# Imaginary future generations: A deliberative approach for intergenerational sustainability dilemma

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# Imaginary future generations: A deliberative approach for intergenerational sustainability dilemma

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## Abstract

The current generation affects future generations, but the opposite is not true. This one-way nature of the dependence of generations is the leading cause of many intergenerational problems, such as climate change. These problems are characterized by the fact that the current generation tends to choose actions to their benefit without considering future generations, which we call the intergenerational sustainability dilemma (ISD). This paper designs and implements deliberation experiments representing ISD with a single generation of three people and examines how the dilemma can be solved. Imaginary future generations (IFG) is suggested as a treatment in which one person in the current generation is asked to be a representative from the future without any obligations. We analyze the recorded deliberation of generation decisions. We find that intergenerational sustainability is enhanced through deliberations when one generational member emerges naturally as a neutral icebreaker to deliberate (neutral icebreaker is defined as a person who voluntarily opens and activates the deliberation from a neutral standpoint) and/or IFG is present in a generation. Specifically, we demonstrate that when an icebreaker and/or IFG is present during deliberation, generation brings a wider variety of ideas and viewpoints about the ISD, leading to intergenerational sustainability. This research illustrates how a deliberative analysis can be usefully combined with economic experiments as a methodology to reveal human behaviors and preferences for intergenerational decision making.

**Key Words:** Intergenerational sustainability; Imaginary future generations; deliberation; economic experiments

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# Nomenclature

NIFG-I   Nonimaginary future generation and icebreakers

NIFG-NI   Nonimaginary future generation and no icebreakers

IFG     Imaginary future generation

IFG-I   Imaginary future generation and icebreakers

IFG-NI   Imaginary future generation and no icebreakers

ISD     Intergenerational sustainability dilemma

ISDG   Intergenerational sustainability dilemma game

# 1  Introduction

Many intergenerational problems have occurred, such as climate change, global warming and biodiversity loss, because only the current generation affects future generations, but the opposite is not true. This one-way nature of the dependence of generations gives a strong incentive for the current generation to chooses an action that is to their benefit, leaving more burdens on future generations and damaging the sustainability of societies in the long run, which we call the "intergenerational sustainability dilemma (ISD)." If the problems of the ISD become severe, it is claimed that the fundamental sustainability of human societies shall be further compromised (Saijo, 2020b). Sustainable futures demand some institutional change for bridging the gap between current and future generations. Democracy has been widely spread over the world as the most dominant social regime and it is believed to be the ideal for ensuring people's freedom of speech and preferences. Therefore, this paper addresses how ISDs can be solved by introducing a negotiator for future generations in a deliberative process of a democratic setting.

Intergenerational sustainability (IS) has been experimentally examined by past literature in different settings. Fischer et al. (2004) conduct intergenerational common pool experiment and claim that the existence of "intergenerational links" motivates people to exploit fewer resources and enhances sustainability. Chaudhuri et al. (2009) have found that communication, such as leaving advice for subsequent generations, enhances intergenerational coordination. Hauser et al. (2014) have demonstrated that median voting as an institution promotes intergenerational sustainability in an intergenerational goods game. Sherstyuk et al. (2016) analyze the level of difficulties of maintaining dynamic externalities over multiple generations, suggesting that controlling negative externalities is more challenging under intergenerational settings. Kamijo et al. (2017) have designed and implemented a laboratory experiment of an ISD game (ISDG) by introducing treatment of negotiators for future generations to improve intergenerational sustainability. Shahrier et al. (2017) have conducted field experiments with ISDG in the capital city of Bangladesh and rural areas and confirmed that urban people fail to maintain intergenerational sustainability due to the high proportion of proself people in urban areas. Overall, these studies have focused on the quantitative

output of the experimental results.

Communications have been studied in the past in relation to social influences, interactions and coordination in groups (Manski, 2000, Henrich et al., 2001, Frey and Meier, 2004, Luhan et al., 2007, Chen et al., 2010, Fischbacher and Gachter, 2010, Fehr and Leibbrandt, 2011, Charness and Sutter, 2012, Kugler et al., 2012). These studies reveal how communications affect people in a group.[1] Cooper et al. (1992), Charness (2000), Duffy and Feltovich (2002), Charness and Grosskopf (2004) and Blume and Ortmann (2007) demonstrate that communications, such as cheap talk or a simple online chat, improve coordination among people in a group. Communications such as free-form natural language are identified to be further effective for enhancing social interaction and coordination in a group (Selten and Warglien, 2007, Demichelis and Weibull, 2008, Houser and Xiao, 2010, Ambrus et al., 2015, Palfrey et al., 2017). Wang and Houser (2019) conduct a coordination game with free communications allowing subjects to pass on both attitudes and intentions, confirming that such communications improve coordination among individuals. Cason and Mui (2015a,b) show that communications allow victims to create successful resistance against the exploiters who extract surplus from them.

In competitive environments communications do not necessarily enhance coordination and group members even engage in costly communication to achieve intragroup coordination (Bornstein et al., 2002, Cason et al., 2012, Keck et al., 2014, Bradfield and Kagel, 2015, Cason et al., 2017, Kagel and McGee, 2016). Cason and Mui (1998) use a sequential dictator game to examine different types of social influences and interactions, concluding that self-regarding subjects are less likely to be influenced by learning others' decisions. Crawford and Harris (2018) use a modified dictator game and measure individual preferences before and after face-to-face interactions in a small group. They find that subjects with strong self-regarding preferences tend to influence others the most and might cause a coordination failure. Overall, individual social preferences between herself and others and the way of communication are key factors for influences, interactions and coordination within a

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[1]There are several forms of communication, such as signaling, exchanges of text messages or rule-based communication regarding what people can say and cannot and free face-to-face communication via natural language (see, e.g., Crawford, 2019).

group, yielding various decisions and outcomes.

