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ZERO-SUM ENVIRONMENTS, THE EVOLUTION OF EFFORT-SUPPRESSING BELIEFS,
AND ECONOMIC DEVELOPMENT

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ABSTRACT

We study the evolution of belief systems that suppress productive effort, such as beliefs about envy, witchcraft, the importance of luck for success, or disdain for competitive effort. In our framework, demotivating beliefs evolve when interactions are zero-sum, i.e., one person's gain comes at the expense of others. They improve material welfare, although they tend to reduce subjective well-being. The model delivers predictions about the relationship between the degree of zero-sumness, demotivating beliefs, material welfare, and subjective well-being. We find that the predictions are supported by data from three samples in the Democratic Republic of the Congo, as well as global evidence from the World Values Survey and the European Values Study.

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1. Introduction

Cultural beliefs and values discouraging individual effort and achievement are widespread today and throughout history. They often take the form of warnings against, and even punishment for, personal ambition and success. A well-known example is belief in witchcraft and the evil eye, i.e., the ability of certain people to intentionally cause harm via supernatural means, which acts as a psychic tax on success (Gershman, 2014, 2015, 2022b, Henrich, 2009). Demotivating beliefs come in many forms and can also be found in contemporary industrialized societies. For example, in Nordic countries, the law of Jante, which states “Du skal ikke tro at du er noget” (“do not think that you are anything”), discourages personal pride or aggrandizement. Similarly, in Australia and New Zealand, “tall poppy” beliefs encourage people to cut down those who stand out in terms of personal achievement. In Japan, a common phrase warns that “the nail that sticks out will be hammered down.”¹ Other forms of demotivating belief systems include beliefs in an “unjust world” (Bénabou and Tirole, 2006), pessimism (Mansour, Jouini and Napp, 2006), fatalism (Whelan, 1996), and anti-materialistic beliefs that reduce the enjoyment of consumption (Flouri, 1999). If such beliefs reduce effort and investment, why are they prevalent across the world and throughout history?

We study this question theoretically and empirically by building on insights from anthropology about the ‘image of limited good,’ first highlighted by George Foster (1962, 1965, 1967, 1972). According to Foster, the limited and fixed nature of resources in small-scale pre-industrial societies meant that anything good was scarce and in limited supply. “If ‘Good’ exists in limited amounts which cannot be expanded,” Foster writes (1965, p. 296), “and if the system is closed, it follows that *an individual or a family can improve their position only at the expense of others*” (emphasis in original). Thus, the presumption in most small-scale societies is that if one person does better, somebody else must do worse. Based on ethnographic research, Foster argued that this zero-sum worldview was at the root of individual decision-making and cultural traits that curb social, economic, and political ambition. Such traits include beliefs in the importance of moderation, feelings of envy and concerns about the envy of others, witchcraft beliefs, an emphasis on the importance of sharing, and a de-emphasis on the value of hard work, thrift,

¹Sometimes these beliefs and norms are embedded in class-based status systems that stigmatize aspiration and effort as “social climbing” (McCloskey, 2010). Accordingly, British Prime Minister Herbert Asquith praised the students of his Oxford College for exhibiting “effortless superiority.”

and individual exceptionalism. Foster believed this worldview inhibited entrepreneurial activity, wealth accumulation, innovation, and economic development.

Our analysis makes two contributions. The first is to develop an evolutionary model that examines the validity of Foster's assertion that demotivating beliefs arise in zero-sum environments. The model allows for production that has varying degrees of zero-sumness. While an individual's effort increases their output, a portion of their output comes at the cost of another player with whom they are paired. The production function captures a range of economic interactions with different degrees of rivalry, ranging from merchants competing over a fixed set of customers (a completely zero-sum situation) to business partners working together in an enterprise but dividing the profits from their joint endeavor (a partially zero-sum situation).

We allow individuals to hold incorrect, demotivating beliefs of varying strength that discount the perceived return to their effort. We also allow for neutral or correct beliefs that correspond to the true return to effort. We use the term 'belief system' or simply 'belief' to denote a cultural trait, such as belief in witchcraft or an unjust world, rather than a probability distribution over known states of the world. Hence, we treat these beliefs as being updated not through Bayesian learning based on frequent feedback from the environment but through social learning and other forms of cultural evolution.² While individuals choose effort based on their (subjective) beliefs, cultural evolution is driven by (true) material payoffs.

Within this framework, Foster's hypothesis can be reframed as: Do demotivating beliefs emerge in zero-sum environments? And are they stronger in more zero-sum settings? Our model shows that despite the distortions in effort generated by demotivating beliefs, such beliefs can still emerge and spread when economic interactions are zero-sum in nature. Incorrect demotivating beliefs arise and, over time, come to dominate the population, reaching fixation. Meanwhile, accurate non-demotivating beliefs are driven to extinction.

Core to these results is the fact that for zero-sum interactions, equilibrium effort exceeds the socially optimal level due to the negative externality that an individual's success imposes on others. Demotivating beliefs mitigate this by reducing individual effort, thereby improving (static) social efficiency. However, reduced effort also diminishes individual material payoffs, which drive the evolutionary process. As a result, demotivating beliefs do not automatically arise. We show

²An alternative label to 'demotivating beliefs' that could be used throughout is 'demotivating values,' and it is these values that are formed through cultural evolution.

that they emerge only under conditions of positive assortative matching – such as homophily, culturally similar communities, or group-level selection – which occurs when individuals with similar cultural beliefs are geographically or socially clustered. In such environments, the direct cost of holding a demotivating belief is outweighed by the benefit of being matched with others who share the belief and, therefore, do not engage in excessive competition.

More broadly, we find that within a society with a given degree of zero-sumness, there is an intensity of demotivating belief that maximizes an individual’s income. As a result, the model predicts a hump-shaped (strictly concave) relationship between the strength of demotivating beliefs and economic welfare. However, when considering subjective well-being – that is, an individual’s perceived payoff, inclusive of the demotivating belief – the relationship is markedly different. For a given level of zero-sumness, subjective well-being is strictly convex in the strength of demotivating beliefs. In addition, subjective well-being is typically maximized at the true (non-demotivating) belief. Intuitively, this occurs because demotivating beliefs cause individuals to perceive their situation as worse than it is, thereby lowering their subjective well-being.

Having derived hypotheses about cross-individual variation within a setting with a set degree of zero-sumness, we next examine the model’s predictions across environments with varying degrees of zero-sumness. The model predicts a positive relationship between the zero-sumness of an individual’s environment and the strength of their demotivating beliefs. However, in contrast to predictions within a fixed zero-sum environment, the model also predicts that greater zero-sumness of the environment – and the resulting demotivating beliefs – are associated with lower material welfare and lower subjective well-being. These negative relationships arise primarily because zero-sum interactions directly reduce both objective and subjective payoffs.

