

What motivates people to conserve marine ecosystem services: a case study in Japan

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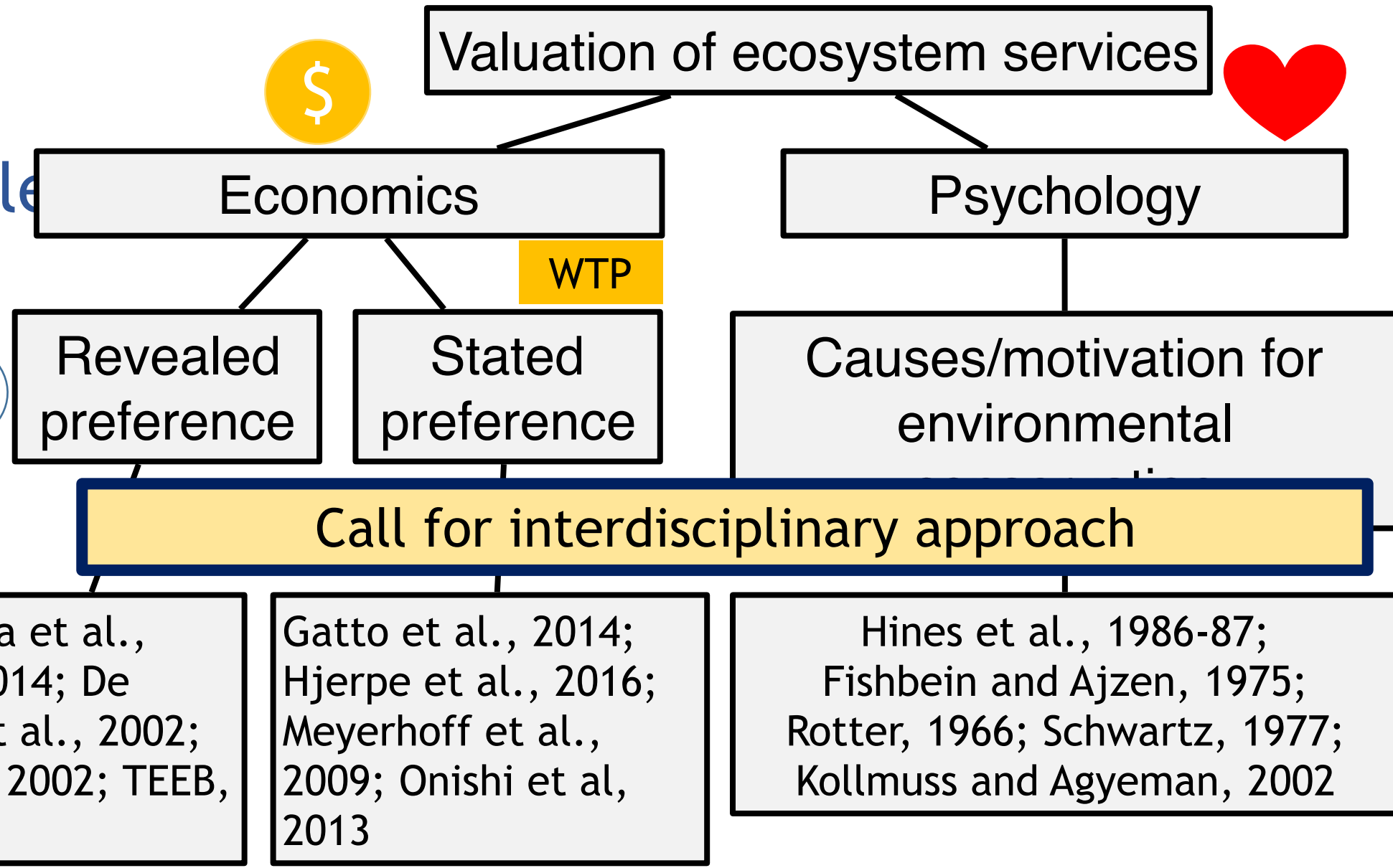
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1. Introduction

Ecosystem services are vital to sustain people's lives

Value of ecosystem services



1. Introduction

Ecosystem
services

critical to
sustain people
live

Valuation of ecosystem services

Economics

Psychology

Objective: To explore the relationships between people's willingness to pay (WTP) to conserve marine ecosystem services and their preferences.