Deliberation among people for collective decisions has been studied mainly in the fields of philosophy and political science (Cohen, 1986, Bohman and Rehg, 1997, Rawls, 1993, Chambers, 2003, Niemeyer and Dryzek, 2007). Some experimental studies have attempted to untangle the roles of deliberations, focusing on different aspects of socio-demographic background, culture, communication devices and so on (see, e.g., Steenbergen et al., 2003, Gronlund et al., 2009, Mercier and Landemore, 2012, Klinger and Russmann, 2015, Pedrini, 2015). Koirala et al. (2021) demonstrate that deliberation alone with majority voting is not sufficient in models of decision making at resolving IS problems and representing future generations' potential interests and concerns. IS has been discussed in relation to justice, ethics and equity (Barry, 1997, Wolf, 2003, 2008). The fundamental problem behind IS is that the current generation cannot consider how and what future generations desire due to the absence of their voices. In other words, how an institution can link current and future generations in a democratic setting is not well explored. In order to overcome these difficulties, we institute a new institution that enables the current generation to virtually take perspective and communicate with future generations, i.e., "imaginary future generations, (IFG)" and implement the experiments with deliberation to determine whether intergenerational sustainability can be enhanced.

Our main idea of a "IFG" comes from the Iroquois Confederacy's Great Law of Peace, claiming "in every deliberation, we must consider the impact on the seventh generation from now" (Saijo, 2019, 2020a). To this end, the current generation should imagine and listen to the future generation. To incorporate the voices of future generations in the experiments, we take a deliberative approach in the collective-decision process where one individual in a generation is asked to be a "deputy (or imaginary) future generation" to represent the future generations without any coercive obligations. We conduct a novel deliberative analysis to reveal whether a cap of future generations affects generation deliberations and decisions, contributing to the two points. First, we find the conditions under which IS is enhanced through deliberations. Some earlier studies aiming at evaluating discourses include respect towards others as a crucial element (Steenbergen et al., 2003, Pedrini,

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2015). With this line of research in mind, it is reasonable to consider that the emergence of a neutral icebreaker enhances the quality and quantity of deliberation. The neutral icebreaker is defined as a person who voluntarily opens and activates the group discussion from a neutral standpoint. With these conditions, we hypothesize that the group brings a wider variety of ideas and different ways of understanding the ISDG to the deliberations, leading to IS. Second, we demonstrate how a deliberative analysis can be usefully combined with economic experiments as a new methodology to reveal human behaviors and preferences in collective decision making. The deliberative analysis in this research tracks how each participant changes her opinions and thoughts from their recorded voices during experiments. This qualitative method is considered to be promising because it clarifies people's motivations, beliefs and assumptions behind their actual actions that social science experiments have ignored.

# 2 Materials and methods

## 2.1 Experimental design

Three subjects were randomly assigned into one generation in a sequence. In one session, there are 18 subjects and they were divided into six generations of different sequences, for instance, there are two or three sequences per session. Each generation is requested to make deliberations and a decision regarding allocating the resources. More specifically, we set up an intergenerational resource allocation problem with a specific focus on the role of deliberation for generation decisions. To this end, we use an intergenerational sustainability dilemma game (ISDG) data of Kamijo et al. (2017). For details, refer to the instructions and Kamijo et al. (2017).

Upon arriving at the reception desk, subjects drew a card that indicated IDs and accordingly, they were introduced to different rooms. Research assistants then distributed instructions and explained the experimental procedures (see Appendix for the specific instructions). The instruction used neutral terminologies and did not refer to the context of the intergenerational resource allocation problem and research objectives were kept silent, such that groups, points were used to refer to

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generations and resource allocation. After receiving the instructions, the first generation was taken to small rooms called "deliberation room" where they were engaged in deliberation and after finishing their decisions, subjects were then moved to another room to complete post questionnaires and received payoff and then dismissed. Subjects were made aware of their generation position in a sequence when they entered the deliberation room and asked to make decisions by choosing between options $A$ and $B$ and received reward associated with it. After the 1st generation's decision, we proceed to the 2nd generation and continue the experiment with the same procedures.[2] These procedures were identical and repeated for all the generations. The generations made oral face-to-face deliberation and it was recorded through a voice recorder. The previous generation's decisions were written on a whiteboard, except for the 1st generation in the sequence others could see previous generation decisions. In each deliberation room, there were research assistants to handle the flow of subjects.

**Intergenerational sustainability dilemma game with deliberation**

In the ISDG, three subjects are randomly assigned as a generation and they are asked to make deliberation for choosing between options $A$ and $B$. By choosing option $A$, the generation receives points $X$, whereas the payoff by choosing option $B$ is $X - 900$. After choosing between options $A$ and $B$, the generation is asked to split the payoff among the generation members. Each subject's payoff in ISDG is her generation's share plus the initial experimental endowment of 900. For instance, suppose $X = 3600$, generation earns 3600 experimental money by choosing option $A$, while the generation earns $2700 (= 3600 - 900)$ by choosing option $B$. Consequently, if members of this generation split the payoff equally, each member earns 1200 with generation choice of option $A$ and 900 with generation choice of option $B$ as their share.

One generation's decision affects the subsequent generations such that the subsequent genera-

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[2]Some readers may wonder that waiting time for the latter generations in a sequence affects generation decisions. To avoid such an effect and streamline the experimental procedures, we have asked those subjects waiting to start filling up the questionnaires. In this way, such subjects remain busy, expecting that other subjects do the same in a different room. In other words, they do not think "we are waiting." In that manner, we believe that the waiting time effect is somehow minimized.

tions' payoffs of $X$s decline uniformly by $900$ when the generation chooses option $A$, otherwise not. Each experimental session consists of a sequence of $6$ generations. Each generation is randomly assigned to the 1st, 2nd, . . . and the 6th generations. For instance, suppose that $X = 3600$ and the 1st generation makes a decision between options $A$ (= $3600$) and $B$ (= $2700$). When the 1st generation chooses option $A$, the 2nd generation will face the game with $X = 2700 = 3600 - 900$ in which they can receive $2700$ and $1800$ by choosing options $A$ and $B$, respectively. When the 1st generation chooses option $B$, the next generation (the 2nd generation) can have the same decision environment as the 1st generation in which they can receive $3600$ and $2700$ by choosing options $A$ and $B$, respectively. The rule "$900$ reduction with the current generation's choice $A$" applies to any intergenerational relation between $n$th and $n + 1$th generations, with which the game continue for the rest of the generations in each session. Hence, option $B$ is considered an intergenerational "sustainable," while option $A$ is an "unsustainable" choice that compromises intergenerational sustainability with the $900$ reduction rule for subsequent generations.

