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CITATION:

Uchida, Yukiko ...[et al]. Farming cultivates a community-level shared culture through collective activities: Examining contextual effects with multilevel analyses.. Journal of Personality and Social Psychology 2019, 116(1): 1-14

ISSUE DATE:

2019-01

URL:

http://hdl.handle.net/2433/234964

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Running Title: Farming cultivates a community-level shared culture

Keywords: culture, farming, collective activities, socio-ecological environment, multilevel analysis

Classification: Major: Social Science, Minor; Psychological and Cognitive Science

JPSP Attitudes and Social Cognition: "*Innovations in Social Psychology*"

Acknowledgement

The part of this manuscript has been previously presented at the 23rd International Congress of International Association for Cross-Cultural Psychology in August 2016 entitled with “farming cultivates a shared culture within a community: Examining the macro-level effects with multilevel analysis in farming and fishing areas.”

This research was supported by The Uehiro Foundation on Ethics and Education, The Tokyo Fisheries Promotion Foundation, JSPS KAKENHI (Grant Number 26380842), and the JST-RISTEX project on ‘Designing a sustainable society through intergenerational co-creation’. We thank Krishna Savani, Pamela Taylor, Kongmeng Liew for their helpful comments on earlier versions of this manuscript.

Abstract:

It has been suggested that the well-known cultural differences in interdependence across cultures are linked to economic activities, such as farming. However, the underlying processes of how such psychological tendencies are shared among people in a society has not been sufficiently investigated. This paper addresses the multilevel processes on how psychological characteristics are shared among people. We focus on collective activities that go beyond the individual's personal economic activities. Multilevel analyses on a large-scale survey (residents of Japanese communities, N = 7,295) of 408 communities, along with a follow-up survey (N = 1,714) of 86 communities, suggested that 'concern for reputation' (one aspect of interdependence) was more prevalent in farming communities than in non-farming communities, not only for farmers but also for non-farmers. Furthermore, multilevel mediational analyses suggested that, (1) the proportion of farmers in a community was positively associated with participation in collective activities (e.g. maintenance of community infrastructure) conducted not only by farmers but also non-farmers, and (2) this is in turn associated with increased levels of concern for reputation at the community level. Community-level longitudinal analyses revealed that collective activities promoted residents' concern for reputation about two years later. These findings support our 'collective activity' hypothesis, and demonstrate that interdependence can be constructed through social interactions via community activities. Fishing was associated with high levels of self-esteem and risk avoidance, and these effects exerted only at the individual level. We conclude that economic activities affect social interaction, which in turn affects the multilevel processes of culture emergence.

Farming cultivates a community-level shared culture through collective activities: Examining contextual effects with multilevel analyses

Socio-economic and ecological factors have been shown to shape psychological and behavioral functions in ways that are adaptive for survival in a given environment. For example, it has been suggested that farming labor affords collective decision making, while herding labor affords independent decision-making processes (see Berry, 1967; Nisbett & Cohen, 1996; Uskul, Kitayama, & Nisbett, 2008; Uskul & Over, 2014). However, the precise mechanisms and extent to which psychological and behavioral functions are constructed and shared, within specific cultural contexts, remains unclear.

One of the basic assumptions of cultural psychology—which strives to understand cultural divergence (differences across cultures) as well as convergence (similarities within cultures) in human psychology (Kashima, 2014; Senzaki, Masuda, & Ishii, 2014)—is that members of a society share psychological and behavioral functions through participation in everyday routines and customs that are required or are afforded by their ecological conditions. While studies in this field have so far focused primarily on documenting how different psychological characteristics are fostered between cultures, it is also imperative to illustrate the process of how psychological characteristics are formed and shared via social activities. Evidence for the latter, however, is limited to a few longitudinal studies on cultural learning processes (for a review, see Kashima, 2014). As such, the present research aims to fill the gap in this literature by investigating how socio-economic and ecological factors, both at the individual level and

community level, influence the sharing of culturally specific psychological characteristics among people.

Cultural differences explained by socio-economic and socio-ecological factors

Accumulating evidence shows that psychological and behavioral functions differ across cultures, and research has emerged to explain the roots of such differences (Henrich, Heine, & Norenzayan, 2010). Cross-cultural studies in psychology have shown that interdependence and a holistic thinking style are prevalent in East Asian cultures, while independence and an analytic thinking style are prevalent in North American/European American cultures (Markus & Kitayama, 1991; Nisbett, Peng, Choi, & Norenzayan, 2001). Of the several causal explanations that have been offered (such as pathogen prevalence, suggested by Fincher et al., 2008, or culture-gene co-evolution, as shown in Chiao and Blizinsky, 2010), the impact of socio-economic/ecological factors has been one of the stronger hypotheses for explaining these cultural differences. Furthermore, recent evidence has suggested that rice-based agriculture promotes interdependence, whereas wheat-based agriculture and herding promote independence (Talhelm et al., 2014; Uskul et al., 2008; Uskul & Over, 2014). Uskul et al. (2008) recruited people from rural Turkish villages who identified farming, fishing, or herding as their primary source of income. Participants undertook various tasks to examine their cultural attention styles (analytic vs. holistic), and results suggest that farmers tend to have more holistic attention styles as compared to their herder counterparts. Uskul and colleagues (Over & Uskul, 2014, 2016; Uskul et al., 2008) also suggested that even family members in farming areas (e.g. wives and children of farmers), who did not actively engage in farming, also showed related psychological tendencies, such as holistic cognition. However, they did not examine if this tendency generalized to the entire community as a whole (i.e. inclusion of non-farmers in a farming area).

How do community-level ecological and economic characteristics shape psychological functions?

While the specific underlying mechanisms of cultural convergence have not been adequately documented, prior research has provided suggestive findings on the prevalence of shared psychological characteristics among people of a similar cultural context.

Talhelm et al. (2014) examined whether economic characteristics foster psychological tendencies through a comparison of "residents" from rice-cropping or wheat-cropping communities in China. They recruited over 1000 university students, who had grown up in either rice-growing or wheat-growing areas in China, and examined their interdependence and holistic attention styles. The results suggest that participants who grew up in paddy rice-growing areas were more likely to be interdependent and have a holistic attention style than those who grew up in wheat-growing areas. This effect persisted even after controlling for climate, modernization, and pathogen prevalence. According to the authors, rice-cropping fosters interdependence because it requires significant amounts of water and labor (e.g., maintaining irrigation systems), which requires large scale cooperation within the community. Given that the study was conducted on university students, who were not likely to be active farmers, these results also suggest that a personal engagement in agriculture might not be necessary for acquiring farming-related psychological characteristics.

This finding raises significant questions for empirical investigation: how do non-farmer residents acquire the psychological tendencies afforded by the economic culture without personally engaging in these farming activities? Correspondingly, do active participants in farming activities (i.e. farmers) acquire such ecologically-fostered cultural ideas more strongly

than non-farmer residents, who live in the same community but do not engage in such activities? Research has yet to directly examine how community-level ecological and economic conditions shape socio-cultural ideas and characteristics across individuals in a community. In order to answer these questions, we argue that it is necessary to compare farmers with non-farmers who reside in farming areas.

Collective activity hypothesis

To understand the mechanisms of emerging interdependence at the community level, we propose the '*collective activity'* hypothesis: we predict that the frequency and prevalence of collective activities in farming (especially rice-cropping) plays an important role in fostering interdependence.

The collective activity hypothesis can be explained through the concept of large-scale activities that create shared norms within a given socio-economic/ecological environment. Here, collective activities refer to collaborative projects involving multiple members from a community, and these include projects of both economic and non-economic natures. For example, in farming communities, especially in Japan, where rice-farming is prevalent, both farmers and non-farmers need to work together to protect large-scale public resources and infrastructure, such as irrigation systems, that require continuous maintenance (Hara & Kumagai, 2008; Hasegawa, 1969; Talhelm et al., 2014). Additionally, as these activities require cooperative behavior and coordination among members, it is important to develop a trust-based system within the community (social capital; Pretty, 2003). In building and maintaining social capital among community members, collective activities of above-mentioned economic (protection and maintenance of resources and

infrastructure, Mace et al., 2018), and non-economic (e.g., ceremonies/festivals) natures, are both shown to be important (Fukushima et al., 2011). In fact, census data in Japan suggests that over 80% of farming communities in Japan regularly hold meetings to plan community festivals (Ministry of Agriculture, Forestry and Fisheries of Japan, 2015). To maintain cooperative relationships for such collective activities that involve large numbers of community members, reputation systems are used to monitor and sanction free-riders and deviators within members of a community (e.g., Dunbar, Duncan, & Marriott, 1997; Milinski, Semmann, & Krambeck, 2002). These conditions may motivate members to avoid gaining a negative reputation and to thus concern themselves with their perceived reputation from other members in the community (which forms one aspect of interdependence; Hashimoto & Yamagishi, 2013; Nisbett & Masuda, 2003; Uskul et al., 2008). In short, the collective activity hypothesis proposes that (1) the repeated interactions that occur while participating in collective activities could provide opportunities for people to form large-scale shared norms and reputation systems that govern these activities and related psychological functions, and (2) psychological functions typical of these types of cooperation that involve large numbers of people, such as concern for reputation, become prevalent within that community.

