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Citizens of warmer countries are more competitive and poorer: Culture or chance?

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Abstract

Data from 43 countries were used to examine the negative association between ambient temperature and economic prosperity during the 1965–1994 period from a cross-cultural perspective. Surprisingly, the inhabitants' overall level of cultural competitiveness does not affect economic growth. However, positive temperature–competitiveness and negative competitiveness–wealth relations do account for the stable negative temperature–wealth association. An evolutionary explanation of the temperature–competitiveness–wealth chain of relations is proposed in terms of paternal investment theory. The additional inference from paternal investment theory that cultural masculinity – male/female differences in competitiveness – also mediates between ambient temperature and economic wealth and growth, was not supported.

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There is no doubt that citizens of nations with warmer climates are usually poorer. For example, Iceland, Norway and Sweden are cold and rich, whereas Egypt, Haiti and India are warm and poor. Of course, exceptions to the rule exist, especially among oil-producing countries such as the United Arab Emirates. In a 136-nation study, Van de Vliert, Schwartz, Huismans, Hofstede and Daan (1999) reported a highly significant −0.68 correlation between average ambient temperature and gross national product per capita (for similar evidence, see Parker, 1995; Williamson & Moss, 1993). How come? Does this temperature–prosperity association represent a meaningfully mediated relationship or a spurious link? What mediators may play a part? Is the association robust over time?

The study to be reported here examines two possible cultural mediators of the temperature–prosperity link – competitiveness and masculinity – employing repeated measures of two aspects of prosperity: absolute economic wealth and relative economic growth. The theory section discusses the choice of cultural competitiveness and masculinity, their relations with ambient temperature, and their relations with economic wealth and growth. This discussion results in a model with rules of correspondence between temperature, cultural competitiveness/masculinity, and economic wealth/growth. Using hierarchical regression analysis, the model is then tested in a sample of 43 countries on which scores are available for male/female competitiveness and for economic wealth and growth during the 1965–94 period.

1. Theory

1.1. Cultural competitiveness and masculinity

Especially relying on Williamson and Moss's (1993) recent publication in the authoritative journal *Nature*, the temperature–prosperity link is no coincidence. The most convincing argument is that mean income per capita and human development are more closely associated with temperature than with latitude per se representing a conglomerate of variables including seasonal and day/night variation. Of course, potential mediators between temperature and prosperity abound. Parker (1995) classifies the many determinants of economic behavior into the following sequence from more exogenous to more endogenous explanations: climatic resources (solar climate, physical climate), marine resources (ocean resources, marine biology, fresh water), non-mineral terrestrial resources (vegetation, zoology), mineral resources

(whether or not petroleum-based), and cultural resources (religion, language, political, social). Clearly, the need to win against others (*competitiveness*) and the extent to which males are more in need of winning against others than females (*masculinity*: Hofstede, 1991; Van de Vliert, 1998) are cultural resources.

Cultural competitiveness and masculinity have been selected as possible mediators between temperature and prosperity for four reasons. First, as cultural resources, they potentially offer a much more proximate explanation of economic behavior than the climatical, geographical, and biological resources proposed by Parker (1995). Second, competitiveness and masculinity are unambiguous constructs having a clear mutual relationship. As the above definitions show, overall competitiveness is a cornerstone of masculinity, that is, male/female differences in competitiveness. Third, competitiveness and masculinity are basic social motives that underlie more specific motivational expressions including economic competitiveness and male/female differences in economic competitiveness. Competitiveness, thus masculinity, has its roots in personality (e.g., MacCrimmon & Messick, 1976; Van Lange, Otten, De Bruin & Joireman, 1997), in social perceptions of negative goal interdependence (e.g., Deutsch, 1973; Johnson & Johnson, 1989), and in the generally expected and accepted cultural values and practices of men and women (e.g., Bonta, 1997; Fiske, 1992; Franke, Hofstede & Bond, 1991; Hofstede, 1980, 1991). These origins of competitiveness and masculinity are integrated in the so-called paternal investment theory (e.g., Miller, 1994), which is therefore chosen as our main point of departure. Fourth, and most importantly, the paper focuses on cultural competitiveness and masculinity because, as will be outlined below, a combination of two theories nominates them as appropriate mediators between temperature and prosperity. Namely, the paternal investment theory relates competitiveness and masculinity to ambient temperature while the economic competitiveness theory relates them to wealth and growth.

1.2. Paternal investment theory

Paternal investment theory (Bjorklund & Kipp, 1996; Buss & Schmidt, 1993; Coltrane, 1988; Daly & Wilson, 1983; Endicott, 1992; Hewlett, 1992; Hurtado & Hill, 1992; Katz & Konnor, 1981; Kenrick, 1994; Miller, 1994) has been derived from the biological evolutionary idea of differential parental care (Trivers, 1972; Clutton-Brock, 1991). The theory can be presented in the

form of a trade-off proposition, a climate proposition, and a behavioral proposition.