Each generation is allowed to deliberate their decision between options $A$ and $B$ for up to 10 minutes. We recorded and transcribed their discussions for deliberative analysis. After the generation makes a decision, the members determine how to split the payoff. In each session, the 1st generation starts ISDG with $X = 3600$, implying that the 5th and the 6th generations may face the game in which options $A$ and $B$ are associated with payoffs of $0$ and/or negative payoffs such as $-900$, respectively.[3] When a decision cannot be made within 10 minutes, the following rules are applied: (1) if the generation share is positive, each member receives an initial experimental endowment of only $900$, (2) if the generation share is negative, say, $-Z$, each member is given an equal share of $-Z$ and receives the payment of $-\frac{Z}{3}$ plus an initial endowment of $900$ (see the supplementary material of experimental instructions for the details).

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[3]Suppose that all generations from the 1st to the 4th choose option $A$, then the 5th generation will face the game in which she receives $0$ and $-900$ by choosing $A$ and $B$, respectively. When the 5th or the 6th generations face such games in which options $A$ and $B$ are associated with $0$ and/or some negative payoffs, the generation members can refund themselves equally from their initial endowment of $900$.

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**Imaginary future generation (IFG)**

We include the treatment of imaginary future generation where randomly one member of a generation is assigned to be a representative for future generations as "IFG" without any extra monetary incentives. IFG is asked to think about his/her and subsequent generations when deciding between options $A$ and $B$.[4] The identity of the IFG is known to other members of the same generation. We introduce this treatment because we are interested in identifying how priming individuals about imagenery future generations can affect deliberation and decisions. A generation members who are not given the role of imaginary future generation are called nonimaginary future generation (NIFG). In this study, 25 generations consist of all three members as NIFG and 35 generations have two NIFG and one IFG. In ISDG, subjects were paid 2500 yen ($\approx$ USD 20) on an average and 4000 yen ($\approx$ USD 33) at maximum.

## 2.2   Deliberative analysis

In the experiments, three subjects in a generation make face-to-face deliberation and express a variety of statements. We analyze these statements made by each subject during the deliberation in ISDG. These statements are formally quantified through a deliberative analysis by following the standard approach of content analysis methodology and adjust statistical reliability for accounting the number of categories the coders use during classification (Hennig-Schmidt et al., 2008, Cason et al., 2012, Vaismoradi et al., 2013, Corbin and Strauss, 2014). In this process, we hire external coders undergraduate students at the Kochi University of Technology, who are neither related to our research project nor in the authorship of this paper, for qualitative coding of arguments. The external coders independently assess all 3038 and 2059 statements in control and treatment, respectively. They made classification according to concepts and categories developed by the second author initially based on discussion during experimental sessions. The coders are initially given a series of pilot tests to see whether they can analyze the statements coherently and independently.

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[4]The IFG does not have any obligation. He/She is asked to think about future generations while deliberating and making his/her generation decision.

Second, each coder independently conducts qualitative deliberative analysis by assessing all the transcribed discussions per generation and submits her coding results, as in the later sections "Analysis 1, 2 and 3." The coders are unaware of the research questions and are asked to code the transcriptions in a conservative way such that the statement is "empty" whenever the intention of a statement is not clear. After the coders submit their results, an inter-rater reliability analysis is performed computing a Kappa statistic for each concept to see the consistency among the coders, as done in Scott (1955), Cohen (1960), Fleiss (1971), Hennig-Schmidt et al. (2008), Cooper and Kuhn (2009), Cason et al. (2012) and Cason and Mui (2015a).A Kappa statistic is computed similarly with intraclass correlation coefficients where "0" represents the amount of agreement expected from random chance, and "1" represents perfect agreement between the coders.[5]

The units of observation for coding are statements made by the subjects during a generation deliberation. If a statement is identified to be best associated with one concept, it is coded as 1 for that concept, otherwise 0. In this analysis, we consider that there are "potentially significant disagreements" for the concepts with a Kappa statistic of less than 0.3. In this case, we ask three coders to go through statements in transcriptions associated with the concepts of such low Kappa statistics. If they find a statement that each coder interprets with a different concept, we consider it as "significant disagreement." In this case, we ask the coders to discuss and decide which concept best describes the statement. When there is no significant disagreement such that at least two coders agree on one concept or "empty" for one statement, it becomes a final coding result. After resolving the significant disagreements, the three coders provide a final coding result for the analysis.

**Analysis 1: Qualitative coding of arguments**

To identify the patterns of the shift in subjects' attitudes and whether they finally support the sustainable option or not, the arguments in deliberations were qualitatively coded. We mainly focus on NIFG subjects in our analysis because they are expected to be influenced by IFG in their generation. The deliberative analysis characterizes what concepts subjects have for their arguments

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[5]A Kappa statistic is interpreted as follows: 0.01-0.20 as none to slight, 0.21-0.40 as fair, 0.41-0.60 as moderate, 0.61-0.80 as substantial and 0.81-1.00 as almost perfect agreement.

and determines whether they are for or against the sustainable option. It may be true that making arguments for the sustainable option does not simply mean that he/she is supporting the option. For example, a subject might make such arguments only as a preliminary remark for drawing his authentic opinions to oppose. However, even if so, coding is still helpful for tracking the contexts of each subject's arguments and concepts and identifying their statuses at each moment of the deliberation.

**Analysis 2: Determination of NIFG subjects' attitudes**

Based on Analysis 1, the attitudes of NIFG subjects toward the sustainable option and the shifts were determined from the transcribed generation deliberation. In the following, we describe the definitions of the subjects' statuses and then define the typologies of the subjects with respect to how they change their statuses throughout the generation deliberation. The states of the subjects in the generation deliberation are classified into the following four types.

- **State $\varphi$**: This state refers to the situation where a subject has not displayed her attitude regarding which option to support.

- **State $A$ or $a$**: This state refers to the situation where a subject has expressed his/her support for option $A$ (i.e., unsustainable option).

- **State $B$ or $b$**: This state refers to the situation where a subject has expressed his/her support for option $B$ (i.e., sustainable option).

- **State $Amb$**: This state refers to the situation where a subject has expressed ambivalence regarding which option to support.

