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Trust as social investment: A life-history model of environmental effects on ingroup and outgroup trust

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ABSTRACT

Trust among closely-related individuals (ingroup) and trust among non-related individuals (outgroup) can be seen as different social investment that involves different life-history tradeoffs. We tested this life-history model using the World Values Survey and the World Health Organization datasets and examined how ingroup and outgroup trust are related to sex, individual-level resource availability, and society-level environmental threats. Results show that, at the individual level, financially disadvantaged people trusted ingroups less. At the societal level, violent-conflict threats were associated with lower ingroup and outgroup trust. Furthermore, higher disease-caused mortality was associated with lower ingroup trust but not lower outgroup trust. Moreover, fertility was associated with lower outgroup trust but not lower ingroup trust. We also found that the sex effect (men trusted others more than women did) was more prominent in societies with greater violent-conflict threats and higher fertility, but less prominent in societies with lower mortality from communicable diseases. These findings are explained within the life-history framework.

1. Introduction

Trust, defined as an expectation of cooperation (Balliet & Van Lange, 2013), can be divided into ingroup trust, which concerns individuals with interpersonal ties or common group membership, and outgroup trust, which concerns unrelated others (Delhey et al., 2011; Welzel, 2010). Based on life history theory (Del Giudice et al., 2015), we postulated a model that regards ingroup and outgroup trust as a future-oriented investment in cooperative relationships, which are differentially affected by various fitness tradeoffs. These tradeoffs depend on several factors, which are individually connected to trust in other evolutionary theories, including sex, resource availability, and environmental challenges that select for different reproductive strategies (e.g., violent-conflicts threats and pathogens). This study tested this life-history model of trust using a combination of large-scale survey data (the World Values Survey Wave 6, WVS6) and archival data from the World Health Organization (WHO).

Both ingroup and outgroup trust vary across societies (Delhey et al., 2011) and between sexes (Maddux & Brewer, 2005). The male warrior hypothesis (McDonald et al., 2012; Van Vugt et al., 2007) highlights the role of violent conflicts in shaping sex differences and cross-society variations in trust. This evolutionary theory argues that such conflicts should select for psychological traits that encourage within-group cooperation and intergroup competition especially among men (Van Vugt et al., 2007). Indeed, research using experimental games demonstrated that men showed increased within-group contributions in intergroup competition contexts compared with non-competition contexts (Van Vugt et al., 2007). Other studies have indicated that outgroup threats trigger outgroup discrimination and higher social dominance orientation among men but not among women (Navarrete et al., 2010; Yuki & Yokota, 2009).

Another environmental challenge that might have shaped trust in different societies is infectious diseases. Because of host-parasite coevolution, interactions with outgroups may be especially dangerous in areas with high pathogen prevalence because pathogens carried by outgroups might be more deadly when spreading among ingroups who have not developed immunity to them (Fincher & Thornhill, 2012). High pathogen environments might lead to outgroup distrust as a behavioral immune response (Fincher & Thornhill, 2012; Schaller & Park, 2011). Indeed, evidence exists that high-pathogen regions tend to adopt strong family ties and collectivist values, which encourage favoritism toward related ingroups over unrelated outsiders (Fincher et al., 2008; Fincher & Thornhill, 2012). Nevertheless, direct evidence for the hypothesis that pathogen stress is associated with lower outgroup trust is scarce. Cross-society studies accounting for other factors such as governance, religion, and material security have found no evidence for low

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outgroup trust or high ingroup favoritism in societies with higher pathogen stress (Hruschka et al., 2014; Hruschka & Henrich, 2013). Unlike violent-conflict threats, which affect the two sexes differently, both sexes are exposed to similar pathogen risks. Therefore, gender differences in ingroup and outgroup trust should be less prominent in societies with higher disease-caused mortality.

