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A Socioecological-Genetic Framework of Culture and Personality: Their Roots, Trends, and Interplay

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Keywords

culture, personality, socioecology, genetics, cultural change, personality change, nature–nurture, genes × environment interaction

Abstract

Culture and personality are two central topics in psychology. Individuals are culturally influenced influencers of culture, yet the research linking culture and personality has been limited and fragmentary. We integrate the literatures on culture and personality with recent advances in socioecology and genetics to formulate the Socioecological-Genetic Framework of Culture and Personality. Our framework not only delineates the mutual constitution of culture and personality but also sheds light on (*a*) the roots of culture and personality, (*b*) how socioecological changes partly explain temporal trends in culture and personality, and (*c*) how genes and culture/socioecology interact to influence personality (i.e., nature × nurture interactions). By spotlighting the roles of socioecology and genetics, our integrative framework advances the understanding of culture and personality.

Contents

1. INTRODUCTION	364
2. DEFINITIONS AND CONCEPTUALIZATIONS	365
2.1. Culture	365
2.2. Socioecology	365
2.3. Personality	365
2.4. Genetics	366
3. THE SOCIOECOLOGICAL-GENETIC FRAMEWORK OF CULTURE AND PERSONALITY	366
4. THE MUTUAL CONSTITUTION OF CULTURE AND PERSONALITY ...	368
4.1. Culture → Personality	368
4.2. Personality → Culture	370
4.3. Culture ↔ Personality	371
5. SOCIOECOLOGY → CULTURE AND PERSONALITY	372
5.1. Socioecological Predictors of Culture and Personality	372
5.2. Socioecological Changes Partly Explain Trends in Culture and Personality ...	378
6. GENES → PERSONALITY	379
7. GENES × CULTURE/SOCIOECOLOGY INTERACTIONS → PERSONALITY	379
8. CULTURE/SOCIOECOLOGY (→ PERSONALITY) → GENE EXPRESSION	380
9. CONCLUSION	381

1. INTRODUCTION

A marriage between culture and personality will never be a love match. Having been pitted against each other for years, these two are an odd couple. Yet an arranged marriage has the potential to bring out some hidden qualities in both parties. Most notably such a union will inevitably reveal the importance of individual and collective meaning systems.

(Markus 2004, p. 75)

Culture: a system of symbols (what is represented), beliefs (what is considered true), values (what is considered important), norms (what is considered standard), and practices (what is performed) shared among a collection of interconnected individuals

Culture and personality are two central topics in psychology. Many psychologists would agree that it is essential to understand the interplay between culture (a collective meaning system) and personality (an individual meaning system), but the literature linking them has been limited and fragmentary. On the one hand, culture is a relatively understudied topic in personality research. For example, a recent *Annual Review of Psychology* article titled “Personality Psychology” (Roberts & Yoon 2022) offers an insightful review of the personality literature over the last 20 years, but it hardly mentions the word “culture.” Similarly, many textbooks of personality neglect the role of culture (Kwan & Herrmann 2015). Meanwhile, personality is a relatively understudied topic in cultural research. For example, a trend analysis of the *Journal of Cross-Cultural Psychology* revealed that, from its inception in 1970 to 2004, the journal moved closer to social psychology and away from other domains such as personality psychology (Brouwers et al. 2004).

The lack of dialogue between cultural research and personality research is unfortunate, because, as we will elaborate, culture and personality are interdependent, such that integrating the two literatures will deepen our understanding of both. What is more, the limited research on

the interplay between culture and personality (Benet-Martínez & Oishi 2008, Heine & Buchtel 2009, Oishi et al. 2021, Triandis & Suh 2002) has not systematically considered the roles of socioecology and genetics, which are intricately linked to culture and personality. Without a grasp of these literatures, it is difficult to comprehensively understand the roots (i.e., sources of influence) of culture and personality, how culture and personality change over time, and how culture and personality shape each other. To address these important issues, we develop the Socioecological-Genetic Framework of Culture and Personality, which attempts to integrate socioecology and genetics with culture and personality to elucidate their interplay. Before delving into our framework, we first define and conceptualize culture, socioecology, personality, and genetics.

2. DEFINITIONS AND CONCEPTUALIZATIONS

2.1. Culture

We define culture as a system of symbols (what is represented), beliefs (what is considered true), values (what is considered important), norms (what is considered standard), and practices (what is performed) shared among a collection of interconnected individuals. Culture is continuously transmitted and reproduced through languages, media, institutions, and the like. Gordon Allport, one of the founding figures of personality psychology, regarded culture as fundamental to the understanding of personhood: “Culture is in part a set of inventions that have arisen. . .to make life efficient and intelligible to mortals who struggle with the same basic problems of life: birth, growth, death, the pursuit of health, welfare, and meaning” (Allport 1961, p. 168). Culture takes many forms, including national, ethnic, political, religious, technological, and social class cultures (Cohen & Varnum 2016). Individuals can thus hold multiple cultural identities reflecting their belonging to different forms of culture (Hong et al. 2000, Morris et al. 2015).

2.2. Socioecology

Socioecology refers to macro conditions of the socioeconomic and ecological environment. For the purposes of our framework, socioecological variables are objective variables measured with scientific units, including ecological variables (e.g., ambient temperature, humidity, latitude, topography, pathogen prevalence, and frequency of natural disasters) and socioeconomic variables (e.g., population density, rice farming area, and median income). For example, the temperature of a given place at a given time is an objective value. By contrast, cultural variables (e.g., Hofstede’s cultural dimension indices) are subjective. Socioecological psychology focuses more on how psychological processes are influenced by objective socioecological conditions, whereas cultural psychology focuses more on how psychological processes are influenced by subjective cultural beliefs, values, and so on (Oishi 2014).

2.3. Personality

The conceptualization of personality is highly debated (e.g., DeYoung 2015, McAdams & Pals 2006, McCrae & Costa 2008). Due to space limitations, our framework focuses on personality traits (also known as dispositions), which are commonly defined as individuals’ relatively stable patterns of emotion, motivation, cognition, and behavior.¹ Based on this definition, personality traits

Socioecology: macro conditions of the socioeconomic and ecological environment (e.g., population density, ambient temperature)

Personality trait: an individual’s relatively stable patterns of emotion, motivation, cognition, and behavior

¹Several personality theories, including Five-Factor Theory (McCrae & Costa 2008), Cybernetic Big Five Theory (DeYoung 2015), and the “new Big Five” principles (McAdams & Pals 2006), distinguish personality traits from characteristic adaptations, which are “a wide assortment of motivational, social-cognitive, and developmental constructs that are more specific than dispositional traits and that are contextualized in time,

Openness:

the tendency to be receptive to new and intellectual experiences

Conscientiousness:

the tendency to be organized, responsible, and hardworking

Extraversion:

the tendency to seek stimulation from the company of other people

Agreeableness:

the tendency to be sympathetic, warm, and cooperative

Neuroticism:

the tendency to be emotionally unstable and prone to psychological distress

Epigenetics: the study of environmental influences on gene expression (without changes in DNA sequence)

include not only the Big Five (openness, conscientiousness, extraversion, agreeableness, neuroticism) and their facets, but also relatively stable individual differences such as narcissism, regulatory focus (Higgins 1998), and collectivistic orientation [also called allocentric personality by Triandis (2001)]. In other words, we argue that stable individual-level cultural orientations are also part of personality. For example, there is little methodological difference between measuring narcissism with a scale (e.g., “I like to be the center of attention” from the Narcissistic Personality Inventory; Raskin & Hall 1979) and measuring collectivistic orientation with a scale (e.g., “I usually sacrifice my self-interest for the benefit of my group” from the Individualism-Collectivism Scale; Singelis et al. 1995)—provided that the scales are psychometrically valid and reliable at the individual level.