By contrast, other areas, such as urban or fishing communities, might have less collective activities within community members, although fishing communities may still have more collective activities compared to urban areas due to established traditional rituals. However, given that fishers work mainly on their ships, they are more likely to be distanced from non-fishers in communities. Furthermore, there is also less of a need for large-scale collective activities (e.g., irrigation maintenance in farming) than in farming communities. Indeed, studies on farmers and fishers (e.g., Takemura & Uchida, 2015) have suggested that collective activities are more

prevalent among professional farmers than professional fishers. Compared to other economic occupations, farming, especially wet (paddy) rice-crop farming, the dominant cultivation method in Japan, requires more collective labor for supporting infrastructure, such as irrigation system maintenance, as suggested by Talhelm et al. (2014).

Additional hypothesis on psychological tendencies associated with fishing

In addition to our main hypothesis, we also examined a hypothesis on the psychological functions associated with fishing (separate from community-level shared characteristics). Fishing may promote psychological tendencies that are independent from collective activities, but are relevant to the demands of their occupation. That is, high levels of self-esteem and risk avoidance orientation. Fishing involves severe competition as it relies on gathering limited resources (i.e. fish) from openly shared areas (e.g. the sea) (Carpenter & Seki, 2011). High self-esteem is functional for survival in such highly competitive and uncertain circumstances as it drives individuals to take on a challenge and helps them avoid missing out on opportunities (Falk et al., 2009; Johnson & Fowler, 2011). At the same time, fishers need to be careful to avoid mistakes, as their work environment (the sea) can be dangerous. For example, in Japan in 2010, the number of accidents per thousand workers was at 0.44 for agriculture and 2.32 for fishery (calculated based on data reported by Japan Industrial Safety and Health Associate in 2014, and Ministry of Agriculture, Forestry and Fisheries of Japan in 2014). In line with these statistics, ethnographic research on Japanese fisheries has suggested that fishing is associated with high levels of risks, and fishers are careful to take the necessary precautions. For example, some fishing communities have a custom that siblings work on different boats to hedge their risk of accidents so that they can rush to help each other in the event of an accident (Kawashima, 2015). Thus, to protect

themselves from the dangers of the sea, fishers need to be attentive and to avoid mistakes, which require a high orientation towards risk avoidance. The current study examined if such psychological functions (higher self-esteem and risk avoidance) were predominantly found in people who are engaged in fishing.

We also predicted that aquaculture (farming of fish and other aquatic organisms under controlled conditions, as opposed to fishing wild fish) will not be linked to high self-esteem or risk avoidance orientation since aquaculture farms are often attached to the shoreline and aquaculturalists are not likely to face the same risky, uncertain, or competitive situations that regular fishers may.

The present research

To separately examine both macro-level effects (e.g. effects of living in farming areas) and individual-level effects (e.g. effects of personally engaging in farming), we conducted a series of large-scale surveys and analyzed data through multilevel modelling.

Following the collective activity hypothesis, we predicted that (H1) farming communities promote tendencies of concern for reputation for all residents, regardless of one's own occupation, such that even non-farmers in farming communities are more likely to show concern for reputation than those in non-farming communities, as a contextual effect (e.g. Christ et al., 2014). We also predicted that (H2) the effect of farming on community-level concern for reputation can be mediated by community members' (including non-farmers) level of participation in collective activities in the community, thereby constructing 'farming community cultures.' This model is shown in Figure 1.

We also predicted that (H3) self-esteem and risk avoidance orientation were higher among fishers (non-aquaculturalists) than the others. We expected these effects of fishing to be found only at the individual level, and independent from collective activities.

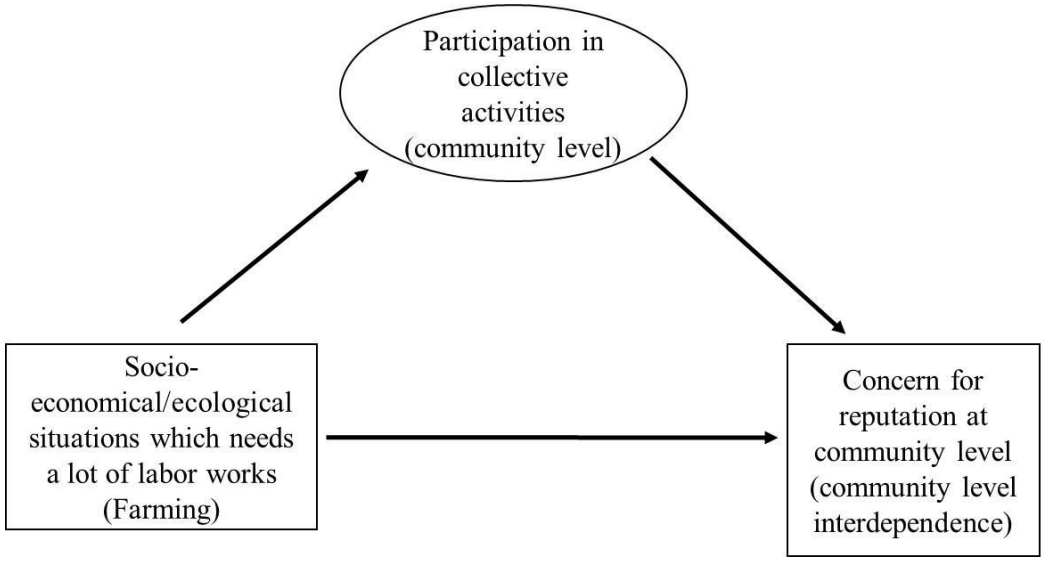


Figure 1. Theory of collective activity hypothesis to promote interdependence through farming

Our analysis is based on two large-scale surveys conducted in the western regions of Japan. These surveys included an item to measure concern for reputation. We also had items which measured self-esteem and risk avoidance orientation in Study 1. In Study 1, we sampled 412 communities from farming areas (including both farmers and non-farmers), fishing areas (including both fishers and non-fishers), and urban areas and had 7,295 respondents in total (see Figure 2 for the geographical distribution of the communities from which these samples were drawn). We applied multilevel modelling to examine if community-level factors (e.g., proportion of farmers) had effects on psychological tendencies above and beyond individual-level factors (e.g., being a farmer). If community-level factors possessed such 'contextual effects' (e.g., Christ et al., 2014), that would suggest the existence of a 'shared community-level culture' (i.e. concern

for reputation as a shared tendency in farming communities, not only among farmers but also non-farmers). We also examined collective activities as a mediating process on the effect of community-level factors on psychological functions. The collection of data from farming, fishing, and urban communities also enabled us to investigate boundary conditions that may affect the propensity towards cultural sharing at the community-level.

In Study 2, we conducted a follow-up survey involving 87 communities from the areas surveyed in Study 1 (1,714 respondents in total). This allowed us to replicate the pattern of results found in Study 1, and examine the robustness of our findings on the collective activity hypothesis in farming areas. It also provided an opportunity for conducting additional longitudinal analyses to examine 'causal effects'. The time difference between the two studies was approximately 1 year 10 months. We predicted that the longitudinal analysis from Study 2 should observe a quasi-causal mechanism, where rates of participation in community-level collective activities at Time 1 (from Study 1) should predict community-level tendencies toward concern for reputation at Time 2 (from Study 2), but not vice versa.

Study 1

Methods

Sampling

In order to examine our hypotheses, we conducted a large-scale survey in the western regions of Japan, and sampled communities from farming, fishing, and urban communities. West Japan is diverse in terms of industry, and has many farming and fishery zones. The farming areas

are mostly comprised of rice fields (72.6%; based on the Statistics Bureau Ministry of Internal Affairs and Communications of Japan, 2014), and fishery is through three oceanic fishing zones (northern, southern, and central, i.e., within the Seto Inland Sea). We collected data from both farmers and non-farmers in farming communities, as well as fishers and non-fishers in fishing communities, and conducted multilevel analyses to disentangle individual-level effects (occupation: farmers/fishers/neither) and community-level effects (proportion of farmers and fishers). All participants resided in Japan, and thus, shared common country-level factors (e.g. law, language).

The sample size was determined based on Maas and Hox's (2005) estimation of sufficient sample sizes for a multilevel analysis. Using a simulation of sample sizes, they suggested that the level-2 sample size (in our data, "communities") should not be less than 50. They also found that the level-1 sample size (in our data, "individuals") has a smaller effect on the accuracy of the estimates than the level-2 sample size. As such, we tried to include over 50 communities for our level-2 data. Because our level-2 samples (communities) were comprised of three main categories—farming communities, fishing communities, and other communities—we determined that each category's level-2 sample size should exceed 50[1], meaning that at least 150 communities would be needed. Furthermore, based on the wide variety of regional differences (i.e., province, oceanic fishing zones), we decided to conduct the survey over as broad a region as possible. Based on our funding, we set our limit at around 400 samples at level-2.

Level-2 sample selections: within our target area of western Japan, we found 60,808 eligible communities.[2] To sample communities,[3] we stratified them along two dimensions: geographical region (seven regional blocks), and type of community (farming, fishing, urban, mixed, or others). Firstly, geographical stratification was to secure sufficient variation in the

sample communities. Based on climatic division, which affected the type of farming and fishing conducted within a community, we categorized the eligible communities into seven regional blocks. Secondly, we stratified the communities based on the following three factors: 1) percentage of farmers in the community, 2) percentage of fishers in the community, and 3) population density (data was obtained from the Population Census of Japan, 2010). We defined 'farming communities' as communities that had a relatively high percentage of farmers (≥ 25%), 'fishing communities' as those that had a relatively high percentage of fishers (≥ 25%),[4] and 'urban communities' as those with a high population density (≥ 4,000 persons/km^2). Note that these three types of communities were not mutually exclusive. For example, there were communities with both a high percentage of farmers and a high population density. We designated communities that met the criteria for at least two of the above three classifications as 'mixed communities'. Communities that did not meet any of the criteria were categorized as 'other'.