Whereas previous theories emphasize the fitness costs of trust (especially outgroup trust) due to various environmental challenge, a life-history model that regard trust as a social investment would instead highlight different cost-and-benefit tradeoffs posed by ingroup and outgroup trust. Life history theory identifies several fundamental reproduction-related tradeoffs affecting organisms' life-span development and behaviors: early versus late reproduction, offspring quantity versus quality, and mating versus parenting efforts (Del Giudice et al., 2015). These tradeoffs lead to contingent expressions of biological and psychological traits in various environments to maximize reproductive fitness, and they converge into “life-history strategies” that vary along a fast-slow continuum (Chang & Lu, 2018; Ellis et al., 2009). Fast life-history strategies, which allocate resources and efforts to achieve high fertility, prevail in unpredictable environments with high morbidity–-mortality risks. By contrast, slow life-history strategies, which emphasize personal development, are favored in predictable environments (Ellis et al., 2009).

From the life-history perspective, trust as a future-oriented social investment should be associated with slow, rather than fast, life-history strategies because trusting a defector would incur greater fitness costs in unpredictable environments (e.g., due to violent-conflict threats or pathogens). Consistent with this view, low birth weight—a biological marker for a fast life-history strategy—is associated with lower general trust in adulthood (Petersen & Aarøe, 2015). Another study reported that slow life-history traits (e.g., stable relationships, future planning, and high emotional intelligence) mitigated outgroup hostility (Figueredo et al., 2011).

Despite the inherent costs of trust, some special features of human life history would nevertheless render ingroup and outgroup trust viable social investment in human society. A major benefit of ingroup trust in traditional human societies is cooperative breeding (i.e., childcare and material assistance by relatives or tribal members, Kramer, 2010). This might be responsible for the high fertility of human hunter-gatherers (due to shorter interbirth intervals and improved infant survival rates) compared with that of other primates (Kramer, 2010). Given that ingroup trust facilitates cooperative breeding, this might offset some cost of trusting ingroups in high-fertility societies. Thus, this would lead to the hypothesis that societies with high fertility should demonstrate lower outgroup trust, but not lower ingroup trust. The benefits of outgroup trust lie in more diverse social interaction opportunities. By freely interacting with outgroups, one gains access to non-local goods and skills. Such interactions also allow diverse mating opportunities that increase the genetic diversity of offspring (Gangestad & Simpson, 2000). These benefits might partly offset the risks of trust in unpredictable situations caused by, for instance, violent conflicts and contagious diseases.

Societies facing violent-conflict threats should demonstrate lower ingroup trust, as such conflicts might reduce the availability of cooperative breeders, such as husbands (Annan & Brier, 2010). There had often been increases in domestic violence in regions traumatized by armed conflicts (Annan & Brier, 2010). Society-level threats of violent conflicts were also associated with increased sexist attitudes (Zhu & Chang, 2020). These findings imply that the benefit of cooperative breeding is more limited in unstable societies with violent-conflict threats, which might contribute to lower ingroup trust. Violent-conflict threats should also predict lower outgroup trust as intergroup conflict disturbs mutually beneficial exchanges with outgroups. Importantly, threats of violent conflicts (even without actual conflicts) might affect life-history tradeoffs because developmental calibrations of life-history strategies are sensitive to proximate psychological adjustments (Del Giudice, 2009).

From the life-history perspective, disease-caused mortality should be associated with lower ingroup trust, but not necessarily outgroup trust. Distrust as a behavioral immune response might not just target outgroups (Aarøe et al., 2016). The fact that people have a greater chance of interacting with ingroups than with outgroups causes the former to pose greater health risks during epidemics caused by pathogens with no long-term immunity (e.g., flu or influenza). This would limit ingroups' engagement in cooperative breeding, rendering ingroup trust less beneficial. By contrast, outgroup mating might become more desirable because it introduces good genes that provide superior immunity against pathogens (Gangestad & Simpson, 2000; Lu et al., 2015). This benefit should offset the tendency of people to distrust outgroups when faced with threats of communicable diseases.

The life-history perspective also has implications for gender differences in ingroup and outgroup trust. Women's heavier parental investment (Trivers, 1972) should predispose them to be more sensitive to defections in cooperative breeding compared with men, especially in environments that favor fast life-history strategies (e.g., because of violent-conflict threats). In such environments, prolonged periods of pregnancies and childcare activities due to having more children or shorter interbirth intervals keep women homebound, thereby reducing their chances of benefiting from outgroup exchanges. Given these reasons, women's ingroup and outgroup trust might be undermined to a greater degree than those of men in environments that favor fast-life-history strategies (e.g., indicated by high violent-conflict threats and high fertility).

