Socio-economic Development and Emotion-health Connection Revisited: Data from 162 Counties in China

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2015.10.09
Abstract

Substantial research has shown that emotions play a critical role in physical health. However, most of these studies were conducted in industrialized countries and it is still an open question whether emotion-health connection is a “first-world problem”. In current study, we examined socio-economic development’s influence on emotion-health connections using a dataset of 33,600 individuals from 162 counties in China, which naturally controls for confounding variables (e.g. language, culture) inherent in previous cross-national comparisons. Results showed that both positive emotions and negative emotions predicted level of physical health and regional Gross Domestic Product Per Capita (GDPPC) had some impact on the association between emotion and health through accessibility of medical resources and educational status. But these impacts were suppressed, and the total effects of GDPPC on emotion-health connections were not significant. These results support the universality of emotion-health connections across levels of GDPPC and provide new insight into how socio-economic development might affect these connections.

Keywords

GDP; Emotion-health Connection; Accessibility of Medical Resources; Educational Status

A great deal of evidence have suggested that emotions play a critical role in physical health, such that negative emotions (NE) are detrimental while positive emotions (PE) are beneficial (e.g., Fredrickson, 2003; Kiecolt-Glaser, McGuire, Robles, & Glaser, 2002; Pressman & Cohen, 2005). One caveat in this literature, however, is that most of the existing studies were conducted in industrialized countries. As suggested by Pressman, Gallagher, and Lopez (2013), people in
developed countries have met the more basic needs such as safety and physiological needs and focus more on their emotional well-being than those in developing countries. To test whether emotion-health connection is indeed a “first-world problem”, they analyzed a dataset of 150,048 individuals from 142 countries. The results didn’t support their original speculation, indicating that both NE and PE could independently and significantly predict physical health regardless of countries’ Gross Domestic Product (GDP) per capita, even after controlling for fulfillments of basis need. However, PE-health link was found to be stronger in countries with lower GDP per capita, suggesting that a country’s level of development might have some impact on emotion-health connection.

One shortcoming of such cross-national analyses, however, is that they are vulnerable to confounding factors. For example, countries’ level of socio-economic development is correlated with culture (Hofstatde, 1980, 2011; Cox, Friedman, & Tribunella, 2011). While some researchers have found weaker emotion-health connection in Eastern cultures (e.g., Curhan et al., 2014; Miyamoto et al., 2013; Miyamoto & Ryff, 2011), others have found the reverse pattern (e.g., Pressman, Gallagher, Lopez, & Campos, 2014). Even though there is no consensus regarding culture’s role in emotion-health relationship, it could potentially hinder testing the moderating effect of development level.

In the study reported here, we used a representative dataset collected in China to examine whether socio-economic development (indexed by regional GDP per capita) affects strength of emotion-health connection. China is a fitting natural test case because it is more ethnically and politically unified than other regions in the world (e.g. such as Europe or America) with more than 90% of its population belongs to Han nationality (e.g., Talhelm et al., 2014). Data from a single ethnicity naturally controls for many confounding variables (e.g., language, culture) inherent in cross-national comparisons, thus providing a more rigorous test of whether and how emotion-health connection is moderated by social-economic development. Furthermore, development is uneven in China and levels of regional GDPs cover both ends of the spectrum from “third-world” to “first-world”. For example, the GDP per

Besides testing the “first-world problem” hypothesis, we looked further into some possible mechanisms which may account for the effect of economic development on the linkage between emotion and health. Pressman et al. (2013) interpreted the weaker PE-health connection in developed countries as medical interventions downgrading the impact of emotion on health. In current study, we tested whether accessibility of medical resources could explain GDP’s effect on emotion-health link. Furthermore, socio-economic development is linked with educational status, which could facilitate emotion-regulation ability (e.g., Boylan & Ryff, 2013), thus also weakening the association between emotion and health.

Method

Participants

The data used in this study was collected in 2010 by the Institute of Social Science Survey of Peking University (extensive information about the survey can be found at www.isss.edu.cn/cfps/) for the China Family Panel Studies which focused on the economic, as well as the non-economic, wellbeing of the Chinese population, and promised to provide the most comprehensive and highest-quality survey data in contemporary China (e.g., Hvistendahl, 2010, 2013; Xie & Zhou, 2014).