The distinction between options $A$ and $a$ ($B$ and $b$) is defined as follows: a subject is regarded as having moved to state $A$ ($B$) only if (i) he/she did not follow a specific subject in expressing support of option $A$ ($B$) or (ii) he/she expressed his/her own reason to support alternative options $A$ ($B$). In contrast, if a subject follows other subjects and expresses that he/she supports options $A$

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$(B)$ without any reasons, his/her new state will be denoted as $a$ ($b$). It should be noted that at the beginning of the generation deliberation, all subjects are in state $\varphi$. In addition, they are in state $a$, $b$, $A$, $B$ or $Amb$ at the end of the deliberation.

On the basis of the aforementioned subjects' states, we classify subjects into three types according to how they change their own states throughout the generation deliberation.

**Definition 2.1 (Dependent subjects)** *Subjects of this type start with $\varphi$ and end with $a$, $b$ or $\varphi$.* ∎

subjects who are not classified into "dependent subjects" shall be classified into either of the following two types.

**Definition 2.2 (Stable subjects)** *Subjects of this type start with $\varphi$ and end with $A$ and during the process, they do not take states $b$, $B$ or $Amb$, or they start with $\varphi$ and end with $B$ and during the process, they do not take states $a$, $A$ or $Amb$. Examples of the status changes are $\varphi \to A$, $\varphi \to B$ and $\varphi \to a \to A$ where "$\to$" denotes the temporal order of changes.* ∎

**Definition 2.3 (Unstable subjects)** *Subjects of this type start with $\varphi$ and end with $A$ and during the process, they take state $b$, $B$ or $Amb$, or they start with $\varphi$ and end with $B$ and during the process, they take state $a$, $A$ or $Amb$. Examples of the status changes are $\varphi \to A \to B$, $\varphi \to B \to A$, $\varphi \to Amb \to A$, $\varphi \to Amb \to B$ and $\varphi \to a \to B$.[6]* ∎

Finally, because we are interested in the roles of neutral discussion facilitators, we define such a person as a neutral icebreaker. Neutral icebreakers are identified according to this definition:

**Definition 2.4 (Neutral icebreaker)** *A neutral icebreaker is defined as a person that satisfies all three of the following conditions.*

1. *She is the first person to speak something other than greeting words, such as "nice to meet you."*

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[6]A detailed example of deliberative analysis for dependent, stable and unstable subjects for group discussion is presented in table 6.

*2. She plays the role of initiating the group discussion either by (i) making explicit the two options given to the group, (ii) proclaiming the start of the group discussion, or (iii) calling for opinions.*

*3. She is neutral in the sense that he/she does not express his/her own attitude toward the options during the statement as the initiator of the group discussion.[7]* ■

## Analysis 3: Quantitative analysis

A total of 210 undergraduate and graduate students of the Kochi University of Technology participated in the experiments.[8] We have utilized only total of 180 students data in the analysis, among which 125 are male and 55 are females.[9] The age of subjects range between 18 and 29 (average = 19.5). We summarize and compare the basic statistics of NIFG subject types following the definitions in Analysis 2. We also compute the ratios of generations with and without the IFG subjects (or with and without a neutral icebreaker) that supported the sustainable option. Next, we run the logistic regression to investigate whether NIFG subjects are affected by the presence of both IFG and (or) neutral icebreakers in their generation. For this, we analyze how a total of 70 NIFG subjects (= 35 generations × 2 persons) in front of the IFG subjects behave differently from 75 NIFG subjects (= 25 generations × 3 persons) without the IFG subjects. For this, the logistic regression analysis is applied to the sample comprised of 145 (= 70 + 75) NIFG subjects.

We model the probability that a NIFG subject is supportive of the sustainable option (i.e., in states $b$ or $B$) at the end of the generation deliberation. The logistic analysis focuses on (i) whether he/she is accompanied by IFG subject, (ii) whether a neutral icebreaker exists or not in his/her generation and (iii) whether the presence of the IFG subject and icebreakers affects other aspects of NIFG. Additionally, we consider the previous generation's choice as an independent variable

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[7]A detailed example of coding for neutral icebreakers through deliberative analysis is presented in table 1.

[8]The 3rd and the 4th authors played essential roles in designing and implementing the experiments. The part of the data has also been utilized and differently analyzed in Kamijo et al. (2017).

[9]35 subjects who are assigned as IFG are not included in the analyses and 30 subjects who were assigned to the sixth generations, who only received benefits following the decisions of the former generations, for details see, Kamijo et al. (2017).

since we expect that it also affects a current generation's deliberation and decision. Then, to better interpret the association identified above, the ratios of dependent, stable, and unstable subjects are obtained for each generation type (i.e., whether the IFG subject is included or not and whether a neutral icebreaker has appeared or not).

To understand the ideas, motivations and reasoning subjects bring to the deliberation, we use "concepts" to represent considering (not considering) future generations during the ISDG. Following the laboratory and field experiments employed in Kamijo et al. (2017) and $15$ concepts for considering (not considering) future generations are developed as a framework for the coders to follow in the qualitative deliberative analysis (table 5). With the $15$ concepts in table 5, external coders read the transcribed deliberations, statements and arguments made by each subject. When the coders identify that a subject makes an argument that is consistent with or based on one concept $i$ in table 5, the argument is coded and counted as $1$ for concept $i$. We ask the coders to be very conservative with this process and they are advised to suggest any new category if they think a concept is missing. After this analysis, we determine how many times concept $i$ emerges in the arguments made by subjects in each generation's deliberation. After Analyses 1 and 2 are complete, we summarize and compare the basic statistics of subjects' types, attitudes and concepts during the deliberation that support sustainable or unsustainable options.

# 3  Results

We analyze data at the generation level first, there are $25$ generations with NIFG subjects, the number of generations that chose the sustainable option is $7$ ($28\%$ and see table 2). On the other hand, among the $35$ generations with a IFG subject, the number is $21$ ($60\%$ and table 2). The chi-squared test for independence between generation choices and generation types (NIFG and IFG) rejects the null hypothesis at the $1\%$ level of statistical significance, meaning that generation choices are dependent on the types of the group they belong. Overall, that the presence of IFG subject significantly influences the choice of sustainable option $B$ in ISDG (Kamijo et al., 2017).

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Next, we present analyses of a neutral icebreaker (I) and its emergence in the generations. 31 out of the 60 generations ($51.66\%$) have a neutral icebreaker (I) (See table 1 as a detail example of coding for neutral icebreakers in deliberative analysis). The inter-rater reliability for the coders is (Kappa $= 0.53$) at $p < 0.01$ for total 60 generation with overall more than $80\%$ agreement among the coders. The total of 60 generations are classified into four groups according to the allocation of IFG subject and the emergence of an icebreaker in the generation. The table 2 summarizes four types of groups that the generations are categorized and their definitions along with the associated choices of options $A$ and $B$.

