Research Article

Psychological Science
2017, Vol. 28(10) 1468–1477

Reprints and permissions:
sagepub.com/journalsPermissions.nav
DOI: 10.1177/0956797617713309
www.psychologicalscience.org/PS

Linking Positive Affect to Blood Lipids: A Cultural Perspective

Jiah Yoo[1], Yuri Miyamoto[1], Attilio Rigotti[2], and Carol D. Ryff[1,3]
[1]Department of Psychology, University of Wisconsin–Madison; [2]School of Medicine, Pontifical Catholic University of Chile; and [3]Institute on Aging, University of Wisconsin–Madison

Abstract
Higher levels of positive affect have been associated with better physical health. While positive affect is seen as highly desirable among Westerners, East Asians tend to deemphasize positive affect. Using large probability samples of Japanese and U.S. adult populations, the present study examined the relations of positive affect with serum lipid profiles, known to be strongly predictive of risk for cardiovascular disease, and tested whether their associations depend on cultural contexts. As predicted, positive affect was associated with healthier lipid profiles for Americans but not for Japanese. Further analyses showed that this cultural moderation was mediated by body mass index. This study highlights the role of culture in the link between positive emotions and key biological risk factors of cardiovascular disease.

Keywords
positive affect, culture, cardiovascular health, lipids, open data, open materials

Received 4/11/16; Revision accepted 5/13/17

Prior studies indicate the beneficial influence of positive affect on health (Pressman & Cohen, 2005; Steptoe, Wardle, & Marmot, 2005). However, most findings to date have been based on Western samples. Because emotional experiences are differently shaped by cultural contexts (Mesquita & Leu, 2007), it is unclear whether the associations between positive affect and health are evident across cultures.

Culture and Positive Affect

Research has documented cultural differences in how positive emotions are viewed and valued (Markus & Kitayama, 1991; Tsai, Knutson, & Fung, 2006). In Western cultural contexts, characterized by independent cultural norms (Markus & Kitayama, 1991) and nondialectical beliefs (Peng & Nisbett, 1999), positive emotions are viewed as desirable (Miyamoto & Ma, 2011; Sims et al., 2015; Uchida & Kitayama, 2009). For example, positive emotions may signal having control over one's life (Kotchemidova, 2005). Similarly, individuals in Western cultures may be motivated to maximize positive affect and minimize negative affect (Miyamoto & Ma, 2011; Sims et al., 2015).

In East Asian cultures, positive affect is not always considered an ideal (Joshanloo & Weijers, 2014; Miyamoto & Ma, 2011; Sims et al., 2015; Spencer-Rodgers, Williams, & Peng, 2010). Feeling positive may negatively impact relational ties (Uchida & Kitayama, 2009). Moreover, Asians have dialectic beliefs that positive emotions are transitory and tend to have negative consequences on one's life (Miyamoto & Ma, 2011). Thus, East Asians may be less likely than Westerners to seek to maximize positive affect and minimize negative affect (Miyamoto & Ma, 2011; Miyamoto, Uchida, & Ellsworth, 2010). East Asians may also experience more mixed emotions during pleasant events, compared with Westerners, who report predominantly positive emotions in such situations (Sims et al., 2015).

Corresponding Author:
Jiah Yoo, University of Wisconsin, Department of Psychology, 1202 W. Johnson St., Madison, WI 53706
E-mail: jyoo32@wisc.edu

Cultural Variation in the Linkage of Positive Affect and Health

Given cultural norms regarding emotions, associations between health and positive feelings may differ across cultural contexts. Negative emotions have been robustly linked to mental and physical ill-being in Western cultures, in which negative internal states are seen as problematic (Kiecolt-Glaser, McGuire, Robles, & Glaser, 2002). In contrast, negative affect may be less detrimental to health in cultures in which experiencing negative emotion is viewed as a natural part of reality (Curhan et al., 2014). Miyamoto et al. (2013) showed that negative affect predicted elevated levels of interleukin-6, a proinflammatory marker conveying risk for clinical diseases, among American but not Japanese adults.

For positive affect, cultural differences between European Americans and Asian American immigrants moderated the negative association between positive emotions and depressive symptoms (Leu, Wang, & Koo, 2011). No study to date has directly compared the biological correlates of positive affect across cultures, although positive affect has been positively associated with self-rated health across numerous countries (e.g., Brazil, Japan, Mexico, Russia, the United States; Pressman, Gallagher, & Lopez, 2013). Self-rated health strongly predicts mortality and longevity, but possible mood biases may conflate links between positive affect and self-rated health (Watson & Pennebaker, 1989). Therefore, the current study examined cultural moderation on the linkage between positive affect and health, focusing on objective measures of cardiovascular risk (blood lipids) that are not susceptible to self-report biases. Cardiovascular disease (CVD) is the leading cause of death worldwide, but risk factors for CVD, including unhealthy lipid profiles, are considered to be modifiable by psychological and behavioral changes (Grundy et al., 1993).

Positive Affect and Healthy Lipid Profiles

Healthy lipid profiles consist of high levels of high-density lipoprotein cholesterol (HDL-C), low levels of low-density lipoprotein cholesterol (LDL-C) or triglycerides, and low ratios of total cholesterol to high-density lipoprotein cholesterol (TC/HDL-C), which are robust predictors of decreased CVD risk (e.g., Castelli et al., 1977; Lemieux et al., 2001). Previous studies with Western samples have linked positive psychosocial factors to healthy lipid profiles. Feeling happier predicted lower levels of total cholesterol (Rahe, Rubin, Gunderson, & Arthur, 1971), and greater positive affect predicted higher levels of HDL-C but not TC/HDL-C (Ryff et al., 2006). Western studies have also shown an association of higher mental vitality with lower total cholesterol (Richman, Kubzansky, Maselko, Ackerson, & Bauer, 2009) as well as a relation of greater optimism with higher HDL-C and lower triglycerides (Boehm, Williams, Rimm, Ryff, & Kubzansky, 2013).