The paper’s second contribution is empirical. Having formalized Foster’s arguments, we turn to the data to evaluate the model’s predictions. We begin by analyzing data collected in Kananga, an urban hub and provincial capital in the Democratic Republic of the Congo (DRC). Home to approximately 1.6 million people originating from villages and towns across the region, the city hosts a large and diverse population. Despite its size, Kananga remains pre-industrial: it is the largest city in the world without consistent electricity or running water, nearly all roads are unpaved, and agriculture and animal husbandry are common even within the urban landscape.

We use this pre-industrial urban setting to test the model’s prediction of a relationship between the zero-sumness of a person’s environment, their demotivating beliefs, and their material wel-

fare. Our analysis draws on three samples: a 200-person survey conducted in 2015, a 1,000-person survey from 2019, and a 128-person experimental sample from 2025. We use the 2015 sample to develop our zero-sum measure and explore its relationship with demotivating beliefs. We then validate and replicate the findings in the larger 2019 sample. Finally, we develop a lab-based experimental test of our hypotheses using the 2025 sample.

To measure the zero-sumness of a respondent's environment, we use multiple survey questions asking whether various types of gains – earnings, profits, wealth, gains in trade, power, and happiness – come at the expense of others. We then use principal components analysis to identify and distill a single factor that captures the extent to which a person views their environment as being zero-sum, which serves as our baseline zero-sum measure. We validate this measure using several strategies. First, we compare it with respondents' expectations in vignette-based scenarios, finding that individuals with a higher zero-sum measure are more likely to predict zero-sum outcomes in the vignettes. Second, we also compare the measure to pre-determined covariates that are likely indicators of a more zero-sum environment. We find that individuals with a recent history of worse employment conditions are more likely to perceive their current environment as zero-sum.

We then examine the relationship between the zero-sumness of a person's environment, demotivating beliefs, and material welfare. First, we estimate the relationship between zero-sum perceptions and the demotivating beliefs emphasized in Foster's ethnography – specifically, envy and traditional religious beliefs, commonly referred to as 'witchcraft.' In both samples, respondents who perceive their environment as more zero-sum are more envious of others' success and more likely to hold traditional religious beliefs. Consistent with the model's predictions, we also find that stronger zero-sum perceptions are associated with lower material welfare.

Given the correlational nature of our findings, we also implemented an experiment to causally identify the effects of a zero-sum environment. We invited groups of participants to visit a lab and randomly varied the monetary payment (endowment) they received before participating in other behavioral games. In the zero-sum treatment, they completed an effortful task, and their relative rank in the task outcome determined their endowment. Only one person per group could receive the highest payment. In the non-zero-sum condition, endowments were assigned randomly, with replacement, and independently of any ranking. All participants could receive the highest payment. Participants then played a Joy of Destruction game, where they could reduce

another player's payoff at a personal cost. This decision was made in private – unobserved by others – but participants knew the identity of the other player whose payoff they could reduce. We find that participants were more likely to reduce the payoff of those with higher baseline endowments in the zero-sum treatment but not in the non-zero-sum treatment. These results align with the theory, suggesting that in zero-sum environments, norms of envy and spite emerge to curb excessive competition.

We then examine the same relationships globally using data from the Integrated Values Surveys (IVS), which is constructed by combining the World Values Survey (WVS) and European Values Study (EVS). Although the survey does not ask about envy or witchcraft, it captures a broader set of demotivating beliefs relevant for more developed countries, which make up the majority of the IVS sample. These beliefs include the perceived importance of hard work for economic success, skepticism about the role of effort in determining success, and the acceptability of receiving help from others. Consistent with the model's predictions, we observe a robust positive association between zero-sum perceptions and demotivating beliefs. While the specific beliefs vary between the Congolese and IVS samples, in both settings, demotivating beliefs co-vary with the perceived zero-sumness of one's environment. We also find that, in line with the model's predictions regarding material welfare and subjective well-being, a more zero-sum environment is associated with lower material welfare, as measured by income, educational attainment, savings, and occupational status. Furthermore, it is associated with lower subjective well-being, as measured by life satisfaction and happiness.

The large size of the IVS sample allows us to test the model's prediction that across individuals within a fixed zero-sum environment, there is a level of demotivating belief that maximizes material welfare. Empirically, we observe a hump-shaped relationship between demotivating beliefs and economic welfare: among individuals with the same degree of zero-sum perceptions, those with an intermediate level of demotivating beliefs have the highest incomes. This pattern holds across all measures of demotivating beliefs. By contrast, the model predicts that within a fixed zero-sum environment, subjective well-being is convex in the strength of demotivating beliefs and maximized at the true (non-demotivating) belief. Our findings support this prediction in the IVS data. Among individuals with the same zero-sum environment, those with stronger demotivating beliefs report lower life satisfaction and less happiness.

This paper provides an empirical application of an evolutionary game-theoretic model in

economics. While much of the existing literature has focused on the evolution of trust and other-regarding preferences, we introduce the concept of a demotivating belief system. Although distorted beliefs also arise in models of motivated reasoning (Bénabou and Tirole, 2006) and misspecified beliefs (Esponda and Pouzo, 2016, Massari and Newton, 2020), our model does not assume psychological motivations or belief misspecification. Instead, we follow the literature in economics on the evolution of preferences (or indirect evolution) (Frank, 1987, Güth and Yaari, 1992) and show how demotivating beliefs can emerge through cultural evolution.³ In particular, we build on the approach of Alger and Weibull (2013, 2016) which relies on positive assortativity. A particularly novel aspect of our analysis is that we place some structure on the divergence between material and subjective payoffs and empirically test these predictions.

Our empirical findings complement the analysis of Chinoy, Nunn, Sequeira and Stantcheva (2026), which highlights the importance of Foster’s insights for the contemporary United States. Their empirical analysis builds on the method developed here for measuring zero-sum perceptions, applies it to zero-sum perceptions between groups (namely, income groups, racial groups, trading countries, and immigrants vs. native born), and examines relationships with government policies about taxation, immigration, gender, and race. They show that zero-sum perceptions explain much of the variation in policy preferences not captured by party affiliation. Given that we show that zero-sum perceptions affect values and beliefs, the natural next step is to examine whether preferences for specific policies are also affected. Their study also provides a rich analysis of the historical determinants of zero-sum perceptions, showing that economic mobility and immigration weaken zero-sum perceptions, while enslavement strengthens them.

