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Expression of Anger and Ill Health in Two Cultures: An Examination of Inflammation and Cardiovascular Risk

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Abstract

Expression of anger is associated with biological health risk (BHR) in Western cultures. However, recent evidence documenting culturally divergent functions of the expression of anger suggests that its link with BHR may be moderated by culture. To test this prediction, we examined large probability samples of both Japanese and Americans using multiple measures of BHR, including pro-inflammatory markers (interleukin-6 and C-reactive protein) and indices of cardiovascular malfunction (systolic blood pressure and ratio of total to HDL cholesterol). We found that the link between greater expression of anger and increased BHR was robust for Americans. As predicted, however, this association was diametrically reversed for Japanese, among whom greater expression of anger predicted reduced BHR. These patterns were unique to the expressive facet of anger and remained after we controlled for age, gender, health status, health behaviors, social status, and reported experience of negative emotions. Implications for sociocultural modulation of bio-physiological responses are discussed.

Keywords

anger expression, inflammation, cardiovascular malfunctioning, culture

Is expressing anger always detrimental to health? Extant evidence suggests a robust positive association between the expression of anger or hostility and compromised health, particularly, cardiovascular morbidity and mortality (Chida & Steptoe, 2009; Everson-Rose & Lewis, 2005; Schum, Jorgensen, Verhaeghen, Sauro, & Thibodeau, 2003; Smith, Glazer, Ruiz, & Gallo, 2004; Vandervoort, Ragland, & Syme, 1996). Consistent with the hypothesis that such effects may be mediated by a pathway of chronic inflammation (Miller, Chen, & Cole, 2009), recent studies have found similar positive associations between the expression of anger and inflammatory markers (Boylan & Ryff, 2013; Elovainio, Merjonen, & Pulkki-Råback, 2011; Graham et al., 2006; Marsland, Prather, Petersen, Cohen, & Manuck, 2008), especially among disadvantaged individuals, such as those with low educational attainment (Boylan & Ryff, 2013) and low childhood socioeconomic status (Beatty & Matthews, 2009). A health-compromising effect of anger has also been documented longitudinally (Kawachi, Sparrow, Spiro, Vokonas, & Weiss, 1996).

However, much of the prior literature is based on Western populations. Thus, the health-compromising effects of expressing anger may not be evident in other cultural contexts, where expression of anger may serve different functions (Consedine, Magai, & Horton, 2005; Consedine et al., 2006). In the current work, using large probability samples of Americans and Japanese, we tested the hypothesis that the association between anger expression and biological health risk (BHR) is moderated by culture.

Our analysis draws on a formulation of anger expression as composed of two separable facets (Park et al., 2013). First, anger expression sometimes reflects frustrating experiences. As has been argued by numerous scholars (e.g., Berkowitz, 1989), when individuals are faced with events that block their goals and desires, they are likely frustrated, which in turn results in experience and expression of anger. Second, researchers in both ethology (Hurd & Enquist, 2001) and social psychology (Tiedens, 2001) have pointed out that expressing anger is a way to display one's dominance and to intimidate others. Anger expression in such contexts can therefore reflect one's dominance over others. Although related, the two aspects of anger are separable and can be differentially salient depending on a variety of contextual variables.

Culture is one way of framing such contextual influences. Culture is a set of symbolic beliefs, practices, and institutions that are recruited to define the meanings of social situations and to regulate social interactions (Adams & Markus, 2001; Kitayama, Markus, Matsumoto, & Norasakkunkit, 1997). These components of culture are shared across individuals within regions or groups that have common historical heritages (e.g., North American cultures and East Asian cultures).