Positive affect has rarely been studied as a correlate of lipids in East Asian populations, although one longitudinal study showed that Japanese men who reported enjoying their lives showed lower incidence of CVD after 10 years than Japanese men who reported not enjoying their lives (Shirai et al., 2009). Life enjoyment is not, however, equivalent to positive affect; it is closer in meaning to life satisfaction. The distinction between a global assessment of life and emotions is important in East Asian cultural contexts, in which life satisfaction is less strongly predicted by emotional experience and, instead, is more strongly linked to normative values of good life, compared with individualistic cultures (Suh, Diener, Oishi, & Triandis, 1998).

The Present Study

We used representative population samples from the United States and Japan to examine whether the linkage between positive affect and blood lipids would differ across Western and East Asian cultures. We hypothesized that positive affect would be positively associated with healthy lipid profiles in the United States, whereas this association would be weaker or absent in Japan.

We also explored potential mediators of this cultural moderation. Prior studies suggest that the cultural fit between one's psychological process and culturally prescribed values and beliefs may have motivational and relational benefits that propel people to make healthy lifestyle choices (Fulmer et al., 2010; Levine et al., 2016). Better cultural fit in emotional styles has been associated with better social relations (De Leersnyder, Mesquita, Kim, Eom, & Choi, 2014), which are known to help individuals make healthy lifestyle choices and engage in normative health behaviors (Cohen, Underwood, & Gottlieb, 2000).

Because positive affect is valued in Western cultural contexts, a high level of positive affect may motivate healthy behaviors. Studies with Western samples have linked positive affect to maintaining a healthy diet, not smoking, moderate alcohol consumption, and exercise (for a review, see Boehm & Kubzansky, 2012). Body mass index (BMI), which involves a constellation of health behaviors and genetic factors (Grilo & Pogue-Geile, 1991), has also been implicated in prior studies (e.g., Saloumi & Plourde, 2010). All such factors are known to affect lipid profiles (Grundy et al., 1993) and thus may help explain associations between positive affect and lipids among

Westerners. On the other hand, such patterns may be weak or absent in East Asian cultures, in which high levels of positive affect are not indicative of cultural fit and thus less likely to facilitate health behaviors.

Method

Participants

The American sample consisted of a subset of participants from the Midlife in the United States (MIDUS) study, a nationally representative survey of midlife and older adults first contacted in 1995 and 1996. The second wave of MIDUS was conducted in 2004 and had a 75% retention rate. Biological data were collected on a subset of MIDUS-2 participants who travelled to a general clinical research center at one of three sites for an overnight visit. A parallel Midlife in Japan (MIDJA) study was conducted in 2008 with a representative sample of midlife and older adults from the Tokyo metropolitan area. The present study used a subset of this sample who participated in clinic-based biological data collection. Only participants for whom positive affect and lipids data were available, 1,017 Americans (461 males, 556 females; mean age = 55.19 years) and 374 Japanese (165 male, 209 female; mean age = 54.26 years), were included in the analyses.

Measures

Positive affect. Participants rated how frequently they had felt each of 10 positive emotions during the past 30 days using a 5-point rating scale: *none of the time* (1), *a little of the time* (2), *some of the time* (3), *most of the time* (4), and *all the time* (5). The items were "cheerful," "in good spirits," "extremely happy," "calm and peaceful," "satisfied," "full of life," "enthusiastic," "attentive," "active," and "proud." Positive-affect scores represent the respondent's average rating of these items. The scale was reliable in the current study (α = .921).

Blood lipids. For HDL-C and total cholesterol, frozen blood samples from MIDUS were shipped to Meriter Labs (Madison, WI) and assayed with a Cobas Integra analyzer (Roche Diagnostics, Indianapolis, IN). HDL-C and total cholesterol of Japanese samples were assayed at Showa Lab (Tokyo, Japan) as well as Meriter Labs; the values from the two assay sites were comparable. We used HDL-C as well as TC/HDL-C as lipid indexes. Studies suggest that TC/HDL-C, as a single index, is the best predictor of a wide range of clinical manifestations of CVD because it indirectly reflects all proatherogenic lipoproteins beyond LDL (Lemieux et al., 2001). We did not include LDL-C and triglycerides because the fasting state of the two samples was different; for MIDUS, frozen sera of fasting samples were used for the assay, whereas for MIDJA, fresh sera of nonfasting samples were assayed at the Showa Lab within 24 hr of collection. Because triglycerides and calculated LDL-C values are particularly sensitive to fasting states (Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults, 2001), we included only HDL-C and TC/HDL-C in the final analysis.[1]

Control variables. The analyses controlled for variables known to be associated with lipid profiles. Demographic variables were age, gender, and years of education. Negative affect was included to ensure that positive affect was associated with lipids independently from negative emotions. Using the same rating scale as for positive affect, participants rated how much they had felt each of 11 negative emotions in the past 30 days: "so sad nothing could cheer you up," "nervous," "restless or fidgety," "hopeless," "that everything was an effort," "worthless," "afraid," "jittery," "irritable," "ashamed," and "upset." The ratings of the items were averaged into a single score. The alpha reliability was .906. To control for preexisting health status related to CVD, we asked participants whether they had been diagnosed by a physician as having any of four relevant chronic conditions: heart disease, hypertension, stroke, and diabetes (maximum = four conditions). We also controlled for use of cholesterol medications (yes/no) because it is known to strongly influence lipids (Baigent et al., 2005).