Costanza et al.,
1997, 2014; De
Groot et al., 2002;
Loomis, 2002; TEEB,
2010

Gatto et al., 2014;
Hjerpe et al., 2016;
Meyerhoff et al.,
2009; Onishi et al,
2013

Hines et al., 1986-87;
Fishbein and Ajzen, 1975;
Rotter, 1966; Schwartz, 1977;
Kollmuss and Agyeman, 2002

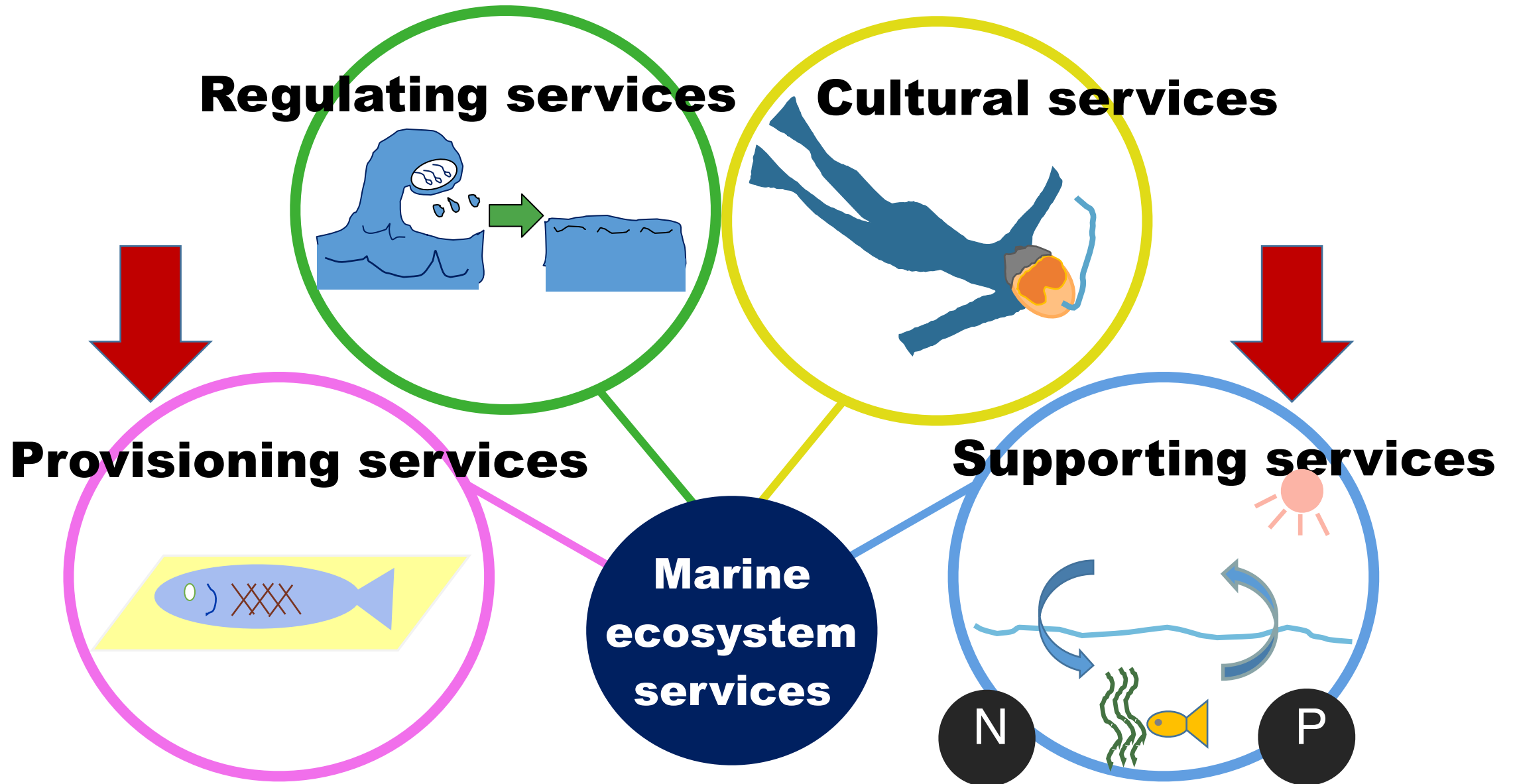
2. Materials and methods

- ◆ A self-explanatory web-based questionnaire
- ◆ Date: November 2016
- ◆ Responses: 946 individuals from all 47 prefectures in Japan
- ◆ Age: 20-69 years old

Responses were stratified in accordance with the age and sex demographics of each prefecture, based on data from population of Japan in 2015.

Age	Scenario for 10-y later	
	Male	Female
20-29	76	74
30-39	86	95
40-49	100	111
50-59	87	97
60-69	100	120
sub total	449	497
Total	946	

Four categories of Ecosystem Services



**Respondents are provided a future scenario: 10-y
later**

**Marine ecosystem services (MES) to prevent
degradation**

Fisheries resources (FR)

**Ability to absorb CO₂
(CO₂)**

Visible

Close to daily lives

Invisible

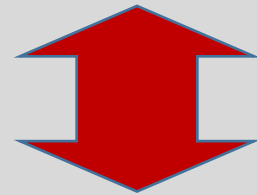
Far from daily lives

Two distinct services

Structure of questionnaire

Part 1: Marginal willingness to pay (MWTP) for conserving marine ecosystem services

★Scenario: 10 years later



relations

Part 2: Preferences of individuals

★10 indexes regarding public spirit, connection with others, etc.