In Western cultural contexts, independence of the self is culturally sanctioned, and as a consequence, personal goals and agendas are highly salient (Kitayama & Uskul, 2011; Markus & Kitayama, 1991). Thus, if individuals lack sufficient resources to meet their personal goals and agendas, they will likely become frustrated, which in turn can lead to expression of anger. In a study consistent with this analysis (Park et al., 2013), we found that Americans with lower social status expressed more anger than their higher-status counterparts and that this relationship was mediated by experiences of frustration. We suggest that if people experience and express anger primarily when they are frustrated, the frequency of anger expression in this cultural context may serve as a reliable index of frustrating personal experiences. We therefore hypothesized that within the United States, greater expression of anger would predict increased BHR as indexed by pro-inflammatory responses (Irwin & Cole, 2011; Medzhitov, 2008; Miller et al., 2009), which are known to increase cardiovascular risks and, eventually, to elevate risk for morbidity and mortality (Everson-Rose & Lewis, 2005; Medzhitov, 2008).

In contrast, in Asian cultural contexts, interdependence of the self is more strongly valued. The self is conceptualized as part of a hierarchically organized social group. In such settings, expression of anger is seen as socially disruptive, and as a consequence, there is a strong normative prohibition against it. An exception to the normative prohibition against anger expression is accorded to people with power and dominance, such as those high in social status. Results of our previous study (Park et al., 2013) are consistent with this view. Japanese adults with high social status expressed more anger than those with low social status; further, this relationship was mediated by the amount of decision authority participants had at work. We suggest that in a cultural context where people express anger primarily when feeling dominant and privileged, the frequency of anger expression may serve as a reliable index of social privileges. We therefore hypothesized that greater expression of anger would predict *reduced* BHR in the Japanese cultural context. The sense of entitlement and power may likely relieve threats to the self (Irwin & Cole, 2011; Medzhitov, 2008; Miller et al., 2009), and thus, Japanese adults who display more anger may be likely to exhibit reduced BHR compared with those who show little anger.

Earlier evidence obtained by Consedine et al. (2005, 2006) is consistent with this emphasis on cultural differences in the link between anger and health. These researchers conducted large-scale surveys of community-dwelling women in Brooklyn, New York, and found that trait anger was associated with poor self-reported health among U.S.-born European Americans. In contrast, among women from all ethnic-minority groups, including African Americans, Black Caribbeans, and East European immigrants, the relationship was reversed: Trait anger was associated with better self-reported health. These results are consistent with our analysis, as individuals from ethnic-minority groups are likely to be more interdependent than European Americans (Oyserman, Coon, & Kemmelmeier, 2002).

In the present work, we extended the evidence obtained by Consedine et al. (2005, 2006) in three important ways. First, we examined whether anger would be linked to reduced health risk among Japanese in Japan, a majority group within their society. Second, whereas Consedine et al. tested only trait anger, we assessed both anger expression and other aspects of anger (i.e., trait anger, anger suppression, and anger control). Third, and most important, whereas Consedine et al. examined self-reported health, we tested objective measures of BHR.

Method

To test the prediction that greater expression of anger would be associated with increased BHR among Americans, but with reduced BHR among Japanese, we used matched surveys from the United States and Japan. To assess BHR, we employed two indices each of

inflammation and cardiovascular malfunctioning. Our indices of inflammation were interleukin-6 (IL-6) and C-reactive protein (CRP), and our indices of cardiovascular malfunctioning were systolic blood pressure (SBP) and the ratio of total to high-density lipoprotein cholesterol (total/HDL cholesterol). We controlled for several variables, including age, gender, waist-to-hip ratio (WHR), chronic health conditions, smoking status, alcohol consumption, social status, and experience of negative emotions, all of which have been linked to these biomarkers in previous work (Coe et al., 2011; O'Connor et al., 2009). We also examined whether the predicted cultural difference in the association between anger expression and BHR might be moderated by social status.

Participants

The American participants were a subset from the Midlife in the United States (MIDUS) survey. A national probability sample of 4,244 adults was initially recruited for this survey through random-digit dialing in 1995 and 1996. The participants completed both a telephone interview and a self-administered questionnaire. The same assessments were used in a follow-up survey conducted in 2004 (MIDUS II; response rate = 75%, adjusted for mortality). Biological data were collected from a subset of the MIDUS II participants, who traveled to one of three General Clinical Research Centers for an overnight visit. Biomarker data were available from 1,054 participants (476 males, 578 females; mean age = 58.04 years, *SD* = 11.62). The parallel survey, the Midlife in Japan (MIDJA) survey, was conducted in 2008 with 1,027 participants randomly selected from the Tokyo metropolitan area. These participants completed a self-administered questionnaire. A subset of the MIDJA participants was recruited to participate in collection of biological data (*N* = 382; 168 males, 214 females; mean age = 55.47 years, *SD* = 14.04). These participants visited a medical clinic near the University of Tokyo (for detailed protocols used for biomarker collection and assaying, see Coe et al., 2011).[1]