Health behaviors. Smoking, alcohol consumption, healthy eating, and BMI were included as potential covariates between the link of positive affect and lipid profiles. Smoking status was categorized into never smoked, formerly smoked, and currently smoke. The number of drinks consumed per week was used as an indicator of alcohol consumption. To measure nutritious eating, we included a healthy-eating index, computed partly following the Alternate Healthy Eating Index (AHEI) proposed by McCullough et al. (2002). Measures in the MIDUS and MIDJA studies allowed us to assess 6 of the 11 AHEI components: sugar-sweetened beverages, vegetables, fruits, nonmeat protein, beef and high-fat meat, and fish (for details about the index, see Levine et al., 2016). Finally, BMI, which is determined by the combination of lifestyle factors related to energy intake and expenditure, as well as genetic factors, was also included (Boehm et al., 2013; Raposa, Bower, Hammen, Najman, & Brennan, 2014).

Results

Descriptive statistics for the key variables are presented in Table 1. Variables with skewed distribution (alcohol

Table 1. Descriptive Statistics for Key Variables in the Japanese and American Samples

	Japanese			Americans		
Variable	*n*	*M*	*SD*	*n*	*M*	*SD*
Positive affect (score)	374	3.22	0.67	1,017	3.52	0.67
Lipid levels						
HDL-C (mg/dl)	374	71.28	21.31	1,017	54.49	17.54
TC/HDL-C	374	3.14	1.15	1,017	3.76	1.42
Covariates						
Age (years)	374	54.26	14.08	1,017	55.19	11.75
Gender[a]	374	1.56	0.50	1,017	1.55	0.50
Education (years)	370	13.64	2.40	1,015	14.58	2.43
Negative affect (score)	374	1.79	0.59	1,014	1.48	0.55
Use of cholesterol medication						
Yes	49			302		
No	325			715		
Number of chronic conditions	374	0.27	0.55	1,017	0.60	0.80
Health behaviors						
Smoking status						
Never smoked	182			583		
Formerly smoked	87			326		
Currently smoke	81			108		
Alcohol consumption (drinks/week)	371	7.31	11.84	1,014	3.15	5.50
BMI	374	22.60	2.96	1,017	29.19	6.02
Healthy eating index	359	20.68	2.55	1,015	17.25	2.68

Note: For alcohol consumption, body mass index (BMI), and high-density lipoprotein cholesterol (HDL-C), the table presents raw data before log transformation. TC/HDL-C = ratio of total cholesterol to high-density lipoprotein cholesterol. [a]Gender was coded 1 for male and 2 for female.

consumption, BMI, HDL-C) were log-transformed for further statistical analyses. See Table S1 in the Supplemental Material available online for the zero-order correlations between positive affect, health behaviors, and lipid outcomes in each culture.

Cultural moderation of the link between positive affect and lipids

A series of multiple regressions was run to test whether the association between positive affect and lipids was moderated by culture (coded as a binary variable; U.S. = .5, Japan = −.5). We centered positive affect at the mean within cultures. In the first model, culture, positive affect, and their interaction, as well as demographic variables, were entered. In the second model, negative affect was added. In the third model, health-status variables were entered as further controls. Each lipid variable was examined as a separate outcome variable.

Results of the regression models are shown in Table 2. There was a significant association between culture and two outcomes regardless of covariates. Americans were estimated to have lower HDL-C, $b = -0.119$, $t(1372) = -14.59$, $p < .001$, and higher TC/HDL-C, $b = 0.092$, $t(1372) = 9.97$, $p < .001$, compared with Japanese. There was no main effect of positive affect on HDL-C and TC/HDL-C.

As predicted, there were significant interactions between positive affect and culture for HDL-C, $b = 0.022$, 95% confidence interval (CI) = [0.001, 0.045], $\eta_p^2 = .03$, $t(1372) = 2.00$, $p = .046$, and TC/HDL-C, $b = -0.035$, 95% CI = [−0.060, −0.010], $\eta_p^2 = .05$, $t(1372) = -2.75$, $p = .006$. The pattern of these interactions on HDL-C and TC/HDL-C are illustrated in Figure 1. The effect sizes of the interactions were comparable with those of other variables, such as education and cholesterol medication, that have been linked to lipids. For example, the effect size of the interaction was about the half of the effect sizes of education for both lipid indexes (HDL-C: $\eta_p^2 = .06$; TC/HDL-C: $\eta_p^2 = .10$), larger than the effect size of cholesterol medication for HDL-C ($\eta_p^2 = .02$), and one third of the effect size of cholesterol medication for TC/HDL-C ($\eta_p^2 = .14$). Benjamini-Hochberg correction was applied to p values of the interaction between culture and positive affect in order to control the false discovery rate in multiple-hypotheses testing for two outcomes (Benjamini & Hochberg, 1995). The interactions for

Table 2. Results of the Regressions Predicting Levels of High-Density Lipoprotein Cholesterol (HDL-C) and Ratio of Total Cholesterol to High-Density Lipoprotein Cholesterol (TC/HDL-C)