Based on these stratifications, we sampled 412 communities, comprising a total of 42,804 households (see Figure 2 for geographical locations of the sampled communities), using the method described below.

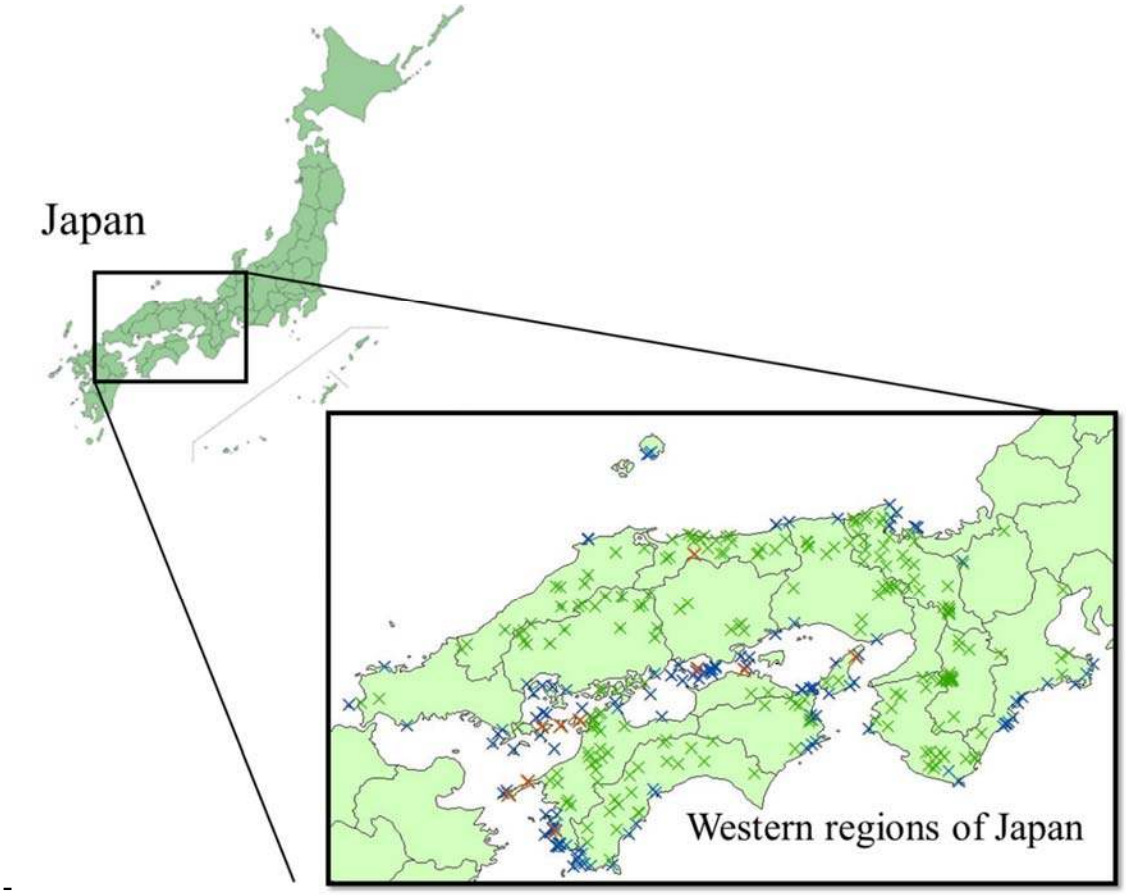


Figure 2. Geographical locations of the sampled farming and fishing communities.

Farming communities (in which at least 25% of the residents are farmers) are represented by green 'X's, fishing communities (in which at least 25% of the residents are fishers) are represented by blue 'X's, and communities meeting both criteria (i.e. communities in which the population is both ≥ 25% farmers and ≥ 25% fishers) are represented by brown 'X's.

First, we decided to include all the mixed communities due to their small numbers in sample pool (20 communities). From the remaining communities, we then sampled each type of community (farming, fishing, urban, and other) equally from the seven geographical blocks. This resulted in a selection of 30 farming and 30 fishing communities from each of the seven regional blocks.[5] As the number of fishing communities was relatively small in our target area, the final

sampling in each block varied from 6 to 32. We also sampled five to six urban communities, as well as five areas designated as 'other', from each of the seven regional blocks. The number of sampled communities varied across the types of community because the number of households varied (generally, the number of households was greater in urban/other communities than in farming/fishing communities).

We mailed our survey to all households in the sample communities and received 7,364 responses (7,295 valid responses[6]) from 408 communities (response rate at the community-level: 99%). Response rate at the individual-level varied across communities (see Supplemental material, Table S1 for analyses controlling for response rate), ranging from 3% to 75% (M = 22%, SD = 11%). The number of valid responses was 3,132; 1,917; and 1,324; for the farming, fishing, and urban communities, respectively.

The study received approval from the Institutional Review Board at Kyoto University. The questionnaire included a statement of consent, and return of the completed questionnaire was considered as providing consent to participate. All information provided by participants was anonymous, except for the zip code of their community, which had been printed on the questionnaires prior to distribution.

Measures

The survey was conducted as a part of large-scale survey on Japanese communities, and contained several items that measured participants' psychological tendencies, daily emotional experiences, and social relationships in their communities. In order to identify farmers and fishers, we asked participants to indicate their occupation (multiple answers were allowed). We classified

those who chose ‘agriculture’ as their occupation as ‘farmers’, and those who chose ‘fishery’ or ‘work in fishery-related professions in the community’ as ‘fishers’. This included a number of respondents who also engaged in side jobs other than farming or fishing in these categories of farmers and fishers (54.4% of farmers and 42.2% of fishers reported having side jobs). From this, we identified 2,160 farmers, 559 fishers (78 were farmer-fishers), and 4,654 individuals who identified as neither. We further divided fishers into two sub-groups based on the type of fishery: 99 individuals were categorized as aquaculturalists (fishers engaged in the farming of fish, shrimp, shellfish, and aquatic vegetation under controlled conditions) who had specified ‘inland water culture’ and/or ‘sea culture’ as the type of fishery. This distinction was made because aquaculturalists acquire resources from controlled areas, rather than in the hunter-gatherer conditions characteristic of oceanic fishery. The remaining 460 fishers were categorized as ‘fishers’. See Tables 1-3 for further information on sample characteristics.

Table 1: Sample characteristics (Studies 1 & 2)

	Study 1			Study 2		
	M	**(*SD*)**	**Prop**	***M***	**(*SD*)**	**Prop**
Concern for reputation	3.46	(0.69)		2.34	(0.98)	
Self-esteem	3.35	(0.82)				
Risk avoidance	3.13	(1.00)				
Male			55.5%			54.8%
Age	65.19	(13.24)		62.92	(15.30)	
Household size	2.88	(1.59)		3.05	(1.65)	
Years in community (50 years or longer)			42.7%			37.2%
Equivalent income (million yen)	2.52	(1.76)				
Unemployed			13.4%			13.5%
Collective activities[a]	2.27	(1.45)		1.88	(1.49)	

[a] A composite index reflecting participation in collective activities (ranging from 0 to 6): 1) community events (e.g., local festivals), 2) disaster-prevention group activities, 3) activities of age cohort association (e.g., senior club, youth organisation), 4) men's/women's group activities, 5) labor to maintain public assets and common infrastructure (e.g., rivers, canals), and 6) assisting during ceremonial occasions.

Table 2:

Sample characteristics as a function of personal profession (Studies 1 & 2)

		Study 1			Study 2	
		Farmers[a]	Fishers[a]	Neither	Farmers	Non-Farmers
Sample size		2,160	559	4,654	506	1,208
Gender	Female	505	113	2,246	153	569
	Male	1,556	405	2,147	324	552
	No response	99	41	261	29	87
Age	30s or younger	0.8%	1.4%	5.8%	2.0%	10.8%
	40s	3.4%	6.1%	8.4%	3.4%	9.6%
	50s	12.6%	13.1%	17.4%	15.2%	15.2%
	60s	35.3%	31.5%	29.7%	33.6%	27.6%
	70s	28.9%	30.8%	23.3%	27.3%	21.4%
	80s or older	15.2%	10.9%	10.9%	13.8%	8.9%
	No response	3.8%	6.3%	4.5%	4.7%	6.5%
Type of farming[bc]	Rice	62.3%			81.5%	
	Vegetables	30.9%			34.8%	
	Fruit	31.7%			8.4%	
	Other crops (e.g., wheat, flowers)	21.9%			28.6%	
Type of fishing[bc]	Coastal fishing		66.3%			
	Offshore fishery or distant fishery		16.4%			
	Aquaculture[d]		19.1%			
	Others		16.6%			
Years in community (50 years or longer)[c]		68.5%	61.3%	32.0%	62.2%	26.5%
At least a fourth-generation resident[c]		63.1%	49.6%	28.5%	—	—

Note: [a] The farmer and fisher categories are not mutually exclusive. Seventy-eight respondents were farmer-fishers. [b] Categories are not mutually exclusive. [c] The percentages were calculated after excluding missing values. [d] This included aquafarming, the farming of fish, shrimp, shellfish, and plants under controlled conditions.