Measures

Anger expression. Anger expression was assessed with the eight-item Anger-Out subscale of the State-Trait Anger Expression Inventory (Spielberger, 1996). Participants rated how often (1 = *almost never*, 4 = *almost always*) they expressed angry feelings through verbally or physically aggressive behaviors when they felt furious and angry (e.g., "I slam doors," "I say nasty things"; αs = .75 and .84 for Americans and Japanese, respectively). In a prior confirmatory factor analysis (Park et al., 2013), when we constrained a multigroup factor model of anger expression so that factor loadings of the pertinent items on the latent variable were equal between the two cultural groups, the fit of the model was no better than when we removed these constraints. This established factor equivalence across the cultural groups (Cheung & Rensvold, 2002).

Other facets of anger. To determine whether our primary predictions would apply only to the expressive aspect of anger, as shown in our prior study (Park et al., 2013), or would extend to other facets of anger (e.g., Consedine et al., 2005; Consedine et al., 2006), we considered three additional facets of anger: trait anger, anger suppression, and anger control, all of which were assessed with the State-Trait Anger Expression Inventory (Spielberger, 1996). The 15-item Trait Anger subscale assessed chronic propensity toward anger. Participants indicated how well each of the items described themselves (e.g., "I have a fiery temper," "I am a hotheaded person"; 1 = *not at all*, 4 = *very well*; αs = .83 and .90 for Americans and Japanese, respectively). The 8-item Anger-In subscale measured the extent to which participants held in, or suppressed, anger (e.g., "I withdraw from people," "I keep things in"; 1 = *almost never*, 4 = *almost always*; αs = .81 and .74 for Americans and Japanese, respectively). Finally, the 4-item Anger Control subscale measured the extent to which participants attempted to control the expression of anger (e.g., "I control my temper," "I keep my cool"; 1 = *almost never*, 4 = *almost always*; αs = .69 and .65 for Americans and Japanese, respectively). Table 1 presents the intercorrelations among the four facets of anger (anger expression, trait anger, anger suppression, and anger control) for both cultural groups.

BHR. We assessed two theoretically linked facets of BHR: inflammation and cardiovascular malfunction. We analyzed two inflammatory measures: IL-6 and CRP. Frozen blood samples were shipped on dry ice from the three General Clinical Research Centers in the United States and from Tokyo to a single testing laboratory (MIDUS Biocore Laboratory, University of Wisconsin, Madison, WI). Serum IL-6 levels were determined by high-sensitivity enzyme-linked immunosorbent assay (ELISA; Quantikine, R&D Systems, Minneapolis, MN), with a lower sensitivity of detection at 0.16 pg/ml. All values were quantified in duplicate; in cases of a value greater than 10 pg/ml, the sample was rerun in diluted sera to fall on the standard reference curve. Plasma CRP levels were determined using the BNII nephelometer (Dade Behring Inc., Deerfield, IL) and a particle-enhanced immunonephelometric assay. To reduce the effect of extreme outliers, we winsorized a small number of high IL-6 (n = 7) and CRP (n = 4) values to 3 standard

Table 1. Intercorrelations Among the Four Facets of Anger for Americans and Japanese

Sample and measure	*n*	Correlations 2	3	4
Americans				
1. Anger expression	1,053	.53***	.20***	−.30***
2. Trait anger	1,050	—	.49***	−.28***
3. Anger suppression	1,052		—	−.16***
4. Anger control	1,053			—
Japanese				
1. Anger expression	381	.49***	.42***	.09†
2. Trait anger	362	—	.43***	.11*
3. Anger suppression	380		—	.27***
4. Anger control	379			—

†$p < .10$. *$p < .05$. ***$p < .001$.