Table 3 summarizes the composition of subjects' types as "stable," "dependent" and "unstable" per group type. The inter-rater reliability for the coders is Kappa $= 0.44$ at $p < 0.01$ with significant of $1\%$ in the agreement among the coders. It appears that IFG-NI, NIFG-I and IFG-I groups reflect that both a IFG subject and an icebreaker have more "stable" and less "dependent" types compare to the NIFG-NI group. This result implies that more subjects voluntarily express their opinions with logic and reasoning consistently and play more active roles without being followers when their generations have IFG subject and/or an icebreaker. To statistically confirm this tendency, we run the chi-squared test of table 3 to test the difference between NIFG-NI and the other three generations group pairs (IFG-NI, NIFG-I and IFG-I). The result rejects the null hypothesis for the pairs (IFG-NI and IFG-I) ($\chi^2 = 12.866, p < 0.01$ and $\chi^2 = 8.522, p < 0.01$), that the distributions are identical, implying that the presence of IFG subjects and icebreakers influences individual subjects' types in deliberation. We further decompose NIFG Subjects' types per group depending on their support for options $A$ or $B$ (table 4). Table 4 shows that the subject type compositions do not differ between options $A$ and $B$; however, more subject support option $B$ when they are in the IFG-NI, NIFG-I and IFG-I group compare with the NIFG-NI generation group. Overall, tables 3 and 4 suggest that the existence of an icebreaker and/or IFG subject induces NIFG subjects to discuss more actively and coherently state their opinions. Also, it appears that NIFG subjects in generations with IFG subjects and icebreakers are more likely to support option $B$.

The results from qualitative coding of the deliberative arguments are summarized in table 5.

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Table 1: A list of neutral icebreakers' statements in deliberative analysis

| Group[1] | Silence-breaking statements by neutral icebreakers | Type of statements | | |
|---|---|---|---|---|
| | | Clarification of option | Proclaiming the start | Call for opinions |
| TA1 | Options *A* or *B* | ✓ | | |
| TA3 | Well, let's start discussion. | | ✓ | |
| TA4 | Well, what do you think, guys? | | | ✓ |
| TA5 | Which shall we choose? | | | ✓ |
| TB2 | Well, shall decide by majority voting? | | | ✓ |
| TB4 | Shall we start? | | ✓ | |
| TC2 | Well, we have only 10 minutes, so.... | | ✓ | |
| TC3 | So, shall we start with deciding how to divide the group fee or start with which option to choose. | | | ✓ |
| TD3 | Which shall we choose? | | | ✓ |
| TD4 | Well, we can choose either 3600 or 2700. Is it more acceptable to divide equally among us? | ✓ | | ✓ |
| TE3 | Well, I would like to hear about your preferences. How shall we decide? | | | ✓ |
| TE4 | Well, what shall we do? | | | ✓ |
| TF3 | Well, all we have to do is to choose an option. | | ✓ | |
| TF4 | What shall we do? We can choose 1800 or 900. | ✓ | | |
| TF5 | Well, option *A* or *B*.... | ✓ | | |
| TG1 | Well, what shall we do? | | | ✓ |
| TG2 | We have a time constraint. Let's start. | | ✓ | |
| CA1 | Shall we start talking? | | ✓ | |
| CA2 | What shall we do? | | | ✓ |
| CA3 | What shall we do? | | | ✓ |
| CB1 | First of all, we have to choose either option *A* or *B*. | ✓ | | |
| CB3 | Well, which shall we choose? | | ✓ | |
| CB4 | Let's start discussions. | | ✓ | |
| CC2 | What shall we do? | | | ✓ |
| CC3 | We can choose either 1800 or 900. Which shall we choose? | ✓ | | ✓ |
| CC5 | We choose either 0 or a negative group fee. | ✓ | | |
| CD1 | Well, we can choose either option *A* or *B*. Who prefers option *A*? | ✓ | | |
| CD2 | Can we start? | | ✓ | |
| CE1 | What shall we do? | | ✓ | |
| CE4 | Nice to meet you. We choose either 900 or 0. | ✓ | | ✓ |
| CE5 | Well, let's start talking. | | ✓ | |

[1] Groups whose names start with "T" are generations with IFG subject, and generation whose names start with "C" are NIFG subjects. Numbers in group IDs stand for the positions of the groups in a sequence of five generations. For example, "CB3" is a group with NIFG subject in a sequence of "B" at the 3rd generation position of CB1, CB2, CB3, CB4 and CB5. Note that icebreakers are not identified in all groups.

Table 2: Number of generations that choose unsustainable and sustainable options under each group type

| Group type | Unsustainable option $A$ | Sustainable option $B$ | Total |
|---|---|---|---|
| NIFG subject and no neutral icebreaker (NIFG-NI)[1] | 9 | 2 | 11 |
| NIFG subject and a neutral icebreaker (NIFG-I)[2] | 9 | 5 | 14 |
| NIFG-NI & NIFG-I groups | 18 | 7 | 25 |
| IFG subject and no neutral icebreaker (IFG-NI)[3] | 7 | 11 | 18 |
| IFG subject and a neutral icebreaker (IFG-I)[4] | 7 | 10 | 17 |
| IFG-NI & IFG-I groups | 14 | 21 | 35 |
| Total | 32 | 28 | 60 |

[1] : NIFG-NI stands for a group in which there are neither IFG subject nor icebreakers.
[2] : IFG-NI stands for a group in which a IFG subject exists but no neutral icebreakers exist.
[3] : NIFG-I stands for a groups in which no IFG subject exists but a neutral icebreaker exists.
[4] : IFG-I stands for a group in which both IFG subject and at least one neutral icebreaker exist.

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Table 3: Contingency table of NIFG subjects by group type and subject type

| Group | Dependent | Stable | Unstable | Total |
|---|---|---|---|---|
| NIFG-NI [1] | 14 (0.42) | 16 (0.48) | 3 (0.09) | 33 (1.00) |
| IFG-NI [2] | 2 (0.06) | 24 (0.70) | 8 (0.24) | 34 (1.00) |
| NIFG-I [3] | 13 (0.32) | 24 (0.59) | 4 (0.10) | 41 (1.00) |
| IFG-I [4] | 5 (0.15) | 28 (0.82) | 1 (0.03) | 34 (1.00) |
| Total | 23 (0.24) | 92 (0.65) | 16 (0.11) | 142 (1.00) |

Numbers in brackets indicate the corresponding proportions of subject types per group type.

