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Climatic Ignition of Motivation

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Abstract

Climatic demands of cold winters and hot summers help explain *why*, whereas poverty and riches help explain *how*, inhabitants adapt culturally to their place of residence, their habitat. Motivational goals, behavioral means, and behavioral outcomes differ systematically in the following four types of habitats: *threatening* (demanding, poor); *unthreatening* (undemanding, poor); *unchallenging* (undemanding, rich); and *challenging* (demanding, rich). Perhaps most notably, there are stepwise increases in freedom, individualism, cooperation and creativity from threatening to unthreatening to unchallenging to challenging habitats. Geographically viewed, north-south differences dwarf east-west differences in climatic demands and wealth resources, and thus in climato-economic habitats. As a consequence, north-south differences also dwarf east-west differences in motives and behaviors. Because of their climato-economic habitats, compared to southerners, northerners manifest higher levels of freedom, individualism, cooperation and creativity in the northern hemisphere, but lower levels of freedom, individualism, cooperation and creativity in the southern hemisphere. This pattern of findings contributes to the burgeoning field of latitudinal psychology—the long-term ambition to map and understand spatial variations of psychological phenomena along the north-south rather than the east-west axis of the Earth.

It is patent to any intelligent person that different climates produce different fauna and flora. Why then should they not produce different kinds of people?

Wheeler (1946, p. 80)

Members of many ancient civilizations were graced with the wisdom of *worshipping the Sun or the Earth, or both*. They must have sensed that all living species would freeze to death in the cold or burn to death in the heat if the Sun were to start shining from farther away or closer up, or if the Earth were to stop rotating around the Sun and around its own tilted axis. Indeed, the Sun and the Earth in conjunction sustain livability, and shape life, through alternating solar radiation patterns between winter and summer. For this obvious reason, one might expect psychologists to have a fundamental interest in why and where and how humans navigate between the extremes of cold stress and heat stress. If in doubt, consider the following psychological consequences of climatic temperatures.

First of all, we warm-blooded humans have evolved (a) basic needs for thermal comfort, nutritional flora and fauna, and a healthy environment; (b) worries and preparations to do with cold winters and hot summers; and (c) strategies to exploit the seasonal availability of plants and animals on which we feed. Second, grown-ups are reluctant to migrate to arctic or desert regions where livability is highly problematic. Third, newborns nowadays enter into an environment to which they have to adapt using socially transmitted ideas, practices, and artifacts including cash and capital, to prevent or manage adverse effects of seasonal cold and heat. As a fourth consequence, highlighted here, many sublimated motives and encultured habits vary typically among inhabitants of habitats with typical cold and hot seasons, and typical levels of wealth.

This article explores the extent to which climatic temperatures ignite differing motors of intention and behavior in various places of residence. To illustrate the issue, take the climatic ignition of working for money rather than for achievement or fun. Economic modeling of climatic cold and heat as cost-raising factors (Burke, Hsiang, & Miguel, 2015; Rehdanz & Maddison, 2005; Welsch & Kuehling, 2009) leads to the conclusion that both colder winters and hotter summers generate less income (Burke et al., 2015; Carleton & Hsiang, 2016), which is extra painful because such seasons are more expensive (Van de Vliert, 2013b). Thus, it may be an incomplete story that poverty drives working for financial reasons. Indeed, blue-collar workers, white-collar workers, and managers all tend to perceive their wages as more important work motivators in poorer countries with harsher climates (e.g., Azerbaijan and Sudan) (Van de Vliert, Van Yperen, & Thierry, 2008).

We begin this scientific expedition with the classic belief that thermal climate matters for human functioning, which has initially produced preliminary descriptions and explanations of links between climate and culture—the shared pattern of needs-based stress appraisals, and embedded goals, means and outcomes within a given habitat (Van de Vliert, 2013a). More refined studies of the climatic origins of encultured motives and behaviors became possible only after the development of a new thermometer that uses 22 °C (~72 °F) as point of reference for optimal livability. As we will discuss, it took two decades (1995–2015) to complete a first scientific cycle from the belief that thermal climate matters, to adequate descriptions of where and when it matters, to general explanations of why that would be the case. Building on the meanwhile accumulated body of climato-economic knowledge, the field is now moving into a second cycle starting with the belief that north-south differences dwarf east-west differences in human functioning, and continuing with latitude-related descriptions and explanations of encultured motives and behaviors.



1. THE FIRST SCIENTIFIC CYCLE

1.1 From Belief to Description

A belief is seen here as a parsimonious system of knowledge that does not accurately distinguish between description, explanation, and generalization. Driven by the archetypal belief in the importance of local temperatures for local human life, classic scientists such as Hippocrates, Ibn Khaldun, Montesquieu, and Quetelet creatively tried to relate climate to culture (Feldman, 1975; Jankovic, 2010; Sommers & Moos, 1976). For example, Hippocrates “noted that climate generally drives basic physiological wants and needs, psychological well-being, and health care in general” (Parker, 2000, p. 23), and Ibn Khaldun observed that “the more emotional people were in the warmer climes with the prudens in the frigid North” (Harris, 1968, p. 41). At the beginning of the 20th century, proponents of the geographical school similarly argued how average temperature shapes all sorts of psychosocial phenomena, including health, human energy, and mental efficiency (Sorokin, 1928; Tetsuro, 1971), sometimes with horrible self-serving claims about the superiority of some races and inferiority of others (e.g., Huntington, 1945; Taylor, 1937).

Back in the 1970s, Hofstede (1980) was the first to perform a large-scale comparison of motivating goals across cultures. Using geographic latitude as a proxy for average ambient temperature, he found that employees in colder

countries are primarily motivated by “Having a job which leaves you sufficient time for your personal life or family life,” “Have considerable freedom to adapt your own approach to your job,” and “Have challenging work to do—work from which you can get a personal sense of accomplishment.” By contrast, employees in warmer countries are primarily motivated by “Have training opportunities (to improve your skills or learn new skills),” “Have good physical working conditions (good ventilation and lighting, adequate work space, etc.),” and “Fully use your skills and abilities on the job.”

Some scholars treading in Hofstede’s (1980) footsteps have statistically and speculatively related average climatic temperature to speech sonority (Fought, Munroe, Fought, & Good, 2004), aggression and violent behavior (Coccia, 2017), interpersonal communication (Andersen, Lustig, & Andersen, 1990), and role overload (Van de Vliert & Van Yperen, 1996). They explicitly searched for linear climate–culture relations, whereas others have documented curvilinear effects of average climatic temperature. For example, compared to inhabitants of colder-than-temperate and hotter-than-temperate habitats, inhabitants of temperate habitats have a higher need for achievement (McClelland, 1961), show a stronger inclination to discriminate between men and women (Van de Vliert, Schwartz, Huismans, Hofstede, & Daan, 1999), and manifest greater domestic political violence (Van de Vliert et al., 1999).