	Model 1			Model 2			Model 3		
Outcome variable and predictor	b	p	η_p^2	b	p	η_p^2	b	p	η_p^2
HDL-C									
Culture	−0.124 (0.008)	< .001	.53	−0.125 (0.008)	< .001	.56	−0.119 (0.008)	< .001	.64
Positive affect	0.010 (0.006)	.087	.01	0.007 (0.007)	> .250	.01	0.008 (0.007)	> .250	.01
Culture × Positive Affect	0.023 (0.011)	.040	.02	0.023 (0.011)	.044	.02	0.022 (0.011)	.046	.03
Age	0.001 (0.000)	.013	.03	0.001 (0.000)	.020	.03	0.001 (0.000)	.001	.07
Gender	0.123 (0.007)	< .001	.59	0.124 (0.007)	< .001	.63	0.121 (0.007)	< .001	.67
Years of education	0.005 (0.001)	.001	.04	0.005 (0.001)	.001	.05	0.005 (0.000)	.001	.06
Negative affect				−0.006 (0.008)	> .250	< .01	−0.004 (0.008)	> .250	< .01
Chronic conditions							−0.010 (0.005)	.059	.02
Cholesterol medication							0.014 (0.009)	.100	.02
TC/HDL-C									
Culture	0.081 (0.009)	< .001	.28	0.086 (0.009)	.000	.30	0.092 (0.009)	< .001	.40
Positive affect	−0.013 (0.006)	.051	.02	−0.010 (0.008)	.214	.01	−0.009 (0.008)	> .250	.01
Culture × Positive Affect	−0.034 (0.013)	.008	.03	−0.033 (0.013)	.009	.03	−0.035 (0.013)	.006	.05
Age	−0.001 (0.000)	.006	.03	−0.001 (0.000)	.010	.07	0.000 (0.000)	> .250	.01
Gender	−0.102 (0.008)	< .001	.44	−0.103 (0.008)	< .001	.30	−0.107 (0.008)	< .001	.56
Years of education	−0.007 (0.002)	< .001	.07	−0.006 (0.002)	< .001	.01	−0.006 (0.002)	< .001	.10
Negative affect				0.007 (0.009)	> .250	.03	0.010 (0.009)	> .250	.01
Chronic conditions							−0.001 (0.006)	> .250	< .01
Cholesterol medication							0.048 (0.010)	< .001	.14

Note: Standard errors are given in parentheses. Culture was coded .5 for United States and −.5 for Japan. Gender was coded 1 for male and 2 for female. Cholesterol medication was coded 1 for yes and 2 for no.

HDL-C and TC/HDL-C remained significant after the adjustment.[2]

Subsequently, we conducted simple-slopes analyses in the fully adjusted model. Supporting our hypotheses, the results showed that positive affect predicted healthy lipid profiles across the outcomes for the U.S. sample. Positive affect was positively associated with HDL-C (b = 0.019, 95% CI = [0.005, 0.033], η_p^2 = .04, p = .008) and negatively associated with TC/HDL-C (b = −0.026, 95% CI = [−0.042, −0.010], η_p^2 = .07, p = .001). An increase of 1 standard deviation in positive affect predicted an increase of 3.328 mg/dL in HDL-C and a 0.52-unit decrease in TC/HDL-C among Americans. Prior studies have shown that an increase of 1 mg/dL of HDL-C is associated with a 3% decrease in the risk of coronary heart disease (Gordon et al., 1989), and a 1-unit decrease of TC/HDL-C is associated with a 53% decrease in the risk of myocardial infarction (Stampfer et al., 1996). Thus, the magnitude of the associations was clinically significant. Among the Japanese sample, on the other hand, there were no associations between positive affect and either of the lipid variables—HDL-C: b = −0.004, t(1372) = −0.36, p > .250; TC/HDL-C: b = 0.009, t(1372) = 0.73, p > .250.

Mediators of the cultural moderation between positive affect and lipids

Additional analyses examined whether health behaviors and BMI were mediators of the cultural moderation of the association between positive affect and lipids. We tested the mediation of all potential pathway variables (i.e., smoking, alcohol consumption, eating, BMI) in a fully adjusted model, using Model 8 in the PROCESS macro with SPSS (Hayes, 2013). We computed the estimates, standard errors, and significance values of the conditional indirect effects for lipids across two cultures, with 10,000 bootstrapped resamples. Benjamini-Hochberg-corrected p values were computed in order to control the false discovery rate in our multiple testing of eight hypotheses (four mediators and two outcomes).

The results of these analyses are summarized in Table 3. The indirect effect of positive affect on lipids through BMI was significantly moderated by culture (HDL-C: index = 0.008, 95% CI = [0.002, 0.015], p = .005; TC/HDL-C: index = −0.011, 95% CI = [−0.019, −0.003], p = .005). The results remained significant after we corrected for multiple testing. Figure 2 depicts our model,