Our findings also contribute to an important and growing empirical literature on intergenerationally transmitted cultural traits (Giuliano, 2007, Fernández, 2007, Fernández and Fogli, 2009, Voigtländer and Voth, 2012). They contribute to our understanding of how the external environment affects the evolution of cultural traits (Nunn and Wantchekon, 2011, Guiso, Sapienza and Zingales, 2016, Grosjean and Khattar, 2018, Schulz, Bahrami-Rad, Beauchamp and Henrich, 2019, Buggle and Durante, 2021, Giuliano and Nunn, 2021).

Our belief-based channel complements and extends prior work on social institutions (e.g.,

³The basic analysis assumes that preferences are observable and can thus alter the behavior of one’s partners in an interaction (Schelling, 1960, Becker, 1976, Frank, 1988). Due to this strategic (commitment) effect, preferences can diverge from the objective fitness function (Ok and Vega-Redondo, 2001, Ely and Yilankaya, 2001, Heifetz, Shannon and Spiegel, 2007). See also Bisin and Verdier (2000, 2017) on the cultural transmission of preferences.

Carvalho, 2013, Nunn and Sanchez de la Sierra, 2017, Akerlof, Matouschek and Rayo, 2020). Most closely related is Gershman's (2015, 2016, 2020) seminal work on witchcraft and evil-eye beliefs. Gershman (2015) develops a model in which these beliefs emerge to reduce an individual's output and thereby discourage envious destruction. Consistent with our empirical findings, Gershman (2022a) documents a positive relationship between the 'image of limited good' and witchcraft beliefs, and Gershman (2023) finds a negative relationship between witchcraft beliefs and subjective well-being.

Our findings also relate to work on sharing norms. Bowles (2006) shows that sharing norms and other forms of reproductive leveling favor the evolution of cooperation by reducing the gains from defection. We show how a seemingly unproductive cultural trait – i.e., demotivating beliefs – can improve short-run efficiency and propagate when the economic environment is zero-sum. Theoretical work by Gavrillets and Seabright (2025) extends our line of inquiry by allowing for the evolution of perceptions that are positive-sum (not only zero-sum). Consistent with our findings, they show that non-random matching (or conformist bias or a cultural authority) is needed for the emergence of inaccurate beliefs.

2. A Model of Foster's "Image of Limited Good"

In the introduction, we provided examples of demotivating beliefs. To help understand why beliefs and value systems that depress productive effort could emerge and survive, we turn to the work of anthropologist George Foster (Foster, 1962, 1965, 1967, 1972). Based primarily on fieldwork in rural Mexico in the 1960s, he argued that people in most pre-industrial societies viewed the world as zero-sum. According to this "image of limited good," if one person gets ahead, someone else must fall behind.

A zero-sum cognitive orientation arises in a world where essential resources and assets are indeed in limited supply. Land is limited, so more land for one individual means less land for another. Similar scarcity applies to authority, social status, and spouses/mates. In such environments, one can only get ahead at the expense of others. George Foster argued that this perception generates envy and encourages beliefs in witchcraft and the evil eye. These serve to discourage effort because there is often suspicion that personal success arose through the use of witchcraft and at the expense of others. Fear of provoking envy also has a similar effect, leading individuals to restrain effort.

Although Foster first proposed the “image of limited good” as a model of rural Mexican society, he subsequently argued that zero-sum beliefs emerged around the world, driven by the actual zero-sumness of social and economic life, particularly in pre-industrial societies with limited trade or economic growth. He also described a relationship between a zero-sum world and demotivating beliefs, noting that zero-sum societies appear to lack what McClelland (1961) calls the “need for achievement.” As noted in the introduction, demotivating beliefs can take a variety of forms, all of which serve to discourage personal ambition and success.

The paper’s first goal is to combine these insights into a formal model that examines the evolution of demotivating beliefs in an environment that is more or less zero-sum. We now turn to the model.

A. Basic Set Up

PLAYERS. Consider a large population which we approximate as infinite, formally a continuum of mass one. We view this as a population of individuals who live in the same environment and can interact with each other. For example, the population could be a neighborhood within a city, a social group, a village, a district within a country, or a country. We later extend the analysis to multiple populations.

TIME. Time is continuous and denoted by $t \in \mathbb{R}_+$.

BELIEF SYSTEMS. There is a potentially large but finite set of belief systems $\Theta = \{\theta_1, \theta_2, \dots, \theta_n\}$, where the intensity of belief i is $\theta_i \in [0, 1]$, $i = 1, 2, \dots, n$. We view each θ_i as a cultural belief (or trait) rather than the more conventional notion of a belief as a probability distribution over known states of the world. As we shall see, $\theta_i = 0$ is the true belief, and any $\theta_i > 0$ is a demotivating belief. (We could also allow for hypermotivating beliefs $\theta_i < 0$, but such beliefs would not evolve in our setting.) The share of each belief i in the population is denoted by q_i , with the population state denoted by $\mathbf{q} = (q_1, q_2, \dots, q_n)$ and $\sum_{i=1}^n q_i = 1$.

ACTIONS. Individuals are paired and engage in production. The effort exerted by a trait i individual is denoted by $x_i \in \mathbb{R}_+$. The cost of production is $\frac{1}{2}x_i$, and the production function is $A\sqrt{x_i}$, where $A > 0$ is the state of technology in the economy.

Environments vary in their degree of rivalry or zero-sumness. The degree to which the environment is zero-sum is measured by $\alpha \in (0, 1]$, which we assume is known by individuals. One interpretation is that a fraction α of tasks are zero-sum in nature, meaning that the benefit

to the individual undertaking the task comes at the expense of the player with whom they are paired.⁴ For example, if player i invests in better marketing for her shop, an increase in sales can come from newly created demand or stealing of player j 's customers.

PAYOFFS. The true (objective) payoff function to an individual with trait i when matched with an individual with trait j is

$$\begin{aligned} U_i(x_i, x_j) &= A [\alpha (\sqrt{x_i} - \sqrt{x_j}) + (1 - \alpha)\sqrt{x_i}] - \frac{1}{2}x_i \\ &= A [\sqrt{x_i} - \alpha\sqrt{x_j}] - \frac{1}{2}x_i. \end{aligned} \quad (1)$$

If α were zero, we have a simple production decision: each individual's payoff is independent of their partner's effort. If $\alpha = 1$, the environment is purely zero-sum: all gains come at the expense of one's partner. This is what Foster (1965) describes as a "limited good" environment.