Today, with the benefit of hindsight, one can easily critique all those early attempts to confirm the belief in a relationship between annual mean temperature and behavioral motives and habits. Average climatic temperature is an insufficiently accurate descriptor of local culture as it neglects the existence of a thermal optimum (4 °C and 40 °C both pose livability problems; Parsons, 2003), overlooks the impact of seasonal variations in cold and heat (small and large differences between winters and summers may have the same average; Van de Vliert & Tol, 2014), and is confounded with year-round variations in temperature (higher latitudes have both lower averages and larger variations; Van Lange, Rinderu, & Bushman, 2017a). An appropriate descriptor of thermal demands and stresses should take account of winter and summer deviations from a biologically optimal point of reference.

1.2 Via Description to Explanation

The millennium change around 2000 came with two entwined discoveries that transformed the conundrum of climatic determinism of culture into a

climato-economic paradigm (Van de Vliert, 2009). The first advance, discussed in Section 1.2.1, was the development of an innovative thermometer for measuring the livability of climate (Van de Vliert, 2003, 2017a). The second advance, discussed in Section 1.2.2, was the rediscovery of Montesquieu's (1748/1989) seminal insight that economic wealth can make up for the adverse effects of bitter winters and scorching summers (Parker, 2000). Both developments are described here in just enough detail to enable the presentation of an explanation in terms of the interactive effects of climatic demands and wealth resources on societal culture, and a typology of cultural adaptations to climato-economic habitats (Section 1.2.3).

1.2.1 *Thermometer for Livability*

Thermometers have salient points of reference: when water freezes (Celsius); when there is an equal mix of ice, water, and salt (Fahrenheit); when the human body temperature is normal (clinical thermometer). What, then, is an apt point of reference for the human livability of thermal environments? After some initial exploration, 22 °C (~72 °F) was adopted as a benchmark from which measurements are made (Fig. 1). For one thing, it is the approximate midpoint of the range of comfortable ambient temperatures (Parsons, 2003) and the temperature preferred by tourists (Bigano, Hamilton, & Tol, 2006). Also, 17–27 °C is the optimal zone for feeding on flourishing flora and fauna (Cline, 2007; Hatfield & Prueger, 2015; Parker, 1995, 2000), and for keeping in good health (Carleton & Hsiang, 2016; Fischer & Van de Vliert, 2011; Tavassoli, 2009). Coincidentally, across countries 22 °C is also the highest temperature in the coldest winter month (on the Marshall Islands) as well as the lowest temperature in the hottest summer month (on the Faroe Islands).

In short, a country's climate—measured across the country's major cities and weighted for population—is more demanding and stressful to the extent that winters are colder than 22 °C and summers hotter than 22 °C. Therefore, it has become customary to measure a country's climatic demands as the sum of the absolute deviations, in centigrades, from 22 °C for the average (a) lowest temperature in the coldest month, (b) highest temperature in the coldest month, (c) lowest temperature in the hottest month, and (d) highest temperature in the hottest month. Indices for cold and heat deviations from 22 °C, and for total temperature deviations from 22 °C, are available for at least 230 independent countries and dependent territories (Van de Vliert, 2013c; <http://www.rug.nl/staff/e.van.de.vliert/projects>). In South Africa, for

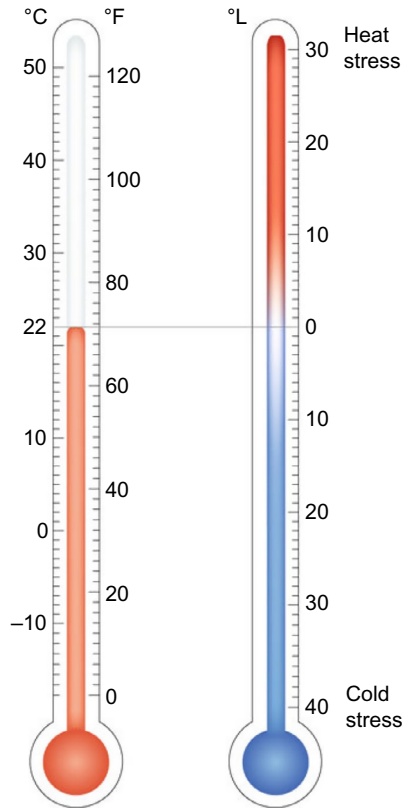


Fig. 1 Thermometer for measuring Livability (°L). First published in Van de Vliert, E. (2017a). *Climatic imprints on personality*. *Nature Human Behaviour*, 1, 864–865 by Nature Publishing Group.

example, with its cold winters ($|-2^{\circ}\text{C} - 22^{\circ}\text{C}| + |7^{\circ}\text{C} - 22^{\circ}\text{C}|$) and hot summers ($|29^{\circ}\text{C} - 22^{\circ}\text{C}| + |39^{\circ}\text{C} - 22^{\circ}\text{C}|$), cold demands (39) and heat demands (24) add up to a total score of 63.

Criticisms of the new thermometer have to do with concerns about 22°C as a questionable point of reference for livability and about the inadequacy of a single index score for large countries spanning multiple climatic subzones. However, somewhat lower or higher reference points than 22°C always yield almost identical research results, and adjusting for error-inducing temperature variations within large countries strengthens rather than weakens the effects (Fischer & Van de Vliert, 2011; Van de Vliert, 2009, 2011a, 2011b). A more realistic reason for caution is that the present-day Earth offers larger cold deviations from 22°C ($M=30.94$, $SD=25.97$) than heat

deviations from 22 °C ($M=21.28$, $SD=7.61$; $t_{231}=4.75$, $P<0.001$). In consequence, cold demands provide potentially more reliable associations with cultural differences than heat demands do.

1.2.2 Wealth Resources Offset Climatic Demands

A terribly mistaken idea is that humankind has no other option than adapting passively to a fixed climatic habitat. Montesquieu (1748/1989) stands out for realizing how important property and money are for managing climatic demands (Parker, 2000). The scientific breakthrough formulated by Montesquieu is the insight that people predominantly manage climate by turning wealth resources into climate-related goods and services that satisfy existential needs. “Basically, Montesquieu saw a harsh climate as posing a crucially demanding and stressful livability problem and national wealth as a proxy for the availability of resources to tackle that problem. During human evolution, family property, liquid cash, and illiquid capital have very slowly but surely come to serve as major tools for turning a given climatic habitat into a climato-economic habitat that is home to a cultural identity” (Van de Vliert, 2017b, p. 121).