Participants were 33,600 individuals (17,314 females, 16,286 males; age ranging from 16 to 110 years old, M = 45.51, SD = 16.41) from 162 counties of 25 provinces in China, the mean size of the county sample was 207.41 (range = 43 – 443). 30,763 participants self-identified as ethnic Han Chinese, 2756 as non-Han minorities, and 81 respondents did not report their ethnic. In order to exclude the effect of culture, we analyzed only Han Chinese (e.g., Talhelm et al., 2014).

Measure

Positive emotion. PE was measured with a single self-report five-point happiness item enquiring whether individuals were happy. Previous studies have found evidence pertaining to the validity of such single-item measure (Oswald & Wu, 2010).
Negative emotion. NE was measured with six items asking how often one felt depressed, agitated or upset, nervous, hopeless about future, felt that everything was difficult or thought life was meaningless in the past month. Cronbach's Alpha of these six items is 0.932.

Health. Self-reported health was assessed with one question regarding whether individuals were satisfied or dissatisfied with their personal health. Responses were recoded so that higher scores indicated superior health.

Socio-economic development. Gross domestic product Per capita (GDPPC) was used as an indicator of socio-economic development. The data of GDPPC was provided by the China Family Panel Studies, and the levels of GDPPC across 162 counties range from CNY 3,191(≈ USD 519) to CNY 320,026(≈ USD 52,068).

Educational status. Educational status was measured as participant’s total years of education.

Accessibility of medical resources. The extent to which medical resources was accessible was measured reversely by the travel time to nearest health facility.

Controlling variables. Individual health behavior (e.g., ever drunk/smoked or not) and other demographic variables (e.g., age, gender, job status, individual income, family size, family income per capita, marriage situation and living in urban or not) were included as covariates.

Data analysis
The relationships between GDP and the emotion-health connection were analyzed in two steps. First, we computed the correlation coefficient of PE/NE and self-reported physical health within each of the 162 counties in China, and computed the summary effect of these correlations. Second, we used a multilevel random-coefficient model (Raudenbush & Bryk, 2002) to test whether and how GDPPC moderated the association between physical health and emotions. In this model, positive emotion, negative emotion, years of education, travel time to nearest health facility and controlling variables were placed in individual-level regression model as predictors. In order to test the mechanism of how GDPPC moderated the emotions-physical health connection, educational status and accessibility of medical
resources were also added into county-level slope model to predict PE-health and NE-health connection, and Sobel test was carried out to assess the indirect effects of GDPPC→mediator→emotion-health. Recent development in mediation analysis suggests that indirect effect of X→M→Y can be directly tested in absence of a statistically significant total effect of X→Y (Hayes, 2009), therefore we tested GDP’s indirect effects on emotion-health connections through accessibility of medical resources and educational status regardless of the total effects’ significance. Individual income, family income per capita (FIPC) and GDPPC are logarithmically transformed (e.g., Kahneman & Deaton, 2010) and all non-dichotomous predictors were grand-mean-centered and entered as random slopes.

Result

Regional emotion-health correlations

Among 162 counties in China, PE was a strong positive predictor of health in 112 counties (59 counties at p<.01 level and 53 counties at p<.05 level), and NE was a strong negative predictor of health in 144 counties (139 counties at p<.01 level and 5 counties at p<.05 level). In the random effect analysis of the overall effect size, we found a significant positive correlation between PE and physical health (r = .202, 95% CI [.19, .22], Z=25.94, p<.001) and a significant negative correlation between NE and physical health(r= -.3458, 95% CI [-.36, -.33], Z=-35.52, p<.001). Test of heterogeneity suggested that both PE-health connection and NE-health connection significantly varied from county to county (Q=325.08, df=161, p<.001; Q=620.34, df=161, p<.001, respectively).