2.4. Genetics

Genetics is the study of genes and heredity. As a branch of genetics, epigenetics researches environmental influences on the expression of genes (without changes in DNA sequence).

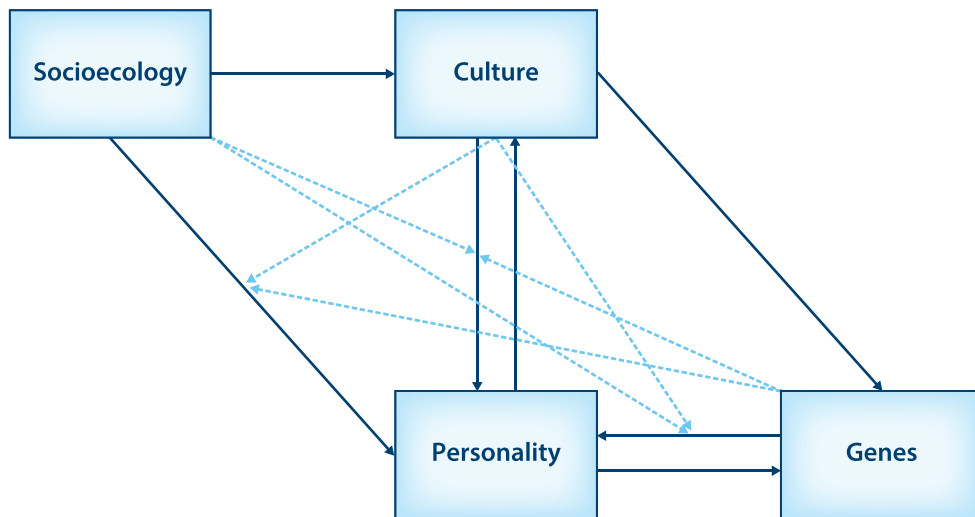
3. THE SOCIOECOLOGICAL-GENETIC FRAMEWORK OF CULTURE AND PERSONALITY

Our Socioecological-Genetic Framework of Culture and Personality (**Figure 1**) integrates socioecology and genetics with culture and personality to elucidate the interplay among these constructs. Before elaborating on the links in **Figure 1** (Sections 4 to 8), we first provide an overview of the framework.²

To begin with, our framework posits that culture and personality are mutually constitutive (see Section 4): While culture shapes individuals' personalities, individuals' personalities collectively shape culture (Markus & Kitayama 2010, Shweder 1991). Cultural influences on individuals are probabilistic and plural rather than deterministic and singular, yielding personalized patterns of emotion, motivation, cognition, and behavior (i.e., personalities). Meanwhile, individuals with different personalities invoke varying cultural elements (symbols, beliefs, values, norms, and practices) as they engage with their environment on a daily basis. At the aggregate level, the common patterns emerging from these cultural elements can reproduce or change culture. In sum, culture is one root of personality (i.e., culture → personality), while the aggregate influence of personality is one root of culture (i.e., personality → culture).

In addition to the mutual constitution of culture and personality, our framework posits that socioecology can influence both culture and personality (i.e., socioecology → culture & personality; see Section 5). Socioecology is one root of personality (i.e., socioecology → personality) because individuals are constantly responding to socioecological conditions (e.g., ambient temperature) that shape individuals' patterns of emotion, motivation, cognition, and behavior. Socioecology is also one root of culture (i.e., socioecology → culture) because culture evolves in response to different socioecological affordances and constraints. As illustrated in **Figure 1**, our framework suggests that socioecology may be a third variable that partly explains the association between culture and personality (e.g., pathogen prevalence may be a third variable that partly explains the well-replicated association between individualism and extraversion at the country level; Hofstede

place, and/or social role” (McAdams 2010, p. 177). However, some personality psychologists acknowledge that it is challenging to empirically distinguish between personality traits and characteristic adaptations, especially because there are few well-defined and testable criteria for distinguishing between them (Henry & Möttus 2020). Hence, for the purposes of our article, we do not discuss traits and characteristic adaptations separately. ²Throughout the article, we use an arrow (→) to denote that a causal link is theoretically plausible, and we discuss empirical evidence for such links.



Culture ↔ Personality: the mutual constitution of culture and personality

Socioecology → Culture: socioecology as one root of culture

Socioecology → Personality: socioecology as one root of personality

Genes → Personality: genes as one root of personality

Culture/Socioecology (→ Personality) → Genes: epigenetics; the parenthesis indicates that personality is a theoretically plausible mechanism

Figure 1

The Socioecological-Genetic Framework of Culture and Personality. The solid arrows denote that a causal link is theoretically plausible. The dashed arrows represent the interactive effects of genes, culture, and socioecology on personality, highlighting nature × nurture interactions. Because our framework focuses on culture and personality (e.g., their roots), we do not elaborate on links such as culture → socioecology (e.g., cultures high in long-term orientation may be more environmentally friendly, leading to lower pollution).

& McCrae 2004). Relatedly, we suggest that socioecological changes partly explain temporal trends in culture (e.g., increase in individualism) and personality (e.g., increase in extraversion).

Besides highlighting cultural and socioecological environments as roots of personality, our framework highlights genes as another root of personality (i.e., genes → personality; see Section 6). In other words, personality is attributable to both nurture (culture/socioecology) and nature (genes). We argue that the key question is not whether personality is influenced *more* by nature or by nurture, but how personality is shaped by the interaction between nature and nurture (Sasaki & Kim 2017). As illustrated by the dashed arrows in **Figure 1**, our framework highlights the interactive effects of genes and culture/socioecology on personality (see Section 7). On the one hand, genes can moderate cultural/socioecological influences on personality, such that these influences may be strengthened or weakened by certain genes. On the other hand, the cultural/socioecological environment can moderate genetic influences on personality: Genes predispose an individual to certain personality phenotypes, but the strength of this link may depend on the individual's cultural/socioecological environment.

Finally, drawing on emerging research on epigenetics, our framework posits that an individual's continuous engagement with cultural and socioecological environments can alter the expression of genes—sometimes by shaping the individual's patterns of emotion, motivation, cognition, and

Phenotype: the observable characteristics of an organism resulting from the interaction of its genotype with the environment

behavior (i.e., personalities). That is, we suggest that epigenetic changes due to cultural and socioecological influences may be mediated by changes in personality (i.e., culture/socioecology → personality → gene expression; see Section 8).

Overall, our Socioecological-Genetic Framework of Culture and Personality offers an integrative perspective on culture and personality by highlighting the roles of socioecology and genetics. The framework helps organize and delineate the complex links among culture, personality, socioecology, and genetics. Having provided an overview, we next elaborate on each of the links in our framework (Sections 4 to 8).

4. THE MUTUAL CONSTITUTION OF CULTURE AND PERSONALITY

To understand the mutual constitution of culture and personality, this section discusses (a) how culture influences personality (culture → personality), (b) how aggregate personalities influence culture (personality → culture), and (c) how culture and personality are mutually constitutive (culture ↔ personality).

4.1. Culture → Personality

Culture shapes personality because individuals are always embedded in cultural environments (Oyserman 2017). Culture provides the context for individuals' emotions, motivations, cognitions, and behaviors—the relatively stable patterns of which represent personality. Fundamental aspects of life (e.g., listening, speaking, reading, and writing) are all situated within culture.