Table 2. Intercorrelations Among the Four Biomarkers for Americans and Japanese

Sample and measure	*n*	Correlations 2	3	4
Americans				
1. Log IL-6	1,044	.49***	.13***	.11***
2. Log CRP	1,040	—	.15***	.19***
3. Log SBP	1,053		—	.13***
4. Log total/HDL cholesterol	1,043			—
Japanese				
1. Log IL-6	382	.50***	.38***	.25***
2. Log CRP	382	—	.27***	.28***
3. Log SBP	382		—	.32***
4. Log total/HDL cholesterol	382			—

Note: Interleukin-6 (IL-6), C-reactive protein (CRP), systolic blood pressure (SBP), and total cholesterol scores were winsorized to 3 standard deviations from the mean (calculated separately for each culture), and all biomarkers were log-transformed.
***$p < .001$.

deviations from the mean (calculated separately for each culture; see Boylan & Ryff, 2013, and Miyamoto et al., 2013, for similar approaches). Because the distributions of both markers were positively skewed, values were log-transformed.

Cardiovascular risk was assessed with SBP and total/HDL cholesterol. Resting blood pressure was assessed three times in a seated position, and the two most similar readings were averaged to yield an index of SBP. Total and HDL cholesterol were assayed at Meriter Labs (Madison, WI), using a Cobas Integra analyzer (Roche Diagnostics, Indianapolis, IN). A few outlying SBP ($n = 1$) and total cholesterol ($n = 3$) values were winsorized to 3 standard deviations from the mean (calculated separately for each culture). The distributions of SBP and total/HDL cholesterol were positively skewed and were log-transformed to reduce skewness.

Because inflammation is a major risk factor for cardiovascular disease, we anticipated that the four biomarkers would be interrelated. As predicted, they were positively correlated within each culture (see Table 2). Principal component analyses showed that all four indices loaded on a single factor, both for the two cultures combined and within each culture. Therefore, we used the factor score for BHR stemming from the more encompassing analysis as our primary dependent variable. A higher number indicates increased BHR (i.e., greater inflammation and higher cardiovascular risk).

We also conducted a confirmatory factor analysis to ensure that the data were consistent with the assumption that all four measures are indicators of a single latent variable, BHR. Results were consistent with this assumption. A single-factor model had a good fit to the data in both the United States, $\chi^2(1, N = 1{,}037) = 6.42$, comparative fit index (CFI) = .985, normed fit index (NFI) = .982, goodness-of-fit index (GFI) = .997, root-mean-square error of approximation (RMSEA) = .072, and Japan, $\chi^2(1, N = 382) = 3.84$, CFI = .987, NFI = .983, GFI = .995, RMSEA = .086. Moreover, in both countries, this model had a significantly better fit than an alternative model that assumed that the four variables are distinct, $\chi^2(4, N = 1{,}037) = 334.60$, $p < .0001$, in the United States and $\chi^2(4, N = 382) = 201.10$, $p < .0001$, in Japan.

Control variables. We controlled for several confounding variables that have been linked to inflammation and cardiovascular risk (O'Connor et al., 2009): age, gender, health status (chronic conditions and WHR), and health behaviors of participants. For example, inflammatory biomarkers are associated with obesity and central adiposity (indexed by WHR), and other chronic health problems (e.g., diabetes) can also be specifically linked to inflammation and cardiovascular functioning (Mohamed, Winn, Rampal, Rashid, & Mustaffa, 2005). Our measure of chronic health conditions was the number of health problems (e.g., diabetes, asthma, tuberculosis; up to 30) respondents reported having experienced in the past 12 months. To reduce the effects of outliers ($n = 2$) and correct for positively skewed distribution, we log-transformed WHR after winsorizing scores to 3 standard deviations from the mean (calculated separately for each culture). Health behavior was assessed with smoking and alcohol consumption. Smoking status was categorized as "never smoker," "former smoker," and "current smoker"; alcohol consumption was measured by the number of drinks consumed per week. To reduce the effect of outliers for alcohol consumption ($n = 29$), we winsorized

scores to 3 standard deviations from the mean (calculated separately for each culture).