To test these predictions, the current study used hierarchical linear models (HLM; Bryk & Raudenbush, 1992) to analyze two-level data obtained from the World Values Survey (WVS, Wave 6; Inglehart et al., 2014). The current model investigated cross-society variations in ingroup and outgroup trust (and their gender differences), after controlling for individual-level variables that are relevant to human life-history strategies. Specifically, we expected that age should be positively correlated with trust because the benefits of trust as social investment render long-term returns (Del Giudice et al., 2015). Similarly, education (especially higher education) as an investment in one's future development should indicate slow the adoption of life-history strategies, which should be conducive to higher trust. By contrast, personal experience of resource scarcity should predict lower ingroup trust because defections in cooperative breeding obligations are more likely during within-group competition for resources (Barker et al., 2012). Indeed, evidence exists that low childhood socioeconomic status (SES) is associated with lower trust, an association that is mediated by life-history strategies (Stamos et al., 2019).

2. Method

2.1. Data

We used data obtained from the latest WVS (Wave 6; Inglehart et al., 2014) between 2010 and 2014. The WVS is the largest non-commercial, international, time-series investigation of human beliefs and values covering countries and regions with vastly different levels of economic development and from all the major cultural zones of the world. These surveys are conducted using a common questionnaire to which nationally representative samples or participants respond. Among the 59 societies (countries and regions) originally included in the WVS Wave 6, one society (New Zealand) was excluded from analysis because of inadequate individual-level data. We combined the WVS data with additional society-level data from the World Health Organization (WHO) databases. Four societies (Taiwan, Palestine, Hong Kong, and Egypt) were excluded because of missing society-level data. After excluding missing cases, the final analysis included data of 74,675 individuals from 54 societies. The sample sizes ranged from 963 (Poland) to 3498 (South Africa).

Table 1
Individual-level model results.

Variable	Regression coefficients			Variance components	
	Coefficient	*SE*	*t*	Variance component	χ^2
Outcome: Ingroup trust					
Intercept	3.0544	0.0300	101.97***	0.0482	1193.95***
Slope of Age	0.0027	0.0003	9.87***	< 0.0001	244.04***
Slope of Education = Secondary	0.0040	0.0059	0.68	0.0008	95.26***
Slope of Education = Higher	0.0236	0.0111	2.14*	0.0047	181.15***
Slope of Resource Insecurity	−0.0880	0.0121	−7.25***	0.0063	726.44***
Slope of Gender = Male	0.0299	0.0088	3.40***	0.0035	298.18***
Outcome: Outgroup trust					
Intercept	1.9867	0.0356	55.77***	0.0658	1084.56***
Slope of Age	0.0014	0.0003	4.35***	< 0.0001	244.47***
Slope of Education = Secondary	0.0151	0.0088	1.71	0.0024	127.68***
Slope of Education = Higher	0.1281	0.0187	6.86***	0.0156	306.73***
Slope of Resource Insecurity	−0.0231	0.01323	−1.74	0.0088	720.48***
Slope of Gender = Male	0.0247	0.0093	2.65*	0.0027	166.82***

* $p < .05$.
*** $p < .001$.

2.2. Dependent variables

We computed indices of ingroup and outgroup trust by using a battery of six items from the WVS originally devised by Welzel (2010). These items started with the question, "how much you trust people from various groups", and were rated from 1 to 4, with higher scores indicating higher levels of trust. An ingroup trust score was the average of three items: (1) family, (2) neighbors, and (3) people you know personally. An outgroup trust score was computed by averaging the following three items: (1) people you meet for the first time, (2) people of another religion, and (3) people of another nationality. Across all respondents, Cronbach's α coefficients for ingroup trust and outgroup trust were 0.58 and 0.79, respectively.