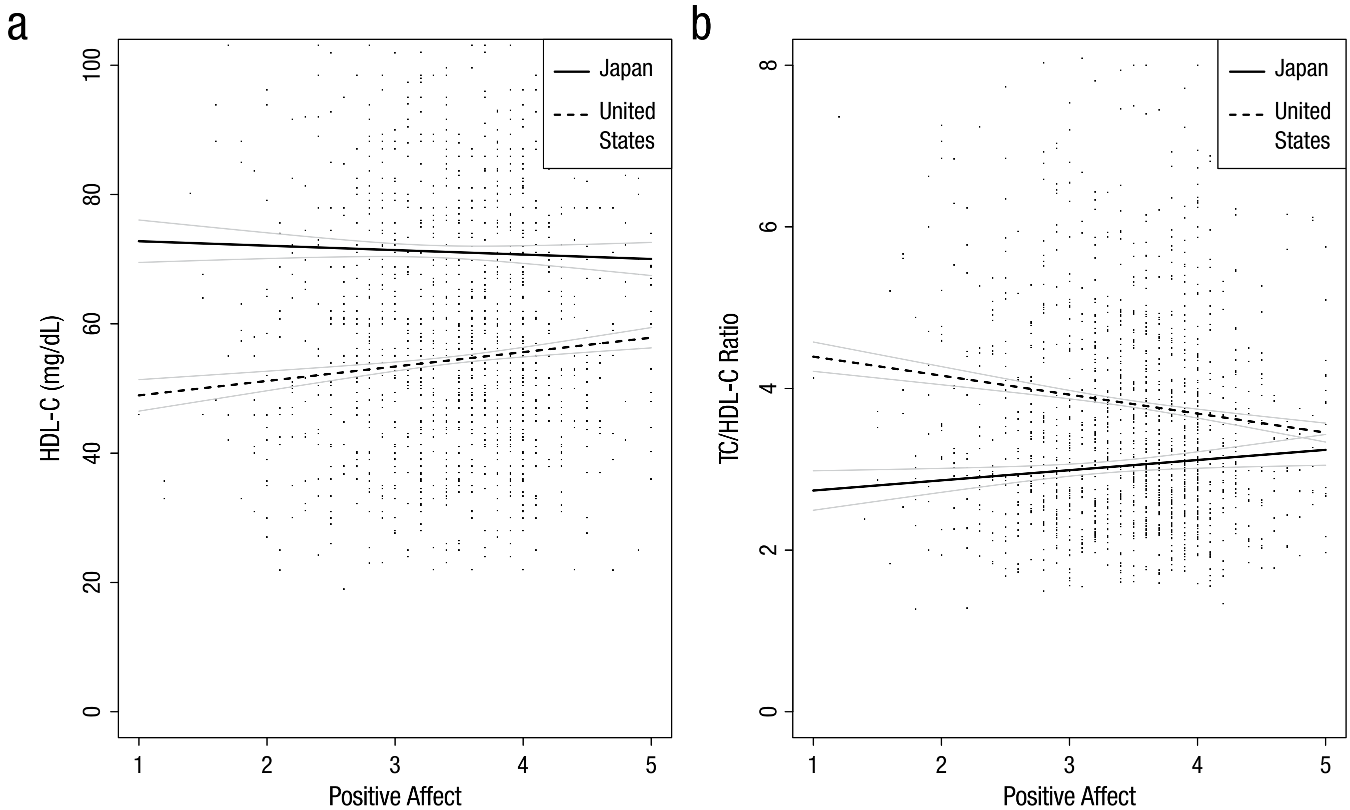

Fig. 1. Scatterplots showing the relation between positive affect and (a) high-density lipoprotein cholesterol (HDL-C) and (b) the ratio of total cholesterol to high-density lipoprotein cholesterol (TC/HDL-C), separately for Japanese and American adults. Best-fitting regression lines are shown for each cultural group; gray lines indicate 95% confidence intervals.

in which the cultural difference in the association between positive affect and lipids was mediated by the culturally divergent association between positive affect and BMI (see Fig. S1 in the Supplemental Material for regression coefficients on each mediation path). Higher positive affect was associated with higher HDL-C and lower TC/HDL-C through lower BMI for Americans (HDL-C: indirect effect = 0.008, bootstrapped SE = 0.003, 95% CI = [0.003, 0.014]; TC/HDL-C: indirect effect = −0.011, bootstrapped SE = 0.003, 95% CI = [−0.017, −0.004]), but not for Japanese (Table 3). The association between positive affect and BMI was significantly negative for Americans, $b = -0.016$, $t(1371) = -3.62$, $p < .001$, but not for Japanese, $b = 0.002$, $t(1371) = 0.256$, $p > .250$. On the other hand, BMI was negatively associated with healthy lipid profiles both for Japanese—HDL-C: $b = -0.807$, $t(1371) = -7.335$, $p < .001$; TC/HDL-C: $b = 1.166$, $t(1371) = 9.549$, $p < .001$—and Americans—HDL-C: $b = -0.502$, $t(1371) = -11.24$, $p < .001$; TC/HDL-C: $b = 0.611$, $t(1371) = 12.389$, $p < .001$. Therefore, the cultural moderation of the association between positive affect and BMI mediated the cultural differences in the link between positive affect and lipids. After BMI accounted for the cultural moderation, the direct effect of the Culture × Positive Affect interaction was significant only for TC/HDL-C, 95% CI = [−0.047, −0.0003]. That is, BMI partially mediated the cultural moderation on TC/HDL-C, while it fully mediated the cultural moderation on HDL-C. There was no conditional indirect effect of smoking, alcohol consumption, or healthy eating.

Table 3. Results of the Bootstrapping Analysis for the Mediated Moderation Model

	Conditional indirect effect of body mass index		Mediated moderation index
Outcome	Japanese	Americans	
HDL-C	−0.0002 (0.003) [−0.005, 0.005]	0.008 (0.003) [0.003, 0.014]	0.008 (0.003) [0.002, 0.015]
TC/HDL-C	0.0003 (0.003) [−0.006, 0.007]	−0.011 (0.003) [−0.017, −0.004]	−0.011 (0.004) [−0.019, −0.003]

Note: See Figure 2 for an illustration of the model. For each effect size, a bootstrapped standard error is given in parentheses, and a 95% confidence interval is given in brackets. An indirect effect is significant when the confidence interval does not contain zero. HDL-C = high-density lipoprotein cholesterol; TC/HDL-C = ratio of total cholesterol to high-density lipoprotein cholesterol.