Culture influences personality in intricate ways, and we highlight three characteristics here. First, cultural influences on personality are often *implicit*, operating without individuals' awareness. As individuals go about their daily lives, they absorb subtle and complex elements of their cultural environments unconsciously, including cultural symbols, beliefs, values, norms, and practices (Chiu et al. 2010). Second, cultural influences on personality are *plural*. Each person belongs to numerous cultural groups (e.g., a working-class Asian American raised in a Christian family in Montana), so personality is partially influenced by elements of multiple cultures, which are constantly interacting and evolving (Morris et al. 2015). Third, like all environmental influences, cultural influences on personality are *probabilistic* rather than deterministic. A culture may incline its members to think, feel, and behave in certain ways, but individuals within the same culture will internalize its cultural elements differentially. What an individual internalizes depends on numerous factors, including temperament, upbringing, education, and what cultural elements happen to be salient in the individual's local environment. As Allport (1961, p. 166) noted, although culture “prescribes limits for personal behavior and broad guidelines for developing personality, it allows a wide range of freedom.” Individuals internalize a culture's different elements to varying degrees, yielding within-culture heterogeneity (Kitayama & Yu 2020).

Having discussed the characteristics of cultural influences on personality, we next review four threads of evidence for cultural influences on personality: (a) cultural differences in personality trait levels, (b) cultural differences in personality factor structure, (c) cultural differences in personality development, and (d) the influence of cultural experiences on personality.

4.1.1. Cultural differences in personality trait levels. Much research has examined cultural differences in personality trait levels (i.e., higher versus lower mean on a personality trait).³ A

³When using surveys to examine cultural differences in personality trait levels, there are many reasons for researchers to interpret their results with caution. For example, participants may exhibit the reference-group effect, or “the tendency for people to respond to subjective self-report items by comparing themselves with

comprehensive review of this literature is beyond the scope of our article and would be redundant with existing reviews (e.g., Benet-Martínez & Oishi 2008, Church 2016, Heine & Buchtel 2009). Regarding the Big Five, both self-rating and peer-rating studies find that East Asians tend to score lower on extraversion and openness than do individuals from other cultures (McCrae & Terracciano 2005, Schmitt et al. 2007), whereas cultural differences in agreeableness, conscientiousness, and neuroticism are less consistent across studies. As another example of cultural influences on personality, allocentrism (collectivistic personality) is higher in East Asian cultures, whereas idiocentrism (individualistic personality) is higher in American cultures (Triandis 2001).

4.1.2. Cultural differences in personality factor structure. Although studies suggested that the five-factor structure is generalizable across a variety of different cultures (for recent reviews, see Kwan & Herrmann 2015, McCrae 2017), this finding did not replicate in some studies conducted on small-scale populations (e.g., forager–horticulturalists; Gurven et al. 2013, Saucier et al. 2014). Moreover, studies in different cultures and languages have identified seven-factor (Benet & Waller 1995, 1997), six-factor (Ashton et al. 2004), four-factor (Cheung et al. 2001), three-factor (De Raad et al. 2010), and two-factor (Saucier et al. 2014) structures. For example, the six-factor model of HEXACO (honesty-humility, emotionality, extraversion, agreeableness, conscientiousness, and openness) has been replicated across 18 countries (García et al. 2022) and 12 languages (Lee & Ashton 2008).

Relatedly, studies have identified culture-specific, indigenous personality factors. For example, Cheung et al. (2001) identified four personality factors in Chinese culture, including an interpersonal relatedness factor. This indigenous factor is not represented in the Big Five personality space, and it taps harmony, face, and *ren qing* (reciprocal relationship orientation), which are elements central to Chinese culture.⁴ Similarly, an indigenous inventory project on South Africans identified a six-factor model that includes a positive social-relational factor and a negative social-relational factor instead of a single agreeableness factor (Fetvadjev et al. 2015). Such indigenous personality factors provide further evidence for cultural influences on personality.

4.1.3. Cultural differences in personality development. Across cultures, individuals tend to become more agreeable, conscientious, and emotionally stable as they mature into adulthood (Roberts et al. 2006). Social investment theory (Roberts et al. 2005) posits that such personality maturation is mostly the result of culturally normative life transitions into adult roles, and thus the age at which personality maturation occurs is a function of culture-specific social clocks. Consistent with social investment theory, a study of 884,328 participants from 62 countries

implicit standards from their culture” (Heine et al. 2008, p. 309). Another issue is that individuals from different cultures may respond to the same personality measure in different ways, such that observed results deviate from actual cultural differences in personality trait levels (Hamamura et al. 2008). Furthermore, cross-cultural studies sometimes show low convergence across different personality instruments. For example, Bartram (2013) has shown that, except for neuroticism, which shows high convergence across different measures, the correlations among the Big Five Inventory (BFI), NEO Personality Inventory, and Occupational Personality Questionnaire (OPQ32) measures of the other four Big Five factors are inconsistent. Given such methodological concerns, it is valuable to examine other types of evidence for cultural differences in personality trait levels, such as behavioral indicators of personality traits (e.g., measuring conscientiousness using postal workers’ efficiency or the accuracy of clocks in public banks; Heine et al. 2008).

⁴Bond (2000) reported several Chinese studies in which the interpersonal relatedness personality factor—above and beyond the Big Five—predicted culture-specific attitudes and behaviors such as filial piety and gentle persuasion.

revealed that cultures with earlier entry into work were marked by earlier increases in self-reported agreeableness, conscientiousness, and emotional stability (Bleidorn et al. 2013).

Besides such cultural differences in personality changes in early adulthood (Bleidorn et al. 2013), research has also revealed cultural differences in personality changes in late adulthood. Americans tend to value independence, autonomy, and youthfulness, but these cultural values are incongruent with the reality of aging in late adulthood. Thus, Americans are prone to experience declines in personality traits like extraversion as they age (Kitayama et al. 2020). In comparison, East Asians are attuned to age-graded social roles, which protects them from the declines in extraversion experienced by elderly Americans (Kitayama et al. 2020).

4.1.4. The influence of cultural experiences on personality. Personality can also change as a result of individuals' cultural experiences. In particular, multicultural experiences (e.g., living abroad, intercultural dating, multilingualism) shape individuals by exposing them to diverse cultural knowledge, beliefs, values, norms, and practices (Adam et al. 2018; Lu et al. 2017a,b, 2022b; Maddux et al. 2021). For example, living abroad is associated with increased openness, agreeableness, and emotional stability—above and beyond self-selection effects (e.g., open individuals may be more likely to study abroad in the first place; Niehoff et al. 2017, Zimmermann & Neyer 2013).

In addition, research indicates that individuals' personalities acculturate to their specific cultural environments. For example, longitudinal studies suggest that East Asians' engagement in American culture fosters self-esteem, which tends to be higher among Americans (Heine et al. 1999). Similarly, Güngör et al. (2013) compared first-generation Japanese immigrants in the United States with Japanese monoculturals and American monoculturals. Their results suggest that the personalities of the Japanese immigrants became more "American" and less "Japanese" as they acculturated to American culture. Furthermore, research suggests that immigrants' exposure to a new culture (e.g., the length of residence) positively predicts the degree of personality acculturation (McCrae et al. 1998).

4.2. Personality → Culture

While culture can influence individuals' personalities (as discussed in Section 4.1), individuals' personalities can also collectively influence culture (Ozer & Benet-Martínez 2006).⁵ Individuals with certain personalities are apt to bring out certain cultural elements (symbols, beliefs, values, norms, and practices) more than other cultural elements. When individuals aggregate, their collective tendencies and preferences may cohere along some general patterns and shape culture (i.e., personality → culture). Consider the example of cultural products such as books, magazines, songs, films, and TV shows. A writer with individualistic orientation (i.e., idiocentric personality) may tend to write books characterized by individualism. When such individuals aggregate at the population level, the resulting culture tends to feature cultural products characterized by individualism.

The personality → culture link can also occur when aggregate personality profiles shape political outcomes that shape culture. For example, aggregate, region-level openness negatively predicted the percentage of votes cast for conservative (Republican) candidates in the 1996, 2000, 2004, and 2008 US presidential elections (Rentfrow 2010, Rentfrow et al. 2009). In addition, lower openness and higher neurotic personality traits at the region level predicted votes for

⁵While a group of people can collectively influence culture, in certain circumstances, the personality of one or few individuals (e.g., authoritarian leaders, influential activists) may also influence culture.