Players maximize a potentially distorted version of the true payoff function. Specifically, a trait i player chooses production effort x_i to maximize the following subjective payoff:

$$\hat{U}_i(x_i, x_j) = A [(1 - \theta_i) \sqrt{x_i} - \alpha\sqrt{x_j}] - \frac{1}{2}x_i. \quad (2)$$

That is, an individual with a belief system i discounts the return to her effort by a factor $(1 - \theta_i) \in [0, 1]$. Our results are robust to alternative specifications of the subjective payoff function, e.g., beliefs that overestimate the cost of effort or discount the value of total output (see Appendix B.I). This specification captures various kinds of demotivating belief systems. For example, individuals may have a (potentially inaccurate) perception about the economic return to effort in the economy (Bénabou and Tirole, 2006). $\theta_i > 0$ could also be the product of a supernatural belief, such as belief in the evil eye, according to which envious individuals cause harm to others through supernatural forces (Gershman, 2014, 2015). Hence, envy exacts a kind of supernatural tax on effort, with believers expecting to lose a fraction θ_i of their output. These belief systems reduce perceived returns to effort and are thus demotivating. The higher the belief intensity θ_i , the more demotivating the belief of individual i .

Maximizing (2) with respect to x_i , we get optimal production effort for each trait i :⁵

$$x_i^* = \arg \max_{x_i \in \mathbb{R}_+} \hat{U}_i(x_i, x_j) = (1 - \theta_i)^2 A^2. \quad (3)$$

⁴An alternative incomplete-information interpretation is that the environment is zero-sum with probability α . In this case, whatever an individual with trait i gains through production, their partner j loses. With probability $1 - \alpha$, i 's effort is fully productive and does not come at the expense of j .

⁵Since i 's marginal utility is independent of j 's choice, the results do not depend on whether individuals have complete or incomplete information regarding their partner's trait.

MATCH PAYOFFS. As in the literature on indirect evolution (e.g., Güth and Yaari, 1992, Ok and Vega-Redondo, 2001), while individual choices are based on their subjective payoff functions given by (2), evolution is determined by the true payoff function (1).⁶ Denote the equilibrium (true) payoff to a trait i individual matched with a trait j individual by

$$\begin{aligned} U_{ij} &= U_i(x_i^*, x_j^*) \\ &= (1 - \theta_i - \alpha(1 - \theta_j) - \frac{1}{2}(1 - \theta_i)^2) A^2. \end{aligned}$$

By observation, the payoff to i in an i, j match is strictly decreasing in the intensity of i 's belief θ_i and strictly increasing in the intensity of j 's belief θ_j . Therefore, one would ideally wish to hold the true belief $\theta_i = 0$, but be matched with individuals who hold a demotivating belief $\theta_j > 0$.

ASSORTATIVE MATCHING. The success of trait i is based on its “cultural fitness,” which we denote by $F_i(\mathbf{q})$, and is given by the expected payoff across all possible matches. It is, thus, a function of the population state $\mathbf{q}$. We allow for partial assortative matching, as in Cavalli-Sforza and Feldman (1981), by assuming that with probability σ , individuals are matched with someone who shares their trait, and with $1 - \sigma$, they are matched uniformly at random with someone from the population. As detailed in Appendix B.V, this form of assortativity arises when there is endogenous matching with partial observability of types (Gale and Shapley, 1962).⁷ Empirically, there is extensive evidence for positive assortativity on cultural traits in a diversity of environments, ranging from small-scale hunter-gatherer bands to modern large-scale societies (see Appendix B.V for additional details).

Given an index of assortativity σ , the cultural fitness of belief i is:⁸

$$\begin{aligned} F_i(\mathbf{q}) &= \sigma U_{ii} + (1 - \sigma) \sum_{j=1}^n q_j U_{ij} \\ &= (1 - \theta_i) \left(1 - \frac{1}{2}(1 - \theta_i)\right) A^2 - \alpha A^2 \left[\sigma(1 - \theta_i) + (1 - \sigma) \sum_{j=1}^n q_j (1 - \theta_j) \right]. \end{aligned} \quad (4)$$

B. Cultural Evolution

The evolution of beliefs in the population is given by a dynamic operating on the n -dimensional unit simplex. We place a minimal restriction that the distribution of beliefs $\mathbf{q}$ evolves according

⁶Our results are preserved when the fitness function is a convex combination of material and subjective payoffs.

⁷An alternative interpretation is that σ is a proxy for group-level selection in the population. For example, consider the population being split into two groups, labeled 1 and 2. Suppose trait i has achieved fixation (i.e., is present in 100% of the population) in group 1 and trait j has achieved fixation in group 2. The index of assortativity σ is then the likelihood of a within-population match.

⁸Since x_i^* is independent of α , the fitness of each belief i does not depend on individuals having accurate perceptions about the degree of zero-sumness.

to a deterministic payoff monotone dynamic: for all i, j such that $q_i > 0$ and $q_j > 0$,

$$F_i(\mathbf{q}) \gtrless F_j(\mathbf{q}) \iff \frac{\frac{dq_i}{dt}}{q_i} \gtrless \frac{\frac{dq_j}{dt}}{q_j}.$$

That is, if the payoff to trait i is higher than the payoff to trait j , then i 's population share grows faster. A leading example is the replicator dynamic, which can be the product of natural selection, imitation, or reinforcement learning (Sandholm, 2010). In addition, we impose the following tie-breaking rule (TB): If $F_i(\mathbf{q}) = F_j(\mathbf{q})$, then $\frac{dq_i}{dt}/q_i > \frac{dq_j}{dt}/q_j$ if $\theta_i < \theta_j$. That is, ties are broken in favor of the belief closer to the truth $\theta = 0$.⁹

We first show that the belief intensity with the highest cultural fitness vis-à-vis any other belief intensity is $\theta^* = \sigma\alpha$, i.e., the product of the degree of positive sorting in interactions and the degree to which the environment is zero-sum. Recall that the (true) non-demotivating belief is $\theta = 0$. We denote the population shares of these beliefs at time t by $q^*(t)$ and $q^0(t)$, respectively.

Proposition 1 . Evolution of Demotivating Beliefs. *Cultural evolution selects a belief system as follows. If there is a belief close to $\theta^* = \sigma\alpha$, then the true belief $\theta = 0$ will be driven to extinction, and all individuals will have a 'distorted' view of the world. If θ^* is in the set of beliefs, then eventually, the entire population will hold this belief. Formally:*

- (i) *If the set of beliefs Θ contains a belief θ_i with $\theta_i < 2\sigma\alpha$ and the initial state is such that $q^0(0) < 1$, then $q^0(t)$ converges to zero.*
- (ii) *If the set of beliefs Θ contains $\theta^* = \sigma\alpha$ and the initial state is such that $q^*(0) > 0$, then $q^*(t)$ converges monotonically to one.*

All proofs are in Appendix A.