10 indexes of preferences

Index	Meaning
PUB	public spirit/willingness to contribute to society which includes trust in others
CONNECT-HUMAN	connection with other people
ENV	consciousness for environmental conservation
REC	love for marine recreation
FISH	love for eating fish
CONNECT-NON-HUMAN	connection to non-human, i.e., belief in invisible objects such as spirits and god-like powers
INT	Internality (degree of controlling one's life)
EXT	externality (ex. fate, circumstances, etc.)
SCIENCE	support for theory of global warming caused by increase of carbon dioxide
FORECAST	support for future forecast of increase of carbon dioxide

} LOC (Locus of control)

Developed scores of 10 indexes through factor analysis and based on psychology and environmental economics.

Web-based questionnaire

Conjoint analysis

Part 1

Estimate MWTP for
conservation of marine ecosystem

Economics

Cluster analysis

Group the respondents in line with the MWTP estimated

Detected differences of preferences among groups
based on degree of positive and negative for 10
indexes

Part 2

Analyze preferences by each group

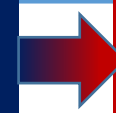
Psychology

3. Results and discussion

MWTP in 2016 Japanese yen/year for 1% prevention of degradation of marine ecosystem services

Variable	JPY/year
Preventing decrease of fisheries resources (FR)	17.1
Preventing increase of CO ₂ in the atmosphere	32.1

- MWTP for CO₂ is larger than that for fisheries resources.



- People put more value on CO₂ than fisheries resources -> value on invisible marine ecosystem services?

MWTP per each group for 1% prevention of degradation of MES

degradation of MES					Strong WTP	Positive payers
Free riders					Group	
Variable	A	B	C	D	E	F
FR (JPY/year)	No WTP	-5.4	17.0	9.9	47.4	-
CO ₂ (JPY/year)	No WTP	3.1	-6.6	30.6	90.1	-
Number of respondents	180	127	195	84	252	108
Total	946				11%	
19 %						

Judgment of each preference index for each cluster

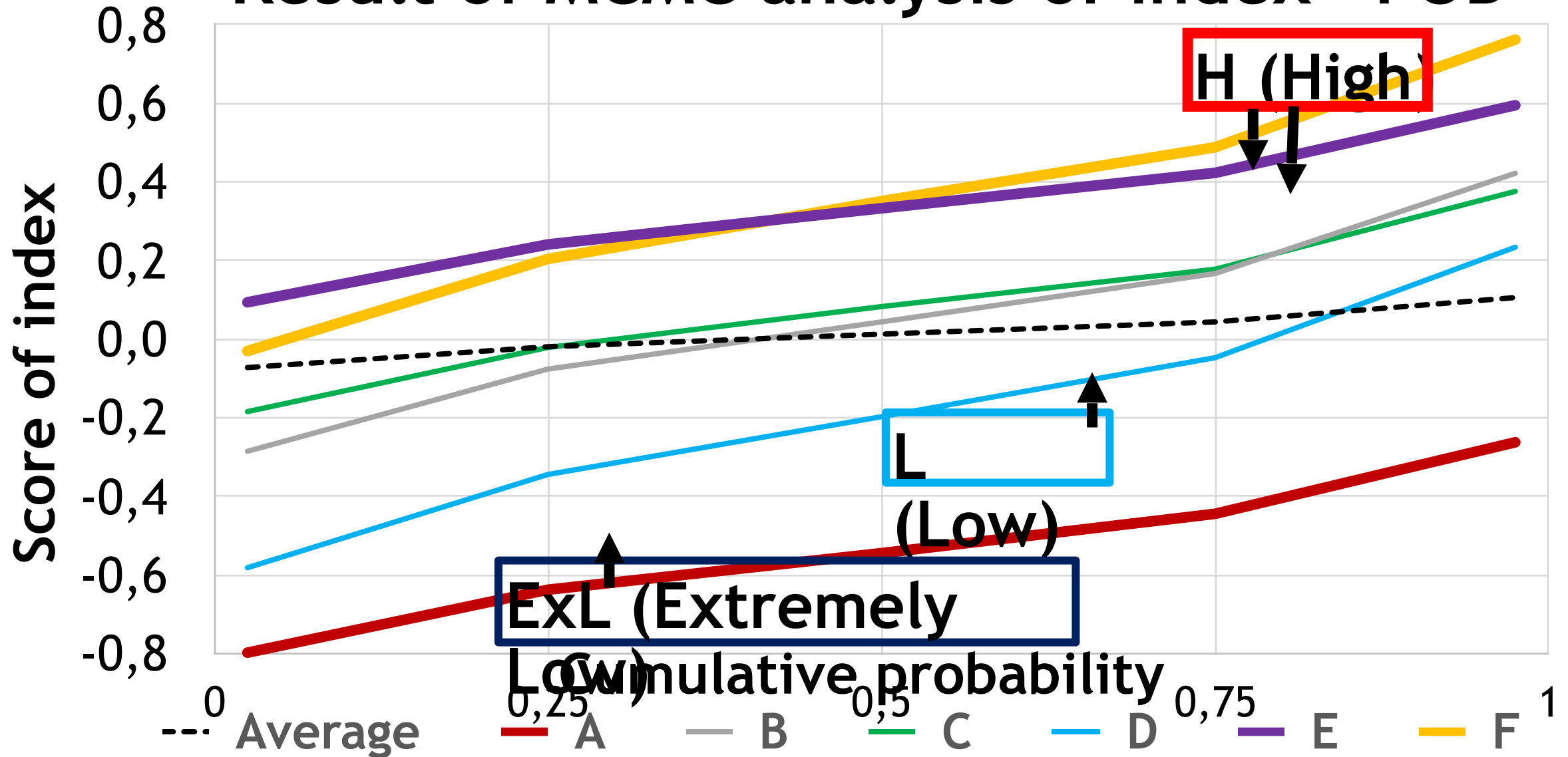
Index cluster	A	B	C	D	E	F
PUB						
CONNECT-HUMAN						
ENV						
REC						
FISH						
CONNECT-NON-HUMAN						
INT						
EXT						
SCIENCE						
FORECAST						
WTP for FR (JPY)	No	-5.4	17.0	9.9	47.4	-
WTP for CO ₂ (JPY)	WTP	3.1	-6.6	30.6	90.1	-