Donald Trump's election as US president and for Brexit (Obschonka et al. 2018a)—events that shaped the cultures of the United States, the United Kingdom, and even the world.

But why do individuals with certain personalities aggregate in the first place? One answer is selective migration, or the notion that individuals select environments that meet and reinforce their psychological needs (Rentfrow et al. 2008). Research on frontier voluntary settlement offers a compelling demonstration of how selective migration contributes to the personality → culture link. Before the arrival of any settlers, a frontier environment is uninhabited and devoid of human culture, thus precluding the culture → personality link. According to the voluntary settlement hypothesis, individuals with independently oriented personalities (e.g., high openness to experience) are more likely to migrate to frontiers, which are “ecologically harsh, sparsely populated, and socially primitive regions” (Kitayama et al. 2010, p. 559). As more independently oriented individuals voluntarily accumulate in the ecologically harsh frontier, an individualistic culture forms gradually. (As we discuss in Section 5.1.1, the socioecological conditions of the frontier also contribute to the development of an individualistic culture.)

4.3. Culture ↔ Personality

Taken together, Sections 4.1 and 4.2 delineate the bidirectional links between culture and personality (culture → personality and personality → culture). Integrating these links, we argue that culture and personality are mutually constitutive: While culture influences individuals' personalities, individuals' personalities collectively influence culture. Culture and personality thus form each other through a continuous, dynamic, and reciprocal process of transaction (Benet-Martínez 2021, Markus & Kitayama 2010, Shweder 1991). As discussed earlier, cultural influences on personality are probabilistic and plural, yielding personalized patterns of emotion, motivation, cognition, and behavior (i.e., personalities). Meanwhile, individuals with different personalities invoke varying cultural elements as they engage with their environment on a daily basis. At the aggregate level, the common patterns emerging from these cultural elements can reproduce or change culture.

Although the mutual constitution of culture and personality is theoretically cogent, limited research has documented it within the same context. One exception is provided by Kitayama et al. (1997), who demonstrated a cycle of mutual constitution between (a) individuals' self-enhancement versus individuals' self-criticism and (b) cultures of self-enhancement versus cultures of self-criticism. American culture encourages self-enhancement, whereas Japanese culture encourages self-criticism. Individuals assimilate these cultural views into their personalities, such that American individuals tend to be more self-enhancing and Japanese individuals tend to be more self-criticizing (i.e., culture → personality). Empirically, Kitayama et al. (1997) found that Americans considered success situations to be more relevant to their self-esteem (i.e., exhibiting self-enhancing tendencies), whereas Japanese considered failure situations to be more relevant to their self-esteem (i.e., exhibiting self-criticizing tendencies). Meanwhile, American individuals collectively construct their everyday situations to encourage self-enhancement, whereas Japanese individuals collectively construct their everyday situations to encourage self-criticism (i.e., personality → culture). Upon analyzing hundreds of everyday situations in America and Japan, Kitayama et al. (1997) found that everyday situations in America (shaped collectively by American individuals) facilitate self-enhancement, whereas everyday situations in Japan (shaped collectively by Japanese individuals) facilitate self-criticism.

As another example of the mutual constitution of culture and personality, consider Silicon Valley. The entrepreneurial culture of Silicon Valley attracts individuals with entrepreneurial personalities. The aggregation of individuals with entrepreneurial personalities reinforces the entrepreneurial culture of Silicon Valley (i.e., personality → culture). In turn, this entrepreneurial

culture may strengthen the entrepreneurial personality of these individuals (i.e., culture → personality).

5. SOCIOECOLOGY → CULTURE AND PERSONALITY

Besides delineating the mutual constitution of culture and personality (see Section 4), our framework suggests that socioecology can influence both culture and personality (see **Figure 1**). Socioecology is one root of personality because individuals are constantly responding to socioecological conditions (e.g., ambient temperature, pollution severity, population density) that shape individuals' patterns of emotion, motivation, cognition, and behavior. Socioecology is also one root of culture because culture evolves in response to different socioecological affordances and constraints. Culture does not exist in a vacuum, but rather it is always situated in a socioecological environment.

To demonstrate socioecological influences on culture and personality, this section discusses (a) socioecological predictors of culture and personality and (b) how socioecological changes partly explain temporal trends in culture and personality.

5.1. Socioecological Predictors of Culture and Personality

Table 1 systematically summarizes the scattered studies on socioecological predictors of cultural and personality variables. Notably, many ecological variables (e.g., latitude, topography, ambient temperature) are unlikely to be shaped by cultural and personality variables, especially in the short run, so reverse causality is unlikely to explain observed links. For example, a study on Chinese university students found that regional ambient temperature was associated with personality trait levels (Wei et al. 2017). These students' personality traits were unlikely to have shaped ambient temperature, so this study precluded the personality → socioecology link. Moreover, the use of historical (rather than contemporary) socioecological indices in some studies strengthens causal inference (e.g., Fincher et al. 2008, Talhelm et al. 2014).

5.1.1. Socioecological predictors of individualistic versus collectivistic cultures. Due to space limitations, we cannot discuss each of the studies in **Table 1**. Instead, we focus on the well-studied cultural dimension of individualism versus collectivism as an example, as disparate theories have proposed how different socioecological variables contribute to individualistic versus collectivistic cultures, including (a) subsistence style theory (Talhelm et al. 2014), (b) modernization theory (Inglehart & Baker 2000), (c) climato-economic theory (Van de Vliert et al. 2013), (d) frontier settlement theory (Kitayama et al. 2006), and (e) pathogen prevalence theory (Fincher et al. 2008).

Subsistence style theory posits that different subsistence styles can produce cultural differences. Whereas the mobility and social independence of herding activities foster individualistic culture, the stability and social interdependence of farming activities foster collectivistic culture (Uchida et al. 2019, Uskul et al. 2008). Within farming activities, rice farming requires more social coordination and interdependence than does wheat farming, thus breeding higher collectivism. A within-China study found that rice-growing southern regions are more collectivistic than wheat-growing northern regions (Talhelm et al. 2014).

Modernization theory posits that socioeconomic development is one root of individualistic (versus collectivistic) culture (Inglehart & Baker 2000, Greenfield 2013, Hamamura 2012). As a society modernizes from an agricultural to an industrial and postindustrial economy, individuals have more resources and opportunities to manage their own lives (e.g., income, living space, marriage decisions). Living in an economically developed society reduces the perceived need to rely on others for survival, allowing individuals to prioritize personal goals and freedom. As