Even though they are inaccurate representations of the world, demotivating belief systems can survive and spread through the population. According to part (i) of the proposition, as long as demotivating beliefs are present initially and are not too intense given the degree of zero-sumness $\alpha > 0$ and index of assortativity $\sigma > 0$, the true belief $\theta = 0$ will be driven to extinction. Only demotivating beliefs will survive in the population. Part (ii) tells us that the demotivating belief with intensity $\theta^* = \sigma\alpha$ will win out, driving all other belief systems to extinction. Hence, under positive assortativity ($\sigma > 0$), the belief intensity that is selected is strictly increasing in the degree

⁹The results would be unchanged if the tie-breaking rule were reversed.

of zero-sumness α .¹⁰ These results do not depend on the specific form of the payoff monotone cultural dynamic. In addition, even when $q^*(0) = 0$, Corollary 1 in the Appendix A shows that evolution will select a belief intensity in the support of $\mathbf{q}(0)$ that is approximately equal to θ^* .

The intuition for the survival of (incorrect) demotivating beliefs is as follows. The belief $\theta > 0$ depresses effort below the first-best level by discounting the return to effort. The direct effect of this distortion is to reduce cultural fitness. There is also an indirect effect we call the ‘interactive effect,’ which is an increase in the likelihood of being matched with someone with demotivating beliefs and who exerts little effort. When interactions are primarily zero-sum (α is large) and there is a high degree of assortative matching (σ is large), the interactive effect dominates. Demotivating beliefs evolve and internalize part of the negative externalities in such environments.

These results are related to Alger and Weibull’s (2013) work on *Homo moralis* and altruistic preferences. Altruistic preferences and our notion of demotivating beliefs are behaviorally equivalent since both cultural traits can produce the same effort choices. However, they differ in how they respond to the zero-sumness of the environment, which yields distinct empirical predictions (see Appendix B.II).¹¹ We also show that our results are robust to the inclusion of different types of effort, i.e., pro-social and anti-social, with demotivation only occurring for the latter (Appendix B.III). They are also robust to demotivating beliefs being driven by a cultural leader or institution that tunes the intensity of demotivating influence over time to maximize the spread of the belief (Appendix B.IV).

C. The Effect of Demotivating Beliefs on Material Welfare and Subjective Well-Being

We have seen that demotivating beliefs have an ‘interactive effect’ at the individual level that enables them to spread through the population. We now turn to the social efficiency of such beliefs. Our efficiency criterion, which we refer to as material welfare, is a function of the objective payoffs, which serve as the cultural fitness of each belief. Specifically, material welfare at time t for a person holding belief θ_i is the objective (or true) payoff given by (1) evaluated at the equilibrium effort levels $(x_i^*)_{i=1}^n$ and averaged over all interactions:

¹⁰This result helps us understand part (i). The (true) non-demotivating belief $\theta = 0$ is driven to extinction whenever there is a demotivating belief that is closer than it to the relative fitness maximizing belief $\theta^* = \sigma\alpha$.

¹¹In particular, the evolutionarily stable demotivating belief depends on the degree to which the environment is zero-sum. The evolutionarily stable degree of altruism does not. If survey responses such as “competition is not good” only reflect altruism, then they should not vary with zero-sumness, which contradicts our empirical results.

$$W_i(t) = F_i(\mathbf{q}(t)) = \sigma U_i(x_i^*, x_i^*) + (1 - \sigma) \sum_{j=1}^n q_j(t) U_i(x_i^*, x_j^*). \quad (5)$$

Proposition 2 . Demotivating Beliefs and Material Welfare. *Material welfare at time t is highest for the holders of belief $\theta^* = \sigma\alpha$ and strictly concave in θ .*

The proposition, which holds regardless of the initial condition $\mathbf{q}(0)$, shows that there is a demotivating belief ($\theta^* = \sigma\alpha$) that maximizes i 's material welfare. Deviations from θ^* in either direction reduce material welfare. In other words, there is a hump-shaped relationship between material welfare and the intensity of demotivating beliefs.

We also examine the effect of demotivating beliefs on perceived welfare, which we refer to as “subjective well-being”. We define subjective well-being at time t for a person holding belief θ_i as the subjective payoff given by (2) evaluated at the equilibrium effort levels $(x_i^*)_{i=1}^n$ and averaged over all interactions:

$$\hat{W}_i(t) = \sigma \hat{U}_i(x_i^*, x_i^*) + (1 - \sigma) \sum_{j=1}^n q_j(t) \hat{U}_i(x_i^*, x_j^*). \quad (6)$$

Proposition 3 . Demotivating Beliefs and Subjective Well-being. *In contrast to material welfare, subjective well-being is not concave in demotivating beliefs, but is strictly convex in θ . If $\theta < 1 - \sigma\alpha$, subjective well-being at time t is strictly decreasing in the intensity of demotivating beliefs θ . Otherwise, it is increasing in θ . Finally, for $\sigma\alpha < 1/2$, subjective well-being is highest for the true belief $\theta = 0$.*

As we saw, material welfare is hump-shaped in the intensity of demotivating beliefs. Subjective well-being does not exhibit this pattern and is, instead, convex in θ . Whether subjective well-being is increasing or decreasing in demotivating beliefs depends on parameter values. If the most intense demotivating belief in the set of beliefs is not too intense, $\max \Theta \leq 1 - \sigma\alpha$, then subjective well-being is strictly decreasing in θ . Otherwise, subjective well-being is decreasing for the lower values of θ and increasing for the higher values of θ . Regardless of the shape of the function, subjective well-being is highest for the true non-demotivating belief $\theta = 0$ as long as $\sigma\alpha < \frac{1}{2}$, which is a condition that likely holds given the existing anthropological evidence.¹² This stands in contrast to material welfare, which we have shown is maximized at $\theta^* > 0$ (for $\sigma\alpha > 0$).

¹²See, for example, Smith, Larroucau, Mabulla and Apicella (2018) and Henrich (2018). Further details are provided in Appendix B.V.

The reason why demotivating beliefs have a different effect on material welfare and subjective well-being is as follows. Material welfare is hump-shaped in θ due to the tradeoff between the direct cost of a distorted belief system and the interactive benefit of being matched with a less motivated partner. There is no such tradeoff for subjective well-being since individuals choose effort to maximize their subjective payoff. Instead, there is an “affective cost” from discounting the material payoff by $1 - \theta$, which makes people feel they are doing worse than they actually are, causing subjective well-being to be typically decreasing in θ . Thus, Propositions 2 and 3 predict a divergence between material welfare and subjective well-being, a prediction that we will take to the data.