ExL

L

H

Result of MCMC analysis of index "PUB"



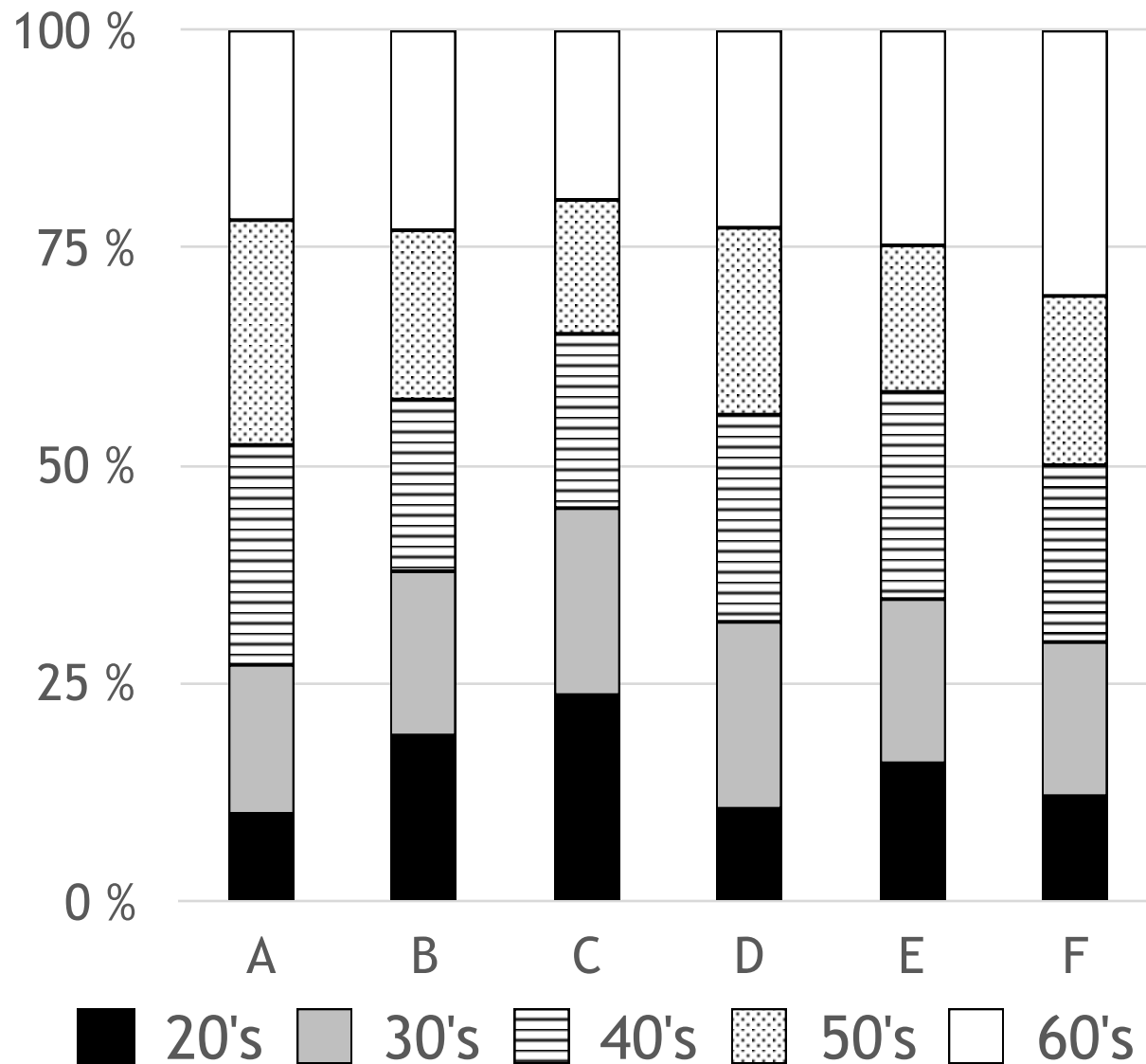
Judgment of each preference index for each