Table 3: Professions of non-farmers in farming communities and non-fishers in fishing communities (Studies 1 & 2)

		Study 1		Study 2
		Non-farmers in farming communities[a]	**Non-fishers in fishing communities[a]**	**Non-farmers in farming communities**
Sample size		1,363	1,405	296
Profession [bc]	Retired or unemployed	50.0%	49.7%	43.5%
	Homemaker	11.8%	14.9%	21.4%
	Self-employed	10.3%	11.0%	9.8%
	Employed at a company or public office	17.4%	12.6%	17.0%

Note: [a] Categories are not mutually exclusive. [b] Categories are not mutually exclusive. [c] The percentages were calculated after excluding missing values.

To measure concern for reputation, we included one item from an established interdependence scale in the field of cross-cultural psychological studies, that shows sizable cross-cultural difference between Japanese and European Americans (Park & Kitayama, 2012; Park, Uchida, & Kitayama, 2015; Takata, Omoto & Seike, 1996) (only one item was used due to the space limitations of the large-scale survey). The item is very similar to items in the 'rejection avoidance' scale (an aspect of interdependence, Hashimoto & Yamagishi, 2013), and assesses interdependent concern for reputation (we modified it to fit the context of the neighborhood: '*I am concerned about what my neighbors think of me*').[7] In order to ensure this measurement of concern for reputation was robustly related to interdependence, we conducted a validation check (see Supplemental materials; Validation study, and Tables S2, S3).

To measure self-esteem, we used two items from the Rosenberg self-esteem scale (Rosenberg, 1965; translated into Japanese by Heine et al., 1999; e.g. '*On the whole, I am satisfied with myself*,' $r = .50$, $p < 0.001$). Finally, to measure risk avoidance orientation (tendency to avoid negative outcomes, Elliot, 1999), we included one item from the Behavioral Inhibition System

scale (‘*I worry about making mistakes.*’) (Carver & White, 1994; translated into Japanese by Kamide & Daibo, 2005). For all items on the questionnaire, response options were on 5-point scales, with options ranging from 1 (strongly disagree) to 5 (strongly agree).

To measure participation in collective activities within the local community, we asked respondents to indicate what activities they usually participated in. The list was diverse, and included activities not directly related to farming or fishing. Specifically, respondents reported whether or not they usually participated in 1) community events (e.g. local festivals), 2) disaster-prevention group activities, 3) hobby-related activities, 4) activities of age cohort associations (e.g. senior club, youth organization), 5) men’s/women’s group activities, 6) activities of professional associations, 7) maintenance work on public facilities (e.g. rivers, canals), 8) assisting during ceremonial occasions, and 9) others.

Results

We first performed single-level (individual-level) regression analyses to examine whether the expected associations between activities of an economic nature (farming and fishing) and psychological functions (concern for reputation, self-esteem, and risk avoidance) were observed. Basic demographic factors (gender, age, household size, years in community, household income, employment status) were included as covariates. Consistent with the findings of previous studies (e.g., Berry, 1967; Talhelm et al., 2014), farming was positively associated with concern for reputation ($b = 0.15$, $p < .001$). Also, as expected, non-aquaculture fishing was associated with higher self-esteem ($b = 0.12$, $p = .011$) and higher risk avoidance ($b = 0.14$, p

= .023)[8]. We then utilized multilevel modelling to examine if these associations remained at the individual level and/or the community level.

Table 4 shows the results of a series of multilevel analyses conducted in Study 1. For all analyses, the individual-level formed the Level 1 unit of analysis and the community-level formed the Level 2 unit of analysis. Data on the proportion of farmers in a community, and population density (an index of the urbanization of the given area), as community-level (Level 2) predictors, were obtained from the Population Census of Japan (2010). Data on the other variables were obtained from our survey (see Tables 1-3 for descriptive statistics). The analyses revealed that concern for reputation was significantly higher ($p < 0.01$) for people in farming communities than it was for people in non-farming communities (i.e. concern for reputation was the effect of community-level profession prevalence). In addition, this community-level effect was above and beyond the corresponding individual-level effect (i.e., contextual effect of farming was significant, $p = 0.005$)[9]. These results were obtained independently from population density: an index of urbanization (urban vs. rural) for each area. Thus, H1 was supported.

Table4: Psychological functions analysed by multilevel models for effects of farming and fishing with control variables (Studies 1 & 2)

	Study 1									Study 2		
	Concern for reputation			Self-esteem			Risk avoidance			Concern for reputation		
	b	(*SE*)	*p*	*b*	(*SE*)	*p*	*b*	(*SE*)	*p*	*b*	(*SE*)	*p*
Individual-level predictors												
Gender	0.01	(0.03)	0.848	0.04	(0.03)	0.188	-0.04	(0.03)	0.228	0.01	(0.07)	0.940
Age	0.00	(0.00)	0.704	**0.01**	**(0.00)**	**< 0.001**	**-0.01**	**(0.00)**	**< 0.001**	0.00	(0.00)	0.654
Household size	0.01	(0.01)	0.204	**0.03**	**(0.01)**	**< 0.001**	0.00	(0.01)	0.733	0.00	(0.02)	0.809
Years in community	0.03	(0.04)	0.485	0.03	(0.03)	0.359	**0.11**	**(0.04)**	**0.004**	0.12	(0.07)	0.096
Equivalent income	-0.01	(0.01)	0.303	**0.09**	**(0.01)**	**< 0.001**	**-0.03**	**(0.01)**	**0.004**	—	—	—
Unemployed	0.06	(0.04)	0.122	**-0.14**	**(0.04)**	**< 0.001**	**-0.10**	**(0.04)**	**0.022**	-0.13	(0.07)	0.051
Farming	0.06	(0.04)	0.151	0.02	(0.03)	0.490	-0.02	(0.04)	0.582	-0.01	(0.07)	0.850
Fishing	—	—	—	—	—	—	—	—	—	-0.14	(0.21)	0.498
Aquaculture	-0.05	(0.12)	0.700	0.11	(0.09)	0.208	0.07	(0.14)	0.591	—	—	—
Non-aquaculture fishing	-0.03	(0.06)	0.597	**0.15**	**(0.06)**	**0.022**	**0.18**	**(0.07)**	**0.011**	—	—	—
Community-level predictors												
Population density	**-0.02**	**(0.01)**	**< 0.001**	0.01	(0.01)	0.243	**-0.01**	**(0.01)**	**0.038**	—	—	—
Ratio of farmers	**0.34**	**(0.09)**	**< 0.001**	0.12	(0.09)	0.163	0.02	(0.09)	0.877	**0.80**	**(0.19)**	**< 0.001**
Ratio of fishers	—	—	—	—	—	—	—	—	—	0.22	(0.24)	0.352
Ratio of aquaculturalists	-0.18	(0.21)	0.390	-0.06	(0.18)	0.729	0.32	(0.25)	0.204	—	—	—
Ratio of non-aquaculturalist fishers	0.00	(0.12)	0.987	0.07	(0.10)	0.453	-0.01	(0.12)	0.937	—	—	—
Contextual effects												
Farming	**0.28**	**(0.10)**	**0.005**	0.10	(0.10)	0.298	0.04	(0.10)	0.701	**0.81**	**(0.20)**	**< 0.001**
Fishing	—	—	—	—	—	—	—	—	—	0.36	(0.37)	0.331
Aquaculture	-0.14	(0.24)	0.571	-0.18	(0.22)	0.421	0.24	(0.28)	0.380	—	—	—
Non-aquaculture fishing	0.03	(0.14)	0.818	-0.07	(0.11)	0.518	-0.19	(0.14)	0.166	—	—	—
Model fit and summary												
Sample size	5648			5483			5449			1476		
Deviance	15584.618			13048.834			15463.642			4064.638		

Note: estimation method: maximum likelihood with robust standard error. All individual-level predictors were centred around the community mean, while all community-level predictors were centred around the grand mean. Effects with $p < .05$ appear in bold print. The following predictors were dummy-coded: Farming (ref = not engaged in farming), Fishing (ref = not engaged in fishing), Aquaculture (ref = not engaged in aquaculture fishing), Non-aquaculture fishing (ref = not engaged in non-aquaculture fishing), Gender (ref = female), Years in community (ref = less than 50 years), Unemployed (ref = employed). Equivalent income (unit = million yen) was household income divided by the square root of household size. Though fishers were divided into two categories (aquaculturalist and non-aquaculturalist) in Study 1, we used a single category "fishing" in Study 2, as the number of fishers in the sample was small, and there were only five aquaculturalist fishers. Population density (unit = 1000 people per square kilometre) was not put into the model in Study 2, as the number of communities was small and multicollinearity occurred in the model.

Fishers (non-aquaculturalists) showed both higher self-esteem (p = 0.022) and a more risk avoidance-oriented motivation style (p = 0.011) than the non-fisher groups at the individual-level. However, at the community-level, fishing communities did not differ from other communities on either self-esteem or risk avoidance (p > 0.05). Aquaculture did not have effects on psychological tendencies at either the individual-level or community-level (see Supplemental materials, Tables S4a and S4b for Pearson's r [effect size], at both the individual and community level; Table S5a shows descriptive statistics of the key variables for each category). Thus, H3 was supported.

We expected that participation in collective activities (e.g. irrigation system maintenance work, local festivals) would mediate the effect of farming on concern for reputation at the community level (H2). If a given area is more 'farming-oriented' (i.e. has a lot of farmers), that would require several collective activities to maintain the agricultural infrastructure and economic system, as well as other activities to sustain social capital among community members. These activities should promote a tendency towards concern for reputation in residents, regardless of their individual professions.