Moderating effect of GDP per capita on emotion-health correlation

At individual-level, positive emotion, education status, individual income, family income per capita and family size were significantly positive predictors of physical health, while age, unhealthy behaviors were significantly negative predictors of physical health. It was also found that BMI, job status and marriage status were significantly predictors of physical health (see Table 1 for details).
<table>
<thead>
<tr>
<th>Effects</th>
<th>Estimate</th>
<th>S.E.</th>
<th>Est./S.E.</th>
<th>95% CI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>intercept of health</td>
<td>3.952</td>
<td>0.041</td>
<td>96.680</td>
<td>[3.872, 4.032]</td>
<td>0.000</td>
</tr>
<tr>
<td>GDPPC coefficient</td>
<td>-0.117</td>
<td>0.065</td>
<td>-1.783</td>
<td>[-0.245, 0.012]</td>
<td>0.075</td>
</tr>
<tr>
<td>Slope of PE</td>
<td>0.089</td>
<td>0.006</td>
<td>14.013</td>
<td>[0.077, 0.102]</td>
<td>0.000</td>
</tr>
<tr>
<td>gdpper coefficient</td>
<td>0.019</td>
<td>0.016</td>
<td>1.241</td>
<td>[-0.011, 0.050]</td>
<td>0.215</td>
</tr>
<tr>
<td>AMR coefficient</td>
<td>0.002</td>
<td>0.001</td>
<td>3.055</td>
<td>[0.001, 0.003]</td>
<td>0.002</td>
</tr>
<tr>
<td>ES coefficient</td>
<td>-0.004</td>
<td>0.002</td>
<td>-2.326</td>
<td>[-0.008, 0.001]</td>
<td>0.020</td>
</tr>
<tr>
<td>Slope of NE</td>
<td>-0.073</td>
<td>0.003</td>
<td>-26.988</td>
<td>[-0.078, 0.068]</td>
<td>0.000</td>
</tr>
<tr>
<td>GDPPC</td>
<td>0.002</td>
<td>0.009</td>
<td>0.274</td>
<td>[-0.015, 0.019]</td>
<td>0.784</td>
</tr>
<tr>
<td>AMR coefficient</td>
<td>-0.001</td>
<td>0.001</td>
<td>-1.608</td>
<td>[-0.002, 0.000]</td>
<td>0.108</td>
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<tr>
<td>ES coefficient</td>
<td>0.004</td>
<td>0.002</td>
<td>2.014</td>
<td>[0.000, 0.007]</td>
<td>0.044</td>
</tr>
<tr>
<td>Slope of gender</td>
<td>0.145</td>
<td>0.013</td>
<td>10.951</td>
<td>[0.119, 0.171]</td>
<td>0.000</td>
</tr>
<tr>
<td>Slope of age</td>
<td>-0.014</td>
<td>0.001</td>
<td>-25.528</td>
<td>[-0.015, -0.013]</td>
<td>0.000</td>
</tr>
<tr>
<td>Slope of education</td>
<td>0.006</td>
<td>0.002</td>
<td>3.894</td>
<td>[0.003, 0.009]</td>
<td>0.000</td>
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<tr>
<td>Slope of AMR (individual-level)</td>
<td>0.001</td>
<td>0.001</td>
<td>2.612</td>
<td>[0.001, 0.002]</td>
<td>0.009</td>
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<tr>
<td>Slope of income</td>
<td>0.058</td>
<td>0.011</td>
<td>5.282</td>
<td>[0.036, 0.079]</td>
<td>0.000</td>
</tr>
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<td>Slope of FIPER</td>
<td>0.097</td>
<td>0.017</td>
<td>5.546</td>
<td>[0.062, 0.131]</td>
<td>0.000</td>
</tr>
<tr>
<td>Slope of family size</td>
<td>0.017</td>
<td>0.004</td>
<td>4.652</td>
<td>[0.010, 0.025]</td>
<td>0.000</td>
</tr>
<tr>
<td>Slope of having job</td>
<td>0.121</td>
<td>0.015</td>
<td>8.231</td>
<td>[0.092, 0.150]</td>
<td>0.000</td>
</tr>
<tr>
<td>Slope of Retired</td>
<td>0.054</td>
<td>0.059</td>
<td>0.916</td>
<td>[-0.061, 0.169]</td>
<td>0.359</td>
</tr>
<tr>
<td>Slope of housework</td>
<td>0.177</td>
<td>0.026</td>
<td>6.696</td>
<td>[0.125, 0.229]</td>
<td>0.000</td>
</tr>
<tr>
<td>Slope of Rich, at home</td>
<td>0.201</td>
<td>0.069</td>
<td>2.897</td>
<td>[0.065, 0.337]</td>
<td>0.004</td>
</tr>
<tr>
<td>Slope of drink</td>
<td>-0.255</td>
<td>0.028</td>
<td>-9.281</td>
<td>[-0.309, 0.202]</td>
<td>0.000</td>
</tr>
<tr>
<td>Slope of Smoking</td>
<td>-0.173</td>
<td>0.024</td>
<td>-7.144</td>
<td>[-0.221, 0.126]</td>
<td>0.000</td>
</tr>
<tr>
<td>BMI≥25</td>
<td>-0.045</td>
<td>0.015</td>
<td>-2.972</td>
<td>[-0.075, 0.015]</td>
<td>0.003</td>
</tr>
<tr>
<td>BMI&lt;18</td>
<td>-0.209</td>
<td>0.023</td>
<td>-9.126</td>
<td>[-0.254, 0.164]</td>
<td>0.000</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th></th>
<th>Intercept</th>
<th>Slope</th>
<th>SE</th>
<th>95% CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slope of married</td>
<td>intercept</td>
<td>-0.094</td>
<td>0.023</td>
<td>-4.017</td>
<td>0.000</td>
</tr>
<tr>
<td>Slope of widowed or divorced</td>
<td>intercept</td>
<td>0.059</td>
<td>0.035</td>
<td>1.681</td>
<td>0.093</td>
</tr>
<tr>
<td>AMR at county-level</td>
<td>intercept</td>
<td>-0.233</td>
<td>0.430</td>
<td>-0.541</td>
<td>0.588</td>
</tr>
<tr>
<td></td>
<td>GDPPC coefficient</td>
<td>5.367</td>
<td>0.976</td>
<td>5.499</td>
<td>0.000</td>
</tr>
<tr>
<td>ES at county-level</td>
<td>intercept</td>
<td>0.073</td>
<td>0.131</td>
<td>0.593</td>
<td>0.553</td>
</tr>
<tr>
<td></td>
<td>GDPPC coefficient</td>
<td>3.577</td>
<td>0.298</td>
<td>12.017</td>
<td>0.000</td>
</tr>
</tbody>
</table>