Index	Free riders	A	B	C	D	E	F	Strong WTP
PUB		ExL			L	H	H	
CONNECT-HUMAN		L				H	H	Positive payers
ENV		L		L		H	H	
REC		L		H	L			
FISH		L			L	H	H	
CONNECT-NON-HUMAN		L		H		H		
INT		H		L		H		
EXT				H				
SCIENCE				L				
FORECAST							H	
WTP for FR (JPY)	No	-5.4	17.0	9.9	47.4	-		
WTP for CO ₂ (JPY)	WTP	3.1	-6.6	30.6	90.1	-		

4. Summary and recommendation

- The group of positive payers to conserve marine ecosystem services has high public spirit, strong preferences to connect with other people.
- The group with strong WTP has high public spirit, strong preferences to connect with both humans and non-humans (invisible).
- The group of free riders with no WTP has extremely poor public spirit and little connection with both humans and non-humans.
- The authors would recommend that politicians and social leaders understand and stress the importance of making connections with others and nurturing public spirit if they want to enhance people's contributions to conserving marine ecosystem services in the long term.

Thank you.



Age composition of each cluster for 10 years later

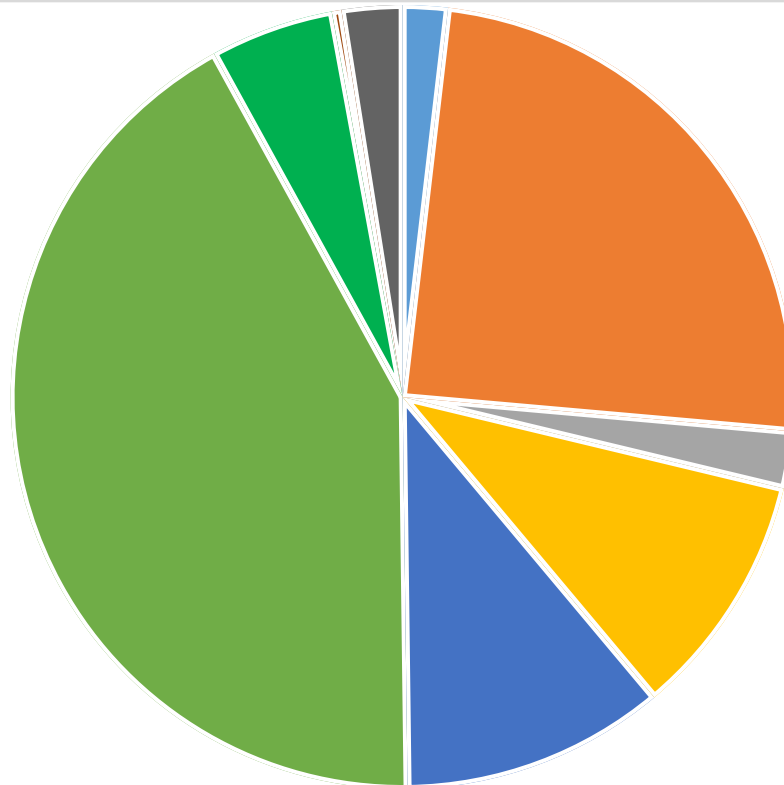
Kruskal-Wallis test

Significant differences of median age among clusters

$\chi^2 (5, N = 946) = 14.57, p = .012$

Cf: Not significant differences regarding age and income

Education



- | | | | |
|----------|--------|--------------|-------------|
| ● 中学校 | ● 高等学校 | ● 高等専門学校（高専） | ● 各種学校・専修学校 |
| ● 短期大学 | ● 大学 | ● 大学院 | ● その他 |
| ● 答えたくない | | | |

Index “CONNECT-NON-HUMAN”

Assume that you are in a following situation:
While you are walking, you happen to come to a shrine or a temple. How much money are you going to throw into an offertory box? Note that you do not visit the shrine or the temple in order to pray for specific objectives.

