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# Climatic effects on the sociocultural and psychological adaptation of migrants within China: A longitudinal test of two competing perspectives

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Little is known about how climatic differences may psychologically impact individuals who migrate from one geographical area to another. A climatic demand theory perspective suggests that migration from more demanding climatic areas to less demanding climatic areas would lead to better psychological outcomes while predicting the opposite for migration from less demanding to more demanding climates. In contrast, a climatic-fit perspective would predict that moving to areas that climatically are similar to one's home would lead to the best psychological outcomes whereas any major deviation would lead to worse outcomes. To test these competing perspectives, a longitudinal, multisite study was conducted with over 1,000 student migrants who moved from various areas in China to 12 cities. Participants' life satisfaction and perceived stress were assessed upon arrival and at the end of the semester together with their sociocultural adaptation. Supporting the climatic-fit perspective, multilevel analyses showed that participants reported the least stress and highest sociocultural adaptation when they migrated to host sites that were climatically similar to their homes. Conversely, individuals who migrated from very demanding to less demanding climatic regions and vice versa reported an increase in stress and lower sociocultural adaptation.

*Keywords*: acculturation, longitudinal study in China, cultural fit hypothesis, climatic demands theory, psychological adaptation, sociocultural adaptation.

From a cross-cultural psychological perspective, human behavior reflects an adaptation to ecocultural contexts (Berry, Poortinga, Breugelmasn, Chasiotis, & Sam, 2011). In support of this perspective, people's affect, behavior, and cognition are often systematically linked to their ecocultural settings, particularly the cultural context (Oishi, 2014). However, although *climatic conditions* undoubtedly are part of individuals' ecocultural environment, it has been only in recent years that their effects on human behavior have started to receive attention (Fischer & Van de Vliert, 2011; Wei et al., 2017). This extant research has nevertheless been limited to the psychological impact of climate at in situ ontexts. Despite increasing human mobility in general, and increasing migration as a result of climatic disasters and increasing demands specifically, very little is known about the role of climate on the acculturation of individuals. In particular, knowledge is lacking about the impact that climatic differences can have on individuals who move from their habitual ecocultural context to an unfamiliar one (Ward & Geeraert, 2016). To fill this gap, the present study investigated the effect of climatic demands and climatic-fit on the psychological and sociocultural adaptation of migrants over time, using the People's Republic of China (PRC) as the context of investigation.

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## Psychological and Sociocultural Adaptation of Migrants

Successfully transitioning and adapting to a new environment requires strategies to manage stressful situations such as learning new cultural norms to *do well* or *fit in* (i.e., sociocultural adaptation) and to *feel well* (i.e., psychological adaptation) in the receiving society (Ward, 2001). Psychological adaptation, hence, is defined by a lack of psychological problems (e.g., distress, depression, anxiety) and presence of well-being such as satisfaction with life. Sociocultural adaptation, on the other hand, refers to the degree to which individuals are competent in carrying out their daily lives in the new social and cultural contexts and the larger society (Masgoret & Ward, 2006). To date, the bulk of acculturation research has focused on mental or physical health indicators as correlates or outcomes of acculturation. Moreover, prior

studies also have tended to focus on how acquired values, practices, and beliefs about the cultures of inception improved an individual's adaptation (Sam & Berry, 2016; Schwartz, Unger, Zamboanga, & Szapocznik, 2010). The tide of acculturation research, however, is shifting. In a seminal theoretical review, Ward and Geeraert (2016) pointed to a research gap in this literature, arguing for the need of an *ecological acculturation framework*. Such a framework postulates that the acculturation process begins with a new cultural experience, and that successful adaptation is the *interaction* between factors of the *home* and *host* contexts, including the compatibility of person and environmental fit. Although little researched, this ecocultural fit should include aspects pertaining to the match of climate of the home and host contexts. However, while climate has been proposed as a major acculturative challenge (Berry, 1990), no study has examined how differences in climate can affect individuals' psychological and sociocultural adaptation during the migration process.

## Psychological Effects of Climatic Demands: Two Alternative Perspectives

Already decades ago, climate had been shown to affect emotions, stress responses, and mental efficiency (Roberts, 1978). Newer research has suggested that climatic effects depend on seasons and day-to-day temperature fluctuations. For instance, Keller et al. (2005) showed that higher temperatures and barometric pressure improved mood during spring, but a hotter climate was associated with lower moods during the summer. Further, highlighting the varying impact of climatic conditions, observational reports from Texas during fall and spring found no consistent effect of weather on mood (Watson, 2000), whereas some researchers have found temperature to predict negative emotions during winter in Germany (Denissen, Butalid, Penke, & Van Aken, 2008). In recognizing that humans are warm-blooded and function best within a certain optimal temperature, Van de Vliert (2007) deviated from previous researchers who focused on absolute temperature as the basis for examining the relationship between climate and psychological functioning. This positioning helped resolve some of the inconsistencies in previous research. Van de Vliert (2008) described this reasoning in the climatic demands theory (CDT).

At its core, CDT posits that the demands and resources of human habitats influence people's needs to survive and function in their natural environment. In poor regions with demanding winters and scorching summers, individuals suffer psychologically whereas temperate climates tend to foster more freedom, autonomy, and openness, and are usually appraised as more comfortable (Van de Vliert, 2013). CDT proposes a 22 °C (~72 °F) point of reference for optimal climatic livability in thermal comfort, nutrition, and positive health outcomes. Cross-national studies have revealed that climatic demands (i.e., climates that are colder than temperate and hotter than temperate) jointly with country wealth affect health outcomes (Van de Vliert, 2007). Single country regional variation studies also have verified the effect of climatic demands on mood, collectivism, and even personality (Wei et al., 2017). Analyzing data from 58 nations, Fischer and Van de Vliert (2011) found that climatic demands negatively influenced general evaluations of life satisfaction and subjective well-being. Their results further suggested that these climatic conditions first impact on overall evaluations of one's life, and that in turn, this influences levels of stress, anxiety, and psychological ill-health.