Owning, earning, saving, and trading can help prevent and dispel thermal stress, hunger, thirst, and illness in cold or hot habitats. Liquid money is particularly useful for handling colder-than-temperate winters or hotter-than-temperate summers because it can so flexibly be moved across buyers and sellers, goods and services, places and times. Nowadays, wealthy people everywhere can buy heat and cold, food and drink, cure and care. This explains why people want to earn more money in poorer countries with harsher climates (Van de Vliert et al., 2008). Broader still, the compensatory function of monetary resources also helps more generally explain where and how inhabitants adapt their culture to their climatic habitat (Fig. 2).

In climato-economic research, wealth resources are measured as income per head. Specifically, the capacity of a country’s currency to buy a given basket of representative goods and services (purchasing power parity in international dollars) is log transformed to reduce its skewed cross-national distribution. Wealth resources thus measured are thought to serve as mediators and modifiers of the impact of climatic demands on behavioral motives and daily functioning. The resulting paradigm offers a demands-resources explanation of motivation as part of the broader family of demands-resources explanations in psychology (e.g., Ajzen, 1991; Bandura, 1997; Karasek, 1979; Lazarus & Folkman, 1984; Tomaka, Blascovich, Kelsey, & Leitten, 1993). In essence, climatic demands are viewed as double-edged swords that

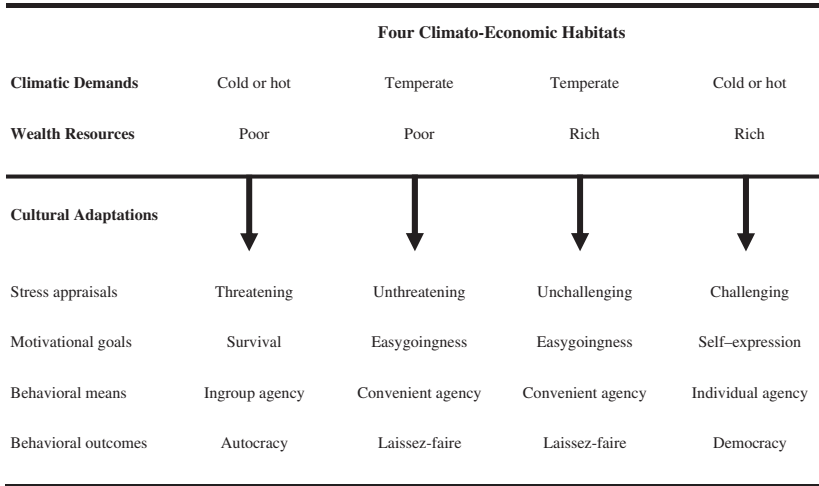


Fig. 2 Climato-economic ignition of stress-based motivation.

produce either collective survival threats and an obsession with control in poor countries, or individual self-expression challenges and an obsession with creation in rich countries (Van de Vliert, 2009, 2013a, 2017b).

1.2.3 Adaptations to Climato-Economic Habitats

Fig. 2 further clarifies how climatic demands and wealth resources interact in shaping various features of culture. The columns above the arrows sketch four prototypical circumstances of livability, and the columns below the arrows relate them to four sequentially ordered domains of cultural adaptation. The process of climato-economic ignition of motivation starts with an appraisal of the stressfulness of the environment (cf. Drach-Zahavy & Erez, 2002; Lazarus & Folkman, 1984; Skinner & Brewer, 2002). *Primary appraisal* assesses to what extent winters and summers are stressfully demanding because basic needs for thermal comfort, nutritional flora and fauna, and a healthy environment cannot be satisfactorily met. *Secondary appraisal* assesses to what extent stressfully demanding winters and summers are threatening or challenging given the available wealth resources to meet the demands. These stress appraisals are construed here as antecedents, and behavioral means and outcomes as consequents, of motivational goal setting.

The arrows in Fig. 2 point to four adaptational paths that have been explored so far. First, poor populations appraise cold or hot habitats as threatening, strive for survival, give primacy to achieving survival by means of

ingroups, and tend to end up with autocratic leaders and institutions. Second, poor populations appraise habitats with temperate climates as unthreatening, strive for easygoing goals in between stressful survival and stressful self-expression, do so in convenient ways, and tend to end up with laissez-faire leaders and institutions (Van de Vliert, 2009, 2013a). Third, and similarly, rich populations appraise habitats with temperate climates as unchallenging, also strive for easygoing goals in convenient ways, and also tend to end up with laissez-faire leaders and institutions. Finally, rich populations appraise cold or hot habitats as challenging, strive for self-expression, give primacy to achieving self-expression by means of oneself, and tend to end up with democratic leaders and institutions.

1.3 Via Explanation to Generalization

Fig. 2 is simultaneously an explanatory matrix and a guide toward empirical validation and generalization. The vertical arrows represent the central tenet of climato-economic theorizing that climatic demands and wealth resources influence each other's impact on encultured motives and behaviors. As discussed below in four subsections, from about 2000 onward, a widening research program has gradually tested and supported the validity of the climato-economic predictions of stress appraisals, motivational goals, behavioral means, and behavioral outcomes, respectively.

1.3.1 Stress Appraisals

Evidence for the appraisal of climato-economic habitats as threatening, unthreatening, unchallenging, or challenging may be inferred from a secondary analysis of clustered data about mental ill-being (Fischer & Van de Vliert, 2011). Across 58 countries, climatic demands (0%), wealth resources (17%), and their interaction (21%) accounted for 38% of the variation in mental misery. Burnout, depression, anxiety, perceived ill health, and unhappiness appeared to be most prevalent in poor populations threatened by harsh winters or summers (e.g., Iranians and Serbs), intermediately prevalent in both poor populations (e.g., Sri Lankans) and rich populations (e.g., Hongkongers) residing in clement climates, and least prevalent in rich populations challenged by harsh winters or summers (e.g., Finns and Swiss). Controlling for parasitic disease burden and income inequality did not eliminate the climato-economic effects, neither did bootstrap analysis indicate that the results were due to spurious correlation or outliers (Fischer & Van de Vliert, 2011).

1.3.2 Motivational Goals

Time and again, the World Values Survey group has demonstrated that motives drive populations to pursue objectives ranging from survival goals to self-expression goals (Inglehart & Baker, 2000; Inglehart, Basáñez, Díez-Medrano, Halman, & Luijckx, 2004; <http://www.worldvaluessurvey.org>). Toward the survival pole, people give higher priority to extrinsic goals of physical and economic security, and are more inclined to distrust others. Toward the self-expression pole, people prioritize intrinsic goals of self-realization and quality of life, and are more inclined to trust others. Mid-range positions on this motivational dimension go together with less stressful, more easygoing goals. Survival versus self-expression goals, measured with eight items that appeared in the same format in all the waves of the still ongoing World Values Surveys, have been shown to relate back to the livability of the climato-economic environment.