AMR = Accessibility of medical resources; GDPPC = GDP per capita; ES = Educational status; all non-dichotomous predictors were grand-mean-centered.

At county-level, GDPPC was a significant negative predictor of the intercept of physical health ($\gamma = -0.148$, SE=0.066, 95% CI [-0.277, -0.020], p=0.024). Critically, the direct effect of GDPPC on PE-health relationship did not significant ($\gamma = 0.015$, SE=0.014, 95% CI [-0.013, 0.044], p>.250), nor NE-health relationship ($\gamma = 0.010$, SE=0.006, 95% CI [-0.003, 0.022], p=.120).

**Mediating roles of accessibility of medical resources and educational status**

As shown in Fig. 1, GDPPC was a significant predictor of years of education and accessibility of medical resources ($\gamma = 3.577$, SE=.298, 95% CI [2.994, 4.160], p=.000; $\gamma = 5.367$, SE=.976, 95% CI [3.454, 7.280], p<.001, respectively). Adding these two variables in county-level slope model of GDP-emotion-health yielded that NE-health connection was significantly affected by years of education ($\gamma = .004$, SE=.002, 95% CI [.000, .006],p=.044) but not by accessibility of medical resources ($\gamma =-.001$, SE=.001, 95% CI [-.002, .000],p=.110). PE-health connection, on the other hand, was significantly affected by both educational status ($\gamma =-.004$, SE=.002, 95% CI [-.008, -.001], p=.020) and accessibility of medical resources ($\gamma =.002$, SE=.001, 95% CI [.001, .003], p=.002). analysis of residual variances showed that NE-health wasn’t fully explained ($\varepsilon=0.001$, SE=0.000, 95% CI [.000, .001], p<.001), while PE-health was ($\varepsilon=0.000$, SE=0.000, 95% CI [.000, .000], p>.250).