Against this background of research and following a CDT perspective, one thus would expect that migrants moving from harsh to less climatically demanding environments would show improved psychological adaptation whereas the opposite would be true for those moving to more demanding climatic environments. In contrast, a climatic-fit perspective (Smit, Burton, Klein, & Wandel, 2000) which builds on a cultural-fit perspective (Mesquita, De Leersnyder, & Jasini, 2017) would suggest that migration that entails remaining in climatic zones that are similar to one's home site—be they demanding or not—will lead to the best adaptation. At the same time, major climatic deviations from the home climatic conditions would be expected to adversely impact migrants' adaptation (Burton, 1996). Under changing climatic conditions, people need to develop new behavioral repertoires to cope and adjust to their environment (Sánchez-Rodríguez, 2008). Accordingly, when migrants face new climatic demands, their previous habitual adaptation may become mismatched to the new context and, in turn, impair adaptation. A climatic-fit perspective thus would predict that when *home* and *host* climatic demands are congruent (i.e., when there is a "climatic match"), one would expect better psychological functioning because there is little need to alter previously adopted coping strategies. Conversely, when individuals migrate from harsh to less demanding climates or vice versa, one would expect less positive psychological outcomes, at least in the short-term.

## The Chinese Cultural and Climatic Context

Diversity of the geography of the PRC is often underemphasized in social scientific research. In terms of size, the PRC is about the same size as Europe and transverses a variety of climatic zones. For example, the Northeast region experiences hot and dry summers, and bitter cold winters with temperatures reaching as low as −30 °C. The North and Central regions experience

temperate summers (26 °C) and mild winters (0 °C). In the Southeastern and some parts of the Southwestern regions of the PRC, temperatures can reach 40 °C in summer whereas winters are milder at around 10 °C. In the Northwestern and in Tibetan regions, temperatures also reach subarctic temperatures, and summers are usually hot and dry (Domrös & Peng, 2012). Figure 1 provides a brief illustration of the climatic zones.

With over 300 million intranational migrants, the PRC is an appropriate cultural context to examine the effects of climatic demands on migrant's adaptation, as rates have drastically increased (Fan, 2008). Unlike earlier waves of migrants who tended to be factory workers, nowadays about 6.5 million migrants annually move to new areas in pursuit of higher education (English & Worlton, 2017).

### The Present Research

To date, very little is known about the effects of changing climatic demands on the psychological and sociocultural adaptation of migrants. In a multisite, longitudinal study, we therefore investigated the impact of differences in climatic demands in a larger sample of intranational Chinese migrants. Specifically, using this design, we tested two competing hypotheses. On one hand, a CDT perspective (Van de Vliert, 2007) would predict that migrating from more challenging[1] to less challenging climates leads to better psychological outcomes while predicting worse psychological outcomes for those moving from less challenging to more challenging climates. On the other hand, a climatic-fit perspective (Smit et al., 2000) would predict the best psychological outcomes when migrants move to environments that match the climatic demands of their home sites that they are used to while predicting that any substantial climate change should impair psychological outcomes. Importantly, when testing these competing predictions, we control for the general collectivist orientation of participants, which likely would emerge as a robust alternative predictor of adaptation following previous research (Du, Li, Lin, & Tam, 2015).

## Method

### Participants and Procedure

In total, 1,723 first-year, recent-arrival (<90 days) college students (for demographics across sites, see Table 1) were surveyed in 12 Chinese cities (see Figure 1). These individuals came from all 32 provinces of the PRC and were part of a larger project called "The China Longitudinal College Acculturation Study" (English, 2015). Within the first month of classes of the fall semester, students were asked to voluntarily participate in a longitudinal study. Students signed a consent form and completed a paper-

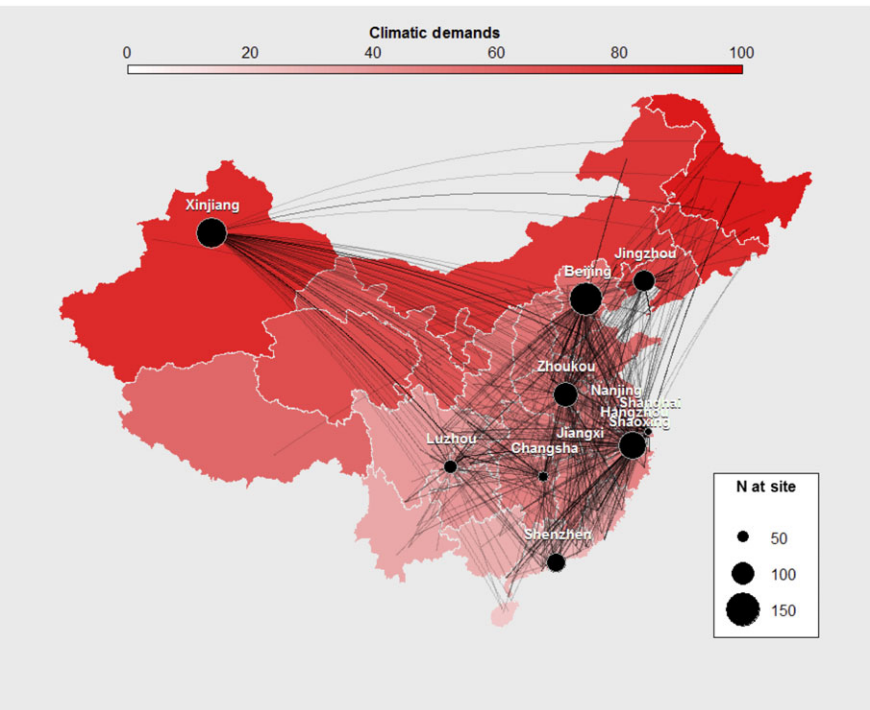


*Figure 1* Migration patterns of participants to destination sites.

and-pencil questionnaire during the first-year courses offered at the universities. Follow-up data were collected 3 to 5 months later in the winter before Chinese New Year, and 1,118 of the original participants completed the survey a second time. The sample ranged from 50 to 150 between sites (42–85% response rate at Time 2 [T2] at each site), and the overall attrition rate was 36%. More males (31%) dropped out of the study as compared to females (19%), $\chi^2(N = 1{,}723, 31.20, p = .001$. Individuals who dropped out were slightly older, $M = 19.65$, $SD = 2.33$ versus $M = 19.12$, $SD = 1.71$, $t(1{,}721) = 4.27$, $p = .001$, and their mothers had fewer years of formal education, $M = 9.08$, $SD = 3.83$ versus $M = 9.67$, $SD = 3.87$, $t(1{,}721) = -2.35$, $p = .020$, as compared to participants who remained in the study. Despite demographic differences in attrition, no differences were found between those who dropped out and those who participated in both waves on the key variables of stress, life satisfaction, length of sojourn in host city, and host and home climatic demands, $t$s $< 1$.