Across 77 countries, climatic demands (0%), wealth resources (52%), and their interaction (20%) accounted for no less than 72% of the cross-national variation in survival versus self-expression goals (Van de Vliert, 2009, 2013b). Supporting the model presented in Fig. 2, survival goals thrive in poorer populations threatened by climates with more demanding winters or summers (e.g., Armenians and Latvians), whereas self-expression goals thrive in richer populations challenged by climates with more demanding winters or summers (e.g., Canadians and Swedes). In between, easygoing goals tend to prevail in poor populations unthreatened by temperate climates (e.g., Ghanaians and Indonesians) and in rich populations unchallenged by temperate climates (e.g., Maltese and Singaporeans).

A related analysis among 62,172 wage earners in 66 countries addressed the strength of the within-country relationship between personal household income and personal motivation to pursue survival rather than self-expression (Van de Vliert, 2007, 2009). Only for members of poorer populations residing in more demanding thermal climates (e.g., Belarusians and Moldovans) did a person's own household income make a difference: they appeared to endorse survival goals over other goals to the extent that they earned less ($R^2=0.42$, $P<0.001$). Apparently, higher household incomes push and pull people away from survival goals and meeting basic needs, but do so only in threatening climato-economic habitats with considerable livability problems.

In addition to this cross-sectional evidence, a longitudinal analysis further corroborated the idea of climato-economic ignition of motivation. For 38 countries, annual percentages of change in survival versus self-expression

goals during 8- to 19-year periods between 1981 and 2002 were analyzed (Van de Vliert, 2007, 2009). Even with national wealth controlled for, populations in more demanding thermal climates appeared to have moved more toward survival goals to the extent that they were exposed to economic decline rather than economic growth ($R^2=0.59$, $P<0.001$). As a noteworthy case in point, Estonians, Latvians, Lithuanians, and Russians all moved toward survival goals after the collapse of communist rule and the subsequent economic decline—an average of minus 5% per year at the end of the 20th century. Given the view of most theorists that cultures are rather stable over time, this degree of motivational adaptation to climato-economic shocks is impressive for the limited span of time investigated.

Taken together, wealth resources seem likely to alter the link between climatic demands and motivational goals in line with the typology in Fig. 2. The analyses revealed that relatively poor populations residing in climates with more demanding winters or summers strive less for easygoingness and more for survival to the extent that they are economically deprived in terms of national income per head, household income, and economic growth. By contrast, relatively rich populations residing in such harsher thermal climates strive less for easygoingness and more for self-expression to the extent that they are economically prosperous in terms of national income per head, household income, and economic growth.

1.3.3 Behavioral Means

Of course, motivations and goals can be handled in multiple ways using multiple means. A crucially important issue is whether people give primacy to achieving goals such as survival or self-expression by means of own groups or by means of oneself, that is, whether they are collectivist, individualist, or a convenient mixture of both (Brewer & Chen, 2007; Hofstede, 2001; Triandis, 1995). Ingroup agency is a coin with two sides: collective goals are realized with the help of members of ingroups (positive discrimination) while excluding members of outgroups (negative discrimination). Individual agency is sideless in that personal goals are realized without or with involvement of indiscriminate others—be they members of ingroups or outgroups. To clarify the issue, take siding in a conflict. Whereas a collectivist is inclined to side with ingroup members in conflict with outsiders, an individualist is inclined to side with the party who is more right, more powerful, or both (Van de Vliert, 1981; Yang, Van de Vliert, & Shi, 2007).

From a sociopolitical perspective, the World Values Survey group (Inglehart & Baker, 2000; Inglehart & Welzel, 2005; Welzel, 2013) has

explicitly built conceptual and empirical connections between survival goals and ingroup agency on the one hand, and between self-expression goals and individual agency on the other hand. More implicitly, halfway the antipoles of survival and self-expression goals, striving for easygoingness has been related to convenient mixtures of ingroup agency and individual agency. A telling example is the use of ingroup cooperation against an outgroup to create joint gains in order to subsequently claim these ingroup gains individually (Van de Vliert, 2013b). Just like the motivational goals, the corresponding behavioral pathways are also fine-tuned to the livability of the climato-economic environment, as evidenced by the following results of three studies (Van de Vliert, 2011a).

First, nonemployment rate (12%), climatic demands (1%), wealth resources (13%), and climato-economic interaction (8%) accounted for 34% of the variation in compatriotistic agency—favoritism shown to fellow nationals by giving them easier access to scarce jobs than is given to immigrants. Second, organizational size (40%), climatic demands (1%), wealth resources (12%), and climato-economic interaction (8%) accounted for 61% of the variation in nepotistic agency—favoritism shown to relatives by giving them organizational positions because of their relationship rather than based on their merits. Third, institutional collectivism (13%), climatic demands (8%), wealth resources (25%), and climato-economic interaction (11%) accounted for 57% of the variation in familistic agency—favoritism shown to one's closest relatives in the nuclear family through mutually beneficial exchanges of time, effort, and feelings of pride.

The three levels of collectivistic versus individualistic behavior appeared to share considerable commonality in origin. Consistently, individual agency was weakest in poorer populations threatened by climates with more demanding winters or summers (e.g., Kazakhstanis and Mongolians), intermediately strong in populations comforted by temperate climates irrespective of income per head (e.g., Guyanese and Taiwanese), and strongest in richer populations challenged by climates with more demanding winters or summers (e.g., Icelanders and Americans). These findings support the adaptational storyline of predominant ingroup agency in threatening habitats, convenient agency in comforting habitats, and predominant individual agency in challenging habitats.

1.3.4 Behavioral Outcomes

It goes almost without saying that people carrying around threat appraisals, survival goals, and ingroup-outgroup biases in relatively closed minds do not seem to qualify as gifted constructors of democratic relationships and

organizations. Mirrorwise, people carrying around challenge appraisals, self-expression goals, and individual preoccupations in relatively open minds do not seem to qualify as gifted constructors of autocratic relationships and organizations. Additionally, unlike unthreatened and unchallenged inhabitants of temperate climates, neither threatened people nor challenged people can be easily associated with an inclination toward laissez-faire relationships and organizations (Van de Vliert, 2013b).