In a prior report (Miyamoto et al., 2013), we documented that one of the biomarkers used in the current work, IL-6, is related to experience of negative emotions. Whereas experience of negative emotions was linked to increased levels of IL-6 for Americans, there was no such relationship for Japanese. The index of negative emotional experience that we used in our prior study did not include anger. Nevertheless, to ensure that the effects predicted for anger expression were unique and distinct from the effects we documented previously for negative emotional experience, we controlled for negative emotional experience in the current study. Participants rated how often (1 = *none of the time*, 5 = *all the time*) they had felt each of six negative emotions (i.e., "so sad nothing could cheer you up," "nervous," "restless or fidgety," "hopeless," "that everything was an effort," and "worthless") during the past 30 days (Mroczek & Kolarz, 1998; αs = .85 and .86 for Americans and Japanese, respectively).

In the present study, we included two indices of social status (objective and subjective) that were used in our prior study (Park et al., 2013) as covariates. These variables were also used as moderators in the present study so as to test whether the predicted relationship between anger expression and BHR might differ as a function of social status. In our prior work, objective social status was assessed as a composite of educational attainment and occupational status. We adopted this composite index as our primary measure of objective social status in the present study, although we also performed separate analyses with educational attainment and occupational status as alternative indices to ensure that the results did not differ.

Because the educational system is different in the two cultures, educational attainment was originally assessed on culture-specific scales ranging from 1 (*8th grade, junior high school*) to 12 (*Ph.D. or other professional degree*) in the United States and from 1 (*8th grade, junior-high-school graduate*) to 8 (*graduate school*) in Japan. To make the scales comparable for the two cultural groups, we rescaled the scores to a 7-point scale (1 = *8th grade, junior high school*, 7 = *attended or graduated from graduate school*), as in our prior study (Park et al., 2013; see also Curhan et al., 2014). Current occupational status was assessed on a 3-point scale (1 = *manual, blue-collar, or service*, 2 = *nonmanual, white-collar, or clerical*, 3 = *managerial or professional*). To obtain a single indicator of objective social status, we standardized the measures of educational attainment and occupational status within each culture and then averaged the two standardized scores for each participant.

Subjective social status was assessed with a ladder instrument. As in prior research (e.g., Adler, Epel, Castellazzo, & Ickovics, 2000), participants were presented with a picture of a ladder that had 10 rungs (1 = *lowest*, 10 = *highest*; Goodman et al., 2001), and were asked to choose the rung corresponding to their standing in their "own community." What "community" meant was left open so that participants could base their choice on what made sense to them. The participants were thus allowed to employ culturally relevant criteria in judging their relative status (see also Leu et al., 2008) because social status is likely to have its greatest impact as a predictor when it is defined with respect to a community that is most meaningful to each individual (Conley, 2008).

Results

Table 3 presents descriptive statistics for the key variables for each cultural group. To test our prediction that the relationship between anger expression and BHR would be moderated by culture, we carried out a series of multiple regression analyses. In Step 1, all control variables were entered along with both culture and anger expression. In Step 2, the interaction between culture and anger expression was tested. In Step 3, we tested whether the Culture × Anger Expression interaction would be moderated by social status (both subjective and objective). The results of these analyses are summarized in Table 4.

As predicted, the interaction between culture and anger expression was statistically significant in Step 2, $b = -0.05$, $t(1337) = -3.56$, $p < .001$. As illustrated in Figure 1, the pattern previously observed in Western studies was replicated in the U.S. sample: Greater anger expression was related to increased BHR among Americans, $b = 0.02$, $t(1337) = 2.78$, $p < .01$. However, also as predicted, greater anger expression was linked to reduced BHR among Japanese, $b = -0.03$, $t(1337) = -2.29$, $p < .05$. As shown in Table 4, this interaction was not moderated by social-status indicators, $|t|$s$(1335) \leq 1.03$, ps $> .30$.