We first performed an exploratory factor analysis on the eight activity items to investigate convergence among activities at the community level. The scree test suggested one factor, which accounted for 22.4% of the variance. Six items had factor loadings greater than .32 (Tabachnick & Fidell, 2007) on the same factor (Table 5). We created a composite index reflecting participation in collective activities by totalizing them (ranging from 0 to 6, α = 0.66). This index was correlated with farming (r = .37, p < 0.001) but not with aquaculture (r = -.04, *ns*) or non-aquaculture fishing (r = -.01, *ns*) at the community level. To examine the effects of collective

activities on concern for reputation at the community-level, we conducted a multilevel mediation analysis.

Table 5: Community-level factor analysis of participation rates for collective activities (Studies 1 & 2)

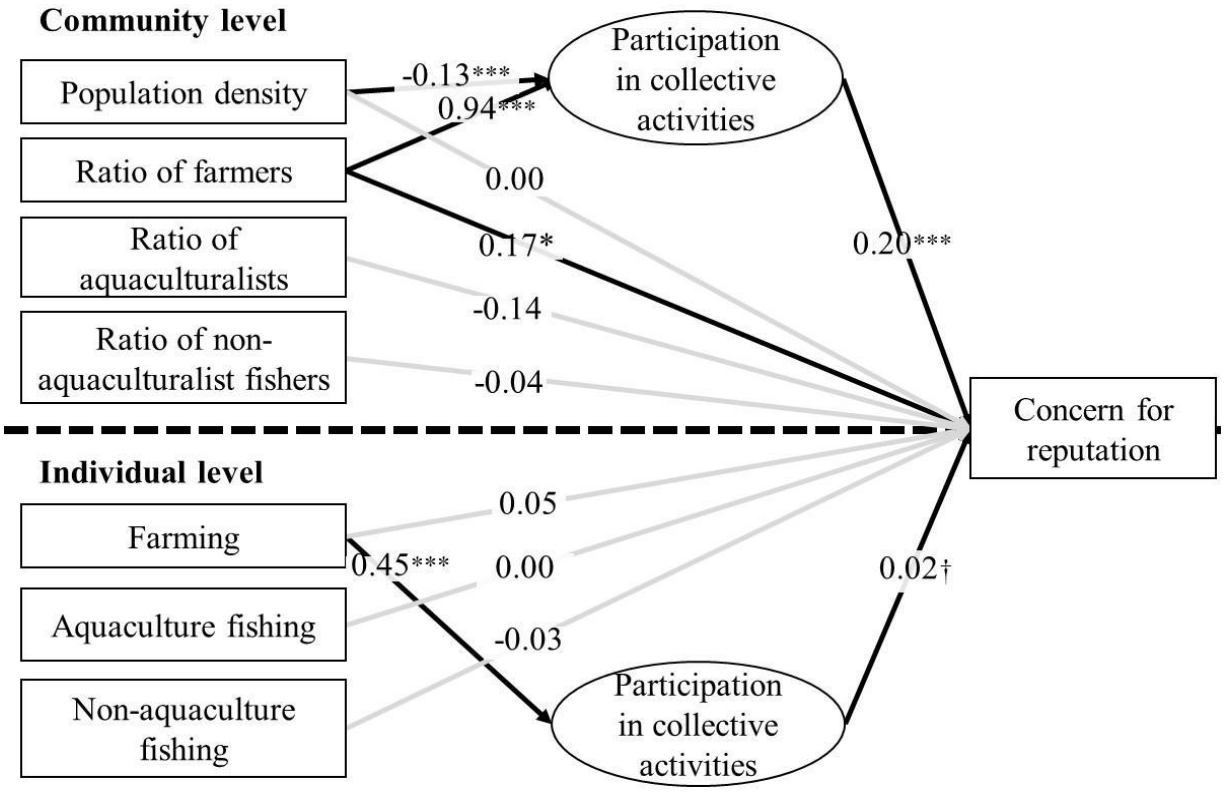
	Factor Loading	
	Study 1	Study 2
Community events (e.g., local festivals)	**.655**	**.757**
Disaster-prevention group activities	**.349**	**.556**
Hobby-related activities	.263	.219
Activities of age cohort associations (e.g., senior club, youth organization)	**.549**	**.359**
Men's/women's group activities	**.495**	**.469**
Activities of professional associations	.309	.247
Maintenance work on public facilities (e.g., rivers, canals)	**.431**	**.729**
Assisting during ceremonial occasions	**.587**	**.763**

Note: estimation method: maximum-likelihood. Factor loadings .32 or greater are shown in bold.

A multilevel mediation analysis (Preacher, Zyphur, & Zhang, 2010) was performed. As none of the individual-level covariates (e.g., gender) had significant effects on concern for reputation (Table 4) and they lowered model fit in our multilevel mediation analysis, we removed them from the model. The final model (Figure 3) fit the data well, CFI > 0.99, RMSEA < 0.01. At the individual level, the indirect effect of farming on concern for reputation through participation in collective activities was marginally significant ($b = 0.01$, $p = 0.069$), suggesting that farmers were more likely than non-farmers to participate in collective activities, and in turn, show greater levels of concern for reputation. In addition to this individual-level effect, participation in collective activities at the community level also had a mediating effect (indirect effect: $b = 0.18$, $p < 0.001$). All contextual effects were significant for farming on participation in collective activities ($b = 0.49$, $p = 0.003$) and for participation in collective activities on concern for reputation ($b = 0.18$, $p < 0.001$), and the indirect effect ($b = 0.18$, $p < 0.001$). Thus, H2 was supported.

Taken together, the results suggest that 1) the prevalence of farmers in a community was associated with increased participation in collective activities not only of farmers but also of non-farmers, and 2) increased participation in collective activities in a community was linked to higher concern for reputation among residents in the community. All in all, these findings support our '*collective activity*' hypothesis.

Figure 3. Multilevel mediation analysis (Study 1). Unstandardised coefficients are shown. All the individual-



level predictors were centred on the community mean. All the community-level predictors were centred on the grand mean. The mediator, participation in collective activities, was centred on the grand mean, and then decomposed into the two levels as latent variables. Black arrows indicate effects with $p < .05$, grey arrows indicate effects that were not significant. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

Study 2

Building on the results of Study 1, we conducted Study 2 to examine the robustness of our findings from Study 1. Furthermore, as the substantial time difference between data collection for Studies 1 and 2 allowed us to conduct a longitudinal analysis at the community level, we also examined the causal mechanisms behind the effects of collective activities on residents' concern for reputation. We predicted that participation rates in collective activities at Time 1 (from Study 1) should predict community-level tendencies toward concern for reputation at Time 2 (from Study 2), but not vice versa.

Methods

Sample

We conducted a survey on a subset of 87 communities (7,188 households in total), from the original sample used in Study 1. Study 2 was conducted in December 2014, while Study 1 was conducted in January/February 2013; there was a time difference of approximately 1 year 10 months between the two rounds of surveys. Despite collecting data from the same regional areas as Study 1, individual responses could not be tracked as all responses were anonymous.

We mailed our survey to all households in the sample communities and received 1,714 responses from individuals in 1,251 households across 86 communities (response rate at the community-level: 99%). Unlike Study 1, we mailed two survey questionnaires per household. Response rate at the household level varied across communities, ranging from 3% to 48% (M = 23%, SD = 10%) (in some households, two individuals provided responses). Among the 86 communities, 46 were farming communities (i.e. at least 25% of residents were farmers). The

number of responses was 622 and 513 for farming and urban communities respectively. In Study 2, as there were only five aquaculturalist fishers, we decided not to divide them into two groups (i.e. aquaculturalist fishers and non-aquaculturalist fishers). The study received approval from the Institutional Review Board at Kyoto University. The questionnaire included a statement of consent, and return of the completed questionnaire was considered as consent to participate. All information provided by the participants was anonymous, except for the zip code of their community, which had been printed on the questionnaires prior to distribution.

Measures

As in Study 1, participants were asked to indicate their occupation, and 506 farmers were identified. See Tables 1-3 for more information on sample characteristics.

We included the same concern for reputation item as in Study 1: '*I am concerned about what my neighbors think of me.*' Responses were made on a 5-point scale, with options ranging from 1 (strongly disagree) to 5 (strongly agree). We also measured the degree to which respondents participated in their local community's collective activities using the same options as in Study 1. Unlike Study 1, participants were not asked to provide details on their household income.