[1] : NIFG-NI stands for a group in which there are neither IFG subject nor icebreakers.

[2] : IFG-NI stands for a group in which a IFG subject exists but no neutral icebreakers exist.

[3] : NIFG-I stands for a groups in which no IFG subject exists but a neutral icebreaker exists.

[4] : IFG-I stands for a group in which both IFG subject and at least one neutral icebreaker exist.

Table 4: Contingency table of final decisions made by NIFG subjects, group types and subject types

| Group | Subjects who finally support $A$ | | | Subjects who finally support $B$ | | | Total |
|---|---|---|---|---|---|---|---|
| | Dependent | Stable | Unstable | Dependent | Stable | Unstable | |
| NIFG-NI [1] | 10 (0.30) | 13 (0.39) | 3 (0.09) | 4 (0.12) | 3 (0.09) | 0 (0.00) | 33 (1.00) |
| IFG-NI [2] | 1 (0.03) | 12 (0.35) | 5 (0.15) | 1 (0.03) | 12 (0.35) | 3 (0.09) | 34 (1.00) |
| NIFG-I [3] | 8 (0.20) | 15 (0.37) | 2 (0.05) | 5 (0.12) | 9 (0.22) | 2 (0.05) | 41 (1.00) |
| IFG-I [4] | 2 (0.06) | 14 (0.41) | 0 (0.00) | 3 (0.09) | 14 (0.41) | 1 (0.03) | 34 (1.00) |
| Total | 21 (0.15) | 54 (0.38) | 10 (0.07) | 12 (0.09) | 38 (0.27) | 6 (0.04) | 142 (1.00) |

Numbers in brackets indicate the corresponding proportions of subject types per generation type.

[1] : NIFG-NI stands for a group in which there are neither IFG subject nor icebreakers.

[2] : IFG-NI stands for a group in which a IFG subject exists but no neutral icebreakers exist.

[3] : NIFG-I stands for a groups in which no IFG subject exists but a neutral icebreaker exists.

[4] : IFG-I stands for a group in which both IFG subject and at least one neutral icebreaker exist.

Table 5: Created categories and concepts

| Category | No. | Concept | Example |
|---|---|---|---|
| Reaction to earlier generation | 1 | Gratitude to earlier generations | The earlier generations kindly considered us. |
| | 2 | Disappointment at earlier generations' decisions | I am disappointed at the earlier generations' decisions. They stick to money for themselves. |
| | 3 | Surprise at earlier generations' decisions | Wow! They chose unsustainable option $A$. |
| Reason not to consider future generations | 4 | Maximization of the current generations' benefit | I cannot find reasons to consider future generations. |
| | 5 | Acceptable disadvantage of future generations | I think there is no problem. They can get at least 900 yen. |
| | 6 | Risk of unsucceeded goodwill | Future generations that choose $A$ may ironically say "thank you" to us. |
| | 7 | Sense of guilt relaxed by earlier generations' decisions | No problem even if we choose $A$. Earlier generations did it too. |
| | 8 | Non-negligible cost of considering future generations | I know it is just 300 yen, but it matters. |
| Reason to consider future generations | 9 | Hope to avoid future generations' disadvantages | I feel terrible for the future generations. |
| | 10 | Maximization of the sum of all generations' benefits | The sum of benefits will be larger if every generation chooses $B$. |
| | 11 | Willingness to succeed goodwill | Let us continue choosing sustainable options and consider future generations. |
| | 12 | Willingness to terminate the chain of badwill | I would like to change the bad chain of choosing $B$. |
| | 13 | Negligible opportunity cost of considering future generations | It is just 300 yen. It does not matter. |
| | 14 | Sense of guilt not to consider future generations | Getting benefit by choosing option $B$ means exploitation of money for future generations. |
| | 15 | Expectation that goodwill will succeed | I expect that if we choose option $B$, future generations will do so. |

Several different concepts have emerged during the deliberation of each generation. A total of 15 concepts are identified and they are classified into three categories: "Reaction to earlier generations," "Reason not to consider future generations" and "Reason to consider future generations." The inter-rater reliability for the coders is Kappa $= 0.47$ and $0.44$ at $p < 0.01$ for all the generation in NIFG and IFG group. The concepts are classified into these three categories and table 5 displays three, five and seven examples in each category, respectively. In total, $83$ and $196$ concepts were identified in NIFG and IFG treatment, respectively. In NIFG group, approximately more than $40\,\%$ concepts are for "Reason not to consider future generations" and in IFG, more than $50\,\%$ concepts support "Reason to consider future generations" wherein both IFG and NIFG groups around $20\,\%$ of the concepts are "Reaction to earlier generations."

The number of different concepts in table 5 that emerge during the deliberation of each generation is summarized in table 7. To statistically confirm these results, we conduct a Mann-Whitney test for the number of concepts that emerge during the deliberation between NIFG and IFG groups. The results show ($Z = 2.9, p < 0.01$), implying that more concepts during deliberation per generation emerge in IFG group. Here, deliberation can be considered more effective and influential when more ideas and concepts are discussed and exchanged within 10 minutes. We can see that the NIFG-NI group mean $= 1.91$ is lower than any other groups (NIFG-I, IFG-NI and IFG-I ) with respect to the number of different concepts discussed during deliberation. This implies that an icebreaker and/or IFG subject increases the variety of concepts discussed in the deliberation. Accordingly, we summarize the deliberation lengths (minutes) by generation type in table 7. Similar to the tendency observed in the number of different concepts, the mean of the deliberation length in the NIFG-NI groups is lower than that in others. Given these results, it appears that the existence of IFG subject and/or an icebreaker in a generation influences the deliberation in the way that it increases the quality and quantity of the discussion contents.