D. Comparative Dynamics across Populations

Thus far, we have considered a population interacting in an environment characterized by a fixed degree of zero-sumness, α . In reality, even within a given society, there can be multiple socioeconomic and geographic niches with different degrees of zero-sumness. We now generate predictions comparing populations interacting in environments with different degrees of zero-sumness. This allows us to derive cross-population predictions, which we also take to the data.

Consider a finite set of populations indexed by $k \in \{1, 2, \dots, K\}$. The degree to which the environment faced by population k is zero-sum is α^k , and the populations are ordered such that $k > k'$ implies $\alpha^k > \alpha^{k'}$. To focus on the degree of zero-sumness α^k , we assume each population has the same index of assortativity $\sigma > 0$ and set of beliefs Θ .¹³

We begin by analyzing the relationship between zero-sumness, on the one hand, and demotivating beliefs, effort, material welfare, and subjective well-being, on the other, across populations $k \in K$. Define the population k share of belief i at time t by $q_i^k(t)$ and the population k state by $\mathbf{q}^k(t)$. The mean demotivating belief, mean level of effort, mean material welfare, and mean subjective well-being in population k at time t are defined, respectively, as:

$$\theta^k(t) = \sum_{i=1}^n q_i^k(t) \theta_i, \quad X^k(t) = \sum_{i=1}^n q_i^k(t) x_i^*, \quad W^k(t) = \sum_{i=1}^n q_i^k(t) W_i^k(t), \quad \hat{W}^k(t) = \sum_{i=1}^n q_i^k(t) \hat{W}_i^k(t) \quad (7)$$

where x_i^* is given by (3), $W_i^k(t)$ is given by (5), and $\hat{W}_i^k(t)$ is given by (6). If we also assume a *regular environment* where the set of beliefs is the discrete grid $\Theta = \{0, \frac{1}{\Delta}, \frac{2}{\Delta}, \dots, 1\}$ and the initial

¹³We assume unchanging α^k . If we were to allow the environment to change, all results would apply regardless of the history of α^k in each population, as long as enough time has passed since the last environmental change.

state $\mathbf{q}(0)$ has full support on Θ , we can then state four propositions. First, demotivating beliefs vary with the zero-sumness of the environment as follows:

Proposition 4 . Zero-Sum Environments and Demotivating Beliefs. *Consider a regular environment with a sufficiently fine set of beliefs (Δ large). If cultural evolution is allowed enough time to operate, the mean demotivating belief will be higher in populations with higher degrees of zero-sumness.*

Second, effort and material welfare vary with zero-sumness as follows:

Proposition 5 . Zero-Sum Environments and Economic Outcomes. *Consider a regular environment with a sufficiently fine set of beliefs (Δ large). If cultural evolution is allowed enough time to operate, the mean effort and material welfare will be lower in populations with higher degrees of zero-sumness.*

Third, subjective well-being varies with zero-sumness as follows:

Proposition 6 . Zero-Sum Environments and Subjective Well-being. *If, in addition to the conditions of Proposition 5, $\sigma \leq \frac{1}{2}$ or $\alpha^K < \frac{1}{\sigma} \frac{1+\sigma}{2+\sigma}$, then mean subjective well-being will also be lower in populations with higher degrees of zero-sumness.*

Hence, under the stated conditions, there exists a finite time T such that for all $t \geq T$, $\theta^k(t)$ is strictly increasing in α^k and $X^k(t)$, $W^k(t)$, and $\hat{W}^k(t)$ are strictly decreasing in α^k . That is, where a population interacts in a more zero-sum environment, it will eventually hold more intense demotivating beliefs, and, as a consequence, exert less effort, have lower material welfare, and experience lower subjective well-being. This applies independently of the precise form of payoff monotone cultural dynamic or of the initial conditions for each population, as long as they are interior.

The intuition behind the proposition's additional condition for the prediction of subjective well-being is as follows. There are three effects of a more zero-sum environment on subjective well-being. The first is to increase negative externalities and thereby lower subjective well-being. The remaining two effects depend on the limiting demotivating belief, $\theta^* = \sigma\alpha^k$, being increasing in zero-sumness. The second effect arises because increased demotivating beliefs discount the returns to effort by approximately $1 - \theta^*$, which reduces well-being by making an individual's situation seem worse than it is. The third effect raises well-being by producing demotivating beliefs that internalize part of the negative externalities from zero-sum interactions. When

positive assortativity σ and the degree of zero-sumness α^k are large, the third effect dominates, and subjective well-being can rise with α^k . As noted, empirically, this is unlikely because estimates of σ in human populations are typically below 0.5 (Smith et al., 2018, Henrich, 2018). The relationship between $\hat{W}^k$ and α^k is illustrated by numerical examples in Figure A1.

Propositions 4–6 also have implications for the relationship between demotivating beliefs, economic outcomes, and subjective well-being across populations, which we summarize as follows.¹⁴

Proposition 7 . *Demotivating Beliefs, Economic Outcomes, and Subjective Well-being.* *Under the conditions of Propositions 4–6, there exists a finite time T such that, for all $t \geq T$, $\theta^k(t) > \theta^{k'}(t)$ implies $X^k(t) < X^{k'}(t)$, $W^k(t) < W^{k'}(t)$, and $\hat{W}^k(t) < \hat{W}^{k'}(t)$.*

That is, mean effort, material welfare, and subjective well-being are all strictly decreasing in a population's mean demotivating belief.

The theory generates a subtle but important point. Within a society characterized by a given degree of zero-sumness, demotivating beliefs can increase material welfare (Proposition 2). However, across societies with varying degrees of zero-sumness, demotivating beliefs are associated with lower material welfare (Proposition 7).

From Theory to Empirics

We now take the predictions from our theory to the data. Propositions 2 and 3 concern the effect of varying demotivating beliefs for a given zero-sumness of the environment. Proposition 2 predicts a hump-shaped relationship between demotivating beliefs and income when looking within an environment with a fixed degree of zero-sumness. By contrast, Proposition 3 suggests that happiness is maximized at the true (non-demotivating) belief $\theta = 0$ and convex in the strength of demotivating beliefs. Together, the two propositions predict a divergence between material welfare and subjective well-being.