Questionnaires were in Chinese and had been previously used and validated in acculturation research (English & Worlton, 2017). The survey included a unique four-item code (day of birth, month mother was born, 2nd Chinese character of the father's name, and year father was born) to identify and match participants to their follow-up data. This scheme ensured a high degree of anonymity and confidentiality, as the code was the only way to match follow-up data. The survey also included measures related to academic adjustment and other scales for different research projects. The entire survey took 15 min, and participants were free to drop out at any time during the study.

## Materials

In terms of demographic variables, participants were to indicate their age, gender, parents' education, the location type (i.e., city, town, village) of where they grew up, and whether the location is rice or wheat in terms of agricultural product cultivated, previous mobility (i.e., number of moves in their life), and length of stay at current university.

In addition to demographic variables reported in Table 1, we measured several constructs.

**Collectivist orientation.** A 14-item measure was adopted from Van de Vliert, Yang, Wang, and Ren (2013) to measure participants' collectivist orientation, which was an important control variable in the present research. Participants were asked to indicate how much they agreed or disagreed with items, such as "I view myself as a member of a social group," and "My close interpersonal relationships reflect who I am." Responses were scored on Likert scales of 1 (*strongly disagree*) to 7 (*strongly agree*). Reliability was acceptable to satisfactory across sites, $\alpha = .62–.82$. This variable was only assessed at T2 because it constituted a control variable.

**Climatic demands.** As in previous research (Van de Vliert, 2013), climatic demands at the home and host sites were operationalized as the sum of the absolute temperature deviation from 22 °C from the average lowest and highest temperature in the coldest and hottest month at the provincial capital. For one example in our study, Xinjiang's January temperature average ranges from −29.0 to −1.0 °C, and from 19.0 and 28.4 °C in July. Hence, Xinjiang's climatic demands are calculated as (−29.0 to 22.0) + (−1.0 to 22.0) + (19.0 to 22.0) + (28.4 to 22.0) = 82.4 (for details, see Van de Vliert, 2013).

**Sociocultural adaptation.** The 12-item brief Sociocultural Adaptation Scale (Demes & Geeraert, 2014) was used to assess the ease of adapting or behaviorally "fitting in" to social and cultural contexts of the university's host city to which participants had moved. This scale is highly used in acculturation research and has been validated in a Chinese context (Bata & Zhixia, 2017). Among others, participants were asked to indicate how easy or difficult they found it to adapt to its "social norms," "population density," "climate," and "food." Responses were rated on a scale of 1 (*very difficult*) to 7 (*very easy*). Reliability estimates ranged from $\alpha = .80$ to .93 across sites. Due to the variable measuring sociocultural adaptation to the specific context of their host site, it was assessed only at T2.

**Perceived stress.** As the first measure of psychological adaptation, a brief version of the Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983) was administered. Participants were asked, on a scale of 1 (*never*) to 5 (*always*), "in the last 2 weeks how often have you felt …," which was followed by seven items such as "felt nervous or stressed?" The scale had acceptable reliability across sites, ranging from $\alpha = .73$ to .92 at Time 1 (T1) and $\alpha = .80$ to .95 at T2.

**Life satisfaction.** The second measure of psychological adaptation was the Satisfaction With Life Scale (Diener, Emmons, Larsen, & Griffin, 1985). It included the standard five items that were rated on scale of 1 (*strongly disagree*) to 7 (*strongly agree*). Participants were asked to complete items such as "How satisfied are you with your present life?" Reliability ranged from $\alpha = .58$ to .80 at T1 and $\alpha = .60$ to .81 at T2.

**Analyses.** Means and standard deviations for the main study variables in the different sites are presented in Table 1. Correlations across participants and different sites are presented in Table 2. Metacorrelation analyses