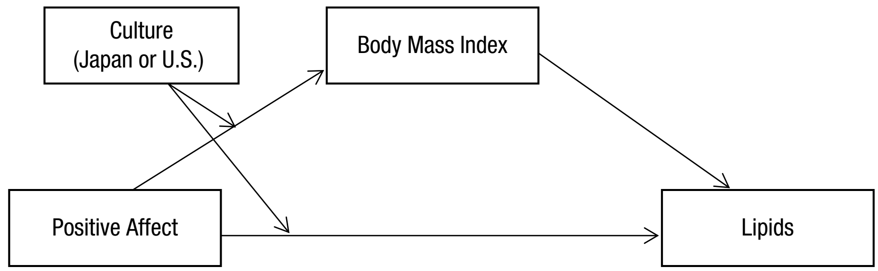

Fig. 2. Illustration of the model showing the influence of positive affect on healthy lipid profiles, as mediated by body mass index and moderated by culture (Model 8 in the PROCESS macro by Hayes, 2013).

Discussion

As predicted, the association between positive affect and healthy lipid profiles was evident among Americans for two indexes of blood lipids, but this association was not found among Japanese adults. These findings suggest that cultural contexts matter for understanding whether positive emotions are linked with better health.

Because cardiovascular disease is a leading cause of death worldwide and greatly affected by behavioral factors, its relationships with psychological factors have been extensively studied. Particularly, a recent review found that positive emotions, as a component of positive well-being, consistently predict cardiovascular health (Boehm & Kubzansky, 2012). However, no prior work has considered cultural contexts. The current study aimed to correct this omission and showed significant cultural differences in the association between positive emotions and lipids, highlighting the role of cultural meanings of emotional experiences. The results also complement and extend previous investigations on the cultural differences of the emotion-health linkage. Western and Asian cultural contexts were previously found to moderate the association between positive affect and mental health (Leu et al., 2011). Such moderation was not found for self-rated physical health (Pressman et al., 2013), however, which is a holistic judgment of health that may be influenced by one's positive affect (Watson & Pennebaker, 1989). Our findings underscore the importance of operationalizing health with objective measures that are free of possible mood effects.

We also found that BMI partially accounted for the culturally moderated link between positive affect and lipids. Given that BMI is an integrative pathway variable determined by a constellation of behaviors (e.g., eating, exercising, and overall lifestyle) and genetic factors (Grilo & Pogue-Geile, 1991), this finding suggests that multiple components rather than a single behavioral pathway may be involved in explicating the cultural moderation of the link between positive affect and lipids. Because no prior work documents associations between positive affect and genetic components of body weight, the links between positive affect and BMI found among Americans are likely due to behavioral components. In fact, a supplementary analysis showed that exercise partially mediated the link between positive affect and BMI among Americans (see the Supplemental Material).[3] These results are consistent with a theoretical prediction that a good fit between one's emotions and one's culturally prescribed values and beliefs may motivate a healthy lifestyle (Fulmer et al., 2010; Levine et al., 2016). Frequent experience of positive affect in the Western context would be aligned with prescribed values and beliefs and thus likely motivate engagement in and pursuit of healthy behaviors. In contrast, positive affect aligns less with norms and beliefs about positive affect in the East Asian context, and thus may not be associated with healthy behaviors. Put succinctly, the links between positive emotions on lipid levels appear to depend on cultural context, possibly because of different cultural norms about positive affect, which may implicate culturally specific health behaviors (indexed by BMI).

Prior studies showed the role of arousal levels in cultural values of positive emotions (Tsai et al., 2006). Following these results, we reason that the cultural differences in the association between positive affect and lipids may be contingent on the arousal levels of positive affect. However, the measure of positive affect in the current study mostly consisted of items that either assess highly aroused states (e.g., "enthusiastic") or are not reflective of arousal (e.g., "satisfied") and included only one low-arousal item (i.e., "calm and peaceful"). We thus could not test whether our findings were affected by the arousal levels of positive emotions. Future research to investigate this possibility with measures of both high-arousal and low-arousal positive affect is needed.

A key limitation of this study is that its cross-sectional design prevented the causal directionality between the variables from being determined. Longitudinal data are needed to examine whether positive affect causes better lipid profiles over time across cultures. Also, although our moderated mediation analyses illuminated the possible pathway in which positive affect is associated with lipids via BMI among Americans, future work based on longitudinal or interventional designs is needed to verify whether positive affect benefits BMI. Additionally, while BMI mediated the cultural moderation of the link between positive affect and lipids, other specific health behaviors did not mediate the effect. As noted earlier, this is likely because multiple behavioral components are responsible for the cultural moderation. At the same time, it is important for future work to include a wider array of health behaviors (e.g., exercise) to identify more specific behavioral pathways. Lastly, future research may employ different statistical methods conducted with latent variables (e.g., structural equation modeling) that tend to yield more accurate estimates of parameters than observed-variable models. Notwithstanding its shortcomings, this is the first study to find that positive affect is differentially related to objective indicators of cardiovascular health across cultures using population-based samples from two countries. A key takeaway is that culture likely shapes not only ideas and practices of emotions, but also how they are related to health. Our findings highlight the importance of incorporating cultural contexts in understanding the relationship between affect and health.

Action Editor

Ayse K. Uskul served as action editor for this article.

Author Contributions

J. Yoo developed the study concept. J. Yoo analyzed the data and drafted the manuscript under the supervision of Y. Miyamoto and C. D. Ryff. Critical revisions were provided by Y. Miyamoto, C. D. Ryff, and A. Rigotti. All the authors 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.