2.3. Society-level predictors

We computed a society-level violent-conflict threats score by aggregating individual-level average ratings of three WVS items that asked respondents to indicate the extent to which they worried about "a terrorist attack," "a civil war," and "a war involving my country" (Cronbach's $\alpha = 0.80$). These items were rated from 1 to 4 and were recoded such that a higher score denoted higher threats of violent conflicts at the society level. The society-aggregated ratings, instead of individual ratings, reflect national concerns over violent conflicts that affect the whole society. We additionally included two society-level predictors from the WHO databases: age-standardized mortality caused by communicable diseases (WHO, 2014a) and total fertility per woman (WHO, 2014b), referred to below as disease-caused mortality and fertility, respectively.

2.4. Individual-level predictors

Resource insecurity at the individual level was assessed by the average rating of three WVS items that asked about the frequency of financial difficulties within the last 12 months: "gone without enough food to eat," "gone without medicine or medical treatment that you needed," and "gone without a cash income" (Cronbach's $\alpha = 0.92$). These items were rated from 1 to 4 and were recoded such that a higher average score denoted a higher degree of resource scarcity. We also included gender (dummy coded: 0 = *female*, 1 = *male*), age, and educational level (two dichotomous dummy variables representing secondary and higher education, respectively) as individual-level predictors.

2.5. Statistical analysis

To account for inter-societal correlations of individual-level variables, hierarchical linear models (HLMs) were used. Using software package HLM 7, we conducted separate HLM analyses for ingroup and outgroup trust, respectively. Each model consisted of two levels of regression analyses. In the individual-level model, we included only the individual-level predictors and allowed their regression coefficients to be randomly estimated for each society. In the full model, the intercept of the dependent variables and the regression coefficients of gender were additionally regressed on the society-level predictors (i.e., violent-conflict threats, disease-caused mortality, and fertility). All the coefficients reported here were unstandardized coefficients. Because some estimates in HLM analysis may become extremely small in value but are still meaningful, we report four digits after the decimal points.

3. Results

Individual-level and society-level descriptive statistics and correlations are presented in Supplementary Material (Tables S1 and S2). Ingroup and outgroup trust correlated with each other at the individual level ($r = 0.35$) and society level ($r = 0.27$). The intraclass correlation coefficients (ICCs) for ingroup and outgroup trust, calculated as the inter-societal variance divided by the total variance, were 0.11, and 0.14, respectively, with significant inter-societal variances on the intercept. These results justified using the HLM to further examine the inter-societal variances of ingroup and outgroup trust.

3.1. Ingroup trust

Adding the individual-level predictors reduced the resulting individual-level variance in ingroup trust by 3.6% (from 0.2616 to 0.2521), indicating that 3.6% of previously unexplained individual-level variances in ingroup trust can be attributed to the individual-level predictors we included. In the individual-level model, older age and higher education level predicted higher ingroup trust ($B = 0.0027$, $p < .001$ and $B = 0.0236$, $p = .037$, respectively), whereas resource insecurity predicted lower ingroup trust ($B = -0.0867$, $p < .001$). Men trusted related others more than women did ($B = 0.0299$, $p < .001$). The variance components of all individual-level predictors were significant, indicating that the effects of gender and resource scarcity on ingroup trust differed considerably across societies and are likely explained by other, society-level predictors (Table 1).

The addition of society-level predictors reduced the variance component of society-level intercept of ingroup trust by 2.4% (0.04818 to

0.04701), indicating that 2.4% of previously unexplained society-level variances in ingroup trust can be attributed to the society-level predictors we included. Both violent-conflict threats and disease-caused mortality predicted lower ingroup trust (Bs = −0.0437, −0.1983, *ps* = 0.041, 0.043, respectively), whereas fertility was not (B = 0.0128, *p* = .530). Furthermore, violent-conflict threats positively predicted the slope of gender (B = 0.0180, *p* = .011), whereas the opposite was true for disease-caused mortality (B = −0.0921, *p* = .004). Like violent-conflict threats, fertility also positively predicted the slope of gender (B = 0.0334, *p* = .016).