Table 1 Socioecological predictors of cultural and personality variables

Category	Predictor	Outcome	Context	Citation
Population density	Population density	(+) Collectivism	United States	(Vandello & Cohen 1999)
	Population density (both in 1500 and 2000)	(+) Tightness	33 countries	(Gelfand et al. 2011)
	Population density	(+) Tightness	China	(Chua et al. 2019)
	Population density (both in 1500 and 2013)	(–) Relational mobility	39 countries	(Thomson et al. 2018)
	Population density	(+) Future orientation	227 countries; within United States	(Sng et al. 2017)
Subsistence style	Agricultural crop farming (versus self-run farming and herding)	(+) Collectivism	United States	(Vandello & Cohen 1999)
	Farming (versus non-farming)	(+) Participation in collective activities, concern for reputation	Japan	(Uchida et al. 2019)
	Rice (versus wheat) farming	(+) Tightness	Within China; 32 countries	(Talhelm & English 2020)
	Interdependent subsistence style (rice versus wheat, herding versus less herding)	(–) Relational mobility	39 countries	(Thomson et al. 2018)
	Rice (versus wheat) farming	(+) Loyalty/nepotism, holistic thinking (–) Individualistic orientation	China	(Talhelm et al. 2014)
	Farmer and fisher (versus herder)	(+) Holistic (versus analytic) cognition	Turkey's eastern Black Sea region	(Uskul et al. 2008)
	Historical employment in coal-based industries and agriculture	(+) N (anxiety, depression) (–) C (order) (n.s.) O, E, A	United Kingdom; United States	(Obschonka et al. 2018b)
Socioeconomic development/modernization/urbanization	Urbanization	(+) Gemeinschaft adaptation (relative frequency of the words “choose”/ “decision” in books) (–) Gesellschaft adaptation (relative frequency of the words “duty”/ “obligation” in books)	United States; United Kingdom	(Greenfield 2013)
	GDP per capita	(+) Individualism	Japan	(Ogihara et al. 2015)
	GDP per capita	(–) Collectivism	Japan	(Yamawaki 2012)
	Socioeconomic development	(+) Individualism	United States	(Grossmann & Varnum 2015)
	Socioeconomic development	(+) Individualistic practices and values	Individualistic practices: 41 countries Individualistic values: 53 countries	(Santos et al. 2017)
	Unemployment rate	(–) Individualism	United States	(Bianchi 2016)
	Poverty rate	(–) Individualism	United States	(Vandello & Cohen 1999)
	GDP per capita	(+) Tightness	China	(Chua et al. 2019)
	GDP per capita	(+) Tightness	Within China; 32 countries	(Talhelm & English 2020)
	GNP per capita	(n.s.) Tightness	33 countries	(Gelfand et al. 2011)
	GNP per capita	(+) Rational, tolerant, trusting, and participatory values (–) Absolute norms and values	65 countries	(Inglehart & Baker 2000)

(Continued)

Table 1 (Continued)

Category	Predictor	Outcome	Context	Citation
	Historical GDP per capita	(−) Relational mobility	39 countries	(Thomson et al. 2018)
	Urban (versus nonurban) residence	(+) Preference for uniqueness	Japan	(Yamagishi et al. 2012)
	Urban (versus rural) residence	(+) O, A (n.s.) C, E, ES	Australia	(Jokela 2020)
	Urban (versus suburban) neighborhood	(+) O, E in urban neighborhoods (+) C, A in suburban neighborhoods	London	(Jokela et al. 2015)
	Neighborhood affluence	(+) O, C, E, ES (n.s.) A	Australia	(Jokela 2020)
	Median annual income	(+) O, E (−) C, A (n.s.) ES	United Kingdom	(Rentfrow et al. 2015)
	Housing price	(+) O (n.s.) C, E, A, ES	United States	(Götz et al. 2021)
Climate/geography	Latitude	(−) Collectivism, hierarchism, intergroup differentiation, and discrimination	Study 1: 90 preindustrial societies Study 2: 53 countries Study 3: 104 countries Study 5: 222 countries	(Van de Vliert 2020)
	Latitude	(+) Individualism, creativity, life satisfaction (−) Aggressiveness	Over 140 countries	(Van de Vliert & Van Lange 2019)
	Frontier	(+) Individualism	Study 1: United States Study 2: Canada Study 3: 13 countries	(Varnum & Kitayama 2011)
	Demanding climate × income	Collectivism	China	(Van de Vliert et al. 2013)
	Demanding climate × income	Societal collectivism, political autocracy	Social collectivism: 121 countries Political autocracy: 174 countries	(Van de Vliert & Postmes 2012)
	Demanding climate × income	Ingroup favoritism (compatriotism, nepotism, familism)	Compatriotism: 73 countries Nepotism: 116 countries Familism: 57 countries	(Van de Vliert 2011)
	Demanding climate	(−) Relational mobility	39 countries	(Thomson et al. 2018)
	Frontier	(+) Independent agency	Japan	(Kitayama et al. 2006)
	Demanding climate	(−) A, C, ES (socialization and stability) and E, O (personal growth and plasticity)	China; United States	(Wei et al. 2017)
	Mountainous areas	(+) O (−) C, E, A, N	United States	(Götz et al. 2020)
Pathogen prevalence	Non-zoonotic pathogen richness	(+) Collectivism, family ties (−) Individualism, democratization	Over 57 countries	(Thornhill et al. 2010)
	Pathogen prevalence	(−) Individualistic practices and values	Individualistic practices: 41 countries Individualistic values: 53 countries	(Santos et al. 2017)

(Continued)

Table 1 (Continued)

Category	Predictor	Outcome	Context	Citation
	Pathogen prevalence	(–) Individualism	United States	(Grossmann & Varnum 2015)
	Historical pathogen prevalence	(+) Collectivism (–) Individualism, democratization	Over 58 countries	(Murray & Schaller 2010)
	Historical and contemporary pathogen prevalence	(+) Collectivism (–) Individualism	68 countries	(Fincher et al. 2008)
	Historical pathogen prevalence	(+) Tightness	33 countries	(Gelfand et al. 2011)
	Historical pathogen prevalence	(+) Behavioral conformity, priority for obedience (–) Tolerance for nonconformity	Behavioral conformity: 17 countries Obedience: 83 countries Tolerance for nonconformity: over 20 countries	(Murray et al. 2011)
	Pathogen prevalence	(+) Gender inequality	United States; United Kingdom	(Varnum & Grossmann 2017)
	Pathogen prevalence	(–) Democratization, gender equality	Democratization: over 169 countries Gender equality: over 50 countries	(Thornhill et al. 2009)
	Pathogen prevalence	(+) Authoritarian governance (+) Authoritarian personality	31 countries; 90 cultural populations	(Murray et al. 2013)
	Historical pathogen prevalence	(–) O, E, sociosexuality	71 countries	(Schaller & Murray 2008)
	Historical pathogen prevalence	(–) O, E, female sociosexuality	230 countries	(Murray & Schaller 2010)
	Non-zoonotic pathogen richness	(–) O, E, female sociosexuality	227 countries	(Thornhill et al. 2010)
Disaster and threat	Disaster frequency (both natural and technological disaster)	(+) Individualism	United States	(Grossmann & Varnum 2015)
	Disaster frequency (both natural and technological disaster)	(+) Individualistic practices (n.s.) Individualistic values	Individualistic practices: 41 countries Individualistic values: 53 countries	(Santos et al. 2017)
	Natural disaster risk	(n.s.) Collectivism	173 countries	(Oishi & Komiya 2017)
	Natural disasters and territorial threats	(+) Tightness	33 countries	(Gelfand et al. 2011)
	Tornado risk	(+) Tightness	United States	(Harrington & Gelfand 2014)
	Threat exposure (% of province destroyed and occupied during World War II, whether a province is located along a national border)	(+) Tightness	China	(Chua et al. 2019)
	Threats of violence (proxied by % of GDP spent on military)	(+) A	54 countries	(White et al. 2012)

(+) indicates a positive link; (–) indicates a negative link; (n.s.) indicates a nonsignificant link. Beyond the scope of this table, there is also a growing literature on the effects of air pollution (a socioecological variable) on patterns of emotion, cognition, and behavior (for a review, see Lu 2020). Abbreviations: A, agreeableness; C, conscientiousness; E, extraversion; ES, emotional stability; GDP, gross domestic product; GNP, gross national product; N, neuroticism; O, openness.

summarized in **Table 1**, modernization theory has been supported by both between-country studies (e.g., Santos et al. 2017) and within-country studies (e.g., Grossmann & Varnum 2015).