Table 1
*Variables for the Different Host Sites*

| | Jiujiang | | Nanjing | | Shanghai | | Changsha | | Luzhou | | Shaoxing | | Shenzhen | | Jinzhou | | Zhoukou | | Hangzhou | | Shihezi | | Beijing | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* |
| 1. Age | 18.8 | 0.79 | 18.3 | 0.69 | 19.9 | 2.54 | 18.9 | 0.88 | 18.3 | 0.72 | 18.8 | 0.81 | 20.7 | 2.38 | 18.9 | 1.13 | 18.9 | 0.96 | 19.2 | 1.92 | 18.7 | 1.06 | 23.1 | 1.74 |
| 2. Gender (%female) | 89.2 | | 63.3 | | 65.3 | | 23.9 | | 54.3 | | 68.6 | | 76.0 | | 55.1 | | 67.9 | | 43.2 | | 66.4 | | 78.9 | |
| 3. Rice area home (%) | 37.5 | | 19.2 | | 72.3 | | 60.0 | | 70.7 | | 87.5 | | 18.8 | | 11.2 | | 41.1 | | 49.2 | | 31.7 | | 25.6 | |
| 4. Mother education | 5.1 | 0.9 | 3. 9 | 1.2 | 3.7 | 1.1 | 5.2 | 1.0 | 5.0 | 1.0 | 5.0 | 1.1 | 4.4 | 1.2 | 4.7 | 1.0 | 5.2 | 0.9 | 4.7 | 1.2 | 4.7 | 1.3 | 4.5 | 1.1 |
| 5. Father education | 4.6 | 0.7 | 3.7 | 1.0 | 3.5 | 1.0 | 4.7 | 0.9 | 4.7 | 1.0 | 4.8 | 1.0 | 4.0 | 1.2 | 4.6 | 1.0 | 4.9 | 0.9 | 4.3 | 1.1 | 4.5 | 1.1 | 4.2 | 1.1 |
| 6. Home site GDP | 12.8 | 1.6 | 15.4 | 4.2 | 18.1 | 4.5 | 15.5 | 2.0 | 15.7 | 2.7 | 19.7 | 4.5 | 15.1 | 2.9 | 13.5 | 2.3 | 15.7 | 3.2 | 18.6 | 5.4 | 15.2 | 2.2 | 14.9 | 3.0 |
| 7. Grew up urban % | 32.4 | | 50.0 | | 58.3 | | 25.4 | | 30.1 | | 25.7 | | 32.0 | | 48.0 | | 22.0 | | 32.5 | | 36.1 | | 35.6 | |
| 8. Previous mobility | 1.5 | 0.8 | 1.2 | 0.6 | 1.5 | 0.7 | 1.4 | 0.8 | 1.3 | 0.8 | 1.6 | 0.8 | 1.9 | 0.8 | 1.2 | 0.6 | 1.2 | 0.5 | 1.4 | 0.7 | 1.2 | 0.5 | 1.8 | 0.7 |
| 9. Time stayed (days) | 0.9 | 0.6 | 4.2 | 2.4 | 30.1 | 101 | 36.8 | 244 | 16.4 | 114 | 3.4 | 0.8 | 162 | 284 | 12.6 | 93.2 | 4.8 | 0.2 | 31.5 | 137 | 25.8 | 83.2 | 37.6 | 103 |
| 10. Collectivist orientation | 4.5 | 0.6 | 4.5 | 0.5 | 4.3 | 0.5 | 4.3 | 0.6 | 4.4 | 0.6 | 4.5 | 0.7 | 4.2 | 0.5 | 4.1 | 0.7 | 4.3 | 0.6 | 4.5 | 0.5 | 4.3 | 0.7 | 4.4 | 0.6 |
| 11. Home climate | 49.8 | 7.6 | 60.2 | 13.9 | 52.0 | 9.4 | 47.6 | 10.1 | 43.2 | 9.4 | 47.1 | 8.2 | 49.4 | 14.1 | 66.5 | 12.7 | 56.7 | 15.8 | 51.3 | 9.7 | 60.4 | 16.4 | 57.6 | 12.7 |
| 12. Host climate | 48.5 | | 51.2 | | 48.2 | | 48.5 | | 39.7 | | 49.0 | | 29.9 | | 74.4 | | 53.9 | | 49.0 | | 84.2 | | 61.0 | |
| 13. Sociocultural adaptation | 4.5 | 0.8 | 4.5 | 1.1 | 4.6 | 1.2 | 4.1 | 1.1 | 4.9 | 1.0 | 5.0 | 1.1 | 4.0 | 1.2 | 4.3 | 1.2 | 4.0 | 1.2 | 4.8 | 1.2 | 4.4 | 1.3 | 4.3 | 1.1 |
| 14. Stress Time 1 | 3.6 | 1.1 | 3.2 | 0.9 | 3.3 | 0.8 | 3.2 | 0.9 | 3.2 | 0.7 | 3.1 | 0.8 | 3.4 | 1.1 | 3.5 | 1.1 | 3.4 | 0.9 | 3.4 | 0.9 | 3.5 | 0.7 | 3.6 | 0.8 |
| 15. Stress Time 2 | 3.5 | 1.0 | 3.1 | 0.7 | 3.3 | 0.9 | 3.1 | 1.0 | 3.2 | 0.8 | 3.5 | 1.1 | 3.3 | 0.7 | 3.3 | 0.9 | 3.4 | 0.8 | 3.6 | 0.9 | 3.4 | 0.8 | 3.4 | 0.9 |
| 16. Life satisfaction Time 1 | 3.7 | 1.0 | 4.4 | 1.1 | 4.3 | 1.0 | 4.0 | 1.1 | 4.4 | 0.9 | 4.2 | 0.9 | 4.3 | 1.1 | 4.1 | 1.1 | 3.9 | 1.0 | 4.4 | 1.0 | 4.3 | 0.9 | 4.4 | 1.0 |
| 17. Life satisfaction Time 2 | 4.0 | 0.8 | 4.1 | 1.1 | 4.3 | 1.1 | 3.9 | 1.0 | 4.3 | 1.1 | 4.1 | 0.8 | 4.3 | 0.9 | 4.0 | 1.1 | 4.0 | 0.9 | 4.2 | 1.0 | 4.1 | 1.1 | 4.3 | 1.0 |
| *N* (T1) | 37 | | 30 | | 148 | | 72 | | 147 | | 35 | | 26 | | 98 | | 209 | | 457 | | 204 | | 260 | |
| *N* (T2) | 21 | | 27 | | 148 | | 62 | | 103 | | 25 | | 16 | | 97 | | 141 | | 199 | | 108 | | 171 | |

*Note.* Due to space limitations, only up to three digits and one decimal are displayed. GDP = gross domestic product.

between both types of correlations (excluding Level 2 variables that otherwise would inflate the correlation coefficient) showed sufficient measurement equivalence across levels, $r(89) = .58$, $p < .001$. We tested different multilevel models with sociocultural adaptation, stress, and life satisfaction at T2 as dependent variables. In each model, we tested the main effects of home climatic demands (Level 2) and host climatic demands (Level 2) and their interaction effect on the respective dependent adaptation variable (Level 1). Moreover, we controlled for the gross domestic product (GDP) at their home site (Level 2) and various demographic variables at the individual level (Level 1), including age, gender, years of parents' formal education, whether participants grew up in a rice or wheat area, whether they grew up urban or rural, and their previous mobility. Moreover, we controlled for the time individuals had already stayed at the host site when completing the survey at T2 and their degree of collectivist orientation. Last, and importantly, for the models in which stress and life satisfaction were the dependent variables, we also controlled for their respective scores at arrival (i.e., at T1), such that the dependent variable represented change in adaptation. In all models, intercepts were allowed to vary for the host and home sites. The home and host climatic demands variables were grand-mean centered in accordance with recommendations for tests of interactions in multilevel models (Enders & Tofighi, 2007). All variables were then *z*-scored to obtain standardized effect estimates. Restricted maximum likelihood estimation was used.