Propositions 4–6 examine variation across environments with varying degrees of zero-sumness. Proposition 4 predicts that a more zero-sum environment will increase the prevalence of demotivating beliefs in the population. Proposition 5 demonstrates that, as a consequence, reduced effort and lower levels of material welfare should be found in more zero-sum environments. Proposition 6 shows that under certain (likely) conditions, we should also see worse

¹⁴Propositions 4–7 deliver comparative statics *from any initial condition* as long as sufficient time has passed. They do not require $t \rightarrow \infty$.

subjective well-being. An implication, which is summarized in Proposition 7, is that a stronger presence of demotivating beliefs should be associated with lower levels of effort, lower material welfare, and (under certain conditions) lower subjective well-being.

We test these predictions in two settings. The first is a pre-industrial setting in the DRC, similar to that studied by Foster. Here, we use information from surveys and experiments, gathered through our fieldwork. The second is an industrialized global sample that is beyond what Foster considered. The sample, which relies on publicly available survey data from the WVS and EVS, provides a much larger sample and sufficient variation to test all predictions of the model, including those concerning cross-individual variation in an environment where α is fixed (Propositions 2 and 3).

3. Evaluating the Model in the Developing World: Evidence from the DRC

A. Data Collection

Our empirical analysis draws on three samples from Kananga, the capital of the Kasai-Central province in the Democratic Republic of the Congo (DRC), collected in 2015, 2019, and 2025. The city has a population of roughly 1.6 million.

The 2015 sample includes approximately 200 individuals, while the 2019 sample includes about 1,000 individuals. Respondents were randomly selected, subject to inclusion criteria ensuring adequate ethnic representation. All surveys were conducted face-to-face at respondents' homes. We use the 2015 sample to develop and validate our measure of the zero-sumness of the environment and to examine its relationship with demotivating beliefs and material welfare (Propositions 4 and 5) as well as the effect of demotivating beliefs on material welfare (Proposition 7). We then replicate these patterns in the larger 2019 sample.¹⁵

The years in which these two surveys were administered offer another source of variation relevant to our theory. Between mid-2016 and late-2017, a violent conflict swept through the region, claiming an estimated 5,000 lives.¹⁶ The conflict triggered a substantial influx of foreign aid. For the first time, major NGOs such as Médecins Sans Frontières, the International Rescue Committee, and Handicap International established operations in the city. Unlike the 2015 survey,

¹⁵Appendix S provides further details on survey design and sampling.

¹⁶A local militia known as the Kamuina Nsapu contested the national government. Although the vast majority of the violence occurred in rural villages, at one point, the militia seized land near Kananga, including the airport, and there was some fighting in the city in early 2017.

the 2019 survey took place after the conclusion of the violence and at the height of the influx of foreign aid, which, at least anecdotally, created a less zero-sum environment. For this reason, our empirical analysis reports results disaggregated by survey wave, in addition to pooled estimates (with survey year fixed effects).

Finally, to estimate the causal effects of zero-sumness on envy and spiteful behavior, we conducted a lab experiment in 2025. We invited a stratified random sample of 128 adults in Kananga to visit an experimental lab in groups of eight. Participants first played an activity that allocated them an initial endowment of varying amounts. We randomly varied whether the allocation across the players in their group session was zero-sum or not. Participants then played the Joy of Destruction game, where they could reduce the payoffs of others at a personal cost – a behavior we interpret as capturing envy and spite. The experimental setup, therefore, allows us to test for a causal effect of being in a zero-sum environment on envy and spiteful behavior.

B. Measuring a Zero-Sum World

Central to our analysis is the extent to which the world is zero-sum, denoted by α . Since we cannot directly observe the zero-sumness of each respondent’s environment, we measure their perception instead. While perceived α is an imperfect proxy, this poses no conceptual issues, as our theoretical results hold even if individuals form biased beliefs about the zero-sumness of their environment.¹⁷ The challenge is therefore empirical – specifically, how well perceptions of zero-sumness align with reality. Fortunately, substantial evidence shows that these perceptions are shaped by the actual zero-sum nature of the world. For instance, in the United States, zero-sum perceptions strongly correlate with factors that shape the zero-sumness of the environment, including economic growth, intergenerational mobility, immigration, and enslavement (Chinoy et al., 2026). We further validate this relationship in our empirical setting in Section 3.C.

We measure respondents’ perceived α using six survey questions designed to gauge the extent to which they believe that the gains achieved by an individual or group come at the expense of others. Each question presents respondents with two contrasting statements, asking how much they agree with one over the other. For example, *In Kananga, people only make money when others*

¹⁷Demotivating beliefs are shaped through a dynamic process driven by α , and individuals’ (mis)perceptions of α do not influence this process.

lose money, versus *In Kananga, no one needs to lose money for others to make money*. All six statement pairs are reported in Table 1.

After being told the two statements, respondents then chose one of the following options: “agree strongly with statement 1,” “agree with statement 1,” “agree with statement 2,” or “agree strongly with statement 2.” For each question, we assign a score ranging from 1–4, increasing with the extent to which the response reflects a zero-sum belief. We then apply principal component analysis (PCA) to construct an index of zero-sumness based on the first principal component, which explains 35% of the variance in the 200-person sample and 36% in the 1,000-person sample.

Table 1 reports the estimated weights for the first principal component. In both samples, all six variables load positively, with similar magnitude (columns 1 and 2). This consistency is informative. Ex-ante, it is unclear whether there exists a generalized perception – or “worldview” as Foster describes it – of zero-sumness that applies equally to income, wealth, trade, power, and happiness, and to life in Kananga and in the village. The similar PCA weights suggest a shared zero-sum perspective across these different domains and settings.¹⁸

In the 200-person sample, we included additional zero-sum questions, introducing new scenarios (e.g., farming) and more varied language (e.g., “created” vs. “taking from others”; “exploiting others” vs. “without exploiting”; “helps people” vs. “hurts people”). We then constructed an additional measure of zero-sum views by incorporating these four questions. The PCA estimates for this extended measure are shown in column 3 of Table 1. The variables generally load as expected.¹⁹ Our measure of zero-sum is very similar whether we use six or ten questions. Their correlation coefficient is 0.98. All of the findings we report using our baseline six-question zero-sum index are similar if we instead use the ten-question index.

C. Validating the Zero-Sum Indices

Although it is reassuring that our zero-sum survey questions, covering various outcomes (happiness, power, gains from trade, income, wealth, crop yields) and actors (individuals/people,

¹⁸It may seem surprising that happiness is viewed as zero-sum, given that, in principle, everyone can be happy. However, if happiness is determined primarily by prestige, power, income, and/or wealth – which are perceived as zero-sum – then it is natural that happiness will be perceived as being zero-sum.