Results

In Study 2, we conducted a multilevel analysis with concern for reputation as the outcome variable. However, some households provided responses from two individuals. Thus, the data was analyzed as three-level data (Level 1 = individual, Level 2 = household, Level 3 = community),

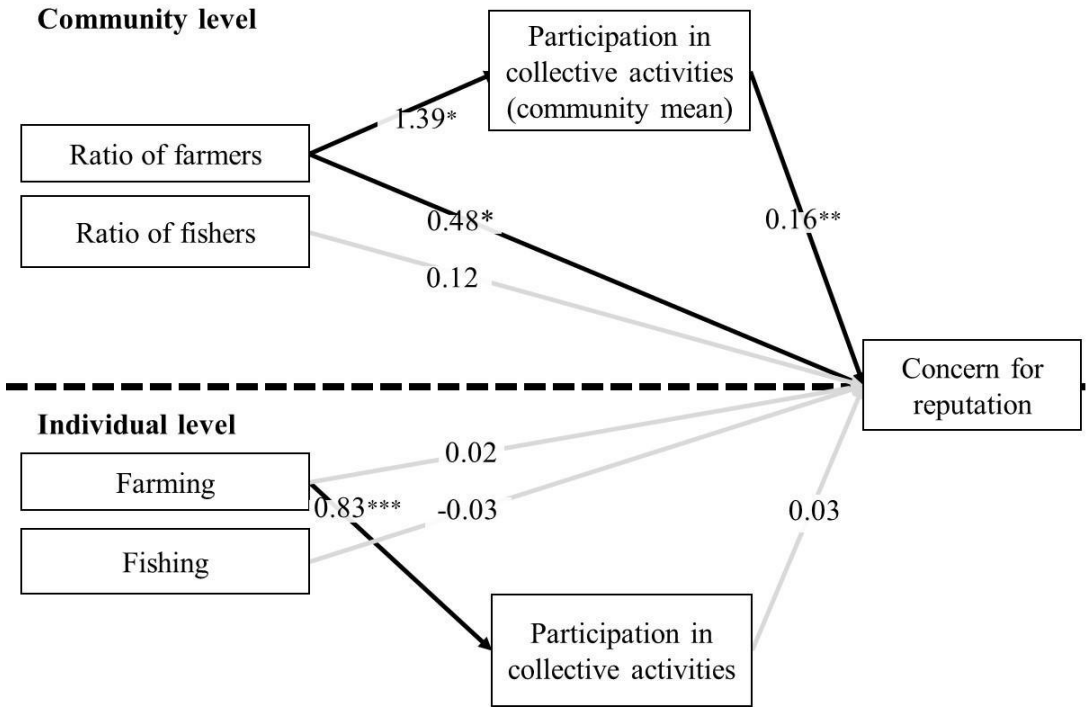
with random intercepts at the household level and community level. However, only individual-level and community-level predictors were included in the model, as in Study 1. Data on the proportions of farmers and fishers in a community were obtained from the Population Census of Japan (2010). Data on the other variables were obtained from our survey results (see Table 1-3 for summary statistics). Although we divided fishers into two subgroups (aquaculturalists and non-aquaculturalist fishers) in Study 1, the 'fishing' category in Study 2 referred to a combination of both subgroups, as fishing was not as prevalent in the target areas of Study 2, and the number of fishers was relatively small ($N = 73$).

Table 4 shows the results of the analysis. The effect of farming on concern for reputation at the individual level was not significant ($p = 0.850$). On the other hand, at the community level, concern for reputation was significantly higher ($p < 0.001$) for people in farming areas than for people in non-farming areas. Additionally, this community-level effect was above and beyond the corresponding individual-level effect (i.e., contextual effect of farming was significant, $p < 0.001$). These results replicate the results of Study 1 (see Supplemental materials, Tables S4c and S4d for Pearson's r at both the individual and community level; Table S5b shows descriptive statistics of the key variables for each category).

As with Study 1, we conducted a multilevel mediation analysis to examine the indirect effect of farming on concern for reputation through collective activities at the community level (see Fig. 3)[10]. The model fit the data well, CFI = 0.98, RMSEA = 0.02. At the individual level, the effect of collective activities on concern for reputation was not significant. Accordingly, the indirect effect of engaging in farming works, through collective activities, on concern for reputation was not significant ($b = 0.02$, $p = 0.134$). On the other hand, at the community level, the corresponding indirect effect was significant ($b = 0.22$, $p = 0.024$). The contextual effect of

the indirect effect was significant (b = 0.20, p = 0.040). Thus, replicating the results of Study 1, Study 2 revealed that the effect of community-level farming on concern for reputation was mediated by participation in collective activities by both farmers and non-farmers.

Figure 4. Multilevel mediation analysis (Study 2). Unstandardised coefficients are shown. All the individual-level predictors were centred on the community mean. All the community-level predictors were centred on the



grand mean. Black arrows indicate effects with $p < .05$, grey arrows indicate effects that were not significant. $^{\dagger}p < .10$, $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

The above multilevel mediation analyses on data from two cross-sectional surveys demonstrates that collective activities have community-level mediation effects on the association between the promotion of farmers in a community and the level of concern for reputation in the

community. However, these analyses could not reveal a causal relationship between collective activities and concern for reputation.

Therefore, we examined a quasi- 'causal relationship' between collective activities and concern for reputation through a longitudinal analysis of the two survey datasets. As mentioned above, 87 of the 408 communities from Study 1 (Time 1) were sampled again (responses were sent from 86 communities) in Study 2 (Time 2), with an interval of approximately 1 year 10 months. This could be interpreted as longitudinal data at the community level. We found that community-level collective activities at Time 1 had a significant effect on community-level concern for reputation at Time 2 ($\beta = 0.23$, $p = 0.035$), but not vice versa ($\beta = 0.07$, $p = 0.417$; see Table 6). This suggests that the economic activity undertaken by farming communities contributes to collective activities by non-farmers in the community, which in turn nurtures community-level concern for reputation. These results also support our '*collective activity*' hypothesis.

Table 6: Longitudinal regression analysis between concern for reputation and participation in collective activities at the community level

	Concern for reputation (Time 2)			Participation in collective activities (Time 2)		
	β	(*SE*)	*p*	*β*	(*SE*)	*p*
Concern for reputation (Time 1)	0.09	(0.10)	0.425	0.07	(0.16)	0.417
Participation in collective activities (Time 1)	**0.23**	**(0.05)**	**0.035**	**0.57**	**(0.08)**	**<0.001**
Adjusted R^2	0.04		0.057	0.33		**<0.001**

Note: Communities served as the unit of analysis. Effects with $p < .05$ appear in bold print. Time 1 was January/February 2013 and Time 2 was December 2014.

General Discussion

In cultural and social psychology, a wide variety of evidence exists to show that psychological and behavioral functions and features differ across cultural contexts through nation level comparisons, such as US-Japan comparisons (see Kitayama & Cohen, 2007). Many cross-cultural studies have specifically shown that psychological functions related to interdependence (e.g., seeking harmony) are prevalent in East Asian cultures, while those related to independence (e.g., seeking uniqueness) are prevalent in North American/European American cultures. However, the causal factors behind the promotion of such cultural tendencies, such as independence/interdependence, have not been fully elucidated. Furthermore, the fact that 'nations' are used as the dominant unit of analysis for 'culture' makes it difficult to identify specific causal functions, as 'nations' are often confounded with numerous elements, such as policy systems or economic situations. In order to fill in these missing links, this research utilized multilevel analyses with the 'community' as the unit of analysis, at a lower level than the commonly-used 'nation' unit. This enabled us to seek evidence of how socio-economic/ecological factors contribute to certain psychological functions. We proposed the '*collective activity*' hypothesis where we predict that the frequency and prevalence of collective activities in farming (especially rice-cropping) plays an important role in fostering interdependence. Where rice-farming is prevalent, both farmers and non-farmers need to work together to protect large-scale public resources and infrastructure (e.g., irrigation systems) and these activities require cooperative behavior and mutual coordination among members. Under such conditions, members may be motivated to avoid gaining a negative reputation from the other members in the community.

The multilevel analyses in Study 1 revealed that concern for reputation, which is one aspect of interdependence, was higher for people in farming communities than for people in

non-farming communities. This result was replicated in Study 2. These results support the existence of a 'farming community culture' where both farmers and non-farmers within that community share psychological tendencies, namely, interdependence. Our data suggests that 1) psychological characteristics were likely to be related to professions (i.e., concern for reputation in farming areas, and self-esteem and risk avoidance in fishing), consistent with the findings of previous studies (Uskul et al., 2008), and 2) the culture of farming-related interdependence exists at the community level, and influences even non-farmers who are residents of farming communities. That is, when collective activities are frequent at the community level (such as in farming areas), concern for reputation, a measure of interdependence, was more likely to be shared throughout the regional communities. This finding is our most significant contribution to the literature, as to our knowledge, we are the first to demonstrate that participation in community-related collective activities fosters interdependence as a form of 'shared community culture'.

Participation rates in collective activities (at the community level) were higher in farming communities than in non-farming communities. The community-level tendency towards concern for reputation in farming communities was affected by participation rates in collective activities. Concern for reputation is a norm for interpersonal relationships (e.g. prioritizing the maintenance of group harmony over individual interests), and such a norm is stronger in communities with higher frequencies of collective activities. Furthermore, the longitudinal analysis from Study 2 observed a quasi-causal mechanism, showing that rates of participation in community-level collective activities at Time 1 predicted community-level tendencies toward concern for reputation at Time 2, but not vice versa, and this hints at causality. However, we were unable to concretely define the processes behind the role of collective activities in promoting

interdependence. A possibility could be that the participation in collective activities promotes cultural learning processes among people in farming areas, including farmers and non-farmers. Alternatively, collective activities themselves could foster the establishment of community-level norms on interdependence. Future studies should clarify this mechanism. The repeated experiences of having to work with community members in various activities that require harmonious relationships, might lead to concern for reputation at the community level. This would be consistent with a previous study conducted by Paez et al. (2015), who found that involvement in collective activities elicited group integration, and those who were engaged in collective actions consequently felt emotional synchrony with the other members. Future research could focus on investigating this process as a means of better understanding the mechanisms surrounding collective activities and interdependence.

In addition, to elucidate the generalizability of this mechanism, we have to examine whether the current research findings can be applied to any other locality outside of rice-cropping farming. Building of the collective activity hypothesis, we predict that interdependence (e.g., concern for reputation) will be higher even among people not in a dominant profession in a community, if that profession places a strong emphasis on collective activities within that community. Future studies could focus on related empirical questions.