Next, we tested whether the Culture × Anger interaction would be observed for other facets of anger. We found a significant interaction between culture and anger suppression, $b = -0.03$, $t(1337) = -2.42$, $p < .05$. The pattern obtained was similar to, but somewhat attenuated compared with, the one observed for anger expression. Greater anger suppression was associated with reduced BHR for Japanese, $b = -0.02$, $t(1337) = -2.03$, $p < .05$. Unlike anger expression, however, anger suppression had only a negligible association with BHR for Americans, $b = 0.01$, $t(1337) = 1.08$, $p = .28$. Further, when we examined the two relevant interaction terms (Culture × Anger Expression, Culture × Anger Suppression) simultaneously as predictors of BHR, the Culture × Anger Expression interaction remained significant, $b = -0.04$, $t(1335) = -2.81$, $p < .01$, but the Culture × Anger Suppression interaction did not, $b = -0.02$, $t(1335) = -1.35$, $p > .18$. No significant interaction effects were observed for trait

Table 3. Descriptive Statistics for the Key Variables for Americans and Japanese

	Americans			Japanese		
Variable	*n*	*M*	*SD*	*n*	*M*	*SD*
Demographic variables						
Age (years)	1,054	58.04	11.62	382	55.47	14.04
Gender (number of females)	578			214		
Educational attainment	1,050	4.97	1.61	378	4.38	1.63
Health status						
Chronic conditions	1,054	2.30	2.34	377	2.31	2.02
WHR	1,052	0.89	0.10	382	0.83	0.08
Log WHR	1,052	−0.05	0.05	382	−0.08	0.04
Health behaviors						
Smoking status (%)	1,054			382		
Never smoker	600	56.9		185	48.4	
Former smoker	342	32.4		89	23.3	
Current smoker	112	10.6		82	21.5	
Missing	0	0		26	6.8	
Alcohol consumption	1,052	3.14	5.52	379	7.24	11.75
Experience of negative emotions	1,050	1.49	0.55	381	1.70	0.65
Social status						
Objective social status	1,050	0.00	1.00	378	0.00	1.00
Subjective social status	1,042	6.59	1.72	374	6.24	2.04
Anger index						
Anger expression	1,053	12.79	3.13	381	12.25	2.63
Trait anger	1,050	23.75	5.21	362	26.25	6.96
Anger suppression	1,052	14.60	4.07	380	14.44	3.68
Anger control	1,053	10.09	2.22	379	8.04	2.50
BHR factor score	1,037	.29	.85	382	−.78	.96
IL-6	1,044	2.79	2.79	382	1.64	2.11
Log IL-6	1,044	0.32	0.32	382	0.04	0.36
CRP (ug/ml)	1,040	2.70	4.28	382	0.76	2.00
Log CRP	1,040	0.14	0.50	382	−0.45	0.42
SBP (mm Hg)	1,053	131.01	17.87	382	121.64	19.95
Log SBP	1,053	2.11	0.06	382	2.08	0.07
Total cholesterol (mg/dl)	1,045	187.12	40.00	382	205.81	38.21
HDL cholesterol (mg/dl)	1,043	54.63	17.61	382	71.24	21.28
Total/HDL cholesterol	1,043	3.75	1.43	382	3.15	1.15
Log total/HDL cholesterol	1,043	0.55	0.15	382	0.47	0.14

Note: Educational attainment was assessed on a culturally matched 7-point scale (1 = *8th grade, junior high school*, 7 = *attended or graduated from graduate school*). The table presents raw data (before winsorizing) for waist-to-hip ratio (WHR), alcohol consumption, interleukin-6 (IL-6), C-reactive protein (CRP), systolic blood pressure (SBP), and total cholesterol. The biological-health-risk (BHR) factor score was obtained from a principal component analysis based on the four biomarkers (IL-6, CRP, SBP, total/HDL cholesterol), which yielded a single factor.

anger or anger control, $|t|$s < 1.67, ps > .10. These findings indicate that the hypothesized cultural moderation of the relationship between anger and BHR is evident primarily for the expressive facet of anger.