Funding

This research was supported by a grant from the National Institute on Aging to conduct the Midlife in Japan study (5R37AG027343) for comparative analysis with the Midlife in the United States study (P01-AG020166).

Supplemental Material

Additional supporting information can be found at http://journals.sagepub.com/doi/suppl/10.1177/0956797617713309

Open Practices

All data and materials have been made publicly available via the Inter-university Consortium for Political and Social Research (ICPSR) Web site and can be accessed at http://www.icpsr.umich.edu/icpsrweb/ICPSR/series/203/studies?archive=ICPSR&sortBy=7. The complete Open Practices Disclosure for this article can be found at http://journals.sagepub.com/doi/suppl/10.1177/0956797617713309. This article has received the badges for Open Data and Open Materials. More information about the Open Practices badges can be found at http://www.psychologicalscience.org/publications/badges.

Notes

1. It is worth noting that the exploratory analyses showed that the pattern of the results remained the same across different measures of lipids, including triglycerides and LDL-C.
2. Although we found significant Culture × Positive Affect interactions for both HDL-C and TC/HDL-C, the effect was particularly stronger for TC/HDL-C, which indicates that the cultural moderation appeared the most clearly when the cholesterol indexes were considered collectively.
3. The exercise measure was available only in the MIDUS study.

References

Baigent, C., Keech, A., Kearney, P. M., Blackwell, L., Buck, G., Pollicino, C., . . . Simes, R. (2005). Efficacy and safety of cholesterol-lowering treatment: Prospective meta-analysis of data from 90,056 participants in 14 randomised trials of statins. *The Lancet*, *366*, 1267–1278.

Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society, Series B (Methodological)*, *57*, 289–300.

Boehm, J. K., & Kubzansky, L. D. (2012). The heart's content: The association between positive psychological well-being and cardiovascular health. *Psychological Bulletin*, *138*, 655–691. https://doi.org/10.1037/a0027448

Boehm, J. K., Williams, D. R., Rimm, E. B., Ryff, C., & Kubzansky, L. D. (2013). Relation between optimism and lipids in midlife. *The American Journal of Cardiology*, *111*, 1425–1431.

Castelli, W. P., Doyle, J. T., Gordon, T., Hames, C. G., Hjortland, M. C., Hulley, S. B., . . . Zukel, W. J. (1977). HDL cholesterol and other lipids in coronary heart disease. The cooperative lipoprotein phenotyping study. *Circulation*, *55*, 767–772.

Cohen, S., Underwood, L. G., & Gottlieb, B. H. (Eds.). (2000). *Social support measurement and intervention: A guide for health and social scientists*. New York, NY: Oxford University Press.

Curhan, K. B., Sims, T., Markus, H. R., Kitayama, S., Karasawa, M., Kawakami, N., . . . Ryff, C. D. (2014). Just how bad negative affect is for your health depends on culture. *Psychological Science*, *25*, 2277–2280.

De Leersnyder, J., Mesquita, B., Kim, H., Eom, K., & Choi, H. (2014). Emotional fit with culture: A predictor of individual differences in relational well-being. *Emotion*, *14*, 241–245. doi:10.1037/a0035296

Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. (2001). Executive summary of the third report of the National Cholesterol Education Program (NCEP) expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (Adult Treatment Panel III). *JAMA*, *285*, 2486–2497.

Fulmer, A. C., Gelfand, M. J., Kruglanski, A. W., Kim-Prieto, C., Diener, E., Pierro, A., & Higgins, E. T. (2010). On “feeling right” in cultural contexts: How person-culture match affects self-esteem and subjective well-being. *Psychological Science*, *21*, 1563–1569.

Gordon, D. J., Probstfield, J. L., Garrison, R. J., Neaton, J. D., Castelli, W. P., Knoke, J. D., . . . Tyroler, H. A. (1989). High-density lipoprotein cholesterol and cardiovascular disease. Four prospective American studies. *Circulation*, *79*, 8–15.

Grilo, C. M., & Pogue-Geile, M. F. (1991). The nature of environmental influences on weight and obesity: A behavior genetic analysis. *Psychological Bulletin*, *110*, 520–531.

Grundy, S. M., Bilheimer, D., Chait, A., Clark, L. T., Denke, M., Havel, R. J., & KrisEtherton, P. (1993). Summary of the second report of the National Cholesterol Education Program (NCEP) expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (Adult Treatment Panel II). *Journal of the American Medical Association*, *269*, 3015–3023.

Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York, NY: Guilford Press.

Joshanloo, M., & Weijers, D. (2014). Aversion to happiness across cultures: A review of where and why people are averse to happiness. *Journal of Happiness Studies*, *15*, 717–735.

Kiecolt-Glaser, J. K., McGuire, L., Robles, T. F., & Glaser, R. (2002). Emotions, morbidity, and mortality: New perspectives from psychoneuroimmunology. *Annual Review of Psychology*, *53*, 83–107.

Kotchemidova, C. (2005). From good cheer to “drive-by smiling”: A social history of cheerfulness. *Journal of Social History*, *39*, 5–37.

Lemieux, I., Lamarche, B., Couillard, C., Pascot, A., Cantin, B., Bergeron, J., & Després, J. P. (2001). Total cholesterol/HDL cholesterol ratio vs LDL cholesterol/HDL cholesterol ratio as indices of ischemic heart disease risk in men: The Quebec Cardiovascular Study. *Archives of Internal Medicine*, *161*, 2685–2692.

Leu, J., Wang, J., & Koo, K. (2011). Are positive emotions just as “positive” across cultures? *Emotion*, *11*, 994–995.