3.2. Outgroup trust

The addition of individual-level predictors reduced individual-level variance of outgroup trust by 2.5% (0.4385 to 0.4276). We found that age and higher education both predicted higher outgroup trust (B = 0.0014, 0.1281, *p* < .001, respectively). Resource scarcity was not associated with outgroup trust. Like ingroup trust, men exhibited greater outgroup trust than women (B = 0.0186, *p* = .033). Besides, the variance components of all individual-level predictors were significant (Table 1).

The addition of society-level predictors reduced the variance component of society-level intercept of ingroup trust by 14% (0.07337 to 0.06274). Both violent-conflict threats and fertility predicted lower outgroup trust (Bs = −0.0622, −0.0942, *ps* = .032, 0.019, respectively), whereas disease-caused mortality was not (B = 0.1676, *p* = .254). The slope of gender was positively associated with violent-conflict threats and fertility (Bs = 0.0227, 0.0259, *ps* < .01, respectively), and negatively associated with disease-caused mortality (B = −0.0542, *p* = .002). Combined with the results of ingroup trust, this means that the gender effect (men trusting others more than women) was stronger in societies with greater violent-conflict threats, higher fertility, and lower disease-caused mortality (Table 2).

4. Discussion

Our findings supported the view that ingroup and outgroup trust are functions of sex, resource availability, environmental threats, and life-history strategies. Furthermore, some of our findings expanded or challenged existing predictions of evolutionary hypotheses regarding trust but are effectively explained by a life-history model. This model regards trust as a social investment that confers specific fitness tradeoffs in different environments.

Table 2
Effects of society-level variables on intercepts and individual-level regression coefficients.

Variable	Coefficient	*SE*	*t*
Outcome: Ingroup trust			
Intercept	3.0600	–	–
Violent-Conflict Threats	−0.0437	0.0208	−2.10*
Disease-Caused Mortality	−0.1983	0.0954	−2.08*
Fertility	0.0128	0.0203	0.63
Slope of Gender Intercept	−0.0320	–	–
Violent-Conflict Threats	0.0180	0.0068	2.64*
Disease-Caused Mortality	−0.0921	0.0303	−3.04**
Fertility	0.0334	0.0134	2.50*
Outcome: Outgroup trust			
Intercept	2.1724	–	–
Violent-Conflict Threats	−0.0622	0.0282	−2.21*
Disease-Caused Mortality	0.1676	0.1452	1.16
Fertility	−0.0942	0.0387	−2.44*
Slope of Gender Intercept	−0.0310	–	–
Violent-Conflict Threats	0.0227	0.0060	3.78***
Disease-Caused Mortality	−0.0542	0.0161	−3.35**
Fertility	0.0259	0.0082	3.17**

* $p < .05$.
** $p < .01$.
*** $p < .001$.

At the society level, violent-conflict threats were associated not only with lower outgroup trust, as predicted by the male warrior hypothesis, but also with lower ingroup trust. This seemingly deviates from the male warrior hypothesis, which predicts increased ingroup favoritism—especially among men—when faced with intergroup conflicts (Van Vugt et al., 2007). Our model, however, considers the tradeoff between the benefits (e.g., cooperative breeders) and costs of ingroup trust in societies confronted with threats of violent conflicts. This view is corroborated by a growing body of evidence showing that violent-conflict threats are associated with increased sexism and violence between intimate partners, both of which undermine the benefits of ingroup trust (e.g., Annan & Brier, 2010; Zhu & Chang, 2020). Moreover, societies facing greater violent-conflict threats exhibited a larger gender difference with men showing higher ingroup and outgroup trust than women. From the male warrior hypothesis perspective, this might be attributed to women being more likely to become victims of sexual assault during violent conflicts (McDonald et al., 2012). This is not mutually exclusive with the life-history explanation, which focuses on women's higher sensitivity to defections in cooperative breeding and limited access to outgroup cooperative opportunities during intergroup conflicts.