The climato-economic theory of culture (Van de Vliert et al. 2013) posits that collectivism can help people cope with temperature harshness, but the relationship between temperature harshness and collectivism is weaker in wealthier regions because economic resources can reduce the psychological need for collectivism. Consistent with this interaction effect between temperature harshness and economic resources, a between-country study (Van de Vliert & Postmes 2012) found that collectivism was strongest in lower-income countries with more demanding cold or hot climates, moderate in countries with temperate climates regardless of income levels, and weakest in higher-income countries with more demanding cold or hot climates. A similar interaction effect was found in a within-China study, which precluded between-country confounds (Van de Vliert et al. 2013).

Frontier settlement theory posits that frontiers, which are sparsely populated, ecologically harsh, and socially primitive, tend to foster individualism (Kitayama et al. 2010). To survive and thrive on frontiers, people may develop individualistic tendencies such as autonomy, self-determination, and self-promotion (Kitayama et al. 2010). Consistent with frontier settlement theory, babies born in frontier regions tend to receive less common names from parents—whether in the United States, in Canada, or globally (Varnum & Kitayama 2011). Similarly, individualism is higher in recently settled Hokkaido (Japan’s “northern frontier”) than in mainland Japan (Kitayama et al. 2006).

Pathogen prevalence theory posits that pathogen prevalence is one root of collectivistic (versus individualistic) culture (Fincher et al. 2008). When pathogens are prevalent in a region, collectivism may be adaptive because its behavioral manifestations (e.g., conformity) inhibit the transmission of pathogens. When pathogen prevalence is low and nonthreatening, individualism may be adaptive because its behavioral manifestations (e.g., need for uniqueness) can facilitate desirable outcomes such as innovations. As summarized in **Table 1**, multiple between-country studies and within-country studies have found a positive link between pathogen prevalence and collectivism. Consistent with pathogen prevalence theory, a study of 126,165 Chinese microblog (Weibo) users found an increase in the use of collectivistic words (e.g., “we,” “family”) after the COVID-19 outbreak (Han et al. 2021).

The above five theories about the socioecological roots of individualism versus collectivism are all plausible and have all received some empirical support (based on different data sets and empirical approaches). However, limited research has tested these socioecological variables simultaneously. In an attempt to explain global increases in individualism, Santos and colleagues (2017) tested socioeconomic development, temperature harshness, pathogen prevalence, and disaster frequency (but not subsistence styles or frontier settlement) as potential explanations. The researchers concluded that cultural differences in individualism were primarily linked to changes in socioeconomic development and somewhat linked to changes in pathogen prevalence and disaster frequency (Santos et al. 2017). The socioecological literature is still fledgling, so more systematic research is needed to test the various socioecological theories simultaneously with diverse data sets.

5.1.2. Socioecology predicts personality trait levels. As detailed in **Table 1**, socioecological variables can predict differences in personality trait levels. We consider ambient temperature and pathogen prevalence as two examples.

Ambient temperature can shape personalities because individuals constantly experience and react to it. As a warm-blooded species, humans have the existential need for thermal comfort. Benign temperatures encourage individuals to explore the outside environment, where social

interactions and new experiences abound; by contrast, when the ambient temperature is either too hot or too cold, individuals are less likely to go outside (e.g., to meet up with friends or to explore new activities). Across two within-country studies in China and the United States, Wei et al. (2017) found that participants who grew up in more benign temperatures (i.e., closer to 22°C) tended to score high on personality traits related to socialization and stability (agreeableness, conscientiousness, and emotional stability) and personal growth and plasticity (extraversion and openness). In their study on Chinese university students, to rule out the possibility that certain personalities may cause individuals to migrate to regions with certain temperatures, the researchers limited the sample to students who had spent their pre-university youth in their birthplace. To further rule out the possibility that parents with certain personalities chose to migrate to a certain region and then gave birth to children with similar personalities, the researchers further limited the sample to students whose birthplace matched their ancestral home. In short, Wei et al. (2017) precluded selective migration as an alternative explanation for the observed link between ambient temperature and personality.

Pathogen prevalence is theorized to deter individuals' openness and extraversion because their behavioral manifestations can accelerate pathogen transmission (Murray & Schaller 2010, Schaller & Murray 2008, Thornhill et al. 2010). Across a 71-country study (Schaller & Murray 2008), a 230-country study (Murray & Schaller 2010), and a 227-country study (Thornhill et al. 2010), pathogen prevalence negatively predicted openness and extraversion. Across the three studies, pathogen prevalence also predicted lower sociosexuality (e.g., lower sexual variety, fewer casual sexual encounters), which can reduce pathogen transmission.

5.1.3. Socioecology predicts personality factor structure. Besides predicting personality trait levels, socioecological variables also predict differences in personality factor structure. The niche diversity hypothesis (also known as the socioecological complexity hypothesis) posits that because humans react to the demands of socioecological niches, the diversity of social and occupational niches in a society is positively associated with the diversity of personality profiles in that society (Durkee et al. 2022). As a hypothetical example, in a complex society with diverse niches, one niche may require low extraversion, high conscientiousness, and high emotional stability (e.g., tax clerks), while another niche may require high extraversion, agreeableness, and openness (e.g., movie star scouts). These diverse niches "lead to the development of a correspondingly diverse set of personality profiles" (Lukaszewski et al. 2017, p. 945). In a less complex society, there are fewer unique niches, which are effectively fulfilled by fewer distinct personality profiles. For example, to be successful in this society, individuals may need to be simultaneously high on openness, conscientiousness, extraversion, agreeableness, and emotional stability, such that the correlation between these personality traits is high. In support of the niche diversity hypothesis, studies suggest that, compared to populations characterized by high niche diversity (e.g., industrialized societies), populations characterized by low niche diversity (e.g., forager-horticulturalists) tend to exhibit fewer unique personality factors (Durkee et al. 2022, Gurven et al. 2013, Smaldino et al. 2019). Such findings provide evidence for socioecological influences on personality factor structure.

5.1.4. Socioecology as a third variable that partly explains the link between culture and personality. In addition to predicting cultural and personality variables, socioecological variables provide insights into the link between culture and personality. As discussed in Section 4, this link is partly attributable to culture and personality's mutual influence (i.e., culture ↔ personality). Beyond this mutual influence, our framework suggests that socioecology may be a third variable that partly accounts for the link between culture and personality.

As a case in point, consider the well-replicated association between individualism and extraversion at the country level (e.g., $r = 0.64$ in Hofstede & McCrae 2004). This association could be explained by several coexisting possibilities. The first possibility is culture \rightarrow personality: When people have internalized values of individualistic cultures like personal expression, autonomy, and variety, they are more likely to exhibit extraverted (versus introverted) behaviors (Hofstede & McCrae 2004). The second possibility is personality \rightarrow culture: The aggregation of extraverts is more likely to yield an individualistic culture because “individualism allows the freer social interactions that come naturally to groups of extraverts” (Hofstede & McCrae 2004, p. 77). The third possibility is socioecology \rightarrow culture & personality: For example, research suggests that pathogen prevalence negatively predicts both individualism (Fincher et al. 2008, Grossmann & Varnum 2015, Santos et al. 2017) and extraversion (Schaller & Murray 2008, Thornhill et al. 2010), such that pathogen prevalence may be a third variable that partly explains the association between individualism and extraversion. This example underscores the importance of understanding socioecological influences.

5.2. Socioecological Changes Partly Explain Trends in Culture and Personality

To further demonstrate socioecological influences on culture and personality (i.e., socioecology \rightarrow culture & personality), we discuss how trends in culture and personality may be partly explained by socioecological changes. Due to space limitations, we use individualism-related constructs and extraversion as two examples to demonstrate how temporal changes in such constructs are partly explained by socioecological changes.