Levine, C. S., Miyamoto, Y., Markus, H. R., Rigotti, A., Boylan, J. M., Park, J., . . . Ryff, C. (2016). Culture and healthy eating: The role of independence and interdependence in the United States and Japan. *Personality and Social Psychology Bulletin*, *42*, 1335–1348.

Markus, H. R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological Review*, *98*, 224–253.

McCullough, M. L., Feskanich, D., Stampfer, M. J., Giovannucci, E. L., Rimm, E. B., Hu, F. B., . . . Willett, W. C. (2002). Diet quality and major chronic disease risk in men and women: Moving toward improved dietary guidance. *The American Journal of Clinical Nutrition*, *76*, 1261–1271.

Mesquita, B., & Leu, J. (2007). The cultural psychology of emotion. In S. Kitayama & D. Cohen (Eds.), *Handbook of cultural psychology* (pp. 734–759). New York, NY: Guilford Press.

Miyamoto, Y., Boylan, J. M., Coe, C. L., Curhan, K. B., Levine, C. S., Markus, H. R., . . . Ryff, C. D. (2013). Negative emotions predict elevated interleukin-6 in the United States but not in Japan. *Brain, Behavior, and Immunity*, *34*, 79–85.

Miyamoto, Y., & Ma, X. (2011). Dampening or savoring positive emotions: A dialectical cultural script guides emotion regulation. *Emotion*, *11*, 1346–1357.

Miyamoto, Y., Uchida, Y., & Ellsworth, P. C. (2010). Culture and mixed emotions: Co-occurrence of positive and negative emotions in Japan and the U.S. *Emotion, 10*, 404–415. doi:10.1037/a0018430

Peng, K., & Nisbett, R. E. (1999). Culture, dialectics, and reasoning about contradiction. *American Psychologist*, *54*, 741–754.

Pressman, S. D., & Cohen, S. (2005). Does positive affect influence health? *Psychological Bulletin*, *131*, 925–971.

Pressman, S. D., Gallagher, M. W., & Lopez, S. J. (2013). Is the emotion-health connection a “first-world problem”? *Psychological Science*, *24*, 544–549.

Rahe, R. H., Rubin, R. T., Gunderson, E. K., & Arthur, R. J. (1971). Psychologic correlates of serum cholesterol in man: A longitudinal study. *Psychosomatic Medicine*, *33*, 399–410.

Raposa, E. B., Bower, J. E., Hammen, C. L., Najman, J. M., & Brennan, P. A. (2014). A developmental pathway from early life stress to inflammation: The role of negative health behaviors. *Psychological Science*, *25*, 1268–1274.

Richman, L. S., Kubzansky, L. D., Maselko, J., Ackerson, L. K., & Bauer, M. (2009). The relationship between mental vitality and cardiovascular health. *Psychology & Health*, *24*, 919–932.

Ryff, C. D., Love, G. D., Urry, H. L., Muller, D., Rosenkranz, M. A., Friedman, E. M., . . . Singer, B. (2006). Psychological well-being and ill-being: Do they have distinct or mirrored biological correlates? *Psychotherapy and Psychosomatics*, *75*, 85–95.

Saloumi, C., & Plourde, H. (2010). Differences in psychological correlates of excess weight between adolescents and young adults in Canada. *Psychology, Health & Medicine*, *15*, 314–325.

Shirai, K., Iso, H., Ohira, T., Ikeda, A., Noda, H., Honjo, K., . . . Tsugane, S. (2009). Perceived level of life enjoyment and risks of cardiovascular disease incidence and mortality: The Japan Public Health Center-Based Study. *Circulation*, *120*, 956–963. doi:10.1161/CIRCULATIONAHA.108.834176

Sims, T., Tsai, J. L., Jiang, D., Wang, Y., Fung, H. H., & Zhang, X. (2015). Wanting to maximize the positive and minimize the negative: Implications for mixed affective experience in American and Chinese contexts. *Journal of Personality and Social Psychology*, *109*, 292–315.

Spencer-Rodgers, J., Williams, M. J., & Peng, K. (2010). Cultural differences in expectations of change and tolerance for contradiction: A decade of empirical research. *Personality and Social Psychology Review*, *14*, 296–312.

Stampfer, M. J., Krauss, R. M., Ma, J., Blanche, P. J., Holl, L. G., Sacks, F. M., & Hennekens, C. H. (1996). A prospective study of triglyceride level, low-density lipoprotein particle diameter, and risk of myocardial infarction. *Journal of the American Medical Association*, *276*, 882–888.

Steptoe, A., Wardle, J., & Marmot, M. (2005). Positive affect and health-related neuroendocrine, cardiovascular, and inflammatory processes. *Proceedings of the National Academy of Sciences*, *USA*, *102*, 6508–6512.

Suh, E., Diener, E., Oishi, S., & Triandis, H. C. (1998). The shifting basis of life satisfaction judgments across cultures: Emotions versus norms. *Journal of Personality and Social Psychology*, *74*, 482–493.

Tsai, J. L., Knutson, B., & Fung, H. H. (2006). Cultural variation in affect valuation. *Journal of Personality and Social Psychology*, *90*, 288–307.

Uchida, Y., & Kitayama, S. (2009). Happiness and unhappiness in East and West: Themes and variations. *Emotion*, *9*, 441–456. doi:10.1037/a0015634

Watson, D., & Pennebaker, J. W. (1989). Health complaints, stress, and distress: Exploring the central role of negative affectivity. *Psychological Review*, *96*, 234–254. doi:10.1037/0033-295X.96.2.234