## Results

### Sociocultural Adaptation

The between-group variance for the sociocultural adaptation model was relatively low, home site: $\sigma^2 = .09$, host site: $\sigma^2 = .03$, home site GDP: $\sigma^2 < .001$, whereas the within-group variance was relatively high, $\sigma^2 = .70$. The intraclass correlation (ICC) was .11 for the home site and .04 for the host site climatic demands whereas it was <.001 for host site GDP. The $R^2$ was .08. As displayed in Table 3, the longer participants had stayed at the host site when taking the survey and the higher their collectivist orientation, the higher sociocultural adaptation they showed. Importantly, the interaction between home and host climatic demands was significant. An inspection of the effects plot (see Figure 2) showed that higher climatic demands at the host site predicted less sociocultural adaptation for individuals from regions with low climatic demands. By contrast, host climatic demands had a positive effect on sociocultural adaptation for individuals moving from regions with high climatic demands. An estimation of the simple slopes (see Figure 3) showed that for individuals moving from areas with low climatic demands, sociocultural adaptation was the highest when they arrived in sites that also had low climatic demands, but was predicted to be markedly lower when they arrived in host sites with high climatic demands. The exact opposite was observed for those arriving from highly demanding home climates.[2]

### Stress

For the model with stress as the dependent variable, the between-group variance was low, home site: $\sigma^2 < .001$, host site: $\sigma^2 = .01$, home site GDP: $\sigma^2 < .001$, as compared to the within-group variance, $\sigma^2 = .76$. The ICCs were accordingly low as well, home site climatic demands: ICC < .001, host site climatic demands: ICC = .01, home site GDP: ICC < .001. The $R^2$ was .25. As displayed in Table 4, in addition to the stress scores at T1, the interaction between home and host climatic demands was significant. An inspection of the effects plot (see Figure 2) showed that higher climatic demands at the host site predicted more stress for individuals coming from places with low climatic demands. In contrast, climatic demands at the host site tended to predict less stress for those coming from demanding climatic conditions, but this effect was significant only for those coming from places with the most extreme climatic demands (i.e., +4 *SD*). For visualization, we further estimated simple slopes of host climatic demands at different levels of home climatic demands using unstandardized stress scores as outcome variable. As displayed in Figure 3, individuals coming from average home climates were largely unaffected by the climate of the host site, be it more or less demanding than what they were used to. However, those coming from climatic regions with little demands, but living in sites with high demands, reported almost twice as much stress as compared to their peers arriving in sites with low climatic demands. For those coming from highly demanding climates, arriving in a host site with a similarly demanding climate seemed to produce the lowest stress levels.[3]

### Life Satisfaction

The between-group variance for the model with life satisfaction as the dependent variable was close to zero, home site: $\sigma^2 < .001$, host site: $\sigma^2 < .001$, home site GDP: $\sigma^2 < .001$, whereas the within-group variance was relatively high, $\sigma^2 = .69$. The ICCs also were close to zero, home site: ICC < .001, host site: ICC < .001, home site: ICC < .001. The $R^2$ for this model was .29. As displayed in Table 5, in addition to life satisfaction at T1, both age and collectivist orientation predicted higher levels of life satisfaction at T2. No main or interactive climatic effects were observed.[4]

Table 2
*Pearson's Correlations Across Participants (presented above diagonal) and Spearman Correlations Across Sites (presented below diagonal) Between the Main Study Variables*

| | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. | 12. | 13. | 14. | 15. | 16. | 17. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Age | – | −.11*** | −.17*** | .04 | −.00 | −.06* | −.04 | .29*** | .10*** | .04 | .12*** | .08** | −.07** | .04 | .04 | .03 | .12*** |
| 2. Gender[a] | −.21 | – | .03 | −.00 | −.02 | .03 | .03 | −.03 | −.01 | −.02 | −.04 | −.09*** | −.01 | −.01 | −.03 | −.05* | −.08* |
| 3. Aggriculture region home[b] | −.23 | .22 | – | −.01 | −.07* | .47*** | −.01 | .03 | .01 | .01 | −.62*** | −.28*** | .12*** | −.06 | −.00 | .00 | −.01 |
| 4. Mother education | −.38 | .03 | .36 | – | .69*** | .03 | −.32*** | −.02 | −.05 | −.03 | −.15*** | −.01 | −.05 | .02 | −.01 | −.12*** | -.10** |
| 5. Father education | −.43 | .10 | .34 | .89*** | – | .02 | −.27*** | −.04 | −.04 | −.03 | −.05 | .03 | −.03 | .03 | −.03 | −.14*** | −.10** |
| 6. Home GDP | −.15 | .39 | .78** | .12 | .21 | – | −.01 | .02 | .07** | .05 | −.33*** | −.20*** | .26*** | −.03 | .01 | .07** | .06 |
| 7. Grew up urban | .15 | .03 | −.36 | −.83*** | −.78** | −.27 | – | .06 | .06* | −.02 | .07** | .04 | .04 | −.05 | .00 | .08** | .04 |
| 8. Previous mobility[c] | .50 | −.51 | .19 | −.26 | −.36 | .04 | −.08 | – | .05 | .05 | −.06 | −.08** | −.05 | .05 | .03 | .05 | .07* |
| 9. Time stayed | .69* | 18. | −.15 | −.36 | −.41 | −.03 | .04 | .37 | – | −.02 | −.06* | −.03 | .14*** | .01 | −.01 | .03 | .00 |
| 10. Collectivist orientation | −.26 | −.06 | .48 | .13 | .02 | .36 | −.08 | .39 | −.34 | – | −.02 | −.08** | .14*** | −.01 | −.01 | .14*** | .22*** |
| 11. Home climate | .15 | −.06 | −.66** | −.38 | −.35 | −.41 | .66* | −.50 | −.04 | −.40 | – | .36*** | −.09*** | .02 | .01 | .03 | .01 |
| 12. Host climate | −.08 | −.05 | −.40 | .07 | .13 | −.21 | .27 | −.54 | −.20 | −.12 | .80** | – | −.09*** | .09*** | .02 | −.02 | −.04 |
| 13. Sociocultural adaptation | −.41 | .17 | .59* | −.10 | .01 | .45 | .20 | .15 | −.40 | .69* | −.36 | −.22 | – | −.16*** | −.14*** | .25*** | .22*** |
| 14. Stress T1 | .43 | −.49 | −.56 | .00 | −.10 | −.71** | .20 | −.03 | .15 | −.35 | .51 | .40 | −.43 | – | .48*** | −.31*** | −.21*** |
| 15. Stress T2 | .25 | −.48 | .22 | .21 | .08 | .13 | −.08 | .37 | −.11 | .46 | −.04 | .17 | .29 | .40 | – | −.23*** | −.35*** |
| 16. Life satisfaction T1 | .06 | .27 | .01 | −.57 | −.43 | .24 | .31 | .24 | .45 | .22 | −.10 | −.18 | .36 | −.20 | −.09 | – | .51*** |
| 17. Life satisfaction T2 | .34 | −.11 | .02 | −.70* | −.57 | .13 | .44 | .42 | .52 | .01 | .03 | −.17 | .24 | .08 | .08 | .83*** | – |