1.2.1. Trade-off proposition

From the perspective of evolution and reproductive success, males more than females have a trade-off possibility between investing time and effort in providing for a single family, and investing in fertilizing multiple partners to increase offspring. The choice men make is partly dependent upon climatological circumstances.

1.2.2. Climate proposition

It is more arduous and difficult for families to meet basic needs for food, safety, and security in cold than in warm climates. Fostering survival of offspring in cold climates requires substantial paternal investment in the family. Consequently, in cold climates, positive goal interdependence and normative role conceptions and expectations have evolved that entail greater demands on husbands and fathers to share with their wives in caring for children. Because it is easier to meet basic survival needs in warmer zones, paternal investment is less critical, and the normative role prescriptions that evolve for men differ from those for women. Men are given leeway to develop negative goal interdependence, to seek multiple mates and to leave many children with them, while women are expected to invest in provisioning and childrearing. Cross-disciplinary evidence confirms that the balance shifts from more caring and sharing norms for husbands and fathers in cold climates towards lower concern for wives and offspring in warmer climates (Kenrick, 1994; Miller, 1994; Robbins, De Walt & Pelto, 1972; Woodburn, 1988).

1.2.3. Behavioral proposition

Greater paternal investment in colder climates requires sacrifice, delay of gratification, and predominantly cooperative or at least non-competitive behavior (Bjorklund & Kipp, 1996; Woodburn, 1988). In contrast, greater male investment in mate-seeking in warmer climates allows immediate gratification and requires relatively dominant and competitive behavior against male rivals and (initially) resisting females. Sometimes males in cultures with higher masculinity do devote a great deal of time and effort to their children and families, but unlike males in cultures with lower masculinity they do so in a more paternalistic way by coupling dominant behavior and

tight control with behavior that fosters the well-being of people (cf. Van de Vliert, 1997). According to paternal investment theory, remnants of more competitiveness and masculinity in warmer climates can be observed in modern-day men and women. Indeed, Hofstede (1980, 1991) observed that inhabitants of warmer countries manifest more competitive as well as more masculine behavior.

1.2.4. Conclusion: Hypothesis 1

Thus, we speculate on the basis of evolutionary research that, cross-nationally, ambient temperature is positively related to both overall competitiveness and male/female differences in competitiveness in the form of masculinity (see Fig. 1).

1.3. Economic competitiveness theory

The economic competitiveness theory (Furnham, Kirkcaldy & Lynn, 1994, 1996; see also Barro & Sala-i-Martin, 1995; Porter, 1990; Sachs & Warner, 1996a,b) is an extension of Schumpeter's (1934) classic insight that the entrepreneurial drive to do better than other people is the prime mover in economic growth. Analogous to paternal investment theory, it can be presented in the form of a competitiveness proposition, a wealth proposition, and an attitude reversal proposition.

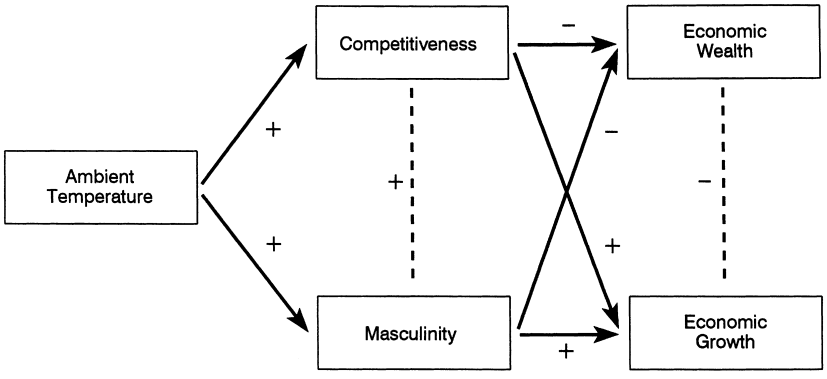

Fig. 1. National competitiveness and masculinity mediating negative temperature–wealth and positive temperature–growth relations.

1.3.1. Competitiveness proposition

Self-evidently, the strategic, structural, and process innovations on which national wealth and economic growth depend are made by workers who need to have some drive or other to make these innovations (Hofstede & Bond, 1988; Lynn, 1991; Porter, 1990). As mentioned above, competitiveness has been proposed as the crucial motive underlying economic success (Schumpeter, 1934; see also King & Levine, 1993). The third author (Lynn, 1991) therefore undertook a 43-nation study to compare the predictive power of motivational explanations in terms of competitiveness, work ethic, mastery, achievement, achievement via conformity, and occupational preferences. The single most important result was that the overall level of competitiveness in a country emerged as the most successful predictor of both poverty and growth. These findings encouraged us to examine the economic relevance of overall competitiveness and gender differences in competitiveness, or masculinity, in the present follow-up study.