In sum, we conclude that our data suggests substantial evidence in support of the collective activity hypothesis: community-level collective activities maintain the ecological/economic functions within a community (e.g. maintaining irrigation systems in farming communities, participating in local festivals), and fosters interdependence for both farmers and non-farmers in farming communities. Furthermore, the scope of the abovementioned ‘collective activities’ were not only limited to economically relevant activities (such as

maintenance work on public facilities), but also included community events or disaster-prevention group activities. In this context, the finding that non-farming-related activities are able to spread cultural norms is of interest. Farming is labor-intensive, and the sustenance of social capital may be in the best interests of farmers to recruit the help of non-farmer residents for economically (infrastructure/maintenance) related collective activities, in the form of additional labor.

In addition to our main hypotheses on farming communities, we also found meaningful results for fishing communities. As predicted, fishers (excluding aquaculturalists), whose jobs involve more competition and uncertain for natural resources, showed higher self-esteem and a more risk avoidance-oriented motivational style at the individual level than the other groups.

The high self-esteem and high risk avoidance tendency could have been fostered directly through fishing activities (competitiveness, uncertainty, and high-risk situations). Though our dataset did not examine other factors involved in the sharing of psychological characteristics within communities aside from collective activities, future studies should examine the conditions specific to fishing communities to investigate the inhibition systems preventing fishery related psychological tendencies from being spread to non-fishers.

The main limitation of the present research was that only self-report questionnaires with a limited number of items were used. Furthermore, space limitations associated with the targeting of a survey towards a large population required us to focus only on core concepts. As such, we had to limit our measures and rely primarily on the ‘concern for reputation’ item as our main dependent variable. Therefore, caution should be exercised regarding the generalization of the current results to other aspects of interdependence, such as ‘harmony seeking’ (Hashimoto & Yamagishi, 2013). Additionally, the quasi-causal mechanism we found cannot definitively suggest causality, and the 1-year 10-month interval might also be too short a time period to

examine causal effects at depth. Nevertheless, we think that this result provides sufficient evidence to hint at the involvement of a causal mechanism. We were also able to obtain large non-student samples in local communities that are geographically scattered and more demographically diverse, e.g. the elderly (> 65 years), for a series of studies with high ecological validity. Nevertheless, future studies using behavioral/cognitive experimental methods are undoubtedly necessary to tease apart the precise underlying mechanisms. Furthermore, we have to reconsider the socio-psychological function of collective activities. As we discovered, participation in collective activities facilitates greater cooperation among community members in a community, which in turn promotes interdependence among community members. However, collective activities serve yet another function: in providing opportunities to transmit cultural ideas to other participants of the same activity. Another line of research can be conducted to investigate the transmission process. As an example, Nisbett and Cohen (1996) suggested that "culture of honor" related psychological tendencies (e.g. justified anger after receiving insults) are associated with herders in the Southern regions of America. They theorized that historically, as herders had to protect their economic assets (e.g., cows) from potential thieves, they had to react aggressively to even the slightest of threats, such as insults to their character, to avoid negative evaluations (e.g. "it is easy to steal cows from his yard"). Over time, this herding related psychological function developed within the entire regional area as a "culture of honor." Although Nisbett and Cohen did not directly examine the processes behind this development, it is highly likely that one of the underlying processes might be related to social interactions between herders and non-herders through collective activities in their community (e.g. Sunday church services).

Taken together, our results present a proof of concept that the collective activity hypothesis is relevant to the sharing of psychological tendencies within a specific culture, and

forms a precedent for future studies to systematically examine the interaction between macro- and micro-level phenomena.

References

Berry, J.W. (1967). Independence and conformity in subsistence-level societies. *Journal of Personality and Social Psychology, 7*, 415–418. (doi:10.1037/h0025231)

Carpenter, J., & Seki, E. (2011). Do social preferences increase productivity? Field experimental evidence from fishermen in Toyama Bay. *Economic Inquiry, 49*, 612-630. (doi:10.1111/j.1465-7295.2009.00268.x)

Carver, C.S., & White, T.L. (1994). Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: The BIS/BAS scales. *Journal of Personality and Social Psychology, 67*, 319–333. (doi: 10.1037/0022-3514.67.2.319)

Chiao, J.Y., & Blizinsky, K.D. (2010). Culture-gene coevolution of individualism-collectivism and the serotonin transporter gene. *Proceedings of the Royal Society B: Biological Sciences, 277*, 529–537. (doi:10.1098/rspb.009.1650)

Christ, O., Schmid, K., Lolliot, S., Swart, H., Stolle, D., Tausch, N., et al. (2014). Contextual effect of positive intergroup contact on outgroup prejudice. *Proceedings of the National Academy of Sciences of the United States of America*, *111*, 3996-4000. (doi:10.1073/pnas.1320901111)

Dunbar, R. I. M., Duncan, N. D. C., & Marriott, A. (1997). Human conversational behavior. *Human Nature*, *8*, 231-246. (doi:10.1007/BF02912493)

Elliot, A.J. (1999). Approach and avoidance motivation and achievement goals. *Educational Psychologist, 34*, 169–189. (doi: 10.1207/s15326985ep3403_3)

Falk, C.F., Heine, S.J., Yuki, M., & Takemura, K. (2009). Why do Westerners self-enhance more than East Asians? *European Journal of Personality, 23*, 183–203. (doi: 10.1002/per.715)

Fincher, C.L., Thornhill, R., Murray, D.R., & Schaller, M.D.R. (2008). Pathogen prevalence

predicts human cross-cultural variability in individualism/collectivism. *Proceedings of the Royal Society B: Biological Sciences, 275*, 1279–1284. (doi:10.1098/rspb.2008.0094)

Fukushima, S., Yoshikawa, G., Saizen, I., & Kobayashi, S. (2011). Analysis on regional differences of social capital focusing on the regional characteristics and regional units: Through the comparison between bonding and bridging types of trust. *Journal of Rural Planning Association, 30*, 345-350.

Gutiérrez, N.L., Hilborn, R., & Defeo, O. (2011). Leadership, social capital and incentives promote successful fisheries. *Nature, 470,* 386-389. (doi: 10.1038/nature09689)

Hara, H., & Kumagai, H. (2008). Non-farmers' willingness of participation in the maintenance and management of irrigation canals: A case study in the central area, Toyama prefecture. *Journal of Rural Planning Association, 26*, 407-415.

Hasegawa, A. (1969). Space structure of the rural community. *Memories of the Institute of Social Sciences, Meiji University, 7*, 243-274.

Hashimoto, H., & Yamagishi, T. (2013). Two faces of interdependence: Harmony seeking and rejection avoidance. *Asian Journal of Social Psychology, 16*, 142-151. (10.1111/ajsp.12022)

Hashimoto, H., & Yamagishi, T. (2016). Duality of independence and interdependence: An adaptationist perspective. *Asian. Journal of Social Psychology, 19,* 286-297. (10.1111/ajsp.12145)

Heine, S.J, Lehman, D.R, Markus, H.R, & Kitayama, S. 1999 Is there a universal need for positive self-regard? *Psychological Review, 106*, 766–794. (doi:10.1037/0033295X.106.4.766)

Henrich, J., Heine, S.J., & Norenzayan, A. (2010). The weirdest people in the world? *Behavioral and Brain Science, 33*, 61-83. (doi:10.1017/S0140525X0999152X)

Japan Industrial Safety and Health Association (2014). *Data on industrial accident*. See

https://www.jisha.or.jp/info/bunsekidata/. (accessed 9 April 2015).

Johnson, D.D.P., & Fowler, J.H. (2011). The evolution of overconfidence. *Nature, 477*, 317–320. (doi:10.1038/nature10384)

Kamide, H., & Daibo, I. (2005). Development of a Japanese version of the BIS/BAS scale. *Japanese Journal of Interpersonal and Social Psychology, 5*, 49-58.

Kashima, Y. (2014). How can you capture cultural dynamics? *Frontiers in Psychology, 5*, 995. (doi:10.3389/fpsyg.2014.00995)

Kawashima, S. (2015) *Sanriku Kaigan ni Okeru Tsunami to Gogyo no Densho: Sanriku no Gyoro Bunka kara Saguru Fukkou no Michi* (In Japanese: "Fishery traditions along the Sanriku coast after the Tsunami of the Great East Japan Earthquake: A road to restoration fostered by fishery culture in Sanriku). *Suisan Shinkou*, *566*, 1-42.

Kitayama, S., & Cohen, D. (2007). *Handbook of Cultural Psychology.* Guilford Press.

Maas, C. J., & Hox, J. J. (2005). Sufficient sample sizes for multilevel modelling. *Methodology, 1*, 86-92.

Mace, R., Thomas, M. G., Wu, J., He, Q., Ji, T. & Tao, Y. (2018). Population structured by witchcraft beliefs. *Nature Human Behaviour*, 2, 39-44. (doi:10.1038/s41562-017-0271-6)

Markus, H.R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological Review, 98*, 224–253. (doi:10.1037/0033-295X.98.2.224)

Milinski, M., Semmann, D., & Krambeck, H. J. (2002). Reputation helps solve the 'tragedy of the commons'. *Nature*, 415, 424-426. (doi:10.1038/415424a)

Ministry of Agriculture, Forestry and Fisheries of Japan (2014). *Basic data of agriculture, forestry and fisheries*.

http://www.maff.go.jp/j/tokei/sihyo/data/08.html (agriculture)

http://www.maff.go.jp/j/tokei/sihyo/data/18.html (fishery). (accessed 9 April 2015).

Ministry of Agriculture, Forestry and Fisheries of Japan. (2015). *Statistics of Agriculture, Forestry and Fisheries*. http://www.maff.go.jp/j/tokei/kouhyou/noucen/pdf/census_15.pdf (accessed 13 December 2016).