*Note.* GDP = gross domestic product.
[a]0 = female, 1 = male.
[b]0 = wheat, 1 = rice.
[c]Previous mobility represents the time participants have moved in their life.
*$p < .05$. **$p < .01$. ***$p < .001$.

Table 3
*Multilevel Model for Sociocultural Adaptation at Time 2*

| Variable | β | *SE* | *df* | *t* | *p* |
|---|---|---|---|---|---|
| Level 1 | | | | | |
| Intercept | −.03 | .09 | 18.10 | −3.34 | .003 |
| Age | −.08 | .04 | 184.50 | −1.81 | .072 |
| Gender[a] | −.05 | .03 | 779.40 | −1.70 | .090 |
| Agriculture region at home[b] | .06 | .05 | 457.50 | 1.08 | .282 |
| Mother education | −.01 | .04 | 790.60 | −.16 | .872 |
| Father education | .01 | .04 | 789.50 | 0.18 | .855 |
| Grew up urban (vs. rural) | .03 | .03 | 787.40 | 1.07 | .283 |
| Previous mobility[c] | −.03 | .03 | 793.90 | −1.08 | .282 |
| Time stayed at host site | .11 | .03 | 798.90 | 3.06 | .002 |
| Collectivist orientation | .11 | .03 | 789.30 | 3.77 | <.001 |
| Level 2 | | | | | |
| GDP at home site | .11 | .07 | 41.30 | 1.60 | .118 |
| Home climatic demands | .03 | .06 | 37.00 | 0.53 | .598 |
| Host climatic demands | −.04 | .06 | 8.90 | −0.07 | .530 |
| Home × Host Climatic Demands | .16 | .04 | 709.50 | 4.37 | <.001 |

*Note.* GDP = gross domestic product.
[a]0 = female, 1 = male.
[b]0 = wheat, 1 = rice.
[c]Previous mobility represents the time participants have moved in their life.

## Discussion

The present research aimed to investigate the effects of climatic differences on the adaptation of migrants, testing competing predictions derived from a climatic demand theoretical perspective (Van de Vliert, 2009) and a climatic-fit perspective that builds on the culture-fit hypothesis (De Leersnyder, Kim, & Mesquita, 2015). In support of the climatic-fit perspective, migrants generally showed the least stress and the best sociocultural adaptation when they moved to areas that had a similar climate (be it relatively demanding or not) to what they were used to from home. Because our data failed to support climatic demands theory, it is possible the theory does not apply to migrants moving to new climates. We discuss this important question next.

Given the crucial importance of adjusting to climatic demands for survival (Van de Vliert, 2007), humans develop sophisticated and complex adaptations to cope with the climatic conditions at their place of living (Mahdavi & Kumar, 1996). However, when people migrate to places with different climatic demands than what they are used to, their previous adaptations may become inapt, causing stress because they are required to change their behavioral patterns. In line with this notion, Chinese migrants who move to areas that climatically diverge from their homes seem to experience increased stress and lower sociocultural adaptation. This finding supports a climatic-fit hypothesis and extends previous research on the culture-fit hypothesis (De Leersnyder et al., 2015). Several studies have shown that a fit between immigrants' individual characteristics such as cultural norms, emotions, personality, and coping styles with those of the people living in the new host context predict successful adaptation (De Leersnyder, Mesquita, & Kim, 2011; Szabo et al., 2017; Ward & Chang, 1997). Our research supports the framework of the culture-fit hypothesis, as we attempted to answer the call for research investigating ecological and environmental factors between *home* and *host* contexts that contribute to successful acculturation.

However, although our results supported a climatic-fit perspective, note that we followed participants only over a relatively short period. It is likely that participants when surveyed during the second time in the winter

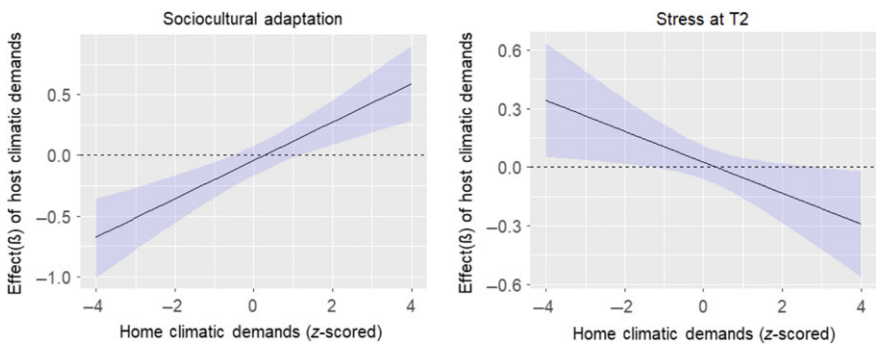


*Figure 2* Standardized effects of host climatic demands on sociocultural adaptation and stress. Ribbons represent 95% confidence intervals.