5.2.1. Increases in individualism-related constructs. By and large, studies spanning different time periods have documented the rise of individualism across the world (Greenfield 2013, Grossmann & Varnum 2015, Hamamura 2012, Santos et al. 2017, Zeng & Greenfield 2015).⁶ Examining 65 countries, Inglehart & Baker (2000) found increases in self-expression and secular values (indicators of individualism) and decreases in traditional and survival values (indicators of collectivism). Analyzing 78 countries across 51 years, Santos et al. (2017) observed country-level increases in individualist practices (smaller household size, higher percentage of people living alone, and higher divorce rate) and individualist values (emphasis on friends relative to family, emphasis on teaching children to be independent, and preference for self-expression). Additionally, studies have documented increases in individualism-related personality constructs, including self-esteem (Gentile et al. 2010, Li et al. 2020, Twenge & Campbell 2001), self-enhancement (Zhang et al. 2017), need for uniqueness (Cai et al. 2018, Ogihara et al. 2015, Twenge et al. 2010), and narcissism (Twenge et al. 2008).

Such increases in individualism-related constructs have been partly attributed to socioecological changes, including increased socioeconomic development and decreased pathogen prevalence (Grossmann & Varnum 2015, Santos et al. 2017). For example, cross-temporal studies found that individualism in the United States rose during prosperous times and fell during recessionary times (Bianchi 2016). Notably, Grossman & Varnum’s (2015) time-lagged analyses provide evidence that changes in socioeconomic development preceded changes in individualism, but not that changes in individualism preceded changes in socioeconomic development.

5.2.2. Increases in extraversion. Consistent with the aforementioned positive link between individualism and extraversion (Hofstede & McCrae 2004), extraversion has also increased over time in many parts of the world, including Australia (Scollon & Diener 2006), China (Peng &

⁶For exceptions and nuanced trends in different countries, readers are referred to Kashima et al. (2019).

Luo 2021), the Netherlands (Smits et al. 2011), and the United States (Twenge 2001). Theoretically, such increases in extraversion have been partly attributed to socioecological changes, such as (a) the development of day-care and educational systems that allow parents to socialize more and (b) the shift from manufacturing-oriented economies to service-oriented economies, which promote extraversion (Twenge 2001).

In sum, socioecological changes may partly explain trends in both culture and personality. This body of research provides further evidence for the socioecology → culture & personality links in our framework.

6. GENES → PERSONALITY

Besides highlighting cultural and socioecological environments as two roots of personality, our Socioecological-Genetic Framework of Culture and Personality highlights genes as another root of personality (**Figure 1**). A consensus in the genetics literature is that all personality traits are partly heritable (Plomin et al. 2016, Turkheimer et al. 2014). This genes → personality link has received consistent support from two findings: (a) Monozygotic twins (who share 100% of their genes) are more similar in personality than are dizygotic twins (who share 50% of their genes on average), and (b) the personalities of adopted children are more similar to the personalities of their biological parents than to the personalities of their adoptive parents (Turkheimer et al. 2014). A meta-analysis of 45 twin, family, and adoption studies found that about 40% of between-individual variation in personality is explained by between-individual genetic variation (Vukasović & Bratko 2015). Similarly, Bouchard & Loehlin (2001) suggested that genetic variation accounted for almost 50% of the variance in each of the Big Five personality factors. To be clear, it does not mean that 50% of a given individual's agreeableness, for example, is explained by genes; rather, it means that 50% of the variance in agreeableness in a population of individuals is explained by genetic variance across those individuals (Krueger & Johnson 2021).

Given the genetic influences on personality traits, a natural question is which genes are linked to which personality traits. This question turns out to be challenging, because personality traits are polygenic, which means that numerous genes are involved in the expression of a personality trait. Mounting evidence suggests that heritability is caused by numerous genes of minuscule effect (Plomin et al. 2016). Moreover, most genes involved in personality traits are also pleiotropic, which means that the same genes can be involved in the expression of many traits. To understand the genetic underpinnings of personality traits, researchers increasingly conduct genome-wide association studies (GWAS). For example, one large GWAS meta-analysis ($N = 449,484$) identified 136 independent genome-wide significant loci associated with neuroticism (Nagel et al. 2018). While promising, this literature is still nascent.

Notably, “genetic effects must be understood in the environmental conditions under which the genes are expressed” (Uchiyama et al. 2021, p. 4). Consider the example of height, which is highly heritable. Although North and South Koreans are genetically similar, North Koreans are about 13 cm shorter than South Koreans because of nutritional differences (Schweskendiek 2009). This example underscores the importance of understanding the interactive effect of genes and culture/socioecology on personality, which we discuss in the next section.

7. GENES × CULTURE/SOCIOECOLOGY INTERACTIONS → PERSONALITY

Besides identifying genes, culture, and socioecology as roots of personality (the solid arrows in **Figure 1**), our framework highlights the interactive effects of genes and culture/socioecology on personality (the dashed arrows in **Figure 1**). Rather than asking whether personality is influenced

more by nature (genes) or by nurture (culture/socioecology), it is essential to ask how personality is shaped by the interaction between nature and nurture (Sasaki & Kim 2017).

As illustrated by the dashed arrows in **Figure 1**, genes can statistically moderate cultural/socioecological influences on personality, while culture/socioecology can also statistically moderate genetic influences on personality. In other words, “being in the same environment may predict different outcomes depending on variation in genes, and likewise, having the same genetic predisposition may predict different outcomes depending on variation in the environment” (Sasaki & Kim 2017, p. 5).

On the one hand, genes can moderate cultural/socioecological influences on personality, such that cultural/socioecological influences on personality may be strengthened or weakened by certain genetic polymorphisms (Kitayama & Yu 2020). As an example of genes moderating *cultural* influences on personality, Kitayama et al. (2014) found that while Asians born in East Asia were more interdependent in social orientation than European Americans on average, this cultural difference in personality was observed only among carriers of the 7/2-R allele of the dopamine receptor D4 gene (DRD4), because carriers tend to be more sensitive to cultural influences. As an example of genes moderating *socioecological* influences on personality, Jokela et al. (2007) found that urban (versus rural) residency predicted lower levels of depressive disorder in Finnish individuals carrying the T/T or T/C genotype of the HTR2A gene T102C polymorphism, but not in those carrying the C/C genotype.

On the other hand, culture/socioecology can moderate genetic influences on personality. Genes predispose an individual to certain personality phenotypes, but the strength of this link may depend on the individual’s cultural/socioecological environment. As an example of *culture* moderating genetic influences on personality, Kim et al. (2011) conducted a cross-cultural study on the expression of the oxytocin receptor polymorphism (OXTR) rs53576, a gene related to socioemotional sensitivity. As emotional suppression is normative in Korean culture but not in American culture, the study found that culture (Korean versus American) moderated the effects of the oxytocin receptor polymorphism on emotional suppression: Koreans with the GG genotype (i.e., the more socioemotionally sensitive genotype) reported suppressing emotions more than Koreans with the AA genotype (i.e., the less socioemotionally sensitive genotype), whereas Americans showed the opposite pattern (Kim et al. 2011). As an example of *socioecology* moderating genetic influences on personality, Fischer et al. (2018) found that dopamine genes (which are involved in reward processing) were linked to extraversion and emotional stability, but only in demanding climates.

Together, such genes \times culture/socioecology interaction effects on personality demonstrate the interplay between nature and nurture. This literature is still fledgling and fast-developing, so future studies should examine the replicability of these findings, some of which were based on small samples.

8. CULTURE/SOCIOECOLOGY (\rightarrow PERSONALITY) \rightarrow GENE EXPRESSION⁷

In Sections 4.1 and 5.1, we elaborated on how culture and socioecology shape personality traits. Taking a step further, our framework suggests that culture and socioecology may shape individuals’ gene expression. This idea is consistent with emerging research on epigenetics, the study

⁷Due to space limitations, we do not cover culture–gene coevolution theory (Laland et al. 2010, Richerson et al. 2010), which suggests that culture and genes may shape each other and coevolve over time at the population level.

of environmental influences on gene expression. Although an individual's DNA is fixed at conception, the expression of DNA is continuously shaped by the environment (Cole 2009). While each modification in gene expression is small, such modifications may accumulate over time into significant changes. In support of environmental influences on epigenetics, evidence suggests that although monozygotic twins are epigenetically indistinguishable during the early years of life, their epigenetic differences increase over time (Fraga et al. 2005).