1.3.2. Wealth proposition

When nations become more well-developed and richer, further economic growth becomes increasingly difficult. Poorer countries lacking the capital stock per person, technology, and management found in the wealthier countries, are able to catch up in these areas faster than the richer countries are able to make new advances (Barro & Sala-i-Martin, 1995; Porter, 1990; Sachs & Warner, 1996b). Thus, if the competitiveness proposition is valid, the cross-national differences in further growth potential would produce positive competitiveness–wealth and negative competitiveness–growth links. Intriguingly, in flat contradiction to this expectation, Lynn (1991) had to report a negative competitiveness–wealth ($r = -0.50,\ n = 41,\ P < 0.001$, reference year 1985) but a positive competitiveness–growth association ($r = 0.59,\ n = 41,\ P < 0.001$, reference period 1970–85; competitiveness–growth, with wealth controlled, $r = 0.59,\ n = 41,\ P < 0.01$). This made Furnham et al. (1994, 1996) develop a social–psychological explanation in terms of the next proposition.

1.3.3. Attitude reversal proposition

The more national wealth has been attained, the more the inhabitants' initially successful competitive urge declines. If the competitiveness and wealth propositions are both valid, this tendency will ultimately result in negative competitiveness–wealth and positive competitiveness–growth associations across countries. Although Furnham et al.'s (1994, 1996) a posteriori

explanation is in line with Lynn's (1991) empirical data, it requires two questionable assumptions. First, over time the initially independent variable of competitiveness becomes the dependent variable while the initially dependent variable of wealth becomes the independent variable. Second, the inhabitants of wealthier nations shift from predominantly competitive to predominantly non-competitive orientations. As a consequence of the contestability of both assumptions, a completely different and more simple explanation in terms of the absence rather than presence of competitiveness suggests itself.

1.3.4. An alternative view: Stability proposition

The need to cooperate rather than compete with others has also been proposed as the crucial force driving economic prosperity (e.g., Axelrod, 1984; Hampden-Turner & Trompenaars, 1994; Johnson & Johnson, 1989; Kanter, 1994; Kohn, 1986; Porter, 1990). If the now wealthier nations have always had relatively cooperative inhabitants due to low levels of competitiveness and masculinity, these inhabitants might well have initially produced large increases in per capita income, gradually resulting in negative competitiveness–wealth and positive competitiveness–growth associations across countries.

For several reasons, this alternative view of stability of national degrees of competitiveness deserves further attention. First, the alternative stability explanation is both more parsimonious and more plausible than the economic competitiveness theory as it does not make the reversal assumption of massive motivational change from competitiveness to non-competitiveness once economic wealth has been secured. Second, compared to the reversal explanation, the stability explanation is more compatible with paternal investment theory discussed above, which proposes a stable temperature–competitiveness association. Third, relatively poor nations should have a positive competitiveness–wealth relation if the reversal explanation holds, but a negative competitiveness–wealth relation if the stability explanation holds. A secondary analysis of Lynn's (1991) competitiveness–wealth data clearly supports the stability proposition, not the reversal proposition (poorer nations, $r = -0.33$, $n = 21$, $P < 0.05$; wealthier nations, $r = -0.31$, $n = 20$, $P < 0.05$). Fourth, contradicting general theories of competitive advantage, many laboratory experiments and field studies have consistently demonstrated that cooperativeness is more productive than competitiveness as it fosters perspective-taking, open communication, social support, resource exchange, constructive controversy, and the like (e.g., Deutsch, 1973; Janssen

& Van de Vliert, 1996; Johnson & Johnson, 1989; Kramer, Pommerenke & Newton, 1993; Tjosvold, 1989, 1991; Tjosvold & Deemer, 1980).

1.3.5. Conclusion: Hypotheses 2 and 3

All in all, we expect that, cross-nationally, competitiveness and masculinity are negatively related to economic wealth (*Hypothesis 2*). If more competitive and more masculine countries are indeed poorer, thus having a larger growth potential, some will realize higher growth rates. As a consequence, cross-nationally, competitiveness and masculinity are positively related to economic growth (*Hypothesis 3*; see Fig. 1).

2. Method

2.1. Samples

Sampling took place with regard to countries, respondents, and periods. All countries ($n = 43$) were included whose male and female levels of competitiveness are listed in Lynn (1991, p. 61). In addition to Australia, Canada, New Zealand, and USA, the data cover 14 Asian, 11 West-European, six South-American, five East-European, and three African countries (see Table 3). Although all continents are represented, this is a convenience sample that excludes worldwide generalizations.