Discussion

The most important contribution of the present study is to provide evidence for a cultural moderation of the link between anger expression and BHR. As found in previous studies conducted in Western cultures, greater anger expression was associated with increased BHR among Americans. However, it was associated with reduced BHR among Japanese. This pattern was quite robust for the expressive facet of anger, but weak for anger suppression and negligible for trait anger and anger control.

Our work extends the pioneering work by Consedine et al. (2005, 2006). First, whereas Consedine et al. found that anger appeared to empower people with disadvantaged

Table 4. Regression Results: Predicting Biological Health Risk (BHR) From Culture, Anger Expression, Control Variables, and Social Status

	Step 1: all main effects (ΔR^2 = .413***)			Step 2: main effects plus two-way interaction term (ΔR^2 = .006***)			Step 3: main effects plus two- and three-way interaction terms (ΔR^2 = .001)		
Predictor	*b*	β	*t*(1338)	*b*	β	*t*(1337)	*b*	β	*t*(1335)
Culture	−0.79	−0.35	−14.44***	−0.81	−0.35	−14.72***	−0.81	−0.35	−14.43***
Anger expression	0.01	0.02	1.03	0.02	0.07	2.78**	0.02	0.07	2.79**
Age	0.01	0.16	6.62***	0.01	0.15	6.50***	0.01	0.15	6.51***
Gender	0.25	0.13	4.16***	0.26	0.13	4.30***	0.26	0.13	4.27***
Chronic conditions	0.03	0.07	2.87**	0.03	0.07	2.83**	0.03	0.07	2.88**
Log WHR	8.79	0.42	13.58***	8.77	0.42	13.61***	8.76	0.42	13.59***
Smoking status (never vs. former)	−0.05	−0.02	−0.92	−0.05	−0.02	−0.95	−0.05	−0.02	−0.94
Smoking status (never vs. current)	0.16	0.05	2.31*	0.16	0.06	2.36*	0.16	0.06	2.41*
Alcohol consumption	0.00	0.01	0.49	0.00	0.01	0.54	0.00	0.01	0.46
Experience of negative emotions	−0.06	−0.04	−1.48	−0.06	−0.03	−1.34	−0.06	−0.04	−1.42
Objective social status	−0.09	−0.09	−3.92***	−0.08	−0.08	−3.81***	−0.08	−0.08	−3.79***
Subjective social status	−0.02	−0.03	−1.35	−0.02	−0.03	−1.21	−0.02	−0.03	−1.23
Culture × Anger Expression				−0.05	−0.09	−3.56***	−0.05	−0.09	−3.43***
Culture × Anger Expression × Objective Social Status							−0.00	−0.01	−0.22
Culture × Anger Expression × Subjective Social Status							−0.01	−0.02	−1.03

Note: N = 1,351. The United States was coded as the referent group for the culture variable. WHR = waist-to-hip ratio.
*p < .05. **p < .01. ***p < .001.

social standing (i.e., ethnic minorities with low socioeconomic standing in U.S. society), our data show that anger is also related to improved health among Japanese in Japan (a majority group in Japan). Second, we tested both anger expression and trait anger, and found that trait anger is unlikely to constitute the primary health correlate, even though it can contribute to anger expression. Instead, it is the expressive facet of anger that is linked more directly to health effects. Third, whereas Consedine et al. assessed self-reported health, we used objectively measured biological risk factors to create our index of health outcome.