To date, epigenetic research has focused on how adverse upbringing conditions (e.g., trauma, childhood abuse) influence gene expression. For example, childhood maltreatment can lead to the epigenetic regulation/modification of glucocorticoid receptor (NR3C1) gene expression (McGowan et al. 2009, Perroud et al. 2011). McGowan et al. (2009) found that, for suicide victims, a history of childhood abuse corresponded to decreased hippocampal NR3C1 gene expression. Similarly, Perroud et al. (2011) found that the severity of childhood sexual abuse was associated with decreased NR3C1 gene expression.

By contrast, little research has examined cultural and socioecological influences on gene expression (Kitayama & Huff 2015). Drawing on the aforementioned epigenetic research, we submit that sustained exposure to and engagement with cultural and socioecological environments may modify the expression of certain genes. By integrating epigenetic research into our framework, we depart from the common assumption that anything that is gene related is immutable. Moreover, we submit that changes in gene expression due to cultural and socioecological influences may be mediated by changes in personality (i.e., culture/socioecology → personality → epigenetic changes). This sequence is theoretically plausible because culture and socioecology may have a stronger and more direct influence on people than on gene expression. We argue that personality traits may serve as the link that connects culture/socioecology (macro environments) with gene expression (micro processes). If cultural and socioecological influences are so strong as to change an individual's gene expression, then it is possible that such changes in gene expression are mediated by changes in the individual's personality—i.e., an individual's relatively stable patterns of emotion, motivation, cognition, and behavior. The examination of such links awaits empirical research.

9. CONCLUSION

In summary, our Socioecological-Genetic Framework of Culture and Personality (**Figure 1**) provides an integrative perspective on culture and personality. First, the framework delineates the mutual constitution of culture and personality (Section 4). We reviewed multiple threads of evidence demonstrating that culture shapes individuals' personalities, while individuals' personalities collectively shape culture. Second, in addition to the mutual constitution of culture and personality, the framework spotlights socioecological influences on culture and personality (Section 5). Relatedly, we suggest that socioecology may be a third variable that partly explains the association between culture and personality, and that socioecological changes partly explain temporal trends in culture and personality. Third, our framework goes a step further to consider how cultural and socioecological influences on personality may result in changes in the expression of genes (i.e., epigenetics) (Section 8). Fourth, besides cultural and socioecological influences on personality, our framework accounts for genetic influences on personality (Section 6). Fifth, we emphasize that instead of debating whether personality is influenced more by nature (genes) or nurture (culture/socioecology), it is essential to understand how personality is shaped by the interaction between nature and nurture (Section 7). Hence, besides identifying the main effects of genes, culture, and socioecology on personality (the solid arrows in **Figure 1**), our framework highlights the interactive effects of genes and culture/socioecology on personality (the dashed arrows in

Figure 1). To our knowledge, we are the first to organize culture, personality, socioecology, and genetics within the same framework, which broadens and deepens the understanding of their interplay.

We would be delighted if our framework led researchers from diverse disciplines to dive into unfamiliar domains (e.g., personality geneticists learning more about socioecology and culture and cultural psychologists appreciating the aggregate influence of personality). By integrating socioecology and genetics, researchers will have a more comprehensive understanding of culture and personality. Culture and personality may be an odd couple (Markus 2004), but a marriage between them could be a love match after all.

SUMMARY POINTS

1. Personality traits—defined as individuals' relatively stable patterns of emotion, motivation, cognition, and behavior—include not only the Big Five and their facets but also relatively stable individual differences such as individualistic and collectivistic orientations, which Triandis (2001) referred to as idiocentric and allocentric personalities. In other words, we argue that stable individual-level cultural orientations are also personality traits.
2. The Socioecological-Genetic Framework of Culture and Personality (**Figure 1**) provides an integrative perspective on culture and personality by spotlighting the roles of socioecology and genetics.
3. In a cycle of mutual constitution, culture shapes individuals' personalities, and individuals' personalities collectively shape culture. Therefore, individuals are culturally influenced influencers of culture.
4. In addition to the mutual constitution of culture and personality, socioecology may be a third variable that partly explains the association between culture and personality. Relatedly, socioecological changes partly explain the temporal trends in culture and personality (e.g., increases in individualism and extraversion over time).
5. Roots of culture: Socioecology is one root of culture because culture evolves in response to different socioecological affordances and constraints. The aggregate influence of personality is another root of culture because individuals collectively construct and influence culture through relatively stable patterns of emotion, motivation, cognition, and behavior (i.e., personalities).
6. Roots of personality: Rather than debating whether nature (genes) *or* nurture (culture/socioecology) is the root of personality, we argue that genes, culture, and socioecology are all roots of personality. Moreover, the key question is not whether personality is influenced *more* by nature or by nurture, but how personality is shaped by the interaction between nature and nurture.

FUTURE ISSUES

1. While aggregate personality influences on culture are theoretically plausible, more research is needed to establish causality. For example, researchers could conduct a

longitudinal field study on unacquainted participants in a new environment (e.g., a summer camp). Researchers could, first, assess their personalities; second, assign them to different communities based on their personalities (e.g., some communities are comprised of extraverts, whereas other communities are comprised of introverts); and third, assess what types of cultures emerge naturally in the different communities (e.g., are introverts more likely to develop a collectivistic culture?).

2. Drawing on epigenetic research, we propose that an individual's continuous engagement with cultural and socioecological environments can alter the expression of genes—sometimes by shaping the individual's patterns of emotion, motivation, cognition, and behavior (i.e., personality). That is, we propose that epigenetic changes due to cultural and socioecological influences may be mediated by changes in personality. This proposition awaits future research.
3. As shown in **Table 1**, socioecological studies have been mostly limited to a few well-studied cultural dimensions (e.g., collectivism, tightness) and the Big Five personality factors. While it is fruitful to study these constructs given their centrality in culture and personality research, future research could examine socioecological influences on other cultural constructs such as power distance and dignity/face/honor cultures (Leung & Cohen 2011) as well as other personality constructs such as narcissism, assertiveness (Lu et al. 2020, 2022a), and narrative identity (McAdams & Pals 2006).
4. The existing literatures have mostly focused on comparing Westerners and East Asians. Future studies should move beyond the West-versus-East paradigm to examine other cultural groups.
5. Given the intricate interplay among culture, personality, socioecology, and genes, strict causal inference is challenging to determine. To mitigate (but not eliminate) causal concerns, studies have used time-lagged analyses, the Granger test of predictive causality (Götz et al. 2021, Grossmann & Varnum 2015), and instrumental variable analysis (Obschonka et al. 2018b). Additionally, the COVID-19 outbreak—an exogenous socioecological shock to the mutual constitution of culture and personality—offers an opportunity to study the causal effects of infectious diseases on personality and culture. Because of COVID-19, social distancing and physical isolation (due to quarantine, school closures, travel bans, etc.) may have shaped personalities at the individual level (e.g., increases in introversion) and cultures at the population level (e.g., increases in collectivism). Meanwhile, culture can shape the transmission and prevalence of COVID-19. For example, large-scale studies have shown that collectivism predicts mask use (Lu et al. 2021), uncertainty avoidance predicts COVID-19 vaccine hesitancy (Lu 2022), and cultural tightness predicts lower COVID-19 morbidity and mortality (Gelfand et al. 2021).

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