Answer: JPY to an offertory



Index “CONNECT-HUMAN” and “ENV”

CONNECT-HUMAN

- 1 I have interests in volunteering.
- 2 I tend to participate in events held in my community or school.

ENV

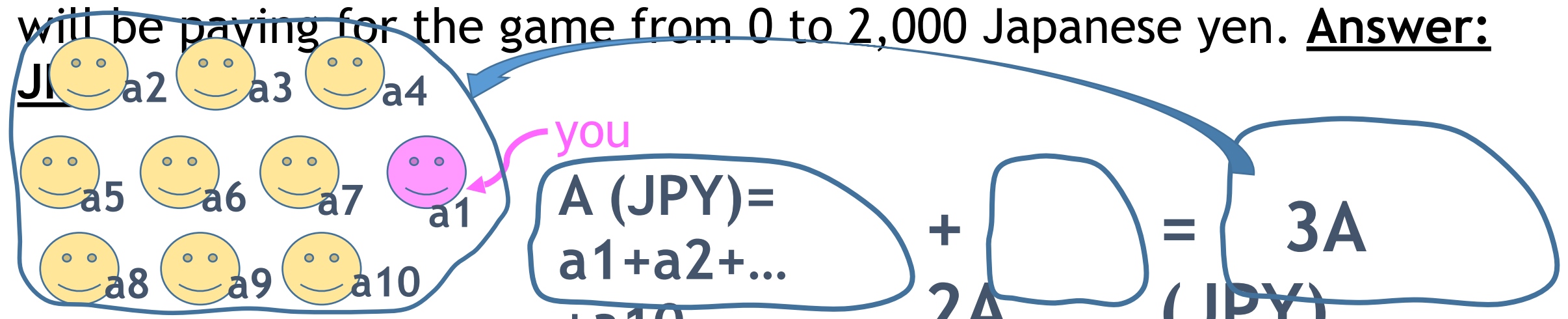
- 1 I think we human beings sustain our lives owing to nature's bounty.
- 2 I think whole society should reconsider importance of natural environment.
- 3 I think we should try to make better choices to reduce waste when buying goods.



1. Strongly agree
2. Agree
3. Neither
4. Disagree
5. Strongly disagree

Index “PUB”

Assume that you and nine other people living in your town are gathered. The nine people may not be your acquaintances. The ten people, including you, are joining the following game. All ten participants are requested to pay some amount of money, ranging from 0 to 2,000 Japanese yen, at your own will. All of the money paid by the participants is gathered, and twice the amount gathered will be added by an organizer of the game. Then, the money in total is equally provided to all the participants, divided up evenly among the ten participants. How much are you going to pay? Please write down exact amount of money that you will be paying for the game from 0 to 2,000 Japanese yen. Answer:



2. Materials and methods (5)

Questionnaire items in the second part and 10 indexes representing characters of individuals

questionnaire items	index	meaning of index
1* Assume that you and nine other people living in your town are gathered. The nine people may not be your acquaintances. The ten people, including you, are joining the following game. All ten participants are requested to pay some amount of money, ranging from 0 to 2,000 Japanese yen, at your own will. All of the money paid by the participants is gathered, and twice the amount gathered will be added by an organizer of the game. Then, the money in total is equally provided to all the participants, divided up evenly among the ten participants. How much are you going to pay? Please write down exact amount of money that you will be paying for the game from 0 to 2,000 Japanese yen	PUB	public spirit or willingness to contribute to society which includes trust in others

2. Materials and methods (6)

Questionnaire items in the second part and 10 indexes representing characters of individuals

questionnaire items		index	meaning of index
2	I have interests in volunteering.	CONNECT-HUMAN	connection with other people
3	I tend to participate in events held in my community or school.		
4	I think we human beings sustain our lives owing to nature's bounty.	ENV	consciousness for environmental conservation
5	I think whole society should reconsider importance of natural environment.		
6	I think we should try to make better choices to reduce waste when buying goods.		
7	I love clam digging.	REC	love for marine recreation
8	I love sea bathing.		
9	I love marine sports, such as surfing, body-board, snorkeling, and diving.		