Namikawa T, Tani I, Wakita T, Kumagai R, Nakane A, Noguchi H. 2012 Development of a short form of the Japanese Big-Five Scale, and a test of its reliability and validity. Japanese *Journal of Psychology, 83,* 495-505. (10.4992/jjpsy.83.91)

Nisbett, R.E., & Cohen, D. (1996). *Culture of honor: The psychology of violence in the South*. Boulder, CO: Westview.

Nisbett, R.E., & Masuda, T. (2003). Culture and point of view. *Proceedings of National Academy of Science, USA, 100*, 11163-11170. (doi: 10.1073/pnas.1934527100)

Nisbett, R. E., Peng, K., Choi, I., & Norenzayan, A. (2001). Culture and system of thoughts: Holistic versus analytic cognition. *Psychological Review, 108*, 291–310. (doi:10.1037/0033-295X.108.2.291)

Over, H., & Uskul, A.K. (2016). Culture moderates children's responses to ostracism situations. *Journal of Personality and Social Psychology, 110*, 710–724. (doi: 10.1037/pspi0000050)

Park, J., & Kitayama, S. (2012). Interdependent selves show face-induced facilitation of error processing: cultural neuroscience of self-threat. *Social Cognitive and Affective Neuroscience*, *9*, 201-208. (10.1093/scan/nss125)

Park, J., Uchida, Y., & Kitayama, S. (2015). Cultural variation in implicit independence: An extension of Kitayama et al. 2009. *International Journal of Psychology, 51, 269-278.* (doi: 10.1002/ijop.12157)

Preacher, K. J., Zyphur, M. J., & Zhang, Z. (2010). A general multilevel SEM framework for assessing multilevel mediation. *Psychological Methods*, *15*, 209-233. (doi:10.1037/a0020141)

Pretty, J. (2003). Social capital and the collective management of resources. *Science*, *302*, 1912-1914. (doi:10.1126/science.1090847)

Rosenberg, M. (1965). *Society and adolescent self-image*. Princeton, NJ: Princeton University.

Senzaki, S., Masuda, T., & Ishii, K. (2014). When is perception top-down and when is it not? Culture, narrative, and attention. *Cognitive Science, 38*, 1493-1506. (doi:10.1111/cogs.12118)

Singelis, T. M. (1994). The measurement of independent and interdependent self-construals. *Personality and Social Psychology Bulletin, 20*, 580-591. (10.1177/0146167294205014)

Statistics Bureau, Ministry of Internal Affairs and Communications of Japan (2010). *Population Census of Japan, 2010*.

Portal Site of Official Statistics of Japan: http://www.e-stat.go.jp/estat/html/kokusei/GL08020101-000001039448.html#t1_000001047504. (accessed 9 April 2015).

Statistics Bureau, Ministry of Internal Affairs and Communications of Japan (2014). Statistical Data on Japan. Section 7: Farming Fishing and Forestry. *Nihon No Tokei (Statistics of Japan*; translated by the authors of this article) http://www.stat.go.jp/data/nihon/07.htm. (accessed 14 August 2014).

Suzuki, E. (1940). *Nihon Noson Syakaigaku Genri* (*Sociological principles of Japanese agricultural community*; translated by the authors of this article), pp. 468. Tokyo: Jicho Sha.

Tabachnick, B.G., & Fidell, L.S. (2007). *Using multivariate statistics* (5th edition). Boston, MA:

Allyn & Bacon.

Takata, T., Omoto, M., & Seike, M. (1996). Construction of a revised scale for independent and interdependent construal of self. *Memories of Nara University, 24*, 157-173.

Takemura, K., & Uchida, Y. (2015). Roles of extension officers to promote social capital in Japanese fishing communities. *Suisan Shinko (Fisheries Promotion)*, *574*, 1-49 (in Japanese).

Talhelm, T., Zhang, X., Oishi, S., Shimin, C., Duan, D., Lan, X., & Kitayama, S. (2014). Large-scale psychological differences within China explained by rice versus wheat agriculture. *Science*, *344*, 603–608. (doi:10.1126/science.1246850)

Uskul, A.K., Kitayama, S., & Nisbett, R.E. (2008). Ecocultural basis of cognition: Farmers and fishermen are more holistic than herders. *Proceedings of National Academy of Science, USA, 105*, 8552–8556. (doi:10.1073/pnas.0803874105)

Uskul, A.K., & Over, H. (2014). Responses to social exclusion in cultural context: Evidence from farming and herding communities. *Journal of Personality and Social Psychology, 106*, 752–771. (doi:10.1037/a0035810)

Watanabe, H. (1978). *Sonraku no Rikai* (*Understanding of the agricultural community*; translated by the authors of this article), in *Nogyo Syuraku Ron* (*A theory of the agricultural community*; translated by the authors of this article) (Watanabe, H. Ed.), pp. 13-50. Tokyo: Ryukei Shosha.

Wilson, D.S, O'Brien, D.T., & Sesma, A. (2009). Human prosociality from an evolutionary perspective: Variation and correlations at a city-wide scale. *Evolution and Human Behavior, 30*, 190-200. (doi.org/10.1016/j.evolhumbehav.2008.12.002)

Zhang, Z., Zyphur, M. J., & Preacher, K. J. (2009). Testing multilevel mediation using hierarchical linear models: Problems and solutions. *Organizational Research Methods*, *12*,

695-719. (doi: 10.1177/1094428108327450)

Footnotes:

1. These categories were used only for sampling purpose. In the data analysis, we used proportions of farmers/fishers as continuous variables at level-2. See the Results section.

2. More specifically, we sampled communities from the following 16 prefectures: Mie, Shiga, Kyoto, Osaka, Hyogo, Nara, Wakayama, Tottori, Shimane, Okayama, Hiroshima, Yamaguchi, Tokushima, Kagawa, Ehime, and Kochi.

3. As a possible unit of regional culture, we focused on local communities or neighborhoods (*cho* or *chomoku* in the dataset of the Population Census of Japan, 2010), which have an average of 103.6 households (*SD* = 139.5). Although previous studies have examined the regional culture of larger groups (e.g. in provinces in China, Talhelm et al., 2014), the present research investigated smaller collective cultures because they might serve as a basic unit of mutual cooperation in Japan (Suzuki, 1940; Watanabe, 1978).

4. The average proportion of farmers to non-farmers in communities was 6.6% (*SD* = 12.5%) for the entire population, and 23.6% (*SD* = 22.2%) for the sampled communities. In our sample of farming communities, the average proportion of farmers was 40.5% (*SD* = 15.6%). For fishing communities, the average proportion of fishers in a community was 0.5% (*SD* = 3.5%) for the whole population, and 13.3% (*SD* = 21.7%) for the sampled communities. In our sample of fishing communities, the average proportion of fishers was 42.7% (*SD* = 16.4%).

5. There were 5,096 farming communities in our target area, but 4% of them (204 communities), as well as 9% of fishing communities (24/268 communities) were not included in the sampling list due to a technical problem.

6. Some respondents chose the same option for several consecutive items (e.g. all items in the

same section) even when the items covered diverse questions. For quality control, 69 cases were removed, as they showed this pattern for more than half of the sections in the survey (see Wilson, O'Brien, & Sesma, 2009, for a similar procedure). Nevertheless, results did not differ when these cases were included.

7. A similar item '*I find myself being concerned about what other people think of me*' has been used in previous studies (e.g. Hashimoto & Yamagishi, 2013). In those studies, this was used to measure 'rejection avoidance', a subscale of interdependence, which was calculated by averaging its score on this item with those on other items, such as '*I worry about what people think of me, and always feel that someone is watching me.*' In the present research, we use the term 'concern for reputation' for a more neutral expression, as our item, by itself, does not distinctively capture general concerns about negative reputation. Rather, it is possible that the item reflected concerns about positive reputations as well. See Supplemental materials for a validation study of this item (and Tables S2 and S3). The longitudinal correlation of this item (at the community level) with an interval of 1 year 10 months was significantly positive (Spearman's $\rho = .62$, $p < .001$, $N = 28$; with communities of response rate > 0.25 in both Time 1 and Time 2; if we include all the communities, $\rho = .31$, $p = .004$, $N = 86$).

8. Some covariates had significant associations with the outcome variables. Concern for reputation was predicted by household size ($b = 0.02$, $p = 0.019$) and years in community ($b = 0.06$, $p = 0.045$). Self-esteem was predicted by age ($b = 0.01$, $p < 0.001$), household size ($b = 0.03$, $p < 0.001$), equivalent household income ($b = 0.09$, $p < 0.001$), unemployment (ref = employed; $b = -0.13$, $p < 0.001$). Risk avoidance was predicted by age ($b = -0.01$, $p < 0.001$), years in community ($b = 0.10$, $p = 0.001$), equivalent household income ($b = -0.03$, $p < 0.001$), and unemployment ($b = -0.09$, $p = 0.041$).

9. We conducted a series of sensitivity analyses. See Supplemental materials for robustness check and Table S6.

10. Unlike Study 1, the multilevel analysis in Study 2 had three levels (i.e., individual, household, and community). The analysis software we used (Mplus version 7) could not perform multilevel structural equation modelling for three-level data. Therefore, following Zhang, Zyphur, and Preacher's (2009) suggestions, we used participation in collective activities (centered on the community mean) as the individual-level mediator, while using community mean of participation in collective activities (centered on the grand mean) as the community-level mediator.