This line of argument, too, has its empirical counterparts. Take autocratic versus democratic leadership cultures in the target industries of food processing, financial services, and telecommunications services, assessed by GLOBE researchers (House, Hanges, Javidan, Dorfman, & Gupta, 2004). Climatic demands (4%), wealth resources (13%), and their interaction (14%) accounted for 31% of the dimensional variation in autocratic, laissez-faire (neither autocratic nor democratic), and democratic leadership among more than 17,000 managers from over 900 organizations in 60 societies (Van de Vliert, 2009). The perceived effectiveness of autocratic leadership was highest in poor populations threatened by demanding thermal climates, intermediate in populations comforted by undemanding climates irrespective of income per head, and lowest in rich populations challenged by demanding thermal climates.

Turning from industrial leadership cultures to the political system, the above pattern of results was replicated in regard to clustered ratings of civil liberties, free elections, party competition, citizen participation, and the like (e.g., Conway et al., 2017). Across 174 countries, climatic demands (6%), wealth resources (22%), and their interaction (7%) accounted for 35% of the variation in autocratic versus democratic governance (Van de Vliert & Postmes, 2012). Even with the prevalence of parasitic diseases controlled for, sociopolitical autocracy is highest in poorer populations threatened by thermal climates (e.g., Afghans and Chinese), whereas sociopolitical democracy is highest in richer populations challenged by thermal climates (e.g., Czechs and Norwegians). Laissez-faire forms of neither autocratic nor democratic governance predominate in poor populations (e.g., Sierra Leoneans) and rich populations (e.g., Singaporeans) comforted by temperate climates.

There is a broad consensus today that autocracy is frustrating whereas democracy is satisfying. In one of our studies (Van de Vliert & Postmes, 2014), we have criticized this stereotypical view by zooming in on experienced satisfaction with freedom of choice in each of Fig. 2's four climato-economic habitats. We found that political democracy is negatively related

to satisfaction with freedom of choice in threatening habitats ($r_{20} = -0.47$, $P < 0.05$); unrelated to satisfaction with freedom of choice in unthreatening habitats ($r_{48} = 0.13$, $P > 0.05$) and in unchallenging habitats ($r_{23} = -0.05$, $P > 0.05$); and positively related to satisfaction with freedom of choice in challenging habitats ($r_{46} = 0.59$, $P < 0.001$). This pattern of links, which persists when controlling for a variety of societal risks, could be replicated for feelings of overall well-being under these political regimes. Thus, while political democracy is appreciated among the rich in challenging habitats, this is not universally so. In the more temperate climates, people may prefer laissez-faire, while the poor in threatening habitats seem to appreciate autocracy instead of freedom of choice.

1.3.5 Accuracy Versus Parsimony

Generalization across cultural adaptations can be achieved through differentiation by adding detail (accuracy) or through integration by removing detail (parsimony). Climato-economic theorizing has followed a path of first differentiation, then integration. When the theoretical framework in Fig. 2 had been empirically supported, the further question was asked whether stress appraisals, motivational goals, behavioral means, and behavioral outcomes may have a meaningful generalizing factor in common. This led to the viewpoint that climato-economic conditions help shape encultured freedom—freedom from want; freedom from fear; freedom of expression and participation; freedom from discrimination; and freedom to realize one's human potential (Van de Vliert, 2013a, 2013b).

In this vein, it has been shown that freedom from ingroup-outgroup discrimination ($r_{123} = 0.83$, $P < 0.001$), freedom from hierarchical discrimination ($r_{189} = 0.81$, $P < 0.001$), freedom from corruption ($r_{174} = 0.92$, $P < 0.001$), freedom from aggression ($r_{167} = 0.86$, $P < 0.001$), freedom to trust ($r_{114} = 0.69$, $P < 0.001$), and freedom to be creative ($r_{155} = 0.90$, $P < 0.001$) are all manifestations of the latent dimension of fundamental freedom (Cronbach's $\alpha = 0.92$) (Van de Vliert & Kong, 2018). Climatic demands (10%), wealth resources (45%), and their interaction (8%) accounted for 63% of the variation in fundamental freedom. Simple-slope tests on the interactive impact indicated significant stepwise increases in fundamental freedom from threatening to unthreatening to unchallenging to challenging climato-economic habitats.

The discovery of the underlying behavioral motivation of freedom led to the formation of an interdisciplinary team intrigued by mapping partial

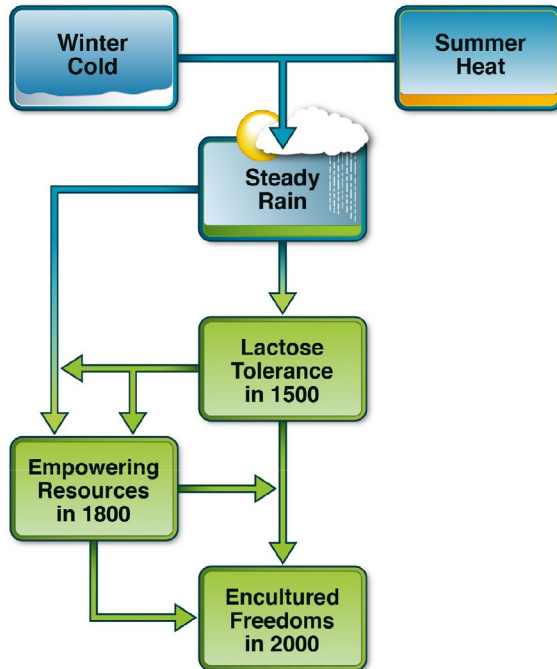


Fig. 3 The thermo-hydraulic theory of freedoms. First published in Van de Vliert, E., Welzel, C., Shcherbak, A., Fischer, R., & Alexander, A. C. (2018). Got milk? How freedoms evolved from dairying climates. *Journal of Cross-Cultural Psychology*, 49, 1048–1065 by Sage Publications.

climatic, genetic, and economic origins of encultured freedom. Based on research across 108 Old World countries, this team (Van de Vliert, Welzel, Shcherbak, Fischer, & Alexander, 2018) developed a thermo-hydraulic theory of freedoms (Fig. 3). The theory proposes that (a) winter cold, summer heat, and steady rain have historically produced climates suitable for dairy farming leading up to lactose tolerance at the eve of the colonial era in 1500 which, over subsequent centuries, (b) has first interacted with steady rain in shaping resources that empowered people in early industrial times around 1800, and (c) has then interacted with empowering resources in shaping encultured freedoms today. These complex gene-environment interactions illustrate how greater parsimony in the measurement of cultural adaptation gives leeway to allow greater accuracy in the selection and modeling of its predictors (for a similar gene-environment interaction effect on trust, see Kong, 2016).