Over the years 1986–1989, competitiveness and masculinity data were obtained for a minimum of 60 male and 60 female, native university students drawn from across all faculties in their respective countries. The total number of respondents was 14.470 ($M = 345$ per country). No claim is made that students produce representative samples of the populations of the various countries. Because basic cultural differences in competitiveness and masculinity are larger in younger people, it is an advantage to employ students as respondents. Above the age of 25 both men with relatively high and women with relatively low levels of competitiveness and masculinity gradually lose their toughness until, at the age of 55, no more gender differences in competitiveness and masculinity are noticeable (Hofstede, 1980, 1991).

Data on economic wealth (1965, 1970, 1975, 1980, 1985, 1990, 1994) and economic growth (1966–1975, 1976–1985, 1986–1994) in different years and decades enabled us to relate the respondents' competitiveness and masculinity in the 1980s to economic prosperity in past, present, and future.

2.2. Independent variable: Temperature

Average daytime temperature of the country's capital city (Garver, Payne & Canby, 1990) was chosen as the indicator of ambient temperature ($M = 20$°C, 68°F; S.D. $= 7$°C, 12°F) for two reasons. First, as a rule, the capital city is one of the main national centres of economic activity. Second, worldwide, the within-country variance in ambient temperature is insignificant compared to the between-country variance. Specifically, the capital city's mean temperature is almost identical to the country's overall mean temperature as reported by Parker (1995; $r = 0.95$, $n = 43$, $P < 0.001$).

2.3. Mediating variables: Culture

2.3.1. Competitiveness

Men and women responded to the following five items of Spence and Helmreich's (1983) task-oriented competitiveness scale: I enjoy working in situations involving competition with others; It is important to me to perform better than others on a task; I feel that winning is important in both work and games; It annoys me when other people perform better than I do; I try harder when I am in competition with other people. To ensure accurate translation, the questions were first translated into the new language, a different person then translated them back into English, and a third person then corrected distortions in the translations by comparing the original and final English versions. Each item was scored on a strongly disagree (0) to strongly agree (4) format, thus giving a possible maximum score of 20 ($M = 12.52$, S.D. $= 3.71$ for males, and $M = 11.86$, S.D. $= 3.68$ for females; for details, see Lynn, 1991, and the country scores in Table 3).

The correlation between male and female scores across countries is 0.91 ($P < 0.001$), indicating that aggregate scores for competitiveness may be used. To that end, the means for male and female competitiveness were marked off on the y-axis and x-axis of a co-ordinate system, respectively, resulting in a triangle (see Fig. 2). The length of the hypotenuse of that triangle, calculated by applying the Pythagorean theorem, was used as an indicator of competitiveness: National degree of competitiveness is the square root of the sum of squared male and squared female competitiveness. The construct validity of this summative index is apparent from its relation to the combined male and female preferences for the competitive occupation of company director, as measured by Lynn (1991), $r = 0.45$, $n = 42$, $P < 0.001$.

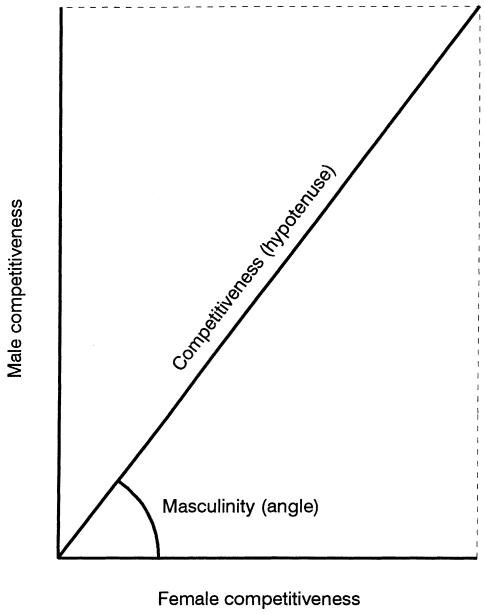

Fig. 2. National competitiveness and masculinity as a function of male and female competitiveness.

With a view to discriminant validity, it is also worthwhile to note that this competitiveness index is unrelated to Hofstede's (1980, 1991) masculinity index, $r = 0.20$, $n = 32$, n.s.

2.3.2. *Masculinity*

Masculinity – the extent to which males are more competitive than females – is a relational and relative construct that is best operationalized with the help of measures from both parties to the relationship. Therefore, the arctan of the ratio between male competitiveness and female competitiveness was used as an indicator of the national degree of masculinity. This masculinity index is represented by the angle in Fig. 2; to obtain the angle in degrees the arctan value was multiplied by $180/\pi$. A larger angle corresponds to higher masculinity, that is higher male competitiveness, lower female competitiveness, or both. Masculinity ranges from 40.95 in Norway (feminine) to 51.43 in Germany (masculine; see Table 3).

There are two indications of construct validity. First, the present masculinity index is positively related to Hofstede's (1980, 1991) 25-year old masculinity index, $r = 0.44$, $n = 32$, $P < 0.02$. Second, the new masculinity index

is, $r = 0.45$, $n = 41$, $P < 0.001$, whereas the above competitiveness index is not, $r = -0.16$, $n = 41$, n.s., related to larger male/female differences in preference for the feminine occupation of social worker.

2.4. Dependent variables: Prosperity

2.4.1. Economic wealth

The World Bank (1966–1995) has published annual overviews of gross national product per capita ever since 1966. To correct for skewness across countries, we employed the natural logarithm of these per capita incomes for 1965, 1970, 1975, 1980, 1985, 1990, and for the last available year 1994.

2.4.2. Economic growth

Economies are subject to short-run fluctuations in productivity, exchange and financial markets, terms of trade, and so forth (Porter, 1990; Sachs & Warner, 1996a). Hence, to average out such fluctuations, three 10-year periods were studied as well as the combined 30-year period (1966–1975, 1976–1985, 1986–1994, and 1966–1994). As discussed above, growth also varies as a function of the absolute national level of socio-economic development (Porter, 1990; Sachs & Warner, 1996b). Therefore, to control level of wealth, per capita incomes were included in the first step of the regression analyses predicting growth. For example, to establish effects on the 1966–1975 growth rates, the proportionate differences in gross national product per capita between 1965 and 1975 were controlled for the per capita incomes in 1965.

3. Results

Table 1 presents the intercorrelations, means, and standard deviations of all independent, mediating, and dependent variables. Contrary to our inferences from paternal investment theory, more competitiveness is associated with less rather than more masculinity, $r = -0.35$, $n = 43$, $P < 0.01$. Note also that, during the last three decades, the nations' relative standing on the economic ladder has changed hardly for wealth (see 21 intercorrelations in Table 1: $0.72 \leqslant r \leqslant 0.98$), but considerably for growth (see three intercorrelations in Table 1: $r = 0.40$, 0.00 and 0.30, respectively).

Table 1
Intercorrelations, means, and standard deviations

		2	3	4	5	6	7	8	9	10	11	12	13	*M*	S.D.
1	Temperature	0.52***	−0.28*	−0.65***	−0.64***	−0.68***	−0.49***	−0.49***	−0.50***	−0.53***	−0.12	0.11	0.07	20.09	6.51
2	Competitiveness	–	−0.35**	−0.63***	−0.70***	−0.72***	−0.57***	−0.50***	−0.55***	−0.63***	0.06	0.36*	−0.18	17.26	2.57
3	Masculinity		–	0.41**	0.38**	0.29*	0.18	0.19	0.25+	0.26+	−0.20	−0.31*	0.04	46.71	2.06
4	Wealth 1965[a]			–	0.97***	0.93***	0.90***	0.87***	0.80***	0.72***	−0.23+	−0.45**	−0.17	6.40	0.91
5	Wealth 1970				–	0.97***	0.93***	0.91***	0.87***	0.82***	−0.17	−0.36*	−0.03	6.89	0.97
6	Wealth 1975					–	0.95***	0.93***	0.90***	0.87***	0.11	−0.27+	−0.01	7.51	1.10
7	Wealth 1980						–	0.98***	0.95***	0.94***	0.07	−0.32*	−0.11	8.14	1.23
8	Wealth 1985							–	0.97***	0.96***	0.13	−0.20	−0.12	8.16	1.21
9	Wealth 1990								–	0.98***	0.09	−0.18	−0.09	8.52	1.38
10	Wealth 1994									–	0.09	−0.12	0.19	8.77	1.42
11	Growth 1966–1975										–	0.40**	0.00	3.36	2.56
12	Growth 1976–1985											–	0.30*	1.90	2.06
13	Growth 1986–1994												–	1.52	3.01

* $P < 0.05$.
** $P < 0.01$.
*** $P < 0.001$.
+ $P < 0.10$.
[a] Wealth = natural logarithm of gross national product in US dollars per capita. Growth = percentage. $n = 43$.

3.1. Test of the model

As expected in Hypothesis 1, inhabitants of warmer countries are more competitive ($r = 0.52$, $n = 43$, $P < 0.001$; with masculinity controlled, $r = 0.45$, $n = 43$, $P < 0.001$). However, in deviation of Hypothesis 1, they do not also have higher degrees of masculinity ($r = -0.28$, $n = 43$, $P < 0.05$; with competitiveness controlled, $r = -0.10$, $n = 43$, n.s.). Hence, masculinity cannot function as a mediator of the temperature–wealth and temperature–growth associations.

3.1.1. Economic wealth

In line with Hypothesis 2, the results of the hierarchical regression analysis in Table 2 show that countries with more competitive inhabitants are poorer, and that this association is stable over time. By contrast, contrary to Hypothesis 2, masculinity has no significant relation with economic wealth. Because inhabitants of warmer countries are not only more competitive ($r = 0.52$, $P < 0.001$) but also poorer (see first row in Table 1; $-0.49 \leqslant r \leqslant -0.68$, $P < 0.001$), competitiveness could mediate the temperature–wealth association. The data in Table 2 imply that, for each of the seven reference years, competitiveness is indeed mediating between higher temperature and less national wealth (partial mediation in 1965, 1970, 1975, and 1994, with a mean reduction in predicted variance of 29%; full mediation in 1980, 1985, and 1990, with a mean reduction in predicted variance of 19%). This supports the upper part of the theoretical model in Fig. 1.

3.1.2. Economic growth (not shown in Table 2)

Competitiveness and masculinity (first step) and temperature (second step) were not significantly related to economic growth controlled for wealth, with only one exception (reference period 1976–1985: competitiveness–growth $\beta = 0.52$, $P < 0.05$), thus failing to generalize Lynn's (1991) earlier finding that competitiveness positively affected the 1970–1985 growth rates. For the decades before and after the 1976–1985 period, as well as for the total period of 30 years, Hypothesis 3 and the temperature–competitiveness–growth chain of relations in Fig. 1 cannot be supported.

3.2. Supplementary analyses

The temperature in a single city may not adequately reflect the broad range of different temperatures in large countries. To check that this source of

Table 2
Hierarchical regression of economic wealth on temperature, competitiveness, and masculinity

Predictors	Wealth[a] 1965		Wealth 1970		Wealth 1975		Wealth 1980		Wealth 1985		Wealth 1990		Wealth 1994	
	β[b]	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2
Temperature	−0.65***	0.43***	−0.64***	0.41***	−0.68***	0.46***	−0.49**	0.24**	−0.49**	0.24**	−0.50***	0.25***	−0.53***	0.28***
Step 1:		0.45***		0.51***		0.53***		0.32**		0.25**		0.31***		0.41***
Competitiveness	−0.38**		−0.45**		−0.49***		−0.43*		−0.33+		−0.39*		−0.48**	
Masculinity	0.18		0.15		0.04		−0.01		0.01		0.07		0.10	
Step 2:		0.14**		0.10**		0.11**		0.04		0.07+		0.06+		0.07*
Temperature	−0.43***		−0.37**		−0.39**		−0.24		−0.32+		−0.29+		−0.29*	
R^2		0.59***		0.61***		0.64***		0.36***		0.32***		0.37***		0.48***

[a] Wealth = natural logarithm of gross national product in US dollars per capita.
[b] Standardized regression coefficients shown are from the equation at the final step.
* $P < 0.05$.
** $P < 0.01$.
*** $P < 0.001$.
+ $P < 0.10$.

inaccuracy does not influence associations with temperature, we repeated all analyses after dropping the six largest countries (Australia, Brazil, Canada, China, India, USA). We obtained the same pattern of findings. Additional regression analyses revealed that competitiveness and masculinity do not have any interactive effect on economic prosperity.

Though the temperature–competitiveness–wealth chain of associations is generalizable across reference years, it might be weakening in time because the size of the mediation effect of competitiveness tends to decrease, $r_s = -0.71$, $n = 7$, $P < 0.05$. The size of the unique temperature effect on national wealth tends to decrease as well, $r_s = -0.68$, $n = 7$, $P < 0.05$.

4. Discussion

The notion that ambient temperature might contribute to poverty deserves close scrutiny since there appears to be a robust correlation, and poverty is painful. The current cross-national research adds to a better understanding of the origins of economic prosperity in at least three regards. First of all, the study makes a strong case for the conclusion that inhabitants of warmer countries are both more competitive and poorer. The temperature–competitiveness link supports our overall-competitiveness inference from paternal investment theory outlined by Katz and Konnor (1981), Kenrick (1994), Miller (1994), and others. Granted, the hidden existence of alternative explanations (see Parker, 1995) prevents us from concluding that temperature is a sure origin, let alone *the* origin, of higher overall competitiveness and lower income levels. Also, the proportions of variance in national wealth attributable to temperature and overall competitiveness were small and decreased over time. Slowly but surely the temperature–wealth link might be undermined by increases in migration, expatriate assignments, intercultural contact, and the like. There are certainly climate-related variables other than overall competitiveness that might predict as much, or even more, variance in wealth, although we have not yet been able to locate them (cf. Van de Vliert & Van Yperen, 1996).

Second, the study challenges Schumpeter's (1934) widely accepted assumption that competitiveness drives economic prosperity (see also Furnham et al., 1994, 1996; King & Levine, 1993; Lynn, 1991). On the one hand, our test–retest approach revealed that the positive competitiveness–growth association is not generalizable beyond the 1976–1985 period. On the other hand, the stable results regarding national wealth lend support to the view

that cooperativeness and other forms of non-competitiveness rather than competitiveness produce competitive advantage and make nations economically successful. The last conclusion is in line with the theory of perceived goal interdependence, which predicts that a negative relation between the attainment of one's own and others' goals elicits a competitive motive followed by unproductive behavior whereas a positive relation between the attainment of one's own and others' goals elicits a cooperative motive followed by productive behavior (e.g., Deutsch, 1973; Johnson & Johnson, 1989; Tjosvold, 1989, 1991; Tjosvold & Deemer, 1980; Van de Vliert, 1997, 1999; Van de Vliert & Janssen, 1999).

Third, the study fails to support the paternal investment theory (e.g., Katz & Konnor, 1981; Kenrick, 1994; Miller, 1994) where it states that, for reasons of natural selection, warmer climates evolve more masculinity (male/female differences in competitiveness). Contrary to Hofstede's (1991) findings, no temperature–masculinity association surfaced, which also ruled out masculinity as a mediator between temperature and economic prosperity. Whereas relatively cold European and Northern American countries including Canada, Germany, Iceland and Ireland are characterized by cultural masculinity rather than cultural competitiveness, relatively warm Asian countries including Bangladesh, India, Iraq and the United Arab Emirates are characterized by cultural competitiveness rather than cultural masculinity (see Table 3).

The stable temperature–competitiveness–wealth relationship is remarkable because the hypothesized differences were put to a conservative test. Really hot and poor countries such as Sudan, Niger, Chad, Mali, and UpperVolta ($M = 36$°C, 97°F; per capita income $M_{1994} = \$\ 224$) were not included in the sample. Moreover, the temperature–competitiveness–wealth association has been controlled for male/female differences in competitiveness, or masculinity. Indeed, these restrictions may well have led to an underestimation of the true positive temperature–competitiveness, negative temperature–wealth, and negative competitiveness–wealth relations. Against this background, we have to nominate both ambient temperature and cultural competitiveness as serious candidates for a position among the antecedent conditions of national poverty.

The economic relevance of cross-national differences in individual competitiveness might have implications for the construct and theoretical positioning of global competition, that is, worldwide human effort to economically outperform foreign organizations and nations (cf. Barro & Sala-i-Martin, 1995; Landes, 1990; Porter, 1990; Sachs & Warner, 1996a,b;

Woronoff, 1986). Global competition is pervasive, it is vitally important, and it is here to stay (Adler, 1991). However, so far social scientists have left it to economists to define and study this phenomenon. If global competition is viewed as a generic term for win–lose attitudes, the results reported here suggest that global competition is counterproductive. Alternatively, if conceptualized as an economic outcome in the sense of competitive advantage reached through strategic behavior, the results might suggest that successful global competition is facilitated by cooperative and other non-competitive attitudes and behaviors. Apparently, Jellinek and Adler (1988) embrace the last view when they claim that women are better global competitors than men because women are more cooperatively competitive (cf. Lado, Boyd & Hanlon, 1997; Van de Vliert, 1999). Obviously, the crossroads of gender differences and cross-national differences is a promising domain of future research.

The present study, despite several notable strengths (independent assessment of culture and economic criteria, valid competitiveness and masculinity measures, and reliable indicators of wealth and growth over a 30-year period), has a number of limitations. A major limitation is the nature of its sampling method. The data, gathered by the third author (Lynn, 1991), were not obtained from representative samples of countries and young working adults who reflect the national levels of cultural competitiveness and masculinity best. In particular, the developing countries were underrepresented. Countries were selected through personal contacts and by searching through journals to find colleagues who would be willing to administer the questionnaires. The university students were then recruited by each country's investigator. Larger samples of countries representing the whole globe as well as better samples of respondents representing each country's relevant population are needed to move the development of cross-national social-psychological theories toward greater generalizability, accurateness, and complexity. In addition, competitiveness and masculinity will gradually change over time and might exert influences on economic prosperity that are felt only decades later, yet we measured them at a single point in time. However, the stability of the results over time warns us not to overstate the seriousness of this problem of changing national competitiveness and masculinity.

The current study is correlational, offering no strong evidence for causality, and there might be potential alternative explanations for the temperature–competitiveness–wealth chain of relations, that should be considered. Lynn's (1991) more elaborate explorations have excluded work ethic,

Table 3
Mean temperature, competitiveness, masculinity, wealth, and growth per country[a]

Country		Temperature[b]	Competitiveness[c]	Masculinity[d]	Wealth[e]	Growth[f]
1	Argentina	21.50	12.06	48.87	2646	0.93
2	Australia	21.25	16.15	46.13	9386	1.67
3	Bangladesh	31.92	20.16	46.25	162	0.60
4	Belgium	14.25	15.24	48.83	10,074	2.53
5	Brazil	27.33	15.80	47.13	1646	2.43
6	Bulgaria	15.17	17.44	43.21	1400	0.35
7	Canada	10.58	17.09	50.46	10,910	1.60
8	Chile	22.25	16.32	44.95	1629	1.20
9	China	18.42	17.50	47.57	427	6.07
10	Colombia	18.83	18.36	47.30	950	2.53
11	Egypt	28.17	22.14	45.90	453	2.77
12	France	15.58	14.41	46.43	10,629	2.23
13	Germany	13.67	12.94	51.43	11,763	1.97
14	Greece	22.58	19.55	45.73	3624	2.30
15	Hong Kong	24.67	17.88	44.41	6704	5.27
16	Iceland	7.42	18.42	49.31	14,738	0.70
17	India	31.83	20.49	46.86	213	1.80
18	Iraq	30.33	19.86	43.45	603	6.70
19	Ireland	13.00	15.57	48.44	5474	2.60
20	Israel	23.08	16.45	50.11	5979	2.30
21	Japan	18.67	17.28	47.25	12,550	3.53
22	Jordan	24.58	20.89	46.40	960	0.27
23	Korea	16.33	19.31	44.06	2610	7.17
24	Mexico	22.33	19.55	46.68	1816	1.40
25	New Zealand	16.25	15.74	46.93	6953	0.90
26	Norway	9.83	13.61	40.95	12,453	2.60
27	Poland	12.33	16.98	46.86	1868	3.35
28	Portugal	20.58	16.89	45.29	3023	3.20
29	Romania	16.67	19.34	44.98	1337	2.00
30	Singapore	31.00	16.09	45.63	7176	6.90
31	South Africa	22.42	17.68	47.27	1800	0.10
32	Spain	19.00	14.79	47.30	5454	2.77

33	Sweden	9.58	12.80	46.52	12,466	1.10
34	Switzerland	13.92	12.74	48.50	16,507	0.73
35	Syria	24.58	19.84	44.35	883	0.73
36	Taiwan	26.00	18.94	47.12	503	6.4
37	Transkei	22.42	22.97	44.01	–	–
38	Turkey	17.92	18.07	45.61	1151	2.60
39	UAE	32.58	20.29	45.30	22,367	−0.40
40	UK	14.17	15.08	48.95	8421	1.50
41	USA	18.33	18.08	49.01	12,937	1.43
42	Venezuela	25.92	15.54	45.99	2340	0.07
43	Yugoslavia	16.67	15.90	47.98	1690	4.30

[a] Wealth data were missing for Transkei (1965–1994), Bangladesh (1965, 1970), Bulgaria (1980, 1985), Iceland (1970, 1975, 1980), Iraq and Taiwan (1980–1994), Poland (1980), Romania (1985), Syria and Yugoslavia (1994), and UAE (1965, 1970, 1975). Growth data were missing for Transkei (1966–1994), Bulgaria (1976–1985), Iceland (1966–1975), Iraq and Taiwan (1976–1994), Poland and Romania (1976–1985), UAE (1966–1975), and Yugoslavia (1986–1994).

[b] Temperature in degrees Celsius.

[c] Competitiveness = square root of the sum of squared male and squared female competitiveness.

[d] Masculinity = arctan of the ratio between male and female competitiveness multiplied by $180/\pi$ to obtain the angle in degrees.

[e] Mean gross national product in US dollars per capita (1965–1994).

[f] Mean percentage of economic growth (1966–1994).

mastery, achievement motivation, achievement via conformity, and occupational preferences as alternative motivational mediators. Yet the temperature–wealth link might be spurious as countries with warmer climates are also those that were colonized and exploited during and after colonization to a point that these countries had less chance to develop their economies. Other potentially relevant third factors are implied in the recently reported cross-national correlations of ambient temperature with higher engagement in agriculture, lower engagement in services, more income inequality, larger power distance, and stronger values of hierarchy and conservatism (Van de Vliert & Van Yperen, 1996), and with the inhabitants' civil liberties and political rights (Van de Vliert et al., 1999).

Overall, our investigation, inspired by some general queries about the mysterious but unmistakable temperature–prosperity link (e.g., Williamson & Moss, 1993), ends with the more specific question: Are inhabitants of warmer countries really poorer because they share a more competitive culture and pass it on from generation to generation? This question highlights the value of further exploration of the little known and complex causal paths through which climate may affect human behavior and performance.

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Appendix A

See Table 3.

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