To confirm the results at an individual level, whether the NIFG subjects in the generation with IFG subject and/or icebreakers have a tendency for supporting option $B$, we perform logistic regression. Table 8 shows the results for explaining the final states of the NIFG subjects (i.e.,

Table 6: A list of deliberative analysis for dependent, stable and unstable types of each subject in generation deliberation (P1: Player 1, P2: Player 2, P3: Player 3 under "Status" column)

| Line no. | Status P1 | Status P2 | Status P3 | Player no. | Statement | Memo by the authors |
|---|---|---|---|---|---|---|
| 1 | $\varphi$ | $\varphi$ | $\varphi$ | 3 | I'm assigned as a IFG player, am I not? I'm not sure what to do.... | No voluntary chairs appeared at the opening of the discussion, because the statement does not match the definition of an icebreaker. |
| 2 | | | | 2 | We should discuss about which option to choose. | |
| 3 | | | | 3 | Do you refer to the option described here in this instruction? | |
| 4 | | | | 2 | Right. | |
| 5 | | | | 3 | Well, there are six generations in total based on the instruction. | |
| 6 | $B$ | | | 1 | Then, we need to choose option $B$, don't we? | Player 1 expressed his attitude to support $B$. |
| 7 | | | | 3 | Now, I understand my role to support $B$ just as you do. | |
| 8 | | $A$ | | 2 | I prefer option $A$. | Player 2 expressed her attitude to support $A$. |
| 9 | | | $a$ | 3 | I prefer option $A$. | Following player 2, player 3 expressed his attitude to support $A$. However, not reasons are provided and the status is expressed with lowercase $a$. He refused being a IFG player. |
| 10 | | | | 2 | What shall we do... Listen! Our payoffs would not decrease so much even if we choose $B$. | Player 2 found a logic to support $B$. This statement is coded as "negligible opportunity cost of considering future generations." It is not clear whether player 2 has changed his position. |
| 11 | | | | 3 | I understand.... | |
| 12 | | | | 2 | Yes... | |
| 13 | | | | 1 | That's correct. | |
| 14 | | $B$ | | 2 | So, why don't we choose $B$. | Player 2 has changed his position. |
| 15 | | | $A$ | 3 | It is true that earlier generations kindly choose $B$. But.... | "But..." implies that player 3 supports $A$. So, his status moved to $A$. |
| 16 | | | | 2 | ...because even if we choose $B$, the next generations will again discuss whether to choose $A$ or $B$ | The statement seems to be a reason for the one in line 14. But, the meaning is not very clear. |
| 17 | | | | 3 | Will the final generation forestall the previous ones? | It is coded as "risk of unsucceeded good will." |
| 18 | | $A$ | | 1 | It's not good if they betray us. | Player 2 returned to $A$. It is coded as "risk of unsucceeded good will." |
| 19 | | | | 3 | I understand, but... | |
| 20 | | | | 2 | Choosing $B$ means to allow the next generations to take the greatest benefit, although they are strangers. We do not feel intimacy. | It is coded as "risk of unsucceeded good will." |
| 21 | | | | 3 | Yes. | |
| 22 | | | | 2 | Even if we choose $B$, the next generation will choose $A$. They do not have the next. | |
| 23 | | | | 1 | Well, we dare to choose $B$ in spite of that. | |
| 24 | | | | 3 | You strongly support $B$. Yes, we can get some benefit even if we choose $B$, and... | |
| 25 | | | | 2 | But, we waited one hour for our turn. Also, I have to take train to go home. I am happy with $A$. | It is coded as "maximization of the current generation's benefit." |
| 26 | | | | 3 | I understand your situation. | |
| 27 | | | | 1 | I understand. Yes, we waited for long. | |
| 28 | | | | 2 | Yes, we waited for a long time. | |
| 29 | | | | 3 | If our turn had come early, I would have supported $B$. | |
| 30 | | | | 2 | It is unfair that previous generations can go home earlier and have advantageous options. | |
| 31 | $A$ | | | 1 | Then, shall we choose $A$? | Player 1 expressed his attitude to support $A$. Consistently with line 27, his status is in $A$. |
| 32 | | | | 3 | Yes, let's choose $A$. | Unanimous consent has been reached. |

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Table 7: Number of different concepts in table 5 that emerge in deliberation of each generation and the deliberation length

| Group | Number of different concepts | | Deliberation length (minutes) | |
|---|---|---|---|---|
| | Mean | SD | Mean | SD |
| NIFG-NI [1] | 1.91 | 1.70 | 2.68 | 2.37 |
| IFG-NI [2] | 3.17 | 1.25 | 5.91 | 2.65 |
| NIFG-I [3] | 2.64 | 1.50 | 4.17 | 2.71 |
| IFG-I [4] | 2.82 | 1.38 | 5.80 | 2.72 |
| Overall | 2.72 | 1.46 | 4.88 | 2.86 |

[1] : NIFG-NI stands for a group in which there are neither IFG subject nor icebreakers.

[2] : IFG-NI stands for a group in which a IFG subject exists but no neutral icebreakers exist.

[3] : NIFG-I stands for a groups in which no IFG subject exists but a neutral icebreaker exists.

[4] : IFG-I stands for a group in which both IFG subject and at least one neutral icebreaker exist.

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Table 8: Logistic regression (The dependent variable is a dummy variable taking 1 when an NIFG subject supports $B$. Otherwise 0).

| Independent variable | Coefficient | s.e.[1] | Odds ratio | 95 % CI[2] |
|---|---|---|---|---|
| Previous generation's decision (Reference generation = Unsustainable option) | | | | |
| No previous generation[3] | 0.28 | 0.48 | 1.32 | [0.52-3.39] |
| Sustainable option | 0.73 | 0.44 | 2.08 | [0.88-4.92] |
| Generation type (Reference group = NIFG-NI generation[4] ) | | | | |
| IFG-NI group[5] | 1.02 | 0.57 | 2.77 | [0.91-8.48] |
| NIFG-I group[6] | 0.98 | 0.55 | 2.66 | [0.91-7.83] |
| IFG-I group[7] | 1.22** | 0.56 | 3.39 | [1.13-10.15] |

\*\*significant at 5 % level.

[1] : Standard errors of estimated coefficients

[2] : Confidence interval of odds ratio

[3] : The 1st generation groups do not have previous groups.

[4] : NIFG-NI stands for a group in which there are no IFG subject and no ice-breakers.

[5] : IFG-NI stands for a group in which a IFG subject exists but no neutral icebreakers exist.