2. THE SECOND SCIENTIFIC CYCLE

2.1 Recycling Old Beliefs

In an ideal test of the classic belief that thermal climate matters for human functioning, one would randomly manipulate climatic demands and wealth resources in one hemisphere of the Earth, use the other hemisphere as a control condition, and demonstrate that motives and behaviors in the two hemispheres start to diverge as predicted. Obviously, such a demonstration of causation of culture is impossible, which has stimulated trial-and-error attempts at reconceptualizing and reanalyzing impacts of thermal climate in the wider context of the Earth's hemispheres. Think of comparisons across geographic latitude and longitude, interhemispheric replication, and cross-validation (Van de Vliert & Daan, 2017; Van Lange et al., 2017a; Van Lange, Rinderu, & Bushman, 2017b). That encultured freedoms vary across countries' mid-range latitude ($b_{106} = 0.28, P < 0.001$) rather than countries' mid-range longitude ($b_{106} = -0.12, ns$; Van de Vliert, 2016) may warrant the climate-transcending belief that north-south differences dwarf east-west differences in human functioning.

This new point of view goes beyond and transforms climato-economic theorizing in several ways. First, motives and behaviors are believed to be ultimately influenced, at least in part, by the ingenious machinery of the Earth's annual rotation around the Sun and its daily rotation around its axis. Second, the annual rotational influence through winters and summers is believed to dwarf the daily rotational influence through nights and days. Third, as a likely consequence, motivational and behavioral differences between northerners and southerners are believed to dwarf any such differences between easterners and westerners. Fourth, all such cultural differences between northerners and southerners are believed to be opposite in the mutually opposite northern and southern hemispheres, whereas such differences between easterners and westerners are believed to be negligible in the mutually equivalent eastern and western hemispheres.

This renovated set of beliefs is part of what has elsewhere been termed *latitudinal psychology* (Van de Vliert & Van Lange, 2018)—the long-term ambition to map and understand spatial variations of psychological phenomena along the north-south rather than the east-west axis of the Earth. Latitudinal psychology aims to contribute renewed insights and breadth to ecological psychology (Oishi, 2014; Oishi & Choi, 2017; Varnum & Grossmann, 2017), environmental psychology (e.g., Gifford, 2014), and

geographical psychology (Rentfrow, 2014; Rentfrow & Jokela, 2016) in that it emphasizes the ultimate impacts of angular solar radiation during winter and summer on the mindsets and habits of the inhabitants of the Earth.

2.2 Recycling Old Descriptions

As amply discussed above, the past writings on climatic temperatures and national cultures often present a mixture of description and explanation. We propose that objective geographic facts serve as descriptors which are essential to our subsequent understanding of why climatic demands, in interaction with wealth resources, might shape stress appraisals, motives and behaviors. Section 2.2.1 first demonstrates that Hofstede's (1980, 2001) climate-related descriptions of cultural individualism versus collectivism and power distance versus power equality can be rewritten to convey objective biogeographic information in a less confounded way. In Section 2.2.2, that showcase is then broadened to include aggression and violence.

2.2.1 Cultural Individualism and Power Distance

Over four decades ago, Hofstede (1980, 2001) reported that lower temperatures at higher latitudes are associated with greater cultural individualism ($r_{53} = 0.79$, $P < 0.001$) and smaller power distance ($r_{53} = -0.68$, $P < 0.001$), with the side note that cultural individualism and power distance tend to be mutually exclusive ($r_{53} = -0.68$, $P < 0.001$). On closer scrutiny, cultural individualism can be understood as latitude-related freedom from the constraint of discrimination between ingroups and outgroups, whereas inverse power distance can be understood as latitude-related freedom from the constraint of discrimination between higher-ups and lower-downs (Van de Vliert & Kong, 2018). Viewing Hofstede's findings from this biogeographic perspective, compared to inhabitants of lower latitudes (e.g., Guatemalans and Malaysians), inhabitants of higher latitudes (e.g., Danes and New Zealanders) appear to have lower levels of freedom from discrimination between ingroups and outgroups including higher-ups and lower-downs.

If we use Hofstede's (2001) data to compute more detailed biogeographic gradients of cultural individualism, power distance, and encultured freedom, we obtain Table 1. The north-south gradients at the left reverse their direction near the equator, whereas five out of the six east-west gradients at the right do not reach significance, let alone that they would reverse their direction near the Greenwich meridian. Specifically, individualistic and egalitarian orientations are more prevalent among northerners in the

Table 1 Gradients of Culture Along Latitude and Longitude.

Gradient	North-South ^a		East-West ^b	
	Northern Hemisphere	Southern Hemisphere	Eastern Hemisphere	Western Hemisphere
Half of the Earth				
Number of countries	42	11	33	20
Cultural individualism	0.80***	-0.68*	-0.45**	0.26
Power distance	-0.72***	0.82**	0.23	-0.25
Encultured freedom ^c	0.82***	-0.71*	-0.34	0.29

Shown are Spearman rank correlations: * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

^aEach country's north-south location is measured as its mid-range degree of latitude (negative below the equator, positive above the equator).

^bEach country's east-west location is measured as its mid-range degree of longitude (negative west of the Greenwich meridian, positive east of the Greenwich meridian).

^cEncultured freedom is the average of the standardized indices of freedom from discrimination between ingroups and outgroups (cultural individualism) and freedom from discrimination between higher-ups and lower-downs (inverse power distance).

Based on Hofstede, G. (2001). *Culture's consequences: Comparing values, behaviors, institutions, and organizations across cultures* (2nd ed.). Thousand Oaks, CA: Sage.

northern hemisphere but among southerners in the southern hemisphere, and are not systematically distributed along the east-west axis of the Earth. More parsimoniously put, encultured freedom increases among inhabitants of habitats away from the equator toward the north and south poles, but does not vary depending on how far inhabitants' habitats are located away from the Greenwich meridian.

The only east-west gradient of culture in Table 1 that does reach significance is the predominantly Eurasian difference between eastern collectivism in Asia and western individualism in Europe ($r_{33} = -0.45$, $P < 0.01$). This Eurasian difference in freedom from ingroup-outgroup discrimination reflects Nisbett's (2003) geography of thought ("how Asians and Westerners think differently ... and why"). It is therefore even more interesting to see that this gradient cannot be replicated in the western hemisphere ($r_{20} = 0.26$, *ns*). In fact, we are looking at a spurious east-west gradient between Asia and Europe that becomes insignificant when we control for the fact that Asian countries are located at lower latitudes than European countries ($r_{33} = 0.04$, *ns*). All in all, these data suggest that valid east-west gradients of culture are extremely rare or nonexistent.