Our finding that disease-caused mortality negatively predicted ingroup trust, but not outgroup trust, appears to be inconsistent with the prediction of the parasite stress theory (Fincher et al., 2008). However, recent research has questioned whether outgroups had more dangerous pathogens historically, which contribute to a link between disease threat and outgroup avoidance (e.g., Aarøe et al., 2016). Moreover, behavioral immune systems might trigger general avoidance of interpersonal interactions (Schaller & Park, 2011) to reduce infection possibilities from one's extended social network, including ingroups, as people interact with ingroups more frequently than with outgroups. Meanwhile, the benefits of outgroup trust from additional trading and mating opportunities should partially offset its fitness costs imposed by contracting diseases from outgroups. We also found that disease-caused mortality reduced the gender difference of ingroup and outgroup trust, which is consistent with the view that danger posed by common infectious diseases evenly affects the reproductive success of women and men.

Our finding that higher fertility was associated with lower outgroup trust but not ingroup trust is consistent with the findings of Figueredo et al. (2011) regarding the association between life-history strategy and outgroup hostility. Although high fertility represents a fast life-history strategy that should reduce future-oriented social investment (Del Giudice et al., 2015), the benefits of trusting ingroups in exchange for cooperative breeding might be vital to sustaining a high fertility rate. Additionally, the finding that women are generally less trusting than men, especially in high-fertility societies, is consistent with women's higher reproductive costs. Such asymmetry in reproductive costs increases women's sensitivity to defections in ingroup cooperative breeding and limits their ability to benefit from outgroup interactions, thereby increasing the costs of ingroup trust and reducing the benefits of outgroup trust for women.

Finally, at the individual level, age was associated with higher ingroup and outgroup trust. College (but not secondary) education was also associated with higher ingroup and outgroup trust. Meanwhile, personal experiences of resource scarcity predicted lower ingroup trust. These findings are consistent with previous research showing that age and college education are associated with higher trust in others (Castle et al., 2012; Huang et al., 2011), and that socioeconomic status was positively related to trust (Stamos et al., 2019). They supported the life-history view that trust serves as a long-term social investment in one's lifespan. However, Stamos et al. (2019) did not distinguish between ingroup and outgroup trust, whereas our findings showed that resource scarcity did not predict lower outgroup trust. The potential resource

benefits of trading with outgroups might partly offset the detrimental effects of resource scarcity on outgroup trust. Interpreting these findings requires caution, however. The relatively large sample size of the WVS at the individual level might also have contributed to some significant results with low effect sizes. Primary studies specifically designed to test the life-history model of trust are needed.

Because of the data and measures we used, one limitation of our study is that variables not included in the model might affect some of the results, and this limitation challenges the robustness of our findings. For example, violent-conflict threats might also include within-society violence, such as police brutality and crime, in addition to worries about war and terrorism. Other factors that are often linked to trust include economic development and modernization (Inglehart & Welzel, 2005). These factors can be roughly reflected at the society level by using per capita gross domestic product (GDP). To account for the factors not included in the current HLM analyses, we tested alternative models that (1) used WVS items measuring community insecurity to indicate violence threats, (2) added economic development (log-transformed per capita GDP) along with the three society-level predictors, and (3) used national statistical reporting of casualties in violent conflicts as an alternative, objective measure of violent-conflict threats. The results for these additional analyses are reported in the Supplementary Materials. Most of our findings were robust in the additional analyses.

Overall, our findings attributed many cross-societal and between-sex variations in trust to flexible, environment-contingent psychological adjustments that are under predictions of our life-history models. As an important complement to existing evolutionary explanations of trust, variations in trust can be regarded as not just passive defenses against fitness costs imposed by environmental threats such as violent conflicts and contagious pathogens. Individuals' levels of ingroup and outgroup trust also reflect the unique fitness tradeoffs predicted by human life-history traits, such as cooperative breeding, outgroup resource exchange, and outgroup mating.

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CRediT authorship contribution statement

Nan Zhu:Conceptualization, Formal analysis, Writing - original draft.**Hui Jing Lu**:Methodology, Writing - review & editing, Funding acquisition.**Lei Chang**:Supervision, Writing - review & editing, Funding acquisition.

Declaration of competing interest

The authors declare that they have no conflict of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.paid.2020.110303.

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