¹⁹The factor loadings are close to zero for the wealth-related questions that use the phrases “created” versus “taking from others” and “exploiting others.” This suggests that, consistent with Foster, respondents do not perceive individual wealth as literally being stolen. Instead, they view the system as having “limited good.”

Table 1: Principal Component Analysis for Zero-Sum Indices

Zero-sum survey questions	(1) 6 question index (200 sample)	(2) 6 question index (1,000 sample)	(3) 10 question index (200 sample)
1. In Kananga, people only make money when others lose money	0.467	0.469	0.434
2. In Kananga, no one needs to lose money for others to make money			
1. In Kananga, businesses only make money when others lose money	0.400	0.471	0.381
2. In Kananga, no one needs to lose money for businesses to make money			
1. If one person in a village gets very wealthy, other people in the village will become poorer	0.320	0.378	0.306
2. If one person in a village gets very wealthy, other people in the village will not necessarily become poorer			
1. In trade, if one party gains, the other party loses	0.325	0.413	0.289
2. In trade, it is possible for both parties to gain at the same time			
1. A person can only gain power by taking it away from others	0.453	0.362	0.451
2. A person can gain power without taking it away from others			
1. Gaining happiness requires taking it away from others	0.456	0.336	0.436
2. It is possible for everyone to be happy			
1. If one farmer has a very large crop, his neighbor is likely to also have a very large crop			0.277
2. If one farmer has a very large crop, his neighbor is likely to have a small crop			
1. The success of the wealthy generally helps other people in the community			0.127
2. The success of the wealthy generally hurts other people in the community			
1. Most wealth is created without exploiting others			0.049
2. Most wealth is obtained by exploiting others			
1. Most of the wealth of the rich was created without taking it from others			-0.032
2. Most of the wealth of the rich was obtained by taking it from others			
Eigenvalue	2.067	2.169	2.209
Proportion of variance explained	0.345	0.362	0.221
Observations	205	984	193

Notes: The table reports the estimated factor loadings from three principal component analyses. Each set of estimates is reported in one column, with the eigenvalue of the first principal component reported in the bottom panel. The questions used in the principal component analyses are respondents' self-reported perceptions of how zero-sum the world is, and respondents choose from one of four options: "agree strongly with statement 1," "agree with statement 1," "agree with statement 2," and "agree strongly with statement 2." Columns 1 and 2 report the factor loadings from the first principal component using the set of six survey questions with the 200-person and 1,000-person samples, respectively. Column 3 reports the factor loadings of the first principal component using the set of 10 questions for the 200-person sample. Where needed, the question is reverse coded to make the variable increasing in zero-sum perceptions.

trading parties, villagers, farmers, citizens in Kananga, and businesses in Kananga) are correlated, we conduct additional tests to validate the link between perceived and actual zero-sumness.

First, we compare the distribution of zero-sum perceptions across the two surveys. Given the unprecedented inflow of foreign aid before the 2019 survey, we expect that period to be perceived as less zero-sum than 2015. For residents of Kananga, the aid may have been seen as "enlarging the pie," enabling gains for many, which mirrors Foster's notion of "treasure" – a non-zero-sum resource, where one person's gain does not come at another's expense. Consistent with this, we observe a substantial shift in the distribution of zero-sum perceptions in 2019. The distribution becomes very right-skewed, and the mean falls to 0.158 (from 0.371 in 2015).²⁰

Second, we compare our survey measures to a revealed measure of zero-sum views. In the 200-person sample, respondents were presented with vignettes paired with illustrations to enhance comprehension.²¹ In one scenario, shown in Figure E1a, respondents were asked about two

²⁰While the means differ, the standard deviations are fairly similar, although slightly higher in 2019. This is consistent with heterogeneous exposure to aid, which did not reach all residents equally, generating more variation in perceived zero-sumness.

²¹See Appendix S.III for the full text of the vignettes.

women, Kapinga and Tshilomba, who sell bananas. On day 1, Kapinga sells 10 bananas, and Tshilomba sells 20. On day 2, Kapinga sells 20 bananas. Respondents were then asked how many bananas they thought Tshilomba sold on day 2, with options of 10 or 40. If respondents perceived sales as zero-sum, they would likely assume Tshilomba sold 10 bananas. If they believed that sales were not zero-sum, they might expect Tshilomba's sales to also double, meaning she sold 40 bananas. A second vignette, shown in Figure E1b, presents an analogous scenario with two farmers growing maize. The responses to these vignettes align well with the zero-sum indices: respondents who chose the zero-sum response had significantly higher scores on the six-question index (Figures E1c and E1d) and the ten-question index (Figures E1e and E1f).

Third, we examine the relationship between zero-sum perceptions and factors that are likely to influence the actual zero-sum nature of the environment. In the 200-person survey, we collected data on the employment history of respondents and their families. We measure whether the respondent had paid employment at the time of the survey and whether each parent had employment for most of their lifetime. We find that employment is negatively associated with the zero-sumness of a respondent's environment (Table C1, columns 1–6).²² We also explore robustness of these patterns to the use of alternative measures that capture recent employment; namely, whether the respondent got a new job (i.e., paid employment) in the past five years or whether any member of the nuclear family had a job in the past five years. We find that these are also negatively associated with zero-sum perceptions (columns 7–10). Thus, our constructed zero-sum index appears correlated with the actual zero-sumness of a respondent's environment.

D. Estimating Equations and Regression Estimates

We now empirically examine Proposition 4, the relationship between the zero-sum index and demotivating beliefs, specifically envy and witchcraft.

In our model, we do not specify the definition of a group. Since our samples comprise 200 or 1,000 people drawn from a total population of 1.6 million, we assume that each observation is drawn from a different group in the city. This assumption aligns with the rich variation we observe in individuals' perceptions of the zero-sumness of the world. We estimate the following

²²Parents' employment was constructed by asking about their "main occupation" (What is/was the main occupation of your [father/mother]?). We construct a paid employment indicator variable that equals one if an occupation is reported and zero if "unemployed" was chosen.

individual-level equation:

$$y_i = \alpha_{e(i)} + \beta \text{ZeroSum}_i + \mathbf{X}_i \boldsymbol{\Omega} + \epsilon_i, \quad (8)$$

where i indexes individuals. The dependent variable y_i captures one of our demotivating beliefs of interest, either envy or indigenous religious beliefs. The term $\alpha_{e(i)}$ denotes ethnicity fixed effects. The vector $\mathbf{X}_i$ includes demographic controls for age, age squared, a gender indicator, and its interactions with age and age squared. Our baseline estimates use robust standard errors, while auxiliary estimates allow for various forms of non-independence. As hypothesized by Foster and predicted by our theory, we expect a more zