Prosociality (base group = proself)			−0.479	−0.463
			(0.952)	(0.954)
Education				−0.029
				(0.744)
Household income				0.147
				(0.360)
Area (base group = nonurban)				0.950
				(0.939)

***significant at 1 %, **significant at 5 percent,*significant at 10 percent

dependent variables in models 2 to 4, building upon model 1. We first find that the generativity is statistically significant with a positive sign at 1 % in a robust manner, irrespective of the models. The estimated coefficients of generativity on subjects' SWB range between 0.265 and 0.293 in models 1 to 4, implying that a participant is likely to increase her SWB by the range when one unit in her generativity rises.

Second, inquisitiveness has a positive effect on people's SWB at 5 % and 10 % significance in models 1 and 4. The estimated coefficients of inquisitiveness in models 1 to 4 suggest that a participant is likely to increase her SWB range between 0.083 and 0.108 when one unit in her inquisitiveness rises. Marital status also exhibits 1 % and 5 % statistical significance with a positive sign in models 2 to 4, implying that a married participant tends to enhance her SWB by $1.773 \sim 2.311$, as compared with a nonmarried participant. Similarly, in models 2 to 4, a participant is likely to enhance her SWB range by $0.045 \sim 0.052$ at 5 % significance when she ages by one year. The other independent variables, such as household income, gender, prosociality, education, family type and area, are identified to be statistically insignificant, as shown in models 3 to 4 in table 2.4. We confirm that the main results qualitatively remain the same, irrespective of the various specifications of models other than models 1 to 4, such as age squared or interaction terms among the variables. Overall, generativity, inquisitiveness, marital status and age are confirmed as the main determinants statistically and practically significant on the likelihood of a participant increasing her SWB.

We use the SEM analysis to check the regression results as another confirmation for the existence of the relationship within key variables. We first analyze the two direct effects from inquisitiveness to SWB (path A in figure 2.3) and from generativity to SWB (path C in figure 2.3). The results demonstrate the existence of path A ($\beta = 0.068, p = 0.148$) and that of path C ($\beta = 0.421, p < 0.000$), meaning that both inquisitiveness and generativity appear to have some direct effects on SWB. Next, we analyze the direct effect from inquisitiveness to generativity (path B in figure 2.3) and an indirect effect from inquisitiveness to SWB through generativity (path $\hat{C}$ in figure 2.3). The analyses demonstrate the significance of path B ($\beta = 0.321, p < 0.000$) as well as that of path $\hat{C}$ ($\beta = 0.135, p < 0.000$). Comparing direct vs. indirect paths from inquisitiveness to SWB in the mediation model, the magnitude

Table 2.4: Estimation results of median regression on subjective wellbeing

Variable	Model 1	Model 2	Model 3	Model 4
Generativity	0.293***	0.267***	0.269***	0.265***
	(0.042)	(0.039)	(0.039)	(0.040)
Inquisitiveness	0.108**	0.083*	0.083*	0.098*
	(0.057)	(0.052)	(0.051)	(0.053)
Marital status (base group = non married)		2.311***	1.773**	1.784**
		(0.771)	(0.801)	(0.842)
Age		0.045**	0.047**	0.052**
		(0.023)	(0.023)	(0.024)
Household income			0.285	0.325
			(0.272)	(0.289)
Gender (base group = male)			0.284	0.297
			(0.710)	(0.621)
Prosociality (base group = proself)			−0.311	−0.252
			(0.730)	(0.765)
Education				0.297
				(0.621)
Family type (base group = nuclear family)				−0.741
				(1.036)
Area (base group = nonurban)				−0.385
				(0.756

[1] ***significant at 1 percent, **significant at 5 percent, *significant at 10 percent

[2] We have run median regression including independent variables of age squared and household income squared. The result shows less influence from independent variables of them on subjective wellbeing. Based on the outcome, we judge that these variables could be removed from the models to simplify showing regression results.

of path $\bar{C}$ ($\beta = 0.135, p < 0.000$) is found to be stronger than that of path A ($\beta = 0.068, p = 0.148$). These results show that the indirect path $\hat{C}$ from inquisitiveness to SWB plays a crucial role through a mediator of generativity, gaining consistent results with the regression results. Overall, generativity and inquisitiveness are confirmed as the main determinants for characterizing subjects' SWB.

2.4 Discussion

We are now ready to summarize the answers to the two open questions posed at the end of the introduction section. As described in our conceptual framework of figure 2.1, it is well known that happiness is mainly characterized by the three factors, such as cognitive factors, noncognitive factors and sociodemographic factors. The first question is, "Does inquisitiveness influence generativity?" Our answer to this question is that inquisitiveness, (α_1), is the crucial determinant regarding whether people possess high generativity in figure 2.1. Inquisitiveness is of utmost importance due to regression and SEM analyses' magnitude and statistical significance. The second question is, "How does inquisitiveness along with generativity affect people's happiness?" Our answer to this question is that generativity, (β_2), and inquisitiveness, (β_1), directly and indirectly, affect subjective happiness, demonstrating the importance of possessing inquisitiveness and generativity for SWB in figure 2.1.

Some studies have pointed out that inquisitiveness is stable as a part of critical thinking disposition, even in the long run, and considered innate because even very young children actively ask adults many questions and pursue explanatory information due to their curiosity (Callanan and Oakes, 1992; Baldwin and Moses, 1996; Gopnik, 1998; Chouinard et al., 2007; Cluver et al., 2013; Blickle et al., 2014). Conversely, other studies have pointed out that inquisitiveness can be acquired and further enhanced by learning (Callanan and Oakes, 1992; Stanovich and West, 1997; Toplak and Stanovich, 2002; Hirayama and Kusumi, 2004; Frazier et al., 2009; Yamaguchi and Sannomiya, 2012; Fusaro and Smith, 2018). For instance, Sannomiya and Yamaguchi (2016) conduct an experiment with 100 Japanese junior high school students, establishing that inquisitiveness and critical thinking ability are fostered with training and meta-cognitive belief. In addition, some leadership training programs have been developed to

enhance inquisitiveness in business because an inquisitive person is considered able to improve productivity, creativity and management in practice (Yeh, 2002; Black, 2005; Harris, 2011; Blickle et al., 2014; Bardone and Secchi, 2017).

Based on the above discussions, inquisitiveness can plausibly be considered to increase through education, experiences and training, i.e., as a part of a culture, in the course of people's lifetimes. If this is true, then the analyses in this paper suggest that both generativity and happiness are expected to increase, as people become inquisitive through such cultural activities, i.e., education, experience and training. It is argued that subjective wellbeing has a positive correlation with sustainable development (Kroll, 2015; De Neve and Sachs, 2020; Kim et al., 2021). At the same time, generativity is known to contribute to sustainable development, because it facilitates intergenerational cultural and resource transfers between current and future generations (Shahrier et al., 2017; Shahen et al., 2019; Timilsina et al., 2019). With these findings in mind, an important contribution of this study that it provides statistical evidence that inquisitiveness is a fundamental human attribute to enhance not only generativity but also people's happiness, possibly leading to the materialization of sustainable societies.

We note some limitations of our research and directions for future research. It should be noted that Japanese cross-sectional data are collected, utilized and analyzed in this study, excluding very young people. Further research shall be conducted to confirm the robustness of our results by spanning such young people or by considering different societies, such as western or other Asian countries, providing some insight about age and cultural differences. At this point in time, we conjecture that inquisitiveness remains consistent and important even in different ages and countries, being in line with our study. Moreover, as some studies have argued, it shall be desirable to collect and examine panel data to confirm and generalize our findings (Cole and Maxwell, 2003; Maxwell and Cole, 2007; Maxwell et al., 2011). To this end, experimental methods can be employed to collect panel data and examine the possible causality among inquisitiveness, generativity and happiness. These caveats notwithstanding, it is our belief that this research is an essential first step toward understanding the importance of inquisitiveness along with generativity and happiness, hoping that further studies will ensure to identify how to enhance people's happiness and sustainability of societies.

2.5 Conclusion

This paper addresses how generativity and happiness are characterized by inquisitiveness. We hypothesize that inquisitiveness is an essential determinant for generativity and happiness, empirically examining the relationships along with sociodemographic, cognitive and noncognitive factors. To this end, we conduct questionnaire surveys with 400 Japanese subjects to collect sociodemographic, cognitive and noncognitive factors, applying the analysis of OLS regression, median regression and structural equation modeling (SEM). First, the analyses identify the importance of inquisitiveness in characterizing generativity in that inquisitive people tend to be generative. Second, people are identified to be happy as they have high inquisitiveness and generativity, demonstrating two influential roles of inquisitiveness, directly and indirectly, through a mediator of generativity. Overall, the results suggest that inquisitiveness (curiosity & acceptance of something and someone different and/or new) is a main engine for one person to enhance generativity and happiness through intergenerational and intragenerational communication or relations.

Chapter 3

How do autonomy and inquisitiveness play roles in sustainable development? Implications from matrilineal Island Palau

3.1 Introduction

Sustainability has become a key issue in protecting our planet and future generations, together with growing concerns for globalism, consumerism and environmental problems (Ostrom, 2009; Sen, 2013; Piketty, 2014). Therefore, sustainable development goals (SDGs) are established and advocated as the missions for humanity, now being a slogan for sustainability all over the world (United Nations, 2015, 2019; WHO, 2019). The literature argues that generativity (a concern and commitment for the next generations) and wellbeing are highly associated with one another, being essential predictors for sustainability or SDGs (Shahrier et al., 2016, 2017; Timilsina et al., 2019; Shahen et al., 2019; Hirose and Kotani, 2022). That is, people shall be sustainable when they are generative and happy in their daily life. Other researchers claim that autonomy (being independent & resisting social pressure) and inquisitiveness (adaptability to new social and/or environmental changes) are fundamental personal elements to characterize people's wellbeing and sustainability (Ryan and Deci, 2000; De-Juanas et al., 2020; Xie et al., 2020; Boiman-Meshita and Littman-Ovadia, 2022; Hirose and Kotani, 2022). For example, people in tradition-oriented societies are usually reluctant to accept something and someone different or new (low inquisitiveness) and tend to follow indigenous rules without expressing their opinions (low autonomy) for maintaining sustainability in their communities (Savells, 1991; Simon, 1997; Kizilhan, 2014; Dewi and Suyasa, 2019; Watson, 2019). In this paper, we consider that such autonomy and inquisitiveness shall be highly concerned with sustainable development, addressing these factors to be important determinants for generativity and wellbeing.

Erikson (1963) introduces the concept of generativity and defines it as concerns of establishing and guiding successive generations. Generativity is associated with bearing and raising children, but is not limited to the domain of parenthood (Kotre, 1996; Rossi, 2001; McAdams, 2013). Various activities and behaviors spanning helping, guiding and teaching something useful to young generations are also considered expressions of generativity (McAdams, 2001). Generativity scales have been developed to measure people's behaviors and concerns (i.e., the Loyola generativity scale (LGS) and the generative behavior checklist (GBC)) (McAdams et al., 1993; McAdams, 2001; Hofer et al., 2008). By employing these scales, the literature establishes that generativity in relation to psychological and sociodemographic factors, such as age, types of societies and value orientations, is highly associated with sustainability or SDGs (Shahen et al., 2019; Timilsina et al., 2019; Shiel et al., 2020; Hirose and Kotani, 2022).

Maslow (1954) introduces a life satisfaction theory based on psychological need gratification processes. Life satisfaction, an indicator of wellbeing, is defined as an evaluation of overall human life (Huebner et al., 2005; Diener, 2009), and the scales have been developed to measure people's subjective wellbeing (SWB), for example, the subjective happiness scale (SHS), the satisfaction with life scale (SWLS) and so on (see, e.g., Diener et al., 1999; Lyubomirsky and Lepper, 1999). Following these works, some literature establishes that age, gender, income, generativity, relationships, personality traits and value orientations are important determinants for people's SWB (Welsch, 2006; Zidansek, 2007; Leung et al., 2011; Bibi et al., 2015; Meisenberg and Woodley, 2015; Magnani and Zhu, 2018; Au et al., 2020). Past studies have also empirically examined the relationship between wellbeing, generativity and social preferences, attracting attention in the emergence of problems on sustainability and finding some mixed results for associations among these three factors (Layous et al., 2012; Dunn et al., 2014; Rudd et al., 2014; Aknin et al., 2015; Morselli and Passini, 2015; Timilsina et al., 2019; Shahen et al., 2019).

Autonomy is known to indicate the extent to which people view themselves as being independent and resisting social pressures as well as the enthusiasm or psychological freedom that people feel in carrying out an activity and in choosing (De Charms and Carpenter, 1968; Hackman and Oldham,

1976; Deci and Ryan, 2000). Therefore, autonomy is considered one of the most valuable orientations for people to be intrinsically motivated to do activities for enjoyment (Gagné, 2003; Chekola, 2007). The measures have been developed as the subscale of several psychological tests, such as the general causality orientations scale, Ryff's psychological wellbeing scales and Iowa developing autonomy inventory (Deci and Ryan, 1985; Jackson and Hood, 1985; Ryff, 1989). Gagné (2003) examines the questionnaire data with 121 Canadian college students and finds that autonomy is positively related to engagement in people's satisfaction and prosocial behaviors. Baard et al. (2004) analyze the data of 59 American workers and present that autonomy is essential in work motivations and satisfactions. Overall, autonomy influences the establishment and maintenance of relations with surrounding people, work motivations and satisfactions (Greeley and Tinsley, 1988; Taub, 1995; Kafka and Kozma, 2002; Baard et al., 2004; Charry et al., 2020; López-Pérez and Zuffianò, 2021).

Inquisitiveness is a concept to express adaptation & acceptance of something and someone different and/or new, and is essential for people to gain creativity, fulfillment and viewpoints (Hirayama and Kusumi, 2004; Black, 2005; Bardone and Secchi, 2017). For example, an inquisitive person tends to start communications with others by asking good questions (Kashdan et al., 2009; Silvia and Kashdan, 2009; Kashdan et al., 2011; Hagtvedt et al., 2019; Watson, 2019). There are several inquisitiveness scales, and some studies demonstrate that an inquisitive person effectively learns something and engage with people regardless of their background, positions and roles, creatively solving certain problems in the case studies of nursing and schooling (Yeh, 2002; Kawashima and Petrini, 2004; Hirayama and Kusumi, 2004; Hogan and Hogan, 2007; Secchi and Adamsen, 2017). Hirose and Kotani (2022) also examine the questionnaire data with 400 Japanese adults and find that inquisitiveness is crucial in enhancing both generativity and wellbeing. Overall, inquisitiveness is established to be a vital element in promoting people's creativity and performances in some domains (Blank and Covington, 1965; Baldwin and Moses, 1996; Black, 2005; Cluver, 2010; Hirose and Kotani, 2022).

No previous researches have addressed how generativity and wellbeing are characterized by cognitive, noncognitive and sociodemographic factors, such as autonomy and inquisitiveness as well as by one another within a single analytical framework. Building upon the previous literature, this research

argues people's generativity and wellbeing as essential elements of sustainable development and characterizes them in relation to autonomy and inquisitiveness with the data from questionnaire surveys and experiments of 413 residents in matrilineal Island Palau. Specifically, we pose the open questions of "how do autonomy and inquisitiveness play roles in people's generativity?" and "how do autonomy and inquisitiveness affect people's wellbeing possibly through an interplay with generativity?" It is hypothesized that people with high autonomy (being independent & resisting social pressure) and inquisitiveness (adaptability to new social and/or environmental changes) tend to be generative and happy. To empirically examine the questions and hypothesis through conducting survey experiments, we choose Palau as the field, because rapid social and environmental changes are ongoing from traditional to modern societies and a wide variation of people is expected to be observed as compared to any other nation, even with small sample size.

3.2 Study regions

We conduct questionnaire surveys and experiments in the Republic of Palau (figure 3.1). Palau is an archipelago consisting of more than 700 islands (only 12 of which are inhabited). Palau has a population of approximately 20 000, with roughly two-thirds of the inhabitants living on Koror Island (OPSP, 2016). This island country possesses the same culture, language and religious variation, except for economic development. Palau had been originally characterized by a strong ascribed-hierarchical social ranking system where matrilineal descent determined social status, inheritance, clan structure, residence and land tenure (Collier et al., 1999; Yuping, 2012). People have shifted their lifestyles from subsistence ones to modern economy ones and begun to live in heterogeneous communities where the level of economic development differs by the areas. Specifically, the rural areas of Palau remain intact as compared to the urban center of Koror where a majority of people live, and some economic factors, such as tourism, have become the most influential to form the social fabric of the country (Collier et al., 1999).

Figure 3.1: Map of Palau

3.3 Materials and methods

Materials

We have chosen three regions for our study because they possess different sociodemographic and geographical characteristics. We have administered the questionnaire and survey experiments to 413 participants in study regions. As of measurement for the main variables in the analysis, the Loyola generativity scale (LGS), the subjective happiness scale (SHS), the autonomy subscale, the inquisitiveness subscale and social value orientations (SVOs) are employed to represent participant' generativity, happiness, autonomy, inquisitiveness and social preferences. Due to budget and time constraints, the maximum sample size is about 400 for this study. We collect 211 and 202 participants in Koror and two rural islands of Peleliu (100) and Babeldaob (102), respectively, using an individual survey following random sampling procedures. The experiments are conducted between March and September 2019.

Koror is the main commercial city representing an urban area ($7°20'39''$N, $134°28'53''$E and see figure 3.1) (Collier et al., 1999). The population and total land area of Koror are 11 444 and 8 km^2, respectively (OPSP, 2016). Two islands are considered rural areas: (i) Babeldaob and (ii) Peleliu. Babeldaob with the land area of 334 km^2 is located at $7°31'49''$N, $134°33'53''$E, consisting of ten districts (Koshiba et al., 2014). We choose two of them, Ngarchelong and Ngaraad (figure 3.1), because these two districts are far from Koror and possess different features as rural areas, such as having enough local workers and intact nature. The population and total land area of Ngarchelong (Ngaraard) are 316 (413) and 10 km^2 (34 km^2), respectively (OPSP, 2016; Carlisle and Gruby, 2019). Peleliu is an isolated island at $7°00'45''$N, $134°15'01''$E (figure 3.1). The population and total land area of Peleliu are 484 and 13 km^2, respectively (OPSP, 2016). Literature demonstrates that prosociality differs between rural and urban areas in Nepal and Bangladesh (Shahrier et al., 2016, 2017; Shahen et al., 2019). Therefore, we decide to collect the samples from urban and rural areas, controlling for such possibilities in statistical analyses.

Methods

The Loyola generativity scale (LGS)

We use the Loyola generativity scale (LGS) to measure a "generative concern," being the most commonly used one in the literature (see, e.g., McAdams and Aubin, 1992; Peterson and Duncan, 1999; McAdams et al., 2001; Lawford et al., 2005; Schoklitsch and Baumann, 2012; Jones and McAdams, 2013; Newton et al., 2014; De Espanés et al., 2015). The LGS scale contains a list of 20 questions, of which 6 questions are reverse ones. Another popular scale for generativity is the generative behavior checklist (GBC) that measures "generative behaviors" in the past two months (McAdams et al., 1993; Schoklitsch and Baumann, 2012). The LGS and the GBC are established to display positive associations, demonstrating consistency between people's generative concerns and behaviors (McAdams et al., 1993). We have decided to employ the LGS in the surveys, because we realize that some questions in the GBC shall be too difficult for participants with different cultures in Palau to answer due to the fact that they never experience the situations, chances and experiences.

The LGS items include question statements, such as (1) "I try to pass along the knowledge I have gained through my experiences," (2) "I have important skills that I try to teach others," (3) "I feel as though I have made a difference to many people," (4) "I have made and created things that have had an impact on other people," (5) "I have made many commitments to many different kinds of people, groups and activities in my life" and (6) "I do not volunteer to work for a charity." Here, question (6) is considered the reverse one. Participants choose one of four options for each statement. The "zero," "one," "two" or "three" scores indicate how often the statement applies to participants (e.g., "zero" if the statement never applies, "three" if the statement applies very often or nearly always). We compute the reverse score (e.g., zero, one, two and three are interpreted to become three, two, one and zero, respectively). The generativity score for each participant is calculated to be the summation of the scores for all 20 items. The theoretical range is between 0 and 60, calculated to be the summation of the scores from the LGS questions — Cronbach alpha for this scale as 0.90 in our sample.

The subjective happiness scale (SHS)

We use the happiness scale with a four-item measurement developed by Lyubomirsky and Lepper (1999) where each item is rated on a 7-point Likert scale. The first question in the scale reports individual "absolute self-rated happiness" by stating "In general, consider myself," and its anchors are "not a very happy person" and "a very happy person." The second item reports individual relative happiness as compared to that of peers by stating "Compared to my peers, I consider myself," and its anchors are "less happy" or "more happy." It is called "peer relative happiness." The third and fourth items correspond to general descriptions of a happy and/or unhappy person where participants choose which description represents themselves. In the items, "Some people are generally very happy. They enjoy life no matter what is going on, getting the most of everything. How much does this sentence describe you?" On the other hand, "Some people are generally very happy. Although they are not depressed, they never seem as happy as they might be. How much does this sentence describe you?" The anchors are "not at all" and "a great deal," called "general subjective happiness" and "general subjective unhappiness," respectively. The average of all items is called "overall subjective happiness (OSH)," while the fourth is reversely coded. We have decided to employ OSH as "subjective wellbeing (SWB)" in the analyses for the purpose of comparison with literature.

The autonomy subcale of the Ryff psychological scale

We use the autonomy subscale of the Ryff psychological scale (Ryff, 1989). Examples of items are (1) "I am not afraid to voice my opinions, even when they are in opposition to the opinions of most people," (2) "My decisions are not usually influenced by what everyone else is doing," (3) "I tend to worry about what other people think of me," (4) "Being happy with myself is more important to me than having others approve of me," (5) "I tend to be influenced by people with a strong opinion," (6) "I have confidence in my opinions, even if they are contrary to the general consensus," (7) "It is difficult for me voice my own opinion on controversial matters," (8) "I often change my mind about decisions if my friends or family disagree" and (9) "I judge myself by what I think is important, not by the values of

what others think is important." Items are rated from $1 =$ "Strongly disagree" to $5 =$ "Strongly agree." Items of (3), (5), (7) and (8) are reverse questions. The reverse score is calculated by taking one, two, three, four and five to be five, four, three, two and one, respectively. The theoretical range is between 9 and 45 — Cronbach alpha for this scale as 0.77 in the present sample.

The inquisitiveness subscale

We use the inquisitiveness subscale of the critical thinking disposition measures developed by Hirayama and Kusumi (2004). This subscale consists of ten items, including (1) "I want to interact with people with various ways of thinking and learn a lot from them," (2) "I want to keep learning new things throughout my life," (3) "I like to challenge new things," (4) "I want to learn about various cultures," (5) "Learning how foreigners think is meaningful to me," (6) "I am interested in people who have a different way of thinking," (7) "I want to know more about any topic," (8) "I want to learn as much as possible, even if I do not know if it is useful," (9) "It is interesting to discuss with people who have different ideas than me" and (10) "I want to ask someone if I do not know." Items are rated from $1 =$ "Strongly disagree" to $5 =$ "Strongly agree." The theoretical range is between 10 and 50 — Cronbach alpha for this scale as 0.92 in the present sample. This subscale is established as a reliable measurement to influence people's behaviors and attitudes in many important contexts, such as intergenerational communications and disaster management (Nakagawa, 2016; Hirose and Kotani, 2022).

The social value orientation (SVO) with the triple dominance game

We use social value orientations (SVOs) in the triple dominance game developed by Van Lange et al. (1997) to characterize participants' social preferences. The SVO game is reliable and reflects a stable personality trait of how people evaluate interdependent outcomes for themselves and others in social environments (Van Lange et al., 1997). This method categorizes individual value orientations into four types; "competitive," "individualistic," "prosocial" and "unidentified," depending on their choices in the questions. In one question, participants choose one option among three options, option (1): you get

480, and the other gets 80, option (2): you get 480, and the other gets 480 and option (3): you get 540, and the other gets 280. In this example, option (1) represents a competitive orientation that maximizes the point gap between themselves and the other ($480 - 80 = 400$). Option (2) is a prosocial orientation that maximizes the joint outcome ($480 + 480 = 960$). Option (3) is an individualistic orientation that maximizes their outcome of 540, being indifferent to the outcome of the other.

This game contains nine questions, each of which consists of three options for oneself and the other in a pair of participants. In each question, one option corresponds to one of the following orientations, i.e., "competitive," "individualistic" and "prosocial." Each participant is asked to choose one option as the most preferred in each item, finally generating nine option choices. Participants are classified as prosocial, individualistic or competitive, respectively, if they make six or more options with that orientation. Otherwise, they are categorized as "unidentified." The SVO game was conducted as experiments because we paid actual monetary payments to participants based on their choices by randomly arranging a pair (you and the other). Specifically, participants are informed that we randomly match two participants as a pair, and the more experimental points one participant gets from their own and partner's nine choices of options in the SVO game, the more real money they will earn with some exchange rate (2000 points with 1 USD). Participants are motivated to seriously take part in the SVO game, considering their opportunity costs and revealing their social preferences. One session with $30 \sim 40$ participants took 20 minutes, and they are paid 4.09 USD on an average in the experiments.

Data analysis

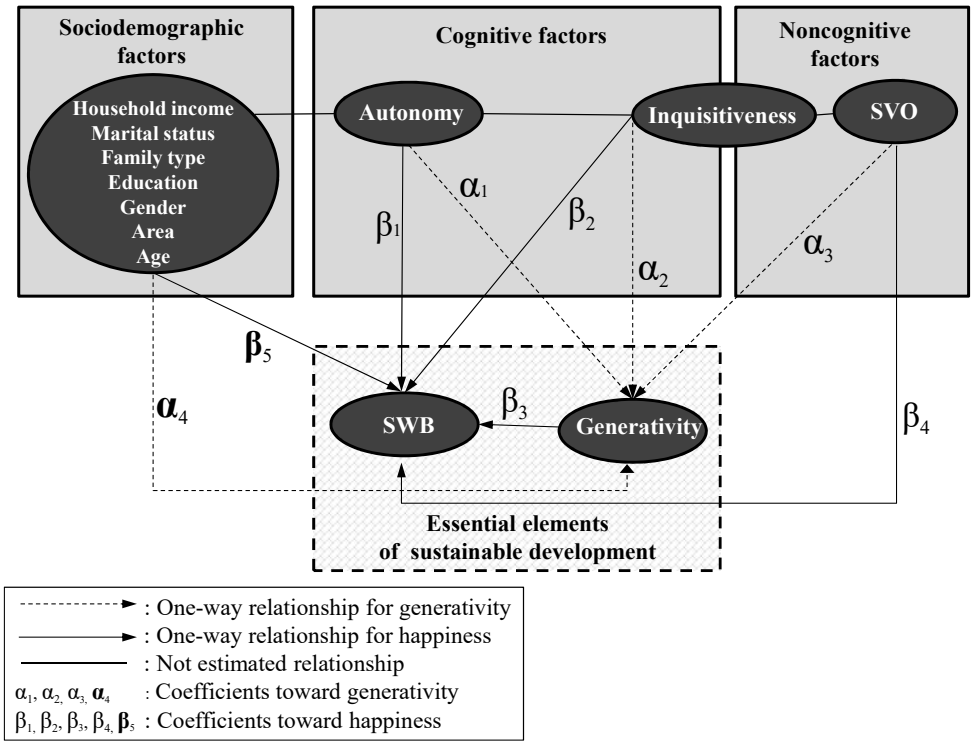


Figure 3.2: Conceptual framework describing the relationships concerning sustainable development among cognitive, noncognitive and sociodemographic factors.

With the data of the above variables, we first characterize generativity in relation to autonomy and inquisitiveness, holding other factors fixed. Second, we characterize subjective wellbeing (SWB) in relation to autonomy, inquisitiveness and generativity, controlling other factors fixed. Although some researchers claim that it is desirable to take panel data for identifying the causality between two variables or relations among several ones, we employ cross-sectional data following the analytical framework of some previous studies (Tkach and Lyubomirsky, 2006; Warner and Vroman, 2011; Salavera et al., 2020). These studies argue that cross-sectional data analysis is acceptable to confirm the effects among variables following some proper statistical procedures. Due to budget and time constraints, we could not collect the panel data. Instead, we conduct our research by collecting and analyzing cross-section

data. To answer questions 1 and 2, we apply ordinary least squares (OLS) regression and median regression models to characterize generativity and SWB as dependent variables, respectively, in relation to other vital independent variables as described in figure 3.2, enabling the identification of important determinants. For characterizing generativity, the regression model is specified as

$$\text{generativity}_i = \alpha_0 + \alpha_1 \cdot \text{autonomy}_i + \alpha_2 \cdot \text{inquisitiveness}_i + \alpha_3 \cdot \text{SVO}_i + \boldsymbol{\alpha}_4 \cdot \mathbf{x}_i' + \epsilon_i, \qquad (3.1)$$

where $\mathbf{x}_i$ is a vector of sociodemographic independent variables including household income, marital status, family type, education and gender from participant i. The associated coefficients of $\alpha_0, \alpha_1, \alpha_2, \alpha_3$ and $\boldsymbol{\alpha}_4$ are the parameters to be estimated, and ϵ_i is a disturbance term. In equation (3.1), parameters α_1 and α_2 are of particular interest to statistically examine question 1. For characterizing SWB, the model is

$$\text{SWB}_i = \beta_0 + \beta_1 \cdot \text{autonomy}_i + \beta_2 \cdot \text{inquisitiveness}_i + \beta_3 \cdot \text{generativity}_i + \beta_4 \cdot \text{SVO}_i + \boldsymbol{\beta}_5 \cdot \mathbf{x}_i' + \varepsilon_i \quad (3.2)$$

where SWB_i stands for participant i's subjective wellbeing.[1] The coefficients, $\beta_0, \beta_1, \beta_2, \beta_3, \beta_4$ and $\boldsymbol{\beta}_5$, are parameters to be estimated and ε_i is a disturbance term. In equation (3.2), parameters β_1, β_2 and β_3 are of particular interest to statistically test question 2.

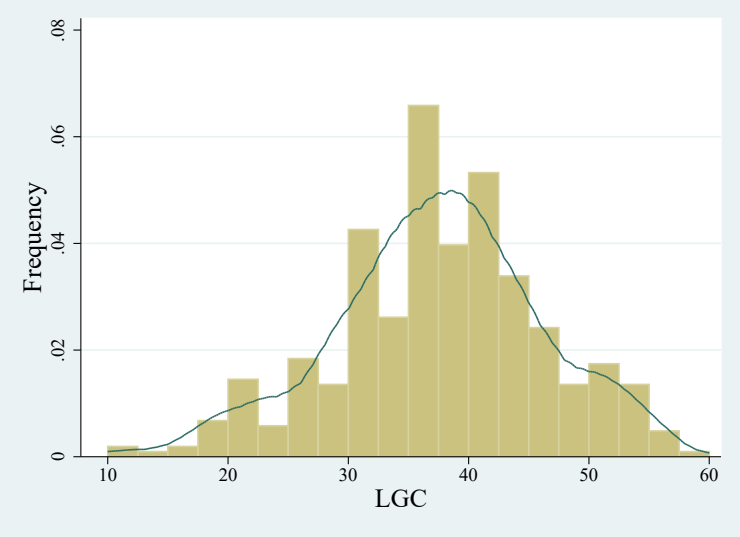
We use the median regression to statistically analyze the determinants of SWB in place of parametric mean-based regressions, when observations of SWB in the samples are considered nonnormally distributed and/or skewed. The literature claims that median or quantile regressions are more appropriate than parametric mean-based ones, such as ordinary least squares (OLS) regression, yielding robust estimations against the boundary values and/or outliers, especially when the dependent variable is bounded on a certain support range, nonnormally distributed and skewed (Hao and Naiman, 2007; Wooldridge, 2019). The highest spike of SWB is found between 5.5 and 5.8 points, and the distribution appears to be skewed on one side as shown in figure 3.3. We have run Shapiro-Wilk tests for the two

[1] Generativity is a measurement to be taken on the basis of the participants' experiences and life-long cognition. On the other hand, SWB is a measurement to be taken when participants express about their life at the moment of the questionnaire surveys. Therefore, reverse causality does not hold between SWB and generativity, and it is valid to take generativity as an independent variable for SWB.

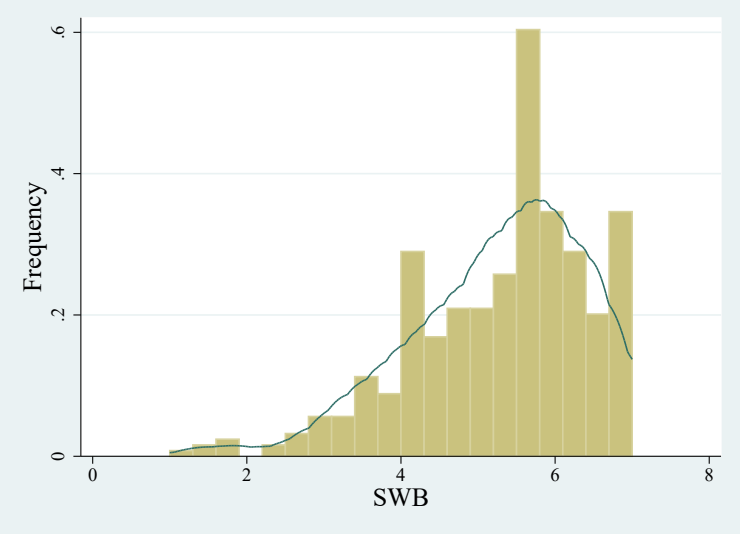
dependent variables of generativity ($Z = 1.984, P < 0.024$) and SWB ($Z = 5.747, P < 0.001$) to check their normality with a null hypothesis that the variable is normally distributed. The results reject the null hypothesis for SWB. Therefore we apply the OLS regression for generativity and median regressions for SWB with the specifications of figure 3.2, respectively.

Figure 3.3: Histograms and kernel densities for generativity (LGC) and subjective wellbeing (SWB)

(a) The distribution of LGC



(b) The distribution of SWB



To further confirm our regression results, we apply structural equation modeling (SEM) to examine the relationships, i.e., "paths," exist: (1) inquisitiveness $\rightharpoonup$ generativity, (2) inquisitiveness $\rightharpoonup$ SWB, (3)

generativity ⇀ SWB. Specifically, the existence of three paths is examined to check that generativity is a mediator in the relationship between inquisitiveness and SWB, as graphically conceptualized in figure 3.4. To this end, the SEM is one of the effective approaches and enables us to test the existing paths among the three variables together with the direct and indirect effects of inquisitiveness, following the procedures (Gunzler et al., 2013, 2014; Venturini and Mehmetoglu, 2019). The SEM analysis computes a beta weight as a standardized coefficient (β), along with the associated statistical significance for each path. We can directly compare the magnitudes of standardized coefficients to estimate the relationships' relative strength, and the standardization is necessary to compare direct and indirect effects among different sets of paths in the same model (Fox, 1997; Cheung, 2009; Kwan and Chan, 2011).

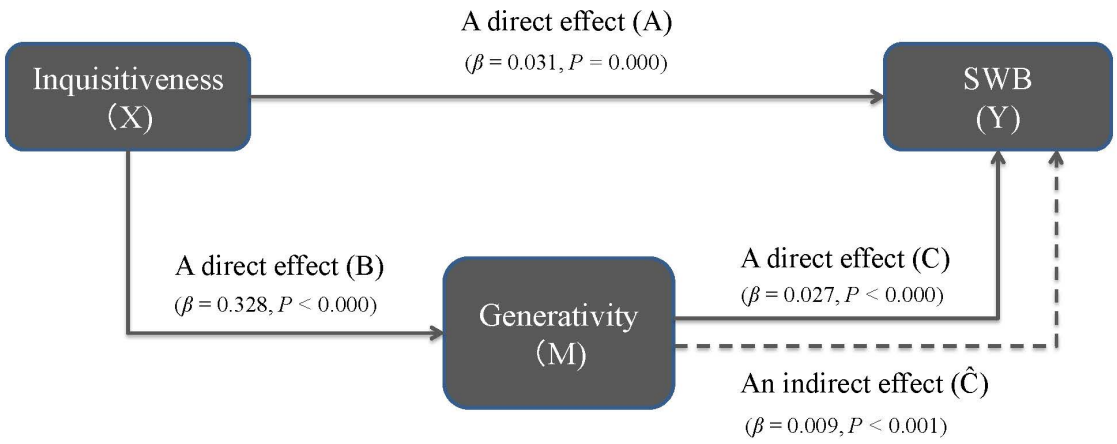


Figure 3.4: Mediating effects among inquisitiveness, generativity and SWB

3.4 Results

Tables 3.1 and 3.2 present the definitions of all variables used in the analysis and the summary statistics. Table 3.2 presents the summary statistics of participants' sociodemographic variables. The percentage of female participants in urban (rural) areas is 56 % (62 %). The mean age in urban (rural) areas is 40.56 (43.14). Concerning marital status, we divide this variable into two categories; "married" and "nonmarried." The percentage of married participants in urban (rural) areas is 62 % (73 %). This result is in line with the expectation because the percentage of married rural participants is 11 points higher than in urban ones. The percentage of extended family in rural participants (50 %) is slightly higher than that in urban ones (47 %). The mean of categorized household income is similar in urban and rural areas (1.99 and 1.89, respectively). The mean of categorized education is slightly high in urban areas (3.34) than that in rural ones (2.92), and the median in urban areas is 1 point higher than that in rural ones.

Table 3.2 presents the summary statistics of participants' autonomy (see the "Cognitive variables" column). We compute Cronbach's alpha for this scale as 0.77, illustrating that the autonomy scale possesses acceptable internal consistency in our sample. The median score of autonomy is 29 points in both urban and rural areas, while the average scores of this are 29.45 and 30.02 points, respectively. Table 3.2 presents the summary statistics of participants' inquisitiveness in urban, rural and overall areas (see the "Cognitive variables" column). We compute Cronbach's alpha for this scale as 0.92, illustrating that the inquisitiveness scale also possesses acceptable internal consistency in our sample. The median score of inquisitiveness is 46 points in both urban and rural areas, while the average scores of inquisitiveness are 44.37 and 44.00 points, respectively. This result implies that the inquisitiveness between urban and rural participants is not much different.

Table 3.2 presents the summary statistics of participants' generativity (see the "Essential elements of SDGs" column). We compute Cronbach's alpha for this scale as 0.78, illustrating that the LGS scale possesses acceptable internal consistency in our sample. The median score of generativity in urban and rural areas is 38 and 37 points, while the average scores of generativity are 37.69 and 37.10 points, respectively. This result indicates that generativity between urban and rural participants is not much

different. Table 3.2 shows the summary statistics of subjective wellbeing (SWB) (see the "Essential elements of susutainable development" column). Rural participants have higher SWB than urban and overall ones in the sample, to be higher for rural participants with an average of 5.40 points (SD $= 1.10$) than urban ones with an average of 5.16 points (SD $= 1.19$) and overall participants in the sample with an average of 5.28 points (SD $= 1.15$). The summary statistics of participants' SVOs are reported by focusing on the percentages of prosocial ones (see the "Noncognitive variables" column in table 3.2). The percentage of prosocial participants in urban areas (65 %) is more significant than that in rural ones (58 %). This result is in sharp contrast with similar studies conducted in Nepal and Bangladesh, showing that the percentages of prosocial participants are pretty different between urban and rural areas, and the rate of prosocial participants in urban areas is higher than that in rural areas (Shahrier et al., 2016, 2017; Timilsina et al., 2019).

To empirically examine question 1, we perform OLS regression in which generativity is taken as a dependent variable, and autonomy and inquisitiveness are taken as independent ones along with other factors, as described in equation (3.1). Table 3.3 reports the estimated coefficients $(\alpha_1, \alpha_2, \alpha_3, \boldsymbol{\alpha}_4)$ and their respective standard errors of the independent variables on generativity, along with statistical significance. Model 1 in table 3.3 contains autonomy, inquisitiveness, age and marital status as independent variables. Next, we gradually add prosociality, household income and other independent variables in models 2 and 3, building upon model 1. We first find that inquisitiveness and age are statistically significant with a positive sign at 1 % in a robust manner, irrespective of the models. The estimated coefficients of inquisitiveness (age) on participants' generativity range between 0.298 (0.126) and 0.318 (0.129) in models 1 to 3, implying that participants are likely to increase generativity (age) by the range when one unit (year) in their inquisitiveness (age) rises.

Second, household income exhibits 5 % statistical significance with a positive sign in models 2 and 3. The estimated household income coefficients in models 2 and 3 indicate that participants are likely to increase generativity by $1.139 \sim 1.141$ when one category in their household income rises. The other independent variables, such as autonomy, marital status, prosociality, gender, education, family type and residential area, are statistically insignificant, as shown in models 1 to 3 in table 3.3. We confirm

Table 3.1: Variable definitions

Variables	Descriptions
Autonomy	Autonomy is defined as the measurement by a subscale of Ryff psychological scale (Range is between 9 from 45)
Inquisitiveness	Inquisitiveness is defined as the measurement by a subscale of the critical thinking disposition scale (Range is between 10 from 50)
SVO	The "SVO" represents a dummy variable taking 1 when the participant is prosocial and otherwise, 0, based on SVO games.
Area	Area is that categorical variable of 0 and 1 where residencial area, rural areas, urban areas are coded as 0 and 1 respectively.
Gender	Gender is a dummy variable that takes 1 when the participant is female, otherwise 0.
Age	Age is defined as years of age.
Marital status	Marital status is a dummy variable that categorical variable of 0 and 1 where nonmarried (i.e., single, divorce or bereavement) and married are coded as 0 and 1, respectively.
Family type	Family type is that categorical variable of 0 and 1 where family type, nuclear family, extended family are coded as 0 and 1 respectively.
Household income	Household income per year in USD. Categorical variable of 1 to 6 with an interval, however where 1 presents as earning $0 < 9999$, and 2 presents as earning $10\,000 < 4999$, 3 presents as earning $25\,000 < 45\,999$, 6 represents as earning more than 100 000 per year.
Education	Education is categorical variables of $1, 2, 3, 4, 5$ and 6 where educational background, less than elementary school, high school, vocational school, associate, bachelor and more than master degree are coded as $0, 1, 2, 3, 4, 5$ and 6, respectively.
Generativity	Generativity is defined as the measurement of the Loyola generative scale (Range is between 0 from 60)
SWB	SWB is defined as as the measurement by subjective happiness scale (SHS), composed by the following four 7-point Likert scale questions; (1) the absolute self-related happiness, (2) the peer-related happiness, (3) the general subjective happiness, (4) the general subjective unhappiness. Overall subjective happiness (OSH) is the average of the four items calculated, while the fourth item is reversely coded. OSH presents SWB in this study

Table 3.2: Summary statistics of participants' sociodemographic information and major variables

	Urban areas					Rural areas					Overall				
	Mean	Median	SD[1]	Min	Max	Mean	Median	SD	Min	Max	Mean	Median	SD	Min	Max
Cognitive variables															
Autonomy	29.45	29	5.46	16	44	30.02	29	4.34	16	42	29.73	29	4.94	16	44
Inquisitiveness[2]	44.37	46	6.29	13	50	44.00	46	6.61	20	50	44.19	46	6.44	10	50
Non-cognitive variables															
SVO (Prosocial)	0.65	1	0.48	0	1	0.58	1	0.49	0	1	0.62	1	0.49	0	1
Sociodemographic variables															
Gender (Female)	0.56	1	0.50	0	1	0.62	1	0.49	0	1	0.59	0	0.49	0	1
Age	40.56	38	13.66	19	90	43.14	43.5	14.73	19	88	41.82	41	14.23	19	90
Marital status (Married)	0.62	1	0.49	0	1	0.73	1	0.45	0	1	0.67	1	0.47	0	1
Family type (extended)	0.47	0	0.50	0	1	0.50	0.5	0.50	0	1	0.49	0	0.50	0	1
Household income	1.99	2	0.94	1	5	1.89	2	0.93	1	6	1.94	2	0.94	1	6
Education	3.34	3	1.39	1	6	2.92	2	1.18	1	6	3.14	3	1.31	1	6
Essential elements of susutainable development															
Generativity	37.69	38	8.03	15	60	37.10	37	9.39	10	57	37.40	38	8.71	10	60
Subjective wellbeing (SWB)[3]	5.16	5.5	1.19	1.5	7	5.40	5.5	1.10	1	7	5.28	5.5	1.15	1	7
Sample size	$n = 211$					$n = 202$					$n = 413$				

[1] SD stands for standard deviation.

[2] Inquisitiveness is positioned across both cognitive and non-cognitive variables because of its characteristics, as shown in figure 2.

[3] SWB is overall subjective happiness (OSH).

that the main results qualitatively remain the same, irrespective of the various specifications of models other than models 1 to 3, such as the interaction terms among the variables. Overall, inquisitiveness and age are the main determinants of people's generativity.

To empirically examine question 2, we perform the median regression in which SWB is taken as a dependent variable, and autonomy, inquisitiveness and generativity are taken as independent ones along with other factors, as described in table 3.4. Table 3.4 reports the estimated coefficients ($\beta_1, \beta_2, \beta_3, \beta_4, \boldsymbol{\beta}_5$) and their respective standard errors of independent variables on SWB along with statistical significances. Model 1 of table 3.4 contains autonomy, inquisitiveness and generativity as independent variables, and next, we gradually add family type, gender, age, prosociality, household income and other factors as independent variables in models 2 and 3, building upon model 1. We first find that autonomy is statistically significant with the positive sign at 1 % in a robust manner, irrespective of the models. The estimated autonomy coefficients in models 1 to 3 indicate that participants are likely to increase SWB by $0.056 \sim 0.062$ when one unit in their autonomy rises.

Second, we find that inquisitiveness exhibits 1 % and 5 % statistical significance with a positive sign in models 1 to 3. The estimated coefficients of inquisitiveness in models 1 to 3 indicate that the participants will likely increase their SWB by $0.026 \sim 0.030$ when one unit in their inquisitiveness rises. Third, generativity is statistically significant with the positive sign at 1 % in a robust manner, irrespective of the models. The estimated generativity coefficients on SWB range between 0.023 and 0.025 in models 1 to 3, implying that the participants are likely to increase their SWB by the range when one unit in their generativity rises. The family type also exhibits 1 % and 5 % statistical significance with a positive sign in models 2 and 3, implying that the participants in the extended family tend to enhance their SWB by $0.244 \sim 0.325$, as compared with participants in a nuclear family. Gender exhibits 10 % statistical significance with a positive sign in models 2 and 3, implying that females positively influence SWB in our results. The other independent variables, such as age, prosociality, household income, education, marital status and areas, are statistically insignificant, as shown in model 3 in table 3.4. We confirm that the main results qualitatively remain the same, irrespective of the various specifications of models other than models 1 to 3, such as the interaction terms among the variables.

Table 3.3: Results of OLS regression on generativity

Variable	Marginal effects on subjective wellbeing		
	Model 1	Model 2	Model 3
Autonomy	0.096	0.073	0.077
	(0.088)	(0.087)	(0.088)
Inquisitiveness	0.318***	0.298***	0.298***
	(0.064)	(0.065)	(0.065)
Age	0.129***	0.126***	0.126***
	(0.030)	(0.030)	(0.030)
Marital status (base group = nonmarried)	1.911**	1.306	1.361
	(0.812)	(0.827)	(0.835)
Prosociality (base group = proself)		0.226	0.193
		(0.818)	(0.844)
Household income		1.139**	1.414**
		(0.475)	(0.476)
Gender (base group = male)		0.014	0.084
		(0.818)	(0.825)
Education		0.460	0.415
		(0.345)	(0.351)
Family type (base group = nuclear)			−0.249
			(0.807)
Area (base group = urban)			−0.658
			(0.820)

***significant at 1 %, **significant at 5 %, *significant at 10 %

Overall, autonomy, inquisitiveness and generativity are the main determinants of people's SWB.

We perform the SEM analysis to reconfirm the regression results and check the main variables' effects on subjective wellbeing (SWB) through an interplay with generativity. We first analyze two direct effects from inquisitiveness to SWB (path A) and from generativity to SWB (path C in figure 3.4). We second analyze the direct effect from inquisitiveness to generativity (path B in figure 3.4), and an indirect effect from inquisitiveness to SWB through generativity (path $\hat{C}$ in figure 3.4). The analyses demonstrate the significance of path A and B ($\beta = 0.031, p < 0.000$ and $\beta = 0.328, p < 0.000$) as well as those of path C and $\hat{C}$ ($\beta = 0.027, p < 0.000$ and $\beta = 0.009, p < 0.001$). These results also display that the indirect path $\hat{C}$ from inquisitiveness to SWB plays a role through a mediator of generativity, gaining consistent results with the regressions. Overall, the SEM analyses reconfirm inquisitiveness and generativity as the main determinants for characterizing participants' SWB, as demonstrated in regression models.

We summarize the answers to the two open questions in the introduction section. As described in our conceptual framework in figure 3.2, it is posed that generativity and subjective wellbeing (SWB) as essential elements of sustainable development are mainly characterized by the three factors, such as cognitive, noncognitive and sociodemographic factors. The first question is, "How do autonomy and inquisitiveness play roles in people's generativity?" Our answer to this question is that autonomy (α_1) has no robust effects on generativity. On the other hand, inquisitiveness (α_2) is the vital determinant regarding whether or not people possess a high level of generativity in figure 3.2. Inquisitiveness is of utmost importance due to the regression and SEM analyses along with statistical significance for enhancing people's generativity. The second question is,"How do autonomy and inquisitiveness affect people's wellbeing possibly through an interplay with generativity?" Our answer to this question is that autonomy (β_1), inquisitiveness (β_2) and generativity (β_3), directly and indirectly, affect SWB, demonstrating the importance of autonomy and inquisitiveness for people's generativity and wellbeing in figure 3.2. Overall, autonomy and inquisitiveness are fundamental determinants of generativity and wellbeing, which are the essential factors of sustainable development, and enhancing the two factors can be considered one crucial pathway to achieving sustainable development.

Table 3.4: Results of median regression on SWB

Variable	Model 1	Model 2	Model 3
Autonomy	0.056***	0.058***	0.062***
	(0.014)	(0.013)	(0.013)
Inquisitiveness	0.030***	0.029**	0.026***
	(0.011)	(0.010)	(0.010)
Generativity	0.023***	0.023***	0.025***
	(0.008)	(0.008)	(0.007)
Family type (base group = nuclear)		0.244**	0.325***
		(0.129)	(0.121)
Gender (base group = male)		0.223*	0.233*
		(0.131)	(0.124)
Age			0.001
			(0.005)
Prosociality (base group = proself)			−0.122
			(0.127)
Household income			−0.032
			(0.072)
Education			−0.063
			(0.053)
Marital status (base group = nonmarried)			−0.106
			(0.126)
Areas (base group = urban)			0.181
			(0.123)

***significant at 1 %, **significant at 5 %, *significant at 10 %

Palau is now considered one of the Pacific island leaders for SDGs (Friedlander et al., 2017; Wabnitz et al., 2018; Pilbeam et al., 2019). For example, the Palau Protected Areas Network (PAN), established in 2003, is the important country's policy agenda for achieving the goals of the Micronesia Challenge, that is, an initiative for sustainability along with the preservation of its unique culture and biodiversity within the region (Friedlander et al., 2017; Pilbeam et al., 2019). Although our study demonstrates that autonomy and inquisitiveness are essential determinants for sustainable development (i.e., generativity and wellbeing), most countries, including Palau, have never paid attention to how to enhance people's autonomy and inquisitiveness in the current plans, policies and programs. Given this state of affairs, we suggest that autonomy and inquisitiveness should be explicitly and practically incorporated into the SDG-related plans, policies and programs for making a bridge between the current societies and future sustainable ones as the crucial pathways of guiding people.

3.5 Conclusion

This research considers that generativity and wellbeing shall be necessary and salient indicators that people in societies must enhance to achieve sustainable development, hypothesizing that people with high autonomy (being independent & resisting social pressure) and inquisitiveness (adaptability to new social and/or environmental changes) tend to be generative and happy. To empirically examine the hypothesis, we analyze people's generativity and wellbeing as essential elements of sustainable development and statistically characterize them in relation to autonomy and inquisitiveness with the data from questionnaire surveys and experiments of 413 residents in matrilineal Island Palau. We choose Palau as the field, because rapid social and environmental changes from the tradition of matrilineal systems are ongoing and a wide variation of people is expected to be observed compared to any other field. Two main results are obtained. First, the analysis identifies the importance of inquisitiveness in that people with high inquisitiveness tend to be generative. Second, people's wellbeing is high as they are generative, autonomous and inquisitive, demonstrating two influential roles of inquisitiveness on happiness as direct and indirect determinants through a mediator of generativity. Overall, the results

suggest that autonomy and inquisitiveness contribute to people's generativity and wellbeing even in tradition-oriented societies, such as Palau, and their improvements are considered practical and crucial paths for materializing sustainable development.

We note some limitations of our research and directions for future research. Our survey is conducted in a tiny scale matrilineal society of Palau, an ethnically and culturally homogeneous community compared to the rest of the world. The same types of empirical studies should be conducted in different types of societies to generalize our findings. Moreover, as some studies have mentioned, it shall be better to collect and examine the panel data than the cross-section ones to confirm our findings for consistency and robustness along with median analyses (Cole and Maxwell, 2003; Maxwell et al., 2011). To this end, experimental methods in the fields shall be employed to collect the panel data and examine the possible causality among autonomy, inquisitiveness, generativity and wellbeing in systematic ways. With these findings in mind, it is our belief that our research is the first study to empirically establish that autonomy and inquisitiveness are fundamental human attributes for generativity and wellbeing, even in a tradition-oriented society, possibly leading to the materialization of sustainable development.

Chapter 4

Is climate change induced by humans? The impact of the gap in perceptions on cooperation

4.1 Introduction

Climate change is a serious problem that requires people's cooperation to solve (Pacheco et al., 2014; Bang et al., 2015; Rajapaksa et al., 2017; Coulibaly et al., 2020). Some organizations have attempted to initiate and facilitate cooperation for climate change through international efforts, such as the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC), and public concern is becoming a force for development of adaptation and mitigation measures (Siebenhüner, 2003; Widerberg and Pattberg, 2015; Hermwille et al., 2017). However, such organizations are facing difficult situations between scientific assessments, geopolitical and economic powers across the world, and do not always have successful outcomes for international negotiation and coordination processes for cooperation exemplified by the greenhouse gas reduction under the Kyoto protocol (Beck and Mahony, 2018; Kreitmair and Bower-Bir, 2021; Poitras, 2021). A human as a cooperative species still has a big challenge in cooperating and/or coordinating their efforts on this issue (Boyd and Richerson, 2009; Tattersall, 2011; Miyama and Managi, 2014). There have been several types of research to analyze how people become cooperative against climate change. These studies establish that correct perception and knowledge of climate change are positively associated with cooperative attitudes, whereas a wide variety of gaps in such perceptions exist (Rand et al., 2009; Tobler et al., 2011; Fischer and Charnley, 2012; Islam et al., 2016; Rajapaksa et al., 2018). Despite its importance, few studies have examined how such gaps in perception are related to knowledge and to other factors and how the relationship influences cooperative behaviors. Given this state of affairs, this research addresses people's perception gaps, focusing on the cause of climate change, knowledge and cooperative behaviors within a single framework.

Past studies have examined people's perceptions of the cause of climate change (Bray, 2010; Cook et al., 2013; Carlton et al., 2015). By and large, there are two ideas about the cause of climate change. One is that climate change is human-induced, in that climate change can be considered to be caused by human activities, such as burning fossil fuels, cutting down forests and farming livestock (Karl and Trenberth, 2003; Koneswaran and Nierenberg, 2008; Doran and Zimmerman, 2009; Solomon et al., 2009; Bechtel and Scheve, 2013; Höök and Tang, 2013). The other idea is that climate change is nature-induced, in that climate change can be considered a part of natural climate cycles. It will continue to be so, being exemplified by many events in the Earth's history, such as changes in solar output, Earth's orbit and volcanic eruptions (Karl and Trenberth, 2003; Solomon et al., 2009; Council, 2011). A group of former studies show that scientists have largely accepted the idea of human-induced climate change (Karl and Trenberth, 2003; Hegerl et al., 2007; Anderegg et al., 2010; Council, 2011; Lehtonen et al., 2019). Leiserowitz et al. (2010) report that approximately 97 % of publications by climate scientists advocate human-induced climate change, while only half of the American public believe in human-induced climate change (Doran and Zimmerman, 2009; Anderegg et al., 2010; Carlton et al., 2015).

Shealy et al. (2017) and Shealy (2018) find that civil engineering students in America who do not believe in human-induced climate change are less likely or never desire to take jobs associated with addressing climate change in their careers. Saleh Safi et al. (2012) examine the relationships among the vulnerability, beliefs and risk perception of human-induced climate change in rural Nevada. They report that climate-change-specific beliefs, particularly whether people believe in the human-induced causes of climate change and/or whether they connect the locally observed impacts to climate change, are the most prominent determinants of risk perception. The idea of human-induced climate change remains a public controversy despite the consensus among climate scientists (Bray, 2010; Cook et al., 2013; Tol, 2014; Carlton et al., 2015). Aside from this controversy, it is likely that the actual perception and attitudes toward climate change will be affected by the extent to which people believe in human-induced climate change.

Some researchers implement surveys on people's perceptions and their cooperative attitudes toward climate problems proxied by their willingness to pay (WTP) (O'Connor et al., 1999; Akter and Bennett,

2011; Brechin and Bhandari, 2011; Khanal et al., 2018). Brechin and Bhandari (2011) confirm that people in some countries remain more concerned about general environmental problems than global climate change through comparative national studies on the public perception of climate change and its WTP. O'Connor et al. (1999) examine the relationship between people's risk perceptions and their WTP for climate problems, reporting that an environmental belief is a strong predictor of behavioral intentions for voluntary actions. Akter and Bennett (2011) examine Australian households' perceptions of climate change and their preferences for mitigation action, finding that people's willingness to take actions against climate problems at national and household levels is influenced by their level of mass media exposure. Moreover, Islam et al. (2016) examine the relationship between climatic perception and flood mitigation cooperation, suggesting that accurate climatic perception is key to increasing people's cooperation in managing climate change.

These studies have demonstrated that people's perceptions generally influence their cooperative attitudes toward climate change. However, few works have addressed people's perceptions of the cause of climate change along with their cooperative behaviors. Specifically, little is known about what makes people perceive that climate change is human-induced, nature-induced or induced by another factor and the linkage between their perception and cooperative behaviors. To examine these issues, we empirically analyze the determinants of people's perception of human-induced climate change and the linkage to their cooperation toward climate change by conducting a survey experiment with a climate donation game (CDG) with 400 Japanese subjects from urban and nonurban areas. Literature establishes that prosociality and cooperative behaviors differ between rural and urban areas in some developing countries (Shahrier et al., 2016, 2017; Timilsina et al., 2019). Therefore, we take the samples from both urban and nonurban areas, controlling for such possibility in statistical analyses.

In this survey, we measure and collect people's scientific literacy, social preferences and actual cooperation toward climate change by the use of the CDG in addition to sociodemographic information. Social psychologists and economists argue that scientific literacy and social preferences can be keys to influencing people's cooperative attitudes toward natural disasters and other social events (Van Lange et al., 2007; Bogaert et al., 2008; Nakagawa, 2016; Mischkowski and Glöckner, 2016; Shahrier et al.,

2016; Timilsina et al., 2019; Fiorillo and Senatore, 2020). With these data, our research addresses the following two open questions. (1) What are the determinants of the human-induced perception of the cause of climate change? (2) How does the gap in perceptions of the cause of climate change, along with scientific literacy and social preferences, affect people's cooperative behaviors?

4.2 Materials and methods

4.2.1 Materials

The online survey experiment is conducted with 400 participants in a web-based research organization, Cross Marketing Inc. The 550 people in a participant pool were randomly invited via email to take part in the online survey and we had waited two weeks for the data collection. The survey was terminated when we confirm that 400 samples are successfully collected as initially intended (i.e., 200 samples from urban and nonurban areas, respectively). Participants' mean age is 49.61 years, with the standard deviation $= 17.32$ ranging between 20 and 89 years. The area the survey covers is divided into urban and nonurban areas according to the population density of 500 people per square kilometer. If the population density in the residential area where a participant lives is above or equal to 500 people per square kilometer, then it is urban; otherwise, it is nonurban. This survey collects a sample of 200 participants in each of the urban and nonurban areas with information about (1) sociodemographic factors, such as age, gender, marital status, occupation, educational background, family characteristics and household income, (2) perceptions on the cause of climate change, (3) scientific literacy, (4) cooperation for climate change and (5) social value orientation (as a proxy for social preferences).

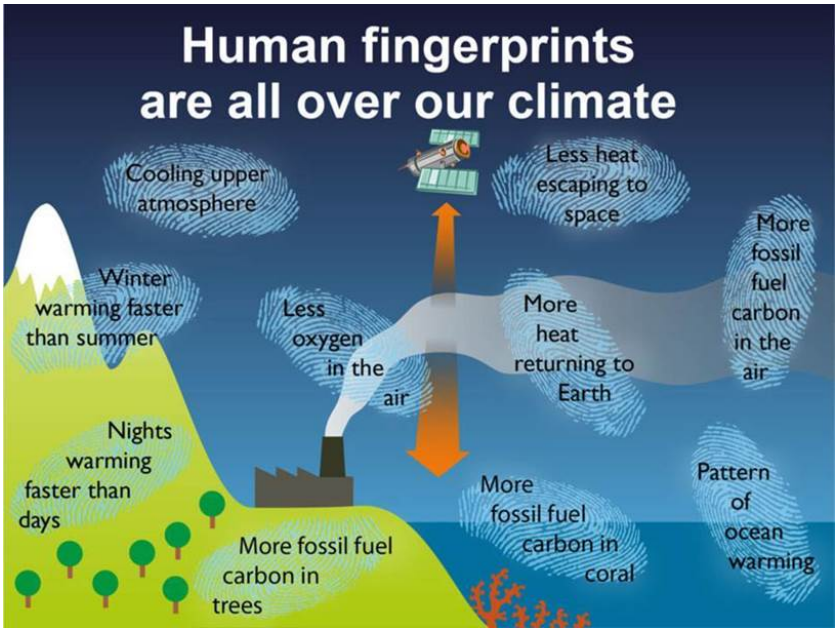
4.2.2 Methods

Climate perceptions

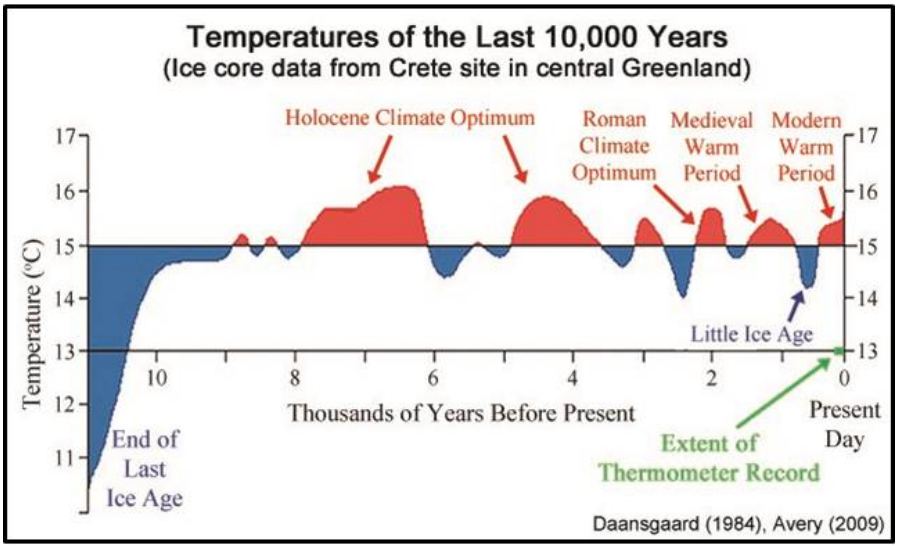
Participants are asked which perception they have concerning the cause of climate change: human-induced, nature-induced or induced by some other factor. Participants read the explanatory notes 1

Figure 4.1: Graphical explanations for human-induced and nature-induced climate change

(a) Human-induced climate change



(b) Nature-induced climate change



and 2, each of which corresponds to the description of "human-induced climate change" and "nature-induced climate change" associated with figures 4.1(a) and 4.1(b), respectively. After participants understand these explanations, they are asked to choose one option that is the closest to their current perception among the five options. (1) "I choose the explanatory note of 1 of human-induced climate change," (2) "I choose the explanatory note of 2 of nature-induced climate change," (3) "Explanatory notes 1 and 2 are somewhat persuasive, but I cannot choose which one to support," (4) "None of explanatory notes 1 and 2 are persuasive" and (5) "I cannot judge it because I do not or cannot understand the explanation."

Explanatory note 1: Some studies on climate change suggest that the greenhouse gases and carbon dioxide released by human production activities are changing the patterns and cycles of climate around the world, as described in figure 4.1(a). Currently, the challenges posed by climate change are well recognized. The greenhouse gases and carbon dioxide released from various human activities have an adverse effect on societies.

Explanatory note 2: Human impacts on climate change may neither be significant nor relevant. In the long term of thousands or tens of thousands of years, it is said that the pattern and cycles of the climate are changing naturally, as demonstrated in figure 4.1(b). Some studies suggest that the cause of climate change cannot be verified as being human-induced, claiming that human-induced climate change is exaggerated too much. It is appropriate to understand that climate change is a part of natural cycles in the long-term dynamics of the earth.

Scientific literacy

Scientific literacy is measured by the NISTEP scientific literacy scale adopted from a national questionnaire survey about people's attitudes toward general science and technology (NISTEP, 2001). The National Institute of Science and Technology Policy of Japan (NISTEP) has organized a scale con-

sisting of 15 questions regarding general scientific knowledge and literacy, and it has been employed in some recent field studies (Nakagawa, 2016; Jingchao et al., 2018). A participant is asked to answer "true," "false" or "no idea" for each question, where either "true" or "false" is usually set to be a correct answer. When she chooses a correct answer for a question, she scores 1, and otherwise, she scores 0. The answer "no idea" for each question is counted as 0. The scale is defined as the number of questions for which a subject answers correctly, ranging from 0 to 15.

Questions 1-13 pose scientific propositions such as (1) "the center of the Earth is very hot," (2) "all radioactivity is humanmade," (3) "the oxygen we breathe comes from plants" and (4) "it is the father's gene that decides whether the baby is a boy or a girl" and so on, each of which shall be answered by choosing "true," "false" or "no idea." Questions 14 and 15 are posed in a different manner. Question 14 is posed as "which travels faster, light or sound?" Each subject is asked to choose one of four answers: "light," "sound," "the speeds are nearly the same" and "I have no idea." Question 15 comprises two subquestions, where the first subquestion is "does the Earth go around the sun, or does the sun go around the Earth?" When a participant answers correctly in the first subquestion, the next subquestion is posed as "if the Earth goes around the Sun, how long does it take?" The NISTEP scientific scale is established as a reliable measurement to influence people's behaviors and cooperative attitudes in disaster management and energy issues (Nakagawa, 2016; Jingchao et al., 2018).

Climate donation game (CDG)

We institute a climate donation game (CDG) to approximate the degree of people's cooperation toward climate change. This game is considered a variant of a dictator game in a two-player setting, where one person (the other person) is assigned to be a dictator (a receiver), and the dictator can decide how to split a fixed amount of money between herself and the receiver (see, e.g., Bolton et al., 1998; Engel, 2011). In most cases, a dictator and a receiver play the game under an anonymous setting so that each player never knows the identity of the other. The CDG is distinct from a typical dictator game in two ways. First, each subject becomes a dictator, knowing who is a receiver. Second, the receiver is not a human but a well-known organization called the "Green Climate Fund" (GCF) in Japan that runs

a series of nonprofit activities to fight against climate change.

In the CDG, each participant is given 1000 JPY as an initial endowment and asked to distribute the money between herself and GCF as she wishes. If she takes everything (nothing) for herself, then the money donated to GCF is 0 JPY (1000 JPY). If she takes 400 JPY for herself, then the money donated to GCF is 600 JPY. In economic dictator game experiments, the standard stakes are 10 USD, and the equivalent in countries with a national currency other than the dollar (Engel, 2011). We have set the endowment to 1000 JPY $\approx$ 10 USD according to common practice. When we instruct participants about the CDG, we are cautious about stating "how to split between yourself and GCF is totally up to you, and nobody can know how you split because everything is recorded by an ID, not by your name." Economists use the amount of money the dictator gives to the receiver in dictator games as a good proxy of altruism, i.e., how much one person cares about the generally unknown other (Diekmann, 2004; Bekkers, 2007; List, 2007; Andreoni et al., 2017). In a similar fashion, we consider that the amount of money the dictator gives to GCF is a good proxy for how much one person cares about climate change, wanting to cooperate for its solution.

The social value orientations (SVOs) with the triple-dominance game

We use social value orientations (SVOs) in the triple-dominance game developed by Van Lange et al. (1997) to characterize subjects' social preferences. It is known to be reliable and to reflect a stable personality trait of how people evaluate interdependent outcomes for themselves and others in social environments (Van Lange et al., 1997). This method categorizes individual value orientations into four types—"competitive," "individualistic," "prosocial" and "unidentified"—depending on their choices in the questions. In one question, a subject chooses one option among three options, option (1): you get 480, and the other gets 80, option (2): you get 480, and the other gets 480 and option (3): you get 540, and the other gets 280. In this example, option (1) represents a competitive orientation that maximizes the point gap between herself and the other ($480 - 80 = 400$). Option (2) is a prosocial orientation that maximizes the joint outcome ($480 + 480 = 960$). Option (3) is an individualistic orientation that maximizes her own outcome of 540, being indifferent to the outcome of the other.

This SVO game contains nine questions, each of which consists of three options for herself and the other. In each question, one option among them corresponds to one of the following orientations, i.e., "competitive," "individualistic" and "prosocial." Each participant is asked to choose one option as the most preferred in each item, finally generating nine choices of options. Each participant is classified as prosocial (individualistic or competitive) if she makes six or more choices of options with that orientation. Otherwise, she is categorized as "unidentified."

Our survey experiments have been conducted with real monetary payments in CDG and SVO games. These are made for motivating participantss to seriously take part in the survey experiment, considering their opportunity costs of time and their true revelation of social preferences and cooperative behaviors toward climate change, and one session took 40 to 60 minutes for each participant. In the CDG, participants are informed that the amount of money they keep is theirs (participants obtain 438 JPY $\approx$ 3.98 USD on average in the CDG). In SVO games, participants are informed that we randomly match two participants as a pair, and the more experimental points one participant gets from her own and partner's nine choices of options, the more real money she will earn with some exchange rate (20 points are converted to 1 JPY) (participants obtain 226 JPY $\approx$ 2.05 USD on average in SVO games). In total, participants are paid on average 769 JPY from the two games and surveys with a fixed participation fee of 105 JPY.

Statistical analysis

Given the qualitative statistical results associated with perceptions and cooperation in what follows, we seek to characterize what makes one person possess the perception of human-induced climate change by regression approaches. To this end, we run logit regression by taking the perception of climate change as a dependent variable ("human-induced" perception is one, otherwise zero) and scientific literacy, prosociality and basic sociodemographic factors as independent variables (see table 4.1 for the definitions of the variables). Initially, we have also run multinomial logit regression by taking three perceptions (human-induced and nature-induced are prepared as separate dummy variables, while "other" is a base group) as dependent variables. However, the result is identified not to be different from

that of logit regression. Therefore, we judge that logit regression is appropriate to address the questions on the perception of human-induced climate change, simplifying the statistical analyses. Logit regressions assume a logit form of the following distribution function:

$$\text{Prob}(y_i = 1) = \frac{\exp(X_i\beta)}{1 + \exp(X_i\beta)} \tag{4.1}$$

where y_i is a binary dependent variable, X_i is a vector of independent variables, and β is a vector of unknown parameters. With this distributional assumption, the maximum likelihood methods estimate the unknown parameters of β, enabling the identification of the marginal probability of one person possessing the perception of human-induced climate change when the independent variable increases by one unit (holding other independent variables fixed). Therefore, the estimation of the logit regression answers the open question (1) posed in the introduction: "What are the determinants of the human-induced perception on the cause of climate change?"

Next, we seek to identify the determinants of people's cooperative behaviors toward the prevention of climate change. To this end, we run tobit regression by taking a donation in the CDG as a dependent variable and the perception of human-induced climate change ("human-induced" perception is one, otherwise zero), scientific literacy, prosociality and basic sociodemographic factors as independent variables (see table 4.1 for the definitions of the variables). Tobit regression is applied because it is established to be appropriate when a considerable portion of observations for a dependent variable is found to be zero in the sample, and our donation data include 106 zero observations in a sample size of 400 (Wooldridge, 2010, 2019). In fact, we have also run tobit regression of donations, including separate dummy variables of "human-induced" and "nature-induced" perceptions as independent variables ("other" as a base group). We confirm that the tobit regression with separate dummy variables for "human-induced" and "nature-induced" perceptions generate similar results with those in table 4.5. Based on these observations, we decide to take the regression analysis by applying tobit models that merge "nature-induced" and "other" perceptions as one group of "nature-induced + other" for brevity.

The tobit regression is described as follows:

$$y_i^* = \beta_0 + X_i\beta_1 + S_i\beta_2 + P_i\beta_3 + O_i\beta_4 + \varepsilon_i \tag{4.2}$$

where subscript i represents a participant ID from 0 to 400, y_i^* is a latent dependent variable of donations in CDG satisfying $y_i = \max(0, y_i^*)$, y_i is an observed actual donation, X_i is a dummy variable of the perception of human-induced climate change, S_i is a scientific literacy scale, P_i is a dummy variable of prosociality, and O_i is a vector of sociodemographic variables at individual and household levels such as age, gender, marital status, household income, education and housing areas.[1] The β_0 is an intercept, β_js for $j = 1, \ldots, 4$ are the unknown parameters associated with X_i, S_i, P_i, O_i to be estimated, and ε_i is a normally distributed error term.

While the latent variable y_i^* is assumed to be normally distributed, the observed donation y_i does not follow the same assumptions. y_i is assumed to be equal to y_i^* when $y_i^* > 0$; otherwise, $y_i = 0$. With the distributional assumptions for the actual donations in CDG and the associated latent variable, a tobit regression identifies the estimates of β_0, β_1, β_2, β_3 and β_4 via the maximum likelihood method, enabling us to calculate a marginal effect of an independent variable on the donation in the CDG. Specifically, the marginal effect is interpreted to be a change in the donation when one independent variable increases by one unit while holding other variables fixed. Therefore, the estimation of the tobit regression for the marginal effects associated with β_js should be able to answer the open question (2) posed in the introduction: "How does the perception gap on the cause of climate change along with

[1]The regression analysis (4.1) assesses the hypothesis that individuals with high scores on scientific literacy tests are also those with a perception of human-induced climate change; the second one (4.2) aims to evaluate the hypothesis that individuals with a perception of human-induced climate change contribute to climate donation. We incorporate scientific literacy and climate perception as independent variables in the same regression analysis on SWB (4.2) because we judge that the regression models are accounted for after the effects of residuals have been partialled out or netted out. The regression analysis (4.2) quantifies the alteration in climate donation amount resulting from a one-unit increase in an independent variable withholding the other independent variables fixed. Thus, the partial regression reveals the impact of solely the explanatory variable on the dependent variable of climate donation, with the effects (i.e., indirect effect) of the other explanatory variables being irrelevant (Wooldridge, 2019). Therefore, we employ structural equation modeling (SEM) to test hypotheses about mediating effect between variables. Partial regression analysis is a simple form of the partial regression coefficient, but SEM provides more advanced capabilities for complex modeling relationships between variables

scientific literacy and social preferences affect people's cooperative behaviors?"

4.3 Results

Tables 4.1 and 4.2 present the definitions of all variables used in the analysis and the summary statistics of the variables for urban, nonurban and overall areas. The percentages of female participants are similar in urban and nonurban areas (38 % and 36 %, respectively). Participants in urban and nonurban areas possess a high school diploma as the median of education. The median household income in urban areas is 1 million JPY higher than that in nonurban areas. With respect to occupations, only 2 % of the participants in nonurban areas are employed in agriculture, while all participants in urban areas report that they are salaried workers, such as company owners, office workers and civil servants.[2] This implies that Japanese people depend on industries other than agriculture, even in nonurban areas. The statistics of the sociodemographic information in table 4.2 are in accordance with our expectation; that is, participants in urban areas have higher education and household income than those in nonurban areas. Additionally, in Japan, there exists a difference between urban and nonurban areas with respect to basic sociodemographic factors; however, the difference is not so large.

We report the summary statistics of participants' SVOs, focusing on the percentages of prosocial participants in urban, nonurban, and overall areas (see the "SVO (prosocial)" row in table 4.2). While 58 % of participants overall are prosocial, 56 % (60 %) of urban (rural) participants are prosocial. This result is in sharp contrast to those of similar studies in developing nations showing that the percentages of prosocial participants between urban and rural areas are quite different, and the percentage of prosocial participants in rural areas is higher than that in urban areas (Shahrier et al., 2016; Fujii et al., 2017; Shahrier et al., 2017; Timilsina et al., 2017, 2019).[3] Our result can be interpreted as indicating that the degree of prosociality among people is not different between urban and nonurban areas in Japan

[2] In nonurban areas, 173 out of 200 participants report that they receive a regular salary in the same way as urban participants.

[3] As mentioned earlier, Japanese people depend on some industries other than agriculture, even in nonurban areas, receiving a regular salary for office work. This may be one of the reasons why the difference in prosociality between urban and nonurban areas is not found in our study.

Table 4.1: Variable definitions

Variables	Definitions
Area	Area is a dummy variable that takes 1 when the area is urban and 0 otherwise.
Age	Age is defined as years of age.
Gender	Gender is a dummy variable that takes 1 when the participant is female, and 0 otherwise.
Education	Education is an ordered categorical variable of $0, 1, 2, 3$ and 4 where no scholastic education, junior high school, high school, undergraduate, graduate and higher education are coded as $0, 1, 2, 3$ and 4, respectively.
Household income	Household income per year in JPY. Categorical variable of 0 to 12 with an interval of 1M, However, 11 presents as earning $10\text{M} < 15\text{M}$, and 12 represents as earning more than 15M per year.
Marital status	Marital status is a dummy variable with categorical variables of 0 and 1 where marital status experienced, marital status nonexperienced are coded as 0 and 1, respectively.
Family type	Family type is the categorical variable of 0 and 1 where family type, nuclear family or extended family, are coded as 0 and 1, respectively.
Occupation/agriculture	Occupation/agriculture is defined as 1 if the respondent engages in agriculture or is employed.
SVO	The "SVO" represents a dummy variable taking 1 when the participant is prosocial and 0 otherwise, based on SVO games.
Scientific literacy	This scale is defined as the number of questions for which participants provided correct answers. The theoretical range is from 0 to 15.
Perceptions	Perception of the cause of climate change is categorized as human-induced climate change, nature-induced climate change or climate change induced by another factor (cannot say and no idea).
Human-induced	Perception of human-induced climate change represents a dummy variable taking 1 when the participant chooses human-induced and 0 otherwise (nature-induced, cannot say, and no idea).
Donation	Donation is defined as a donation payment (range is between 0 and 1000 JPY)

Table 4.2: Summary statistics of the variables

	Urban areas				Nonurban areas				Overall			
	Mean (Median)	SD[1]	Min	Max	Mean (Median)	SD	Min	Max	Mean (Median)	SD	Min	Max
Age	49.4 (47)	17.72	20	89	49.82 (49)	16.96	21	86	49.61 (48)	16.32	20	89
Gender (female)	0.38 (0)	0.49	0	1	0.36 (0)	0.48	0	1	0.37 (0)	0.48	0	1
Education	2.71 (3)	0.70	0	4	2.54 (3)	0.67	1	4	2.65 (3)	0.69	0	4
Household income	6.21 (6)	3.1	0	12	5.52 (5)	2.97	0	12	5.86 (5)	3.05	0	12
Marital status (experienced)	0.69 (1)	0.47	0	1	0.66 (1)	0.48	0	1	0.67 (1)	0.47	0	1
Family type (nuclear family)	0.1 (0)	0.3	0	1	0.12 (0)	0.33	0	2	0.11 (0)	0.31	0	1
Occupation (agriculture)	0 (0)	0	0	0	0.02 (0)	0.12	0	1	0.01 (0)	0.12	0	1
SVO (prosocial)	0.56 (1)	0.50	0	1	0.60 (1)	0.49	0	1	0.58 (1)	0.49	0	1
Scientific literacy	8.53 (9)	3.36	0	14	8.24 (9)	2.95	0	14	8.39 (9)	3.16	0	14
Human-induced	0.3 (0)	0.46	0	1	0.33 (0)	0.47	0	1	0.32 (0)	0.47	0	1
Donation	455.53 (500)	403.88	0	1000	419.90 (400)	381.09	0	1000	437.71 (500)	392.56	0	1000
Sample size		200				200				400		

[1] SD stands for standard deviation.

[2] We run t and/or chi-square tests to see the distributional difference in key variables between urban and nonurban areas. The results are as follows: Age ($t = 0.245, p = 0.81$); Education ($t = -2.481, p = 0.014$); Household income ($t = -2.258, p = 0.025$); Marital status ($\chi^2 = 0.407, p = 0.52$); Family type; SVO ($\chi^2 = 0.829, p = 0.36$); Scientific literacy ($t = -0.917, p = 0.36$); Human-induced ($\chi^2 = 0.417, p = 0.52$) and Donation ($t = -0.9075, p = 0.36$).

compared to other developing countries.

Table 4.2 shows the summary statistics of participants' scientific literacy in urban, nonurban and overall areas. We compute the Cronbach's alpha of this scale to be 0.76, illustrating that the scientific literacy scale possesses acceptable internal consistency in our sample. The median score of scientific literacy is 9 points in both urban and nonurban areas, while the average scores of scientific literacy are 8.53 and 8.24 points, respectively. This implies that scientific literacy between urban and nonurban participants is not much different; however, scientific literacy in urban participants is slightly higher than that in nonurban participants. This result is in line with the expectation because education levels are almost the same between the two areas. With respect to people's perception of the causes of climate change (see the "Perception of climate change" row in table 4.2), 30 % (33 %) of urban (nonurban) participants answer that climate change is caused by human-induced factors. Conversely, 12 % (14 %) of urban (nonurban) subjects answer that climate change is caused by nature-induced factors, implying that, interestingly, 59 % (53 %) of urban (nonurban) participants answer that the cause of climate change cannot be judged to be human-induced or nature-induced. Regarding the results of the climate donation game (CDG) (see the last row of "Donation" in table 4.2), the donation (JPY) by urban participants (mean $= 455.53,$ median $= 500$) is generally higher than that by nonurban participants (mean $= 419.90,$ median $= 400$), while the overall average donation is 437.71 (median $= 500$).

Table 4.3 demonstrates that there is some relationship between participants' perceptions of the causes of climate change and their donations (JPY) to climate change. With respect to those with the perception of human-induced climate change, the average (median) donations are 590.25 (500) by urban participants and 525.00 (500) by nonurban participants, respectively, as shown in the "Human-induced" row of table 4.3. With respect to those with the perception of nature-induced climate change, the average (median) donations are 535.22 (500) by urban participants and 272.50 (100.00) by nonurban participants. Finally, with respect to those with "Other," the average (median) donations are 370.78 (300) by urban participants and 393.39 (300.00) by nonurban participants. Overall, it appears that participants who perceive climate change as being human-induced tend to donate more to the prevention of climate change than those who perceive climate change to be nature-induced or induced by another

Table 4.3: Donations and participant' perception of the cause of climate change across urban, nonurban and overall areas

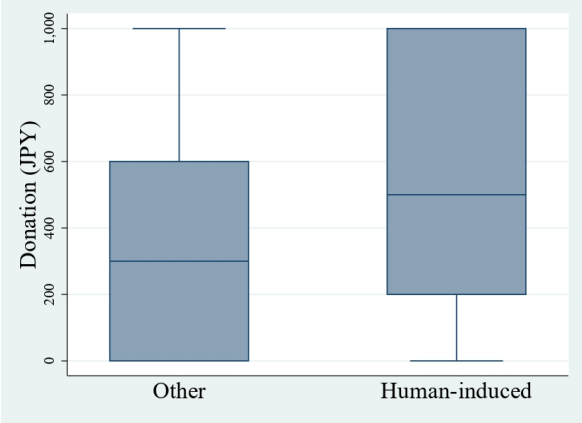
Perception	Urban areas					Nonurban areas					Overall				
	n	Mean (Median)	SD[1]	Min	Max	n	Mean (Median)	SD	Min	Max	n	Mean (Median)	SD	Min	Max
Human-induced	60	590.25 (500)	386.23	0	1000	66	525 (500)	365.88	0	1000	126	556.07 (500)	375.62	0	1000
Nature-induced	23	535.22 (500)	444.23	0	1000	28	272.50 (100)	326.7	0	1000	51	390.98 (300)	402.36	0	1000
Other	117	370.78 (300)	385.55	0	1000	106	393.39 (300)	389.2	0	1000	223	381.52 (300)	386.58	0	1000
Sample size	n = 200					n = 200					n = 400				

SD stands for standard deviation.

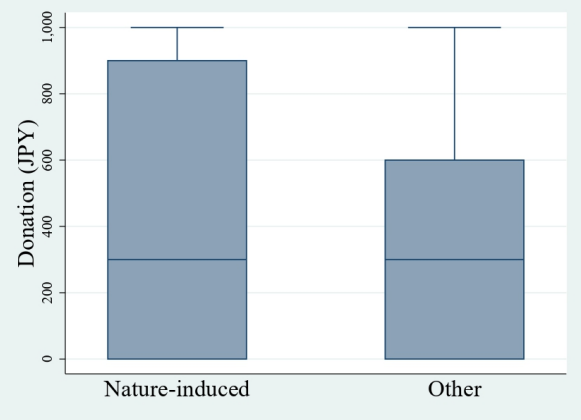
Figure 4.2: Boxplots of donations among human-induced, nature-induced and other climate change

(a) Nature-induced vs. Human-induced

(b) Other vs. Human-induced



(c) Nature-induced vs. Other



(d) Nature-induced + Other vs. Human-induced

factor, irrespective of urban and nonurban areas. We can also confirm the same tendency from the "Overall" column of table 4.3, depending on whether participants perceive human-induced climate change.

Figure 4.2 shows a series of boxplots to represent whether there is a distributional difference of donations among those with perceptions of human-induced, nature-induced, and other climate change. Figures 4.2(a) and 4.2(b) present that the distribution of donations by participants with the perception of human-induced climate change is in higher positions than those by participants with the perception of nature-induced and other climate change. Moreover, figure 4.2(c) shows that there is little difference between those with the perception of nature-induced and those with the perceptions of other climate change. To statistically check whether the distribution of donations differs by participants' perceptions

on the cause of climate change, we run Mann-Whitney tests with the following three pairs of donations by those with different perceptions: (a) human-induced *vs.* nature-induced, (b) human-induced *vs.* other, (c) nature-induced *vs.* other and (d) nature-induced + other *vs.* human-induced.[4] For each pair, a null hypothesis is that the distribution of donations by those with one perception is the same as that by those with the other perception. The Mann-Whitney tests show that pairs (a), (b) and (d) statistically reject the null hypotheses ($Z = -2.667, p < 0.01$; $Z = -4.106, p < 0.01$ and $Z = 4.31, p < 0.01$), while pair (c) does not ($Z = 0.946, p = -0.068$). This implies that whether subjects have human-induced perceptions can truly matter in determining their cooperative behaviors regarding climate change.

Table 4.5 reports the marginal effects and their respective standard errors of independent variables on participants' donations by the CDG along with the statistical significance. Model 1 of table 4.5 contains only the perception of human-induced climate change as independent variables, and next, we gradually add scientific literacy, prosociality, age and other factors as independent variables in models 2 to 4, building upon model 1. We first find that the perception of human-induced climate change is statistically significant, with a positive sign at the 1 % level in a robust manner, irrespective of the models. The estimated marginal effects of the perception of human-induced climate change on their donations range between 235.016 JPY and 136.400 JPY in models 1 to 4, implying that a subject with the perception of human-induced climate change is likely to make more donations by 235.016 JPY $\sim$ 136.400 JPY than that with other perceptions.

Second, scientific literacy has a positive effect on donations at the 1 % significance level in models 2 and 3 but at the 10 % significance level in model 4. The estimated marginal effects of scientific literacy in models 2 to 4 suggest that a participant is likely to increase her donation by 24.101 JPY $\sim$ 13.506 JPY when her scientific literacy increases by one point. The prosociality also exhibits 5 % statistical significance with a positive sign in models 3 and 4, implying that a participant with prosocial orientation tends to make more donations by 102.215 JPY $\sim$ 105.148 JPY than that with

[4]For pair (d), we have combined the observations of donations from "nature-induced" and "other" climate changes as "nature-induced + other."

Table 4.4: Marginal probability of multinomial logit regression with other perceptions as base group

Variable	Marginal probability			
	Model 1	Model 2	Model 3	Model 4
Scientific literacy	0.044***	0.039***	0.039***	0.040***
	(0.007)	(0.008)	(0.008)	(0.008)
Age		0.004***	0.004***	0.003**
		(0.001)	(0.001)	(0.001)
Female (base group = male)		0.096**	0.100**	0.083**
		(0.045)	(0.045)	(0.046)
Prosocial (base group = proself)			0.069*	0.066*
			(0.049)	(0.045)
Marital status (base group = nonexperienced)				0.069
				(0.059)
Education				−0.040
				(0.045)
Household income				0.007
				(0.008)
Urban area (base group = nonurban area)				−0.045
				(0.234)
Family type (= extended family)				−0.004
				(0.070)

[1] *** significant at the 1 % level, ** significant at the 5 % level, and * significant at the 10 % level

[2] The age squared variable is not added to these models because we judge this variable as less important by a predicted probability logistic regression.

Table 4.5: Marginal effects of independent variables in tobit regression for donations to the prevention of climate change

Variable	Marginal effect			
	Model 1	Model 2	Model 3	Model 4
Perception of human-induced (base group = "nature-induced + other")	235.016***	190.834***	183.948***	136.4***
	(54.566)	(56.004)	(55.835)	(55.317)
Scientific literacy		24.101***	22.996***	13.506*
		(8.490)	(8.477)	(8.881)
Prosocial (base group = proself)			102.251**	104.477**
			(51.441)	(50.191)
Age				4.935***
				(1.696)
Female (base group = male)				67.191
				(64.313)
Marital status (base group = nonexperienced)				93.457*
				(64.313)
Household income				6.037
				(8.611)
Education				−27.055
				(3.912)
Urban area (base group = nonurban area)				49.880
				(49.651)

*** significant at the 1 % level, ** significant at the 5 % level, and * significant at the 10 % level

other orientations. Similarly, in model 4, a participant is likely to make more donations by 4.935 JPY (93.457 JPY) when her age (marriage) increases by one year (is experienced). The other independent variables, such as the gender dummy, household income, education and area dummy, are identified to be statistically insignificant, as shown in model 4 of table 4.5. Here, we have again confirmed that the main results in the tobit regressions qualitatively remain the same, irrespective of the various specifications of models other than models 1 to 4, such as including additional terms among the variables. Overall, the perception of human-induced climate change, scientific literacy, prosociality and age are established as the main determinants that are statistically and practically significant in cooperation with the prevention of climate change.

We discuss the strength of independent variables' coefficients based on the estimation results in tables 4.4 and 4.5. To this end, we focus on the magnitudes of changes that derive from the estimated coefficients, when one standard deviation (a unity from 0 to 1) in a continuous independent variable (a dummy independent variable) increases for the purpose of comparison between dummy and continuous variables on the same basis. Model 3 in table 4.4 reveals that scientific literacy is the most important variable for the perception of human-induced climate change, because its magnitude (0.123) is larger than that of age (0.065), gender (0.100) and prosociality (0.069). Next, model 4 of table 4.5 reveals that the perception of human-induced climate change is the most significant determinant for donation against climate change because its magnitude (136.400) is larger than that of scientific literacy (42.678), prosociality (104.477) and age (80.539). Overall, comparing the magnitudes of changes from the regressions confirms the strong effects of scientific literacy on the perception of human-induced and the perception for donation against climate change.

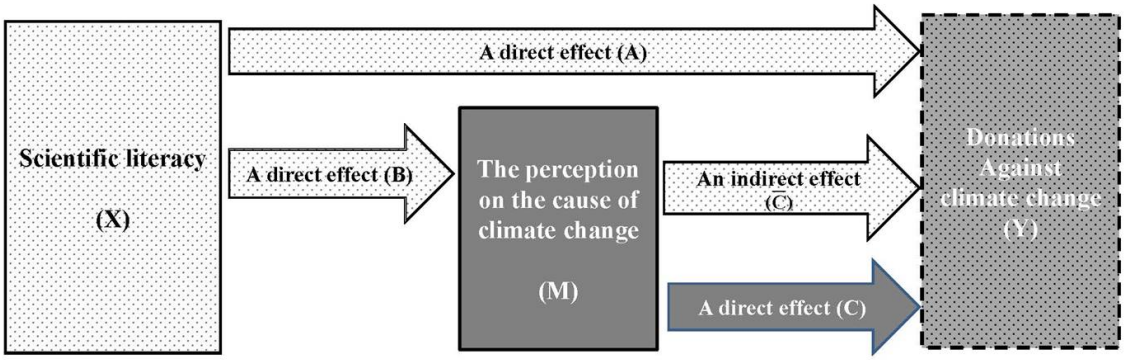
Based on the aforementioned results, there appear to exist some "path" relationships in the following three pairs: (1) scientific literacy $\rightarrow$ the perception of human-induced climate change, (2) scientific literacy $\rightarrow$ donations in the CDG and (3) the perception of human-induced climate change $\rightarrow$ donations in the CDG. Examining the existence of the three paths is interpreted to test that the perception of human-induced climate change is a mediator between donations in the CDG and scientific liter-

acy as graphically conceptualized in figure 4.3.[5] To statistically address whether the perception of human-induced climate change is a mediator or not, structural equation modeling (SEM) is employed by checking the paths among the three variables together with the direct and indirect effects of scientific literacy, following the procedures in (Gunzler et al., 2013, 2014) and (Venturini and Mehmetoglu, 2019). The SEM analysis computes a beta weight as a standard coefficient, β, along with the associated statistical significance for each path. This analysis enables us to establish that scientific literacy and the perception of human-induced climate change are important determinants for people's cooperation through not only their direct but also indirect effects, which is another robustness check for the regression results.

We first analyze the two direct effects from scientific literacy to donations in the CDG (path A in figure 4.3) and from the perception of human-induced climate change to donations in CDG (path C in figure 4.3) by SEM analysis. The results successfully show the existence of the path A with ($\beta = 0.144, p < 0.001$) and that of path C ($\beta = 0.165, p < 0.001$), meaning that both the perception of human-induced climate change and scientific literacy have direct effects on donations in the CDG. Next, we analyze the direct effect from scientific literacy to the perception of human-induced climate change (path B in figure 4.3) and an indirect effect from scientific literacy to donations via the perception of human-induced climate change (path $\bar{C}$ in figure 4.3). The SEM analysis demonstrates the significance of path B ($\beta = 0.275, p < 0.001$) as well as path $\bar{C}$ ($\beta = 0.045, p < 0.01$). Overall, the SEM analysis establishes that scientific literacy and the perception of human-induced climate change directly and indirectly affect donations in the CDG, where the perception of human-induced climate change is a mediator between scientific literacy and donations.

[5]Mediation is established as a concept to describe a causal chain in which the first variable, X, (scientific literacy), affects a second variable, M, (the perception of human-induced climate change) that affects a third variable of the outcome, Y, (donations in the CDG), where the second variable is called a "mediator" (Baron and Kenny, 1986; Jason, 2018).

Figure 4.3: Mediating effects among scientific literacy, people's perceptions and donations



4.4 Discussions

We are now ready to summarize the answers to the two open questions posed at the end of the introduction section based on our statistical analyses. The first question is "what are the determinants of the human-induced perception of the cause of climate change?" Our answer to the question is that scientific literacy, age, gender and prosociality are the main determinants regarding whether people possess the perception of human-induced climate change. In particular, scientific literacy is of utmost importance due to the magnitude and significance of the regression and SEM analyses. The second question is "how does the gap in perceptions on the cause of climate change along with social preferences and scientific literacy affect people's cooperative behaviors?" Our answer to the question is that the perception of human-induced climate change, scientific literacy, prosociality and age positively affect people's cooperative behaviors toward climate change, demonstrating the importance of possessing the perception of human-induced climate change and high scientific literacy for cooperation with climate change.

Some literature has reported an importance of prosociality, age, gender and social capital for people's perceptions and behaviors toward climate change, which is in line with our findings (Bord and O'Connor, 1997; O'Connor et al., 1999; Meyer and Liebe, 2010; Gatersleben et al., 2014; Kline et al., 2018; MacManus, 2018). Specifically, the literature shows that people are likely to possess correct

perceptions and cooperate for climate change as they are prosocial, aged and female. Here, a majority of people agree that age and gender shall be considered almost impractical to change, while some may wonder whether or not social preferences of prosociality change over time. The literature appears to reach a consensus that people's social preferences remain the same once they are fixed at their young ages. Brosig-Koch et al. (2011) study people's cooperation between East and West Germany before and after reunification by performing a solidarity game, demonstrating that their social preferences had remained unchanged over 20 years. Thus, prosociality, age and gender are considered exogenous and impossible to change by policy interventions or training in the short run.

American Association for the Advancement of Science (2016) and Wigginton et al. (2016) report that further urbanization will have taken place and $65\,\% \sim 75\,\%$ of the world population are predicted to concentrate in urban cities in Asia and Africa. Although technology and education will be making progress along with such urbanization processes in the world, there remains an important question of how people's perception and cooperative behaviors toward climate change evolve over time. The literature claims that people tend to be proself, individualistic, and less cooperative with social problems when societies transition from rural to urban (Schwartz, 2007; Shahrier et al., 2016; Timilsina et al., 2017, 2019).[6] If this is the case, our results suggest that people are unlikely to have the perception of human-induced climate change, being less cooperative with climate change and having negative impacts on future generations.

Scientific literacy is known to be increased by education or cultural learning at any age, while urban city life is reported to detach people from having hands-on experience, knowledge and learning about nature (NISTEP, 2001; Nakagawa, 2016; Jingchao et al., 2018). Given the findings in our research, how to enhance scientific literacy shall be a key for giving positive influences on not only the perception of human-induced climate change but also actual cooperative behaviors, especially when

[6]In our study, prosociality does not differ between urban and nonurban Japanese people. We conjecture that this may be due to the fact that Japanese nonurban life is urbanized and depends on industries other than agriculture in comparison with developing countries, as demonstrated by our data. For example, Shahrier et al. (2016, 2017); Timilsina et al. (2017) and Timilsina et al. (2019) study people between urban and rural areas that are quite different from one another with respect to industries and practices.

societies are further urbanized. Akter and Bennett (2011) and Sun and Han (2018) present that people are likely to have risk perception and willingness to take actions toward climate change when they are educated or exposed to mass media. While the results are quite plausible, they can be reinterpreted. We conjecture that scientific literacy works as a substitute or complement of hands-on experience, mass-media exposure, education, knowledge and training about nature even in urbanization processes. In this sense, scientific literacy may be more important than years of schooling for linking people with the perception of human-induced climate change and cooperative behaviors. Thus, it is vital for climate scientists to prepare and explain some evidence, facts and the associated programs for not only enhancing people's scientific literacy but also convincing people to recognize that climate change is genuinely human-induced, as argued in Lehtonen et al. (2019).

Climate change is the greatest threat to future generations, and it appears that the current generation neither cooperates nor takes effective countermeasures. To make matters worse, it is reported that human-nature interactions have been lost in contemporary societies, because people do not have enough opportunities and real experiences to learn literacy and perception about climate and nature (Soga and Gaston, 2016; Gaston, 2020). If this is the case, people in the current generation have further difficulty cooperating for climate change. This study reveals that one possible way for the resolution is to affect people's scientific literacy and perception fundamentally. Fukushima et al. (2017) also suggest that the structure of a platform for education and capacity building should be redesigned to enhance people's cooperation for the sustainability of future earth.

We consider that future studies approaches shall be utilized to increase people's cooperation against climate change (Lindgren and Bandhold, 2003; Helm, 2009; Robinson et al., 2011; Wiek and Iwaniec, 2014; Nakagawa et al., 2019; Saijo, 2019; Timilsina et al., 2020). The future studies approaches adopt case-method materials for participants to carefully read and discuss from various viewpoints in workshop, and the participants see and experience how their judgements and preferences change before and after the workshop (Hamilton et al., 2015; Hess and Maki, 2019; Luo and Zhao, 2021). Some studies demonstrate that such approaches (i.e., visioning, backcasting, scenario planning and future design) enable people to possess a new viewpoint, enhancing their metacognition (Keough and Shanahan, 2008;

Migliorini and Lieblein, 2016; Holmberg and Larsson, 2017; Nakagawa and Saijo, 2020). It is also documented that fostering metacognition plays a vital role in nurturing scientific literacy (Yore and Treagust, 2006; Choi et al., 2011; Seraphin et al., 2012; Avargil et al., 2018). We argue that future studies approaches can be customized to enhance not only people's metacognition but also their scientific literacy and perceptions of human-induced climate change, consequently inducing them to cooperate.

4.5 Conclusions

This research has explored the determinants of the perception of human-induced climate change and the impact of the perception gaps on cooperative behaviors toward climate change by conducting a survey experiment with a climate donation game for 400 Japanese participants. The results suggest two main findings. First, the analysis finds the importance of people's scientific literacy to explain the perception gaps in that those with high scientific literacy tend to have the perception of human-induced climate change. Second, people are identified as cooperative toward climate change, as they have prosocial value orientation, high scientific literacy and the perception of human-induced climate change, demonstrating that scientific literacy plays two important roles as not only a direct determinant but also an indirect determinant through a mediator of people's perceptions of human-induced climate change. The results imply that the enhancement of scientific literacy among people shall be a key for giving positive influences on not only the perception of human-induced climate change but also actual cooperative behaviors to climate change.

We note some limitations of our study and directions for future research. This survey experiment was conducted in one country (Japan), which is culturally homogeneous and relatively urbanized, even in nonurban areas, compared to the rest of the world. To generalize our findings, the same types of empirical studies should be conducted in other countries, especially developing countries that are in contrast with Japan in several aspects and are more vulnerable to climate change than developed countries. In addition, our findings are established only by empirical and quantitative research methods. Future research should employ a qualitative approach, such as individual interviews, to clarify the

detailed processes of how a personal perception of the human-induced climate change actually "influences" her cooperative behaviors, as suggested in Corbin and Strauss (2014), contributing to further policy implications. These caveats notwithstanding, we believe that this study is the first step toward understanding the importance of having the perception of human-induced climate change along with the associated determinants, hoping that further studies will ensue for further identification of how to enhance cooperation toward climate change for its resolution.

Chapter 5

Conclusion

Many countries have increasingly adopted economic competition as their social and economic institutions, pursuing further economic growth. Consequently, these social values bring people consumerism, individualism and self-maximization behaviors to be a primary source of satisfaction or happiness, leading to various sustainability problems among generations (Weiss, 2008; Gilovich et al., 2015; Diprose et al., 2019). Nowadays, sustainability is crucial in protecting our planet and future generations and growing concerns for globalism, consumerism and environmental problems. Sustainable development goals (SDGs) have become common missions for humanity worldwide. However, little is known about what types of people or societies are likely to follow the paths for sustainable development steadily and what kinds of indicators people in societies must enhance to achieve these goals. Thus, clarifying what factors facilitate sustainable development to suggest the proper mechanism to improve and maintain sustainability is crucial. This thesis attempts to find the paths for materializing sustainable development from both peripersonal (whatever is in your arm's reach) and extrapersonal (whatever is beyond your arm's reach) aspects of human nature, for example, wellbeing (happiness), generativity, social preferences, perceptions and cooperative behaviors. For this purpose, this thesis conducts a questionnaire and survey experiments and collects primary data to examine determinants of wellbeing (happiness) at the individual levels, empirically explores the potential factors concerning inquisitive and autonomous people to influence wellbeing (happiness) and generativity in place with different cultures, addresses the relationships between the perception and people's cooperative behaviors toward global issues (i.e., climate change).

In the first study, the thesis examines relationships between happiness, the concern for inquisitiveness (curiosity & acceptance to something and someone different), generativity, social preferences, along with sociodemographic factors, within a single analytical framework. This study hypothesizes that inquisitiveness is a fundamental determinant of generativity and happiness (subjective wellbeing), posing two research questions (1) Does inquisitiveness play a role in generativity? (2) How does in-

quisitiveness, along with generativity, affect people's happiness? This study conducts questionnaire surveys with 400 Japanese participants, applying OLS regression, median regression and structural equation modeling to the data. This study empirically characterizes determinants of wellbeing (happiness) with the data, focusing on generativity and inquisitiveness, controlling for sociodemographic factors. First, the analysis identifies the importance of inquisitiveness in characterizing generativity in that people with high inquisitiveness tend to be generative. Second, people are identified to be happy as they have high generativity and inquisitiveness, demonstrating two influential roles of inquisitiveness as direct and indirect determinants through a mediator of generativity. Overall, the results suggest that inquisitiveness shall be an essential element of people's happiness through intergenerational and intragenerational communication.

In the second study, the thesis considers that generativity and wellbeing shall be necessary and salient indicators that people in societies must enhance to materialize sustainable development, hypothesizing that people with high autonomy (being independent & resisting social pressure) and inquisitiveness (adaptability to new social and/or environmental changes) tend to be generative and happy. To empirically examine the hypothesis, we analyze people's generativity and wellbeing as essential elements of sustainable development and statistically characterize them in relation to autonomy and inquisitiveness with the data from survey experiments of 413 residents in matrilineal Island Palau. We choose Palau as the field, because rapid social and environmental changes are ongoing from traditional to modern societies and a wide variation of people is expected to be observed compared to any field in other nations, even with a small sample size. Two main results are obtained. First, the analysis identifies the importance of inquisitiveness in that people with high inquisitiveness tend to be generative. Second, people's wellbeing is high as they are generative, autonomous and inquisitive, demonstrating two influential roles of inquisitiveness on happiness as direct and indirect determinants through a mediator of generativity. Overall, the results suggest that autonomy and inquisitiveness contribute to people's generativity and wellbeing even in tradition-oriented societies, such as Palau, and their improvements are considered specific paths to sustainable development.

In the third study, the thesis analyzes the determinants of human-induced perception and the im-

pact of the gap in perceptions on cooperative behaviors toward climate change by conducting a survey experiment with a climate donation game with 400 Japanese participants. This study empirically characterizes determinants of people's cooperative behaviors through the climate donation game with the data, focusing on social value orientation (SVO), scientific literacy and the perception of the cause of climate change, controlling for sociodemographic factors. First, the analysis identifies the importance of people's scientific literacy in explaining the perception gaps in that those with high scientific literacy tend to have the perception of human-induced climate change. Second, people are identified as being cooperative toward climate change, as they have a prosocial value orientation, high scientific literacy and the perception of human-induced climate change, demonstrating two critical roles of scientific literacy as not only a direct determinant but also an indirect one, through a mediator of people's perceptions. Overall, the results suggest that scientific literacy shall be a key to enhancing cooperation toward climate change by promoting the perception of human-induced climate change.

This thesis attempted to find the paths to sustainable development from both peripersonal and extrapersonal sides of human nature, for example, wellbeing (happiness), generativity, social preferences, perceptions and scientific knowledge. Pleasant experiences in the peripersonal space, such as rearing, caring and teaching, will bring people happiness, reassurance and joy. On the other hand, finding new views and knowledge may require time, planning and cooperation to share them with others. This thesis indicates that both peripersonal and extrapersonal space activities are essential to materialize sustainable development, for being required to enhance inquisitiveness, autonomy and generativity, along with the wellbeing and cooperative behaviors for the sake of current and future generations.

NOMENCLATURE

SWLS Satisfaction With Life Scale

LGS Loyola generative scaled

OSH Overall Subjective Happiness

SDGs Sustainable Development Goals

SHS Subjective Happiness Scale

SWB Subjective Wellbeing

USD US Doller

CDG Climate Donation Game

GCF Green climate fund

JPY Japanese Yen

NISTEP National Institute of Science and Technology Policy of Japan

SEM Structural equation modeling

SVO Social Value Orientation

WTP Willigness To Pay

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