2. Materials and methods (7)

Questionnaire items in the second part and 10 indexes representing characters of individuals

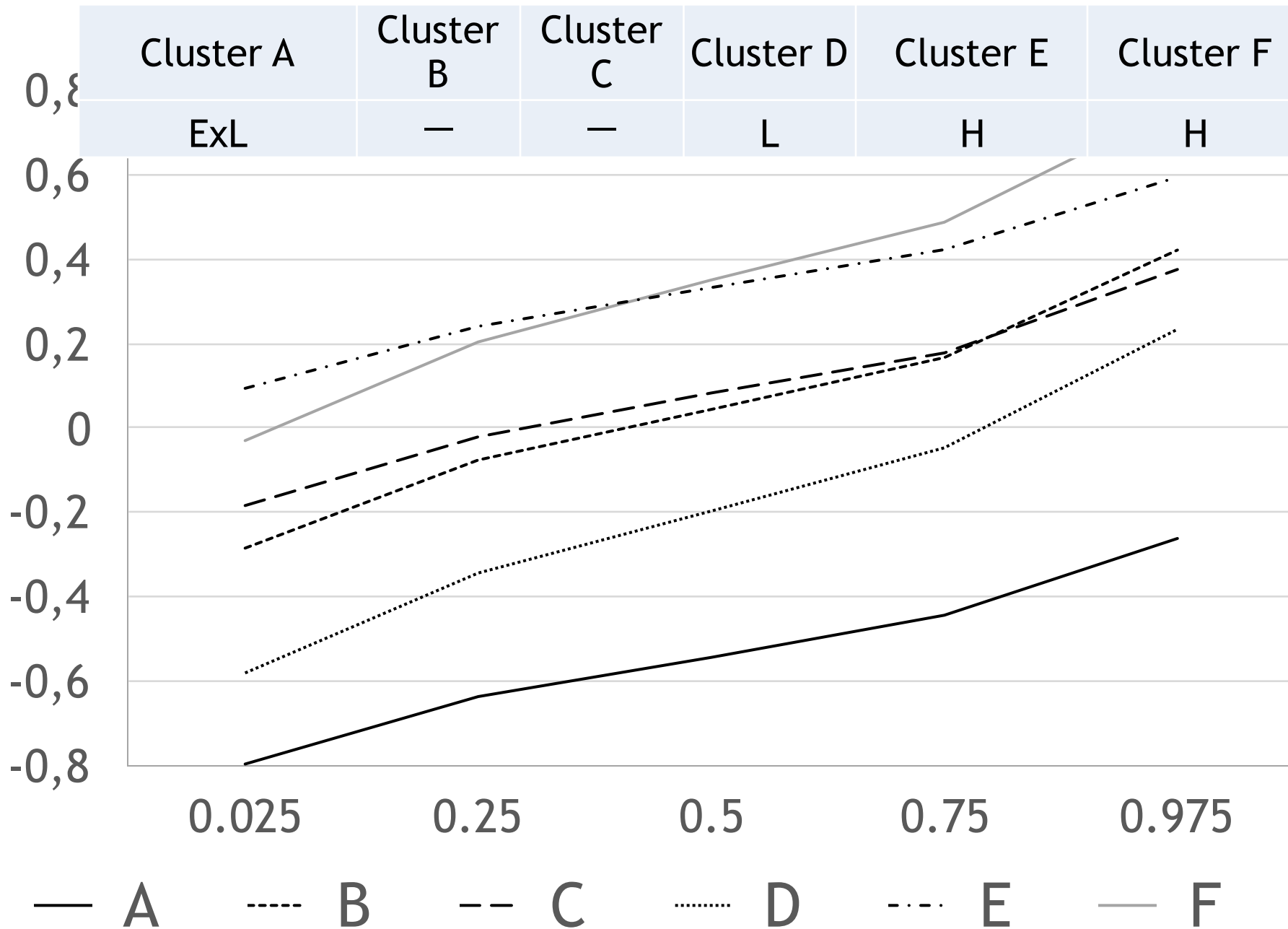
questionnaire items		index	meaning of index
10	I often eat fish.	FISH	love for eating fish
11	I love seafood.		
12	I think fish is essential for my diet.		
13*	Assume that you are in a following situation: While you are walking, you happen to come to a shrine or a temple. How much money are you going to throw into an offertory box? Note that you do not visit the shrine or the temple in order to pray for specific objectives.	CONNECT- N O N HUMAN	connection to non-human, i.e., belief in invisible objects such as spirits and god-like powers
14	I think my life is determined by myself.	INT	internality
15	I think decision by myself get good results in most cases.		
16	I think whether being happy or not depends on my effort.		

2. Materials and methods (8)

Questionnaire items in the second part and 10 indexes representing characters of individuals

questionnaire items		index	meaning of index
17	I think my life is determined by my fate.	EXT	externality
18	I think what happens to my life is determined by my surroundings.		
19	I think my future depends on luck and chance.		
20	I believe that increase of carbon dioxide in the atmosphere is one of the major causes of accelerating global warming.	SCIENCE	support for theory of global warming caused by increase of carbon dioxide
21	I believe that carbon dioxide in the atmosphere will increase in line with future forecast.	FORECAST	support for future forecast of increase of carbon dioxide

MCMCによる性格分析の例 (PUB)



2. Materials and methods (5)

Part 1

Estimate of MWTP for conserving marine ecosystem services

Suppose that international societies including Japan establish an “International fund for conserving marine ecosystem services” to achieve two respective targets below and that international societies develop and implement “International collaborative project for conserving marine ecosystem services”.