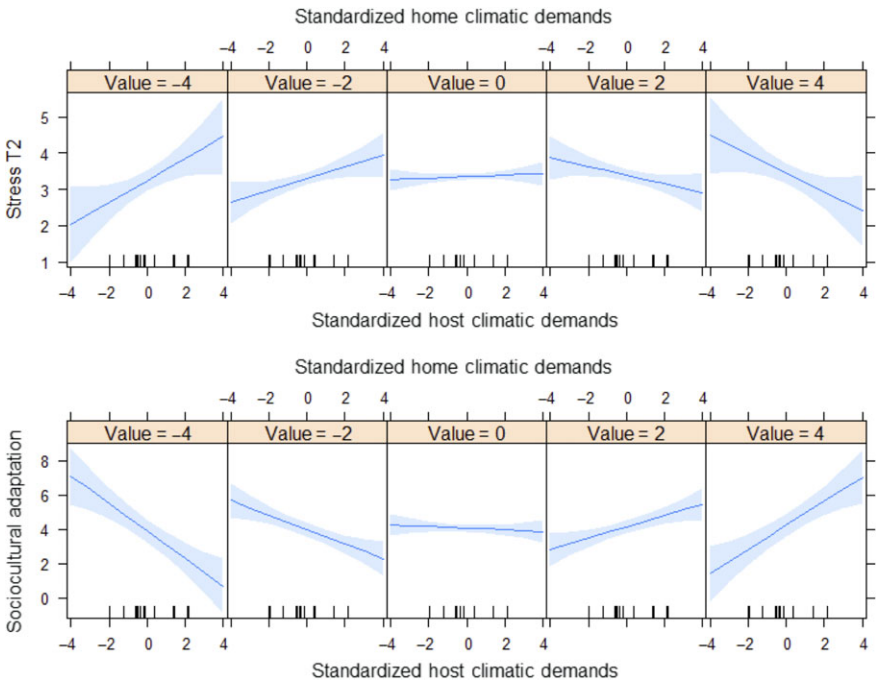


*Figure 3* Simple slopes of host climatic demands on unstandardized stress and sociocultural adaptation for different levels of home climatic demands. Ribbons represent 95% confidence intervals.

were in the midst of the (arguably stressful) process of adapting to the new climatic demands for the first time. We would assume resulting lower sociocultural adaptation and increased stress to be temporary phenomena that decline back to their initial levels once an optimal level of adaptation is achieved after a longer period of time. Hence, in the long run, it is still possible that moving to less demanding climates may lead to better adaptation and that our findings only reflect short-term changes. As such, CDT and climatic-fit perspectives may in fact be reconcilable, addressing different stages of adaptation during the acculturation process.

No effects on satisfaction with life were observed despite the fact that evidence often links climatic demands to subjective well-being (Rehdanz, & Maddison, 2005). Yet, our findings are consistent with evidence suggesting that people in pleasant climates do not appear to be any happier than do people in harsh climates (Schkade & Kahneman, 1998). Life satisfaction also can be seen as a measure that is more stable and less likely to fluctuate than, for instance, perceived stress. Similarly, given that sociocultural adaptation in essence is context-dependent, it should be more sensitive to contextual changes in a new ecological environment than should general life satisfaction. However, another possible psychometric explanation for why no significant effects were observed for life satisfaction also may be that in the current study, the measure had low reliability in many sites.

## Implications for Theory and Future Research

Our findings underscore the notion that climatic influence on psychological functioning may be more pervasive for many social phenomena than was previously assumed (Fischer & Van de Vliert, 2011) and, hence, contribute to the growing evidence of the role of climatic conditions on different areas of human behavior and functioning (Fischer, Lee, & Verzijden, 2018). Specifically, it did so for the process of acculturation. Whereas acculturation research tends to attribute migrants' adaptation primarily to cultural change (Sam & Berry, 2016), findings from this study suggest that climatic change may be another important factor to be considered. Acculturation researchers may have underestimated the climatic adaptation challenges that many migrants face in their new ecocultural contexts despite the general acknowledgement that climatic change may be theoretically implicated (Berry, 1990). Nevertheless, note that generally effects were small in the present research. This suggests that climatic demands may play one role together with other established factors.

One reason for the generally small effect size of the Host × Home Site Climatic Demands interaction may be that the sample represented a group of comparatively resourceful Chinese young adults who voluntarily moved to a new site to pursue higher education. These migrants may have the socioeconomic means to adapt to their new climatic environment, which is in line with previous research

Table 4
*Multilevel Model for Stress at Time 2*

| Variable | β | *SE* | *df* | *t* | *p* |
|---|---|---|---|---|---|
| Level 1 | | | | | |
| Intercept | −.01 | .04 | 7.30 | −0.34 | .747 |
| Stress at Time1 | .49 | .03 | 801.00 | 15.85 | <.001 |
| Age | .02 | .04 | 49.00 | 0.62 | .539 |
| Gender[a] | −.03 | .03 | 682.80 | −1.03 | .305 |
| Agriculture region at home[b] | .03 | .04 | 769.30 | 0.79 | .433 |
| Mother education | .03 | .05 | 757.80 | 0.75 | .454 |
| Father education | −.06 | .04 | 776.80 | −1.35 | .178 |
| Grew up urban (vs. rural) | .03 | .03 | 800.10 | 1.02 | .306 |
| Previous mobility[c] | −.01 | .03 | 801.00 | −0.47 | .642 |
| Time stayed at host site | −.02 | .04 | 800.40 | −0.47 | .640 |
| Collectivist orientation | −.01 | .03 | 799.60 | −0.38 | .701 |
| Level 2 | | | | | |
| GDP at home site | .03 | .04 | 683.60 | 0.72 | .472 |
| Home climatic demands | .03 | .04 | 629.00 | 0.71 | .479 |
| Host climatic demands | .02 | .04 | 12.30 | 0.57 | .582 |
| Home × Host Climatic Demands | −.08 | .03 | 346.30 | −2.32 | .021 |

*Note.* GDP = gross domestic product.
[a]0 = female, 1 = male.
[b]0 = wheat, 1 = rice.
[c]Previous mobility represents the time participants have moved in their life.