To exam whether educational status and medical resources are indeed mediating the relationship between GDPPC and emotions-physical health, we carried out Sobel
test on the indirect effects. For educational status, both the indirect effects of GDPPC→years of education→PE-health connection and GDPPC→years of education→NE-health connection were significant (γ=-.015, SE=.007, 95% CI [-.028, -.002], p=.022, and γ=.013, SE=.006, 95% CI [.000, .025], p=.047, respectively). For accessibility of medical resources, the indirect effect of GDPPC→accessibility of medical resources→PE-health connection was significant (γ=0.009, SE=0.003, 95% CI [.002, .016], p=.008), while the indirect effect of GDPPC→accessibility of medical resources→NE-health connection was not (γ=-0.004, SE=0.003, 95% CI [-.010, .001], p=.123).

Educational status and accessibility of medical resources fully mediated the effects of GDPPC on emotions-health connections such that GDPPC’s direct effects were still non-significant after adding the two variables (γ= 0.019, SE= 0.016, 95% CI [-.011, .050], p=.215, and γ= 0.002, SE= 0.009, 95% CI [-.015, .019], p>.250). Furthermore, neither the total effect of GDPPC on PE-health relationship nor the total effect of GDPPC on NE-health relationship was significant (γ=0.076, SE= 0.046, 95% CI [-.015, .167], p=.100, and γ=0.015, SE=0.022, 95% CI [-.028, .058], p>.250, respectively).

Fig. 1. Mediation model showing the relationships between GDPPC and emotion-health connection as mediated by accessibility of medical resources and educational status. In this multilevel random-coefficient model, positive emotion, negative emotion and health were individual-level variables, and GDPPC, educational status and accessibility of medical resources were county-level.
variables. Unstandardized regression coefficients are shown, and standard errors are given in parentheses. One asterisks indicate significant coefficients ($p < .05$), two asterisks indicate significant coefficients ($p < .01$).

### Discussion

Using a large-scale dataset collected from a representative sample in China, we replicated Pressman et al.’s (2013) finding that both PE and NE could independently and significantly predict self-reported health, once again showing that emotions play a critical role in physical health. Contrary to their results, however, neither PE-health connection nor NE-health connection was moderated by regional GDPPC. Given that our data was collected within a single nation, which naturally controlled for many confounding factors such as culture (Curhan et al., 2014; Kitayama et al., 2015; Pressman et al., 2013), the current study provided a more rigorous test of socio-economic development’s effect on the association between emotion and health, and suggested that emotion-health connection is not after all a ‘first-world problem’.

Despite of the non-significance of GDPPC’s total effects on emotion-health connections, several mediating pathways through accessibility of medical resources and educational status were confirmed. To interpret GDP’s moderation effect on PE-health connection in their results, Pressman et al. (2013) proposed that in developed regions’ medical interventions downgraded the impact of emotions on health. Our empirical test of the pathway showed that it was statistically significant, but in opposite direction: GDPPC predicted easier accessibility of medical resources, which actually strengthened PE-health connection. One interpretation is that positive emotion might promote people to utilize available medical resources to deal with physical problem. In addition, educational status showed a significant mediating effect between GDPPC and PE-health, such that higher GDPPC was linked with higher educational status, which in turn predicted weaker association between PE and health. Previous studies have shown that education could facilitate emotion-regulation ability (e.g., Boylan & Ryff, 2013), which might in turn downgrades emotions’ impact on health. This interpretation is also applicable to NE-health connection, which shifted closer to zero as educational status increased. Overall, these results provide
new insight into the underlying mechanism through which socio-economic
development might affect emotion-health connection. Beyond the two mediators
examined here, other pathways in opposite direction may also exist that renders the
total effects of socio-economic development on emotion-health connections to be
non-significant, which is worthy of future research.

Although using sample from single country rules out many potential
confounding factors, it also leaves one to wonder whether characteristics of the
specific country could affect the results and whether they can be generalize to other
countries. For example, previous cultural psychological studies showed that in
Western cultures, emotions are the reflection of inner world, while in East Asian
cultures they are more affected by the social relationships and interpreted as products
of situation (Chentsova-Dutton & Tsai, 2010; Curhan et al., 2014; Kitayama et al.,
2015; Uchida, Townsend, Markus, & Bergsieker, 2009), and such different
approaches towards emotion may in turn affect emotion-health connection. However,
existing studies on cultural differences are limited in number and yielded mixed
results (e.g., Curhan et al., 2014; Miyamoto et al., 2013; Miyamoto & Ryff, 2011;
Pressman et al., 2014). Future studies could try to measure culture variables directly
and examine their impact on emotion-health connection.

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