Target 1: Preventing decrease of fisheries resources internationally (FR)

Target 2: Preventing increase of carbon dioxide by maintaining function of its absorption by ocean (CO₂)

2. Materials and methods (6)

Attribute and level of conjoint profile

Attribute	Scenario and Level	
	10-y later	100-y later
Decrease of fisheries resources (FR) (%)	100 93 86	100 47 22
Increase of CO ₂ (CO ₂)	1.00 1.025 1.05	1.00 1.28 1.65
Tax to pay (JPY)	500 3,000 5,000	500 3,000 5,000

2. Materials and methods (7)

Example of a choice set

	A	B	C	D
Target 1: FR (%)	Level 1 (100%)	Level 3 (22%)	Level 2 (47%)	Neither
Target 2: CO ₂	Level 2 (1.28)	Level 2 (1.28)	Level 3 (1.65)	
Tax to pay (JPY)	3,000	500	3,000	

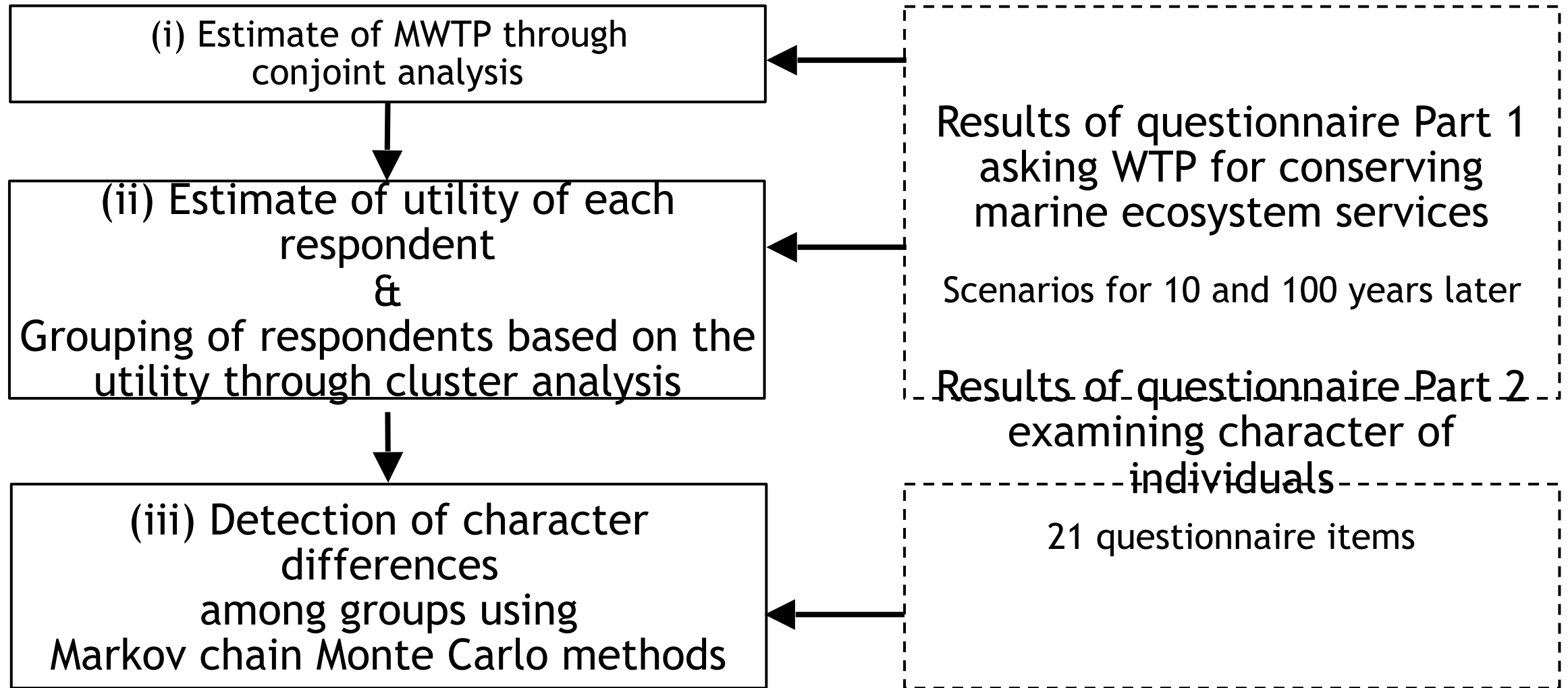


Fig. 1: Overall structure of this study