[6] : NIFG-I stands for a group in which no IFG subject exists but a neutral icebreakers exists.

[7] : IFG-I stands for a group in which both a IFG subject and at least one neutral icebreaker exist.

"$b$ or $B$" $= 1$ and "$a$ or $A$" $= 0$) in terms of generation type. The reference group is without IFG subject and a neutral icebreaker (NIFG-NI). The results show that in a generation with both (IFG-I) is positively associated with supporting the sustainable option at the $5\,\%$ level of statistical significance and the odds ratio is $3.39$. Being in a group with either IFG subject or a neutral icebreaker (IFG-NI or NIFG-I) is positively associated, and the odds ratios are $2.77$ and $2.66$, respectively. Finally, comparing being in a generation whose previous generation chose the unsustainable option, being in a generation whose previous generation choose the sustainable option is a positive predictor of supporting the sustainable option. Note that this logistic regression analysis is applied to $142$ of the $145$ NIFG subjects because three of the subject's final statuses are not determined from the transcriptions of the discussions due to a lack of information.

Overall, we find that the IFG subject and/or an icebreaker enhances the probability that the

generation supports the sustainable option. First, the positive influence of IFG subject can be reasonably explained in terms of the social pressure for conformity (see, e.g., Santee and Maslach, 1982). In fact, according to table 4, while the percentage of dependent subjects who finally supported $A$ is $30\%$ in NIFG-NI group, the number decreased to $3\%$ in the IFG-NI group. A similar gap of percentages was observed between NIFG-NI and IFG-I groups (i.e., $20\%$ and $6\%$, respectively). It might also be interpreted that the presence of IFG subject successfully alleviates the social pressure to conform to the unsustainable subjects.

On the other hand, the finding that the influence of neutral icebreakers is sustainability-oriented rather than non-neutral is harder to interpret. Some earlier studies aiming at evaluating discourses include respect towards others as a crucial element (Steenbergen et al., 2003, Pedrini, 2015). With this line of research in mind, it is reasonable to consider that the emergence of a neutral icebreaker enhances the quality and quantity of the deliberation, leading to a situation where other members of a generation recognize the importance of thinking about future generations. However, the previous studies do not predict that neutral icebreakers have non-neutral effects. Another possible way of deriving the reason is to focus on the percentage of unstable subjects who finally support the unsustainable option. The percentage in the IFG-I group was $0\%$, while it is $15\%$ in the IFG-NI group. It might be that neutral icebreakers prevent the emergence of people who face a dilemma between the sustainable and unsustainable options and then end with supporting the unsustainable one, at least in the presence of IFG subject. Another experiment with a larger size would determine the reliability of this discussion.

Our research seems to have successfully identified several concepts that might be useful for gaining deeper insights into peoples' behaviors facing the ISD. First, within the study and the practice of social justice, a significant concern is paid to remedying injustices suffered by past generations, which is sometimes called "restorative justice" (Golub et al., 2013). Our concept, "willingness to terminate the chain of bad will," could be useful in understanding the psychological process by which restorative justice works. Second, the present study identifies the concept "risk of unsucceded goodwill" as the hampering factor for choosing the sustainable option. Although the

existence of people with such risk had been predicted by Hauser et al. (2014), the present study seems to be the first to provide empirical evidence of its existence. Hauser et al. (2014) generalize the concept "conditional cooperators" in the intergenerational context. Fischbacher et al. (2001) originally propose this concept to describe if people are willing to contribute more to the public good the more others contribute. Similarly, this research also identifies that the context or perspective is more important in the shadow of the future for individuals to care about the state of the world where they are no longer be living (Pevnitskaya and Ryvkin, 2012).

Third, the present study identifies another concept that refers to in the literature: "Sense of guilt relaxed by earlier generation's decision" and this explanation might be similar with previous findings of guilt aversion that facilitated self-deception (Andreoni and Rao, 2011). The current generation convinces herself that not considering future generations is a morally acceptable action. More specifically, generation's relaxed guilt for exploiting future generations when earlier generations had exploited the generation. In the future, it is important to test the applicability of this concept by checking if statements are observed in the real world or other experimental settings. Fourth, the present study identifies two concepts that are both sides of the same coin: "Non-negligible cost of considering future generations" and "negligible cost of considering future generations." More interestingly, some generations refer to both concepts, suggesting that "reframing" occurs in their generation deliberation. In general, while framing seeks a measure of control over how communication will be perceived by others, reframing consists of a deliberate attempt to alter someone else's frame (Kaufman and Smith, 1999) and the latter is regarded as a promising tool for conflict management. The findings of the present study suggest some possibilities for current generations to decide in favor of future generations. It is essential in the future to characterize the conditions under which the sustainable side of the coin dominates the others in the intergenerational decision-making process.

# 4  Conclusion

This paper has addressed how the intergenerational sustainability dilemma (ISD) can be solved with deliberations and imaginary future generations through a new qualitative-deliberative approach, contributing to two points. First, we find a series of concepts and conditions that emerge as reasons, logic and factors for the current generations to decide between sustainable and unsustainable options. More specifically, the importance of icebreakers in deliberation with imaginary future generations is identified to amplify the quality and quantity of discussions, leading to higher intergenerational sustainability. To the best of our knowledge, this study is the first to demonstrate the importance of IFG subject and icebreakers that facilitate the discussions and interactions with others in a group. Second, this research illustrates how a deliberative analysis can be usefully combined with economic experiments as a new methodology to reveal human behaviors and preferences in collective decision making. Economists have not paid attention to the contents and dynamics of individual motivations, beliefs and assumptions in "collective" economic decisions and suggest a novel approach to clarify such issues.

The present study has several limitations. First, the present study traces the statuses of the subjects only based on their transcribe voices in the group discussions. Thus, the present study inevitably focuses more on their expressed positions than on their actual or authentic ones. It is important to utilize other sources and, more precisely, to grasp the dynamics of the group discussion. Second, there are several dimensions according to which the goodness of deliberation is characterized. The present study considers only a small part of them, such as respect toward the group. We should further consider how/whether other dimensions influence group decisions in the ISD context. Third, although our sample size is not very small, analyses with larger sample sizes could have better identified the effects of icebreakers and IFG subject. We believe these caveats notwithstanding that this work is the first step as an experimental and deliberative study to establish the importance of icebreakers and imaginary future generations for addressing intergenerational sustainability.

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