2.2.2 Aggression and Violence

Taking for granted that east-west gradients are irrelevant, a new model of CLimate, Aggression, and Self-control in Humans (CLASH; Van Lange

et al., 2017a) has postulated that aggressive inclinations and violent tendencies increase toward the equator—in tandem with faster life strategies, weaker future orientations, and diminishing self-control. CLASH has generated much debate (e.g., Jonason & Schmitt, 2017; Roscoe, 2017; Van Lange et al., 2017b), and some initial support. Inhabitants of countries at lower latitudes do have higher homicide rates in the northern hemisphere ($R^2 = 0.11$, $P < 0.001$), although this latitudinal gradient of homicide could not be reversely replicated in the smaller subsample of countries below the equator ($R^2 = 0.01$, *ns*; Fuentes, Kissel, Oka, Sheridan, & Piscitelli, 2017).

Another cross-national test of the CLASH model (Van de Vliert & Daan, 2017) covered three measures of aggressiveness: the 2010 index of domestic conflict and violence ($n = 146$), mean press repression during the years 2005–2007 ($n = 160$), and reported business costs of aggressive crime and violence in 2006 and 2007 ($n = 128$) ($M = 0.05$, $SD = 0.82$; Cronbach's $\alpha = 0.70$). Confirming the core idea of CLASH, violent aggression appeared to peak in populations near the equator was weaker among more northern populations above the equator ($r_{132} = -0.53$, $P < 0.001$), but was stronger among more northern populations below the equator ($r_{35} = 0.42$, $P < 0.01$). Thus, just like the latitudinal gradients of cultural individualism, power distance, and encultured freedom, the latitudinal gradients of aggression and violence reverse their direction near the equator.

2.3 Recycling Old Explanations

The latitudinality of many motives and behaviors opens a new window for explanation and generalization. What we are bound to see, first of all, is that latitude-related distributions of cultural features such as encultured freedom and violent aggression are in need of latitude-related explanations of culture. What comes to mind next is that there are multiple latitude-related conditions that qualify as potential explanators of culture, most notably thermal stress due to too-cold winters or too-hot summers, hydraulic stress due to too little or too much rain, parasite stress, and subsistence stress manifested in poor wealth resources. In Section 2.3.1, we discuss the previously reported worldwide gradient strengths of these latitude-related stressors as indicators of explanatory potential. In Section 2.3.2, we cumulatively continue with hemispheric validation tests of the viability of climato-economic understandings of cultural adaptations.

2.3.1 Revaluating Environmental Stressors

Overall, the latitudinal gradients of thermal stress in the northern and southern hemispheres are much stronger or steeper compared to the latitudinal

gradients of hydraulic stress, parasite stress, and subsistence stress (Van de Vliert & Van Lange, 2018). Along longitude, none of these environmental stressors has a gradient that is replicable across the eastern and western hemispheres, with the consequence that north-south differences dwarf east-west differences in climato-economic habitats. These findings suggest that latitude-related thermal stress is the most promising explanatory condition of the geography of human functioning. Perhaps this should not come as a surprise because the machinery of Sun-Earth rotation is specialized in producing cold winters and hot summers rather than other stressful conditions, adjusting them to latitude rather than longitude.

Indeed, as the mother of all stresses, thermal stress appears to have the greatest potential to maximize north-south differences while minimizing east-west differences in motives and behaviors. If one zooms in on the ultimately relevant latitudinal gradient of thermal stress, it splits into a steep gradient for cold stress and a flat gradient for heat stress. These different gradients remind of the warning in Section 1.2.1 that the present-day Earth offers larger cold deviations from 22 °C than heat deviations from 22 °C. Consequently, additive effects of cold stress and heat stress on human functioning are usually mainly impacts of cold demands, at least at the current planetary levels of colder winters and hotter summers.

With that being said, the flatness and uninterestingness of the latitudinal gradient of heat stress should not be exaggerated as higher latitudes do have cooler summers worldwide ($r_{231} = -0.51$, $P < 0.001$), and in the northern hemisphere ($r_{175} = -0.60$, $P < 0.001$), only not in the southern hemisphere ($r_{56} = -0.22$, *ns*) (Van de Vliert & Van Lange, 2018). Especially samples with many countries from the northern hemisphere may show additive or interactive contributions of cold demands and heat demands to the effects of thermal stress on encultured motives and behaviors. The theory of freedom in Fig. 3, tested across 90 countries from the northern hemisphere and 18 countries from the southern hemisphere, offers a case in point. Across those 108 Old World countries, the ultimate interaction of cold winters and cool summers produced steady rain, gradually evolving into lactose tolerance at the eve of the colonial era, empowering resources during early industrial times, and encultured freedoms in the information age of today (Van de Vliert et al., 2018).

2.3.2 Hemispheric Validation of Explanations

The above biogeographic considerations place both the environmental stressors and the resulting cultural adaptations against the background of

the Earth's northern, eastern, southern, and western hemispheres. A logical follow-up is to cross-validate explanations of encultured motives and behaviors in distinct hemispheres. A more sophisticated use of the biogeographic perspective is to conduct a targeted explanatory regression on populations above the equator and then use the resulting regression equation to predict and validate the prevalence of the target motives or behaviors in populations below the equator. This more sophisticated validation approach has been applied to a core proposition of climato-economic theorizing, already alluded to in [Section 1.2.2](#), that greater climatic demands produce a greater obsession with creation in richer populations. Before elaborating on hemispheric validation, we give an overview of this research.

[Murray \(2014\)](#) argued that (a) humans are equipped with psychological defense mechanisms that inhibit disease transmission and contact with potentially infectious others, (b) these disease-avoidant processes promote traditionalism, conformity, and xenophobia, and (c) traditionalism, conformity, and xenophobia, in turn, hamper creative outputs. Using a 155-country index, Murray showed that lower prevalence of disease-causing pathogens at higher latitudes is indeed robustly associated with higher levels of invention and innovation. Creativity was represented by (a) rates of Nobel Prize laureates per country of birth, (b) the technology index of the United Nations, (c) country rates of patent applications from the World Intellectual Property Organization, (d) Cornell University's global innovation index, and (e) a measure of innovation versus invention from the World Economic Forum. Building on this work, [Van de Vliert and Murray \(2018\)](#) then investigated which variable predicts creative behavior the best—parasite stress or climato-economic stress.

Controlling for societal intellectualization, industrialization and urbanization, conditional process analysis with bootstrapping revealed that climato-economic stress is a better ultimate predictor of creativity than parasite stress is ([Van de Vliert & Murray, 2018](#)). Specifically, there are four latitude-related paths from thermal climate to creative culture, accounting for 79% of the cross-country variation in invention and innovation: (a) a direct wealth-dependent path from cold stress to more creativity, (b) a direct poverty-dependent path from heat stress to less creativity, (c) an indirect parasite-mediated and wealth-dependent path from cold stress to more creativity, and (d) an indirect parasite-mediated and wealth-dependent path from heat stress to more creativity. The predictability of creativity drops from 79% to 56% if the influence of thermal stress is excluded, to 26% if parasite stress is excluded, and to 18% if wealth resources are excluded. Thus, it

is unlikely that the proposed explanation is too complex; each of the four effects contributes substantially to the explanatory power of the model.