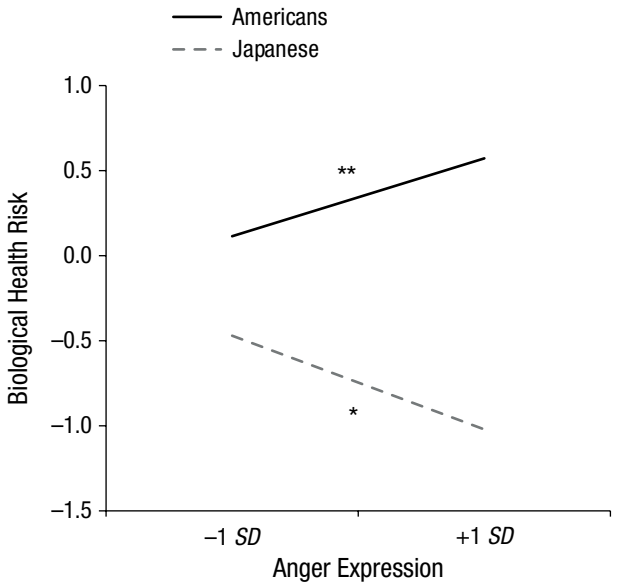

Fig. 1. Biological-health-risk factor score as a function of anger expression for Americans and Japanese. Higher numbers on the *y*-axis indicate greater biological health risk. In the analysis reported, demographic variables, health status, health behaviors, experience of negative emotions, and social-status indicators were controlled. Asterisks indicate statistically significant relationships (*p < .05, **p < .01).

The current evidence for the cultural moderation of the association between anger expression and BHR was obtained after controlling for a number of variables known to be associated with BHR, including age, gender, health status, health behaviors, and social status. Moreover, we also controlled for experience of negative emotions. In an earlier study (Miyamoto et al., 2013), we found that experience of negative emotions (which did not include anger) was positively linked to BHR (assessed with a single biomarker, IL-6) among Americans, but there was no such association among Japanese. The positive effect of anger expression on BHR observed among Americans in the present study is analogous to the effect we previously observed. However, in the current study, the effect was above and beyond the effect of negative emotions and thus distinct. Moreover, unlike our previous study, the current work showed a contrasting negative relationship between anger expression and BHR among Japanese. This novel finding casts doubt on the

currently dominant assumption that anger expression and hostility have adverse effects on health.

To account for these differing cultural patterns, we have hypothesized that the expression of anger in the two cultural contexts serves as a reliable index of different experiences. Whereas in the United States, it may index the degree to which individuals are exposed to negative events (e.g., life difficulties, annoyances, and frustrations), in Japan, it may index the degree to which individuals are empowered and entitled. Extending this reasoning, we suggest that potentially many factors other than social status can contribute to either negative experiences (in the case of the United States) or power and entitlement (in the case of Japan). For example, among individuals who are equally low in their social standing, one may experience additional life difficulties, such as a more demanding boss at work. In the United States, this person may experience more frustration than the others, and this additional frustration could lead to greater anger expression. Likewise, among individuals who are identical in high social standing, one may have additional sources of social dominance, such as subordinates at work who are docile and meek. In the Japanese context, this person may be more at liberty than the others to display anger because of his or her enhanced dominance and power. Our point is that anger expression is a complex phenomenon likely motivated by a variety of factors, many of which could be culture-specific. These cultural factors must be taken into account to achieve a full understanding of the link between anger and health.

One limitation of the current work is the cross-sectional nature of the design. It will be important to examine the longitudinal influence of anger expression on morbidity and mortality over time across different cultures. Such work will provide explicit tests of the mechanistic pathways linked with the biological risk factors we assessed here. Nevertheless, the current work is the first to draw on large, population-based, cross-cultural samples to test theoretically driven predictions regarding the association between anger expression and health. Moreover, our focus on multiple indices of BHR (inflammatory measures, cholesterol, and blood pressure) will likely stimulate further work on the interface between sociocultural processes and neurobiological processes. In particular, our finding that the association between anger expression and these health risks varies cross-culturally qualifies some simpler, unidirectional conclusions about the relationship between anger and health (Chida & Steptoe, 2009; Elovainio et al., 2011; Everson-Rose & Lewis, 2005). It thus highlights the importance of incorporating cultural perspectives into the analysis of anger expression, and especially its effects on physical health.

Author Contributions

S. Kitayama and J. Park conceived the study. J. Park carried out all data analysis. S. Kitayama and J. Park drafted the manuscript. J. M. Boylan, Y. Miyamoto, C. S. Levine, H. R. Markus, C. L. Coe, and C. D. Ryff provided critical revisions. M. Karasawa, N. Kawakami, and G. D. Love played significant roles in collecting the Japanese data. All authors participated in discussions of the manuscript. They have approved the final version of the manuscript for submission.

Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

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