Table 5
*Multilevel Model for Life Satisfaction at Time 2*

| Variable | β | *SE* | *df* | *t* | *p* |
|---|---|---|---|---|---|
| Level 1 | | | | | |
| Intercept | .03 | .03 | 803 | 1.02 | .309 |
| Life satisfaction at Time 1 | .47 | .03 | 803 | 15.61 | <.001 |
| Age | .10 | .03 | 803 | 3.13 | .002 |
| Gender[a] | −.04 | .03 | 803 | −1.31 | .191 |
| Agriculture region at home[b] | .00 | .04 | 803 | 0.01 | .991 |
| Mother education | −.05 | .04 | 803 | −1.08 | .279 |
| Father education | .01 | .04 | 803 | 0.32 | .752 |
| Grew up urban (vs. rural) | .00 | .03 | 803 | −0.08 | .934 |
| Previous mobility[c] | .04 | .03 | 803 | 1.30 | .194 |
| Time stayed at host site | −.02 | .03 | 803 | −0.64 | .520 |
| Collectivist orientation | .15 | .03 | 803 | 4.90 | <.001 |
| Level 2 | | | | | |
| GDP at home site | .05 | .04 | 803 | 1.15 | .249 |
| Home climatic demands | .03 | .04 | 803 | 0.84 | .401 |
| Host climatic demands | .00 | .03 | 803 | −0.56 | .573 |
| Home × Host Climatic Demands | .00 | .03 | 803 | 0.27 | .784 |

*Note.* GDP = gross domestic product.
[a]0 = female, 1 = male.
[b]0 = wheat, 1 = rice.
[c]Previous mobility represents the time participants have moved in their life.

(Berry, 1976). In addition, future analyses should consider measuring climatic demands at the county level, as other studies have begun to reveal cultural variation across counties in the PRC (Dong, Talhelm, & Ren, 2018; English et al., 2019). Also note that parts of Northern PCR have centralized heating in the winter whereas for winters in Southern PCR, being students, their main daily activities likely took place inside (e.g., within buildings with air conditioning and/or heating) and, hence, are relatively unaffected by climatic factors. Future research thus should investigate changes in adaptation among groups from diverse socioeconomic backgrounds and whose occupations are impacted by, or even dependent on, climatic factors (i.e., farmers). Similarly, it may be important to assess subjective experience of the objective climatic demand on the individual.

Moreover, future research should test the impact of shifting climates among the over 25 million migrants who have involuntarily left their homes due to increasing climatic demands (i.e., "environmental refugees;" Biermann & Boas, 2010). As global warming proceeds, this number is likely to grow drastically in the future. Hence, we believe that considering the effects of climate on adaptation, which currently are understudied in acculturation research, will become increasingly important in future research. To our knowledge, our research is the first to establish the link between climate and acculturation, but future research is needed to explore its complex dynamics.

Our research also may point to some interesting issues that policymakers as well as social workers should consider when receiving and accommodating refugees and immigrants. Although further longitudinal research over longer periods of time is needed to fully establish the temporal trajectories of adaptation to climatic differences, our findings suggest that migrants who experience large climatic differences may experience an increase in stress and lowered sociocultural adaptation—at least temporarily. This finding may guide interventions. For instance, integration programs that mostly focus on cultural differences also may educate migrants (and especially those arriving from climatic regions different from

the host site) about how to best adapt (e.g., choice of clothing) to the climatic challenges that they face.

Because the present study dealt with intranational migrants, we did not measure perceived discrimination and acculturation strategies, which are two of the major individual-difference variables affecting sociocultural adaptation (Berry, Phinney, Sam, & Vedder, 2006). However, given the large cultural and ethnic variety of the PRC, such measures optimally should have been included to parse out the unique effects that climate exerts on adaptation over and above acculturation strategies. In addition, given the lack of research on the climatic-fit hypothesis that we proposed and tested for the first time, future studies may profitably use qualitative interviews to gather in-depth insights into the climate experiences of migrants.

## Conclusion

Migration and global warming are two of the leading challenges of our time (UN, 2015). The present study has important ramifications for gaining a deeper understanding of one aspect of the relationship between these challenges; namely, how shifting climatic demands impact the adaptation of migrants. In support of a climatic-fit perspective, this study showed that any divergence from the climate that migrants are used to from their home sites, at least temporarily in the short-term, may impair their psychological and sociocultural adaptation.

## Notes

[1] Please note that although the CDT distinguished between "threatening" climatic demands (when inhabitants are poor) and "challenging demands" (when inhabitants are rich), we consistently use the term *challenging* in this article because the present research focuses on a comparatively privileged population for which the climate hardly can be seen as threatening.

[2] As suggested by one of the reviewers, we estimated an extended model in which collective income (assessed by the proxy variable GDP of home province) was expected to interact with climatic demands at the home and at the host sites. The three-way interaction was significant, $p = .016$. Simple slopes presented in the Supporting Information (see Figure S1) suggest that the effect, which home and host climatic demands interactively had on sociocultural adaptation, was particularly pronounced among participants with high incomes (+1 *SD*).

[3] As with the previous dependent outcome, we also estimated an extended model to test whether income would interact with home and host climatic demands. However, this three-way interaction did not reach significance, $p = .46$[2]).

[4] Also for this dependent outcome, we tested whether income would interact with home and host climatic demands in an extended model. The three-way interaction was nonsignificant, $p = .691$.

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## Supporting Information

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