Supplementary analyses demonstrated that imperfect sampling of small and adjacent countries within the same climatic subzone, and of large countries with different climatic subzones, has biased these results only to a trivial extent; and that the results fully account for the latitudinal variation in invention and innovation (Van de Vliert & Murray, 2018). In addition, a re-analysis from the viewpoint of Fig. 2 showed significant stepwise increases in creativity from threatening to unthreatening to unchallenging to challenging climato-economic habitats (Van de Vliert, 2017b). Our own calculations for this article finally reveal that, compared to southerners, northerners are more creative in the northern hemisphere ($r_{125} = 0.61$, $P < 0.001$) but less creative in the southern hemisphere ($r_{30} = -0.53$, $P < 0.01$). Looking almost too elegant to be true, the near-equatorial reversal point of the latitudinal gradient of creativity is neatly located at the equator ($0^{\circ}36'$ N).

The distribution of countries above and below the equator provides an opportunity for hemispheric cross-validation of the climato-economic explanation of creativity. The hemispheric split can be made in three ways using the near-equatorial reversal point at $0^{\circ}36'$ N, the meteorological equator at about 6° N, or the biological equator of seasonal human mortality at about 10° N (Aschoff, 1981; Douglas & Rawles, 1999; Sasaki, 1988). Van de Vliert and Murray reran their analysis for the 104 countries above the biological equator, and used the resulting regression equation for the validating prediction of creativity in the countries below the biological equator ($r_{51} = 0.73$, $P < 0.001$), the meteorological equator ($r_{38} = 0.79$, $P < 0.001$), and the near-equatorial reversal point ($r_{30} = 0.86$, $P < 0.001$). Additionally, reflecting discriminant validity, this considerable variation in creativity on the basis of winter-summer differences along latitude ($\geq 53\%$), dwarfs the negligible variation in creativity on the basis of night-day differences along longitude (1%).



3. FUTURE PROGRESS

3.1 Finer Grid of Analysis

National borders are imperfect cultural boundaries. Nonetheless, the reported country-level studies are valuable because nations “are political units with distinctive ecological, historical, political, educational, legal, regulatory, social, and economic characteristics. As such, they constitute systems and have cultures” (Smith, Bond, & Kağıtçıbaşı, 2006, p. 77).

Using somewhat smaller units of analysis, climato-economic theorizing has also been supported for collectivistic versus individualistic behavior in Chinese provinces (Van de Vliert, Yang, Wang, & Ren, 2013) and across the United States (Van de Vliert, 2013a), and for destructive leadership cultures in 191 Norwegian municipalities (Van de Vliert, Matthiesen, Gangsøy, Landro, & Einarsen, 2010). Further zooming in on even smaller scales and spaces could refine our knowledge about the latitude-related associations between environmental stressors and human functioning.

A school example of such research with a more precise grid of analysis has recently been published. In it, Wei et al. (2017) report two studies that relate local temperatures to local personality traits. In the first study, 5587 inhabitants of 59 Chinese cities completed a personality questionnaire online. In the second study, data were likewise gathered from 1,660,638 inhabitants of 12,499 ZIP-code areas in the United States. Advanced multi-level analyses showed that both Chinese and US inhabitants who grew up in places with milder winters and summers closer to 22 °C score higher on agreeableness, conscientiousness, emotional stability, extraversion and openness to experience. The observed generalizability from a relatively poor population (Chinese) to a rich population (US inhabitants) raises the further climato-economic question of how the main effects of temperate versus harsh climates are modified by economic conditions.

3.2 Biogeographic Refinements

The systematic and systemic distribution of creativity across hemispheres, discussed in Section 2.3.2, is reminiscent of Diamond's (1997) work. Diamond professed that historical-geographic diffusions of inventions and innovations, such as those regarding domestication of plants and animals, have taken place much more easily and rapidly along the east-west axis of longitude (minimizing differences in creativity) than along the north-south axis of latitude (maximizing differences in creativity) (for quantitative evidence, see Laitin, Moortgat, & Robinson, 2012; Turchin, Adams, & Hall, 2006). The present state of climato-economic knowledge confirms and refines this insight: threatening, unthreatening, unchallenging, and challenging climato-economic habitats might have to be held responsible for Diamond's discovery of diffusion of creativity as the reason for the predominance of north-south differences over east-west differences in cultural functioning.

In common with the spatiality of creativity, the spatialities of cultural individualism, power distance, and encultured freedom also have a north-south

instead of east–west inclination (Table 1), and the same holds for aggression and violence (Van de Vliert & Van Lange, 2018). Psychology and other human sciences could benefit from using both the presence of covariation with latitude (convergent validity) and the absence of covariation with longitude (discriminant validity) as criteria for assessing the construct validity of multiple measures and theories of human motives and behaviors. Furthermore, the strength, or steepness, of the latitudinal gradients of environmental stressors and of cultural features could be considered as estimates of the strength of construct validity.

Finally, the oppositely sloping north–south gradients of thermal demands, wealth resources, and cultural adaptation in the opposite northern and southern hemispheres offer the opportunity of inverse validation. For example, if one were to test and compare the remote impact of thermal demands and the mediating and modifying impact of wealth resources on the freedom and creativity of inhabitants of Australia and the US, the main hypothesis could read something like: “Owing to the higher demands of cooler winters and summers, and the availability of greater wealth resources, (a) Australians south of the equator tend to be freer and more inventive and innovative in more southern places of residence, whereas (b) Americans north of the equator tend to be freer and more inventive and innovative in more northern places of residence.”

3.3 Concluding Remarks

In line with Diamond’s (1997) seminal work, we propose that latitude provides more psychological information than longitude does, be it at the level of countries, of counties, cities, or postal code areas. Unlike longitude, latitude is thought to be related to cold winters and hot summers as drivers of environmental stressors, and to local climato–economic conditions as drivers of local freedom, individualism, cooperation and creativity. Unlike longitude, latitude is considered of methodological importance too, given that solid north–south gradients must be replicable across the northern and southern hemispheres and, moreover, must reverse their direction near the equator. Replicability and reversibility across latitudinal hemispheres may reveal themselves as effective tools for contributing to the burgeoning field of latitudinal psychology—the long-term mission of mapping and understanding spatial variations in motives and behaviors along the north–south rather than the east–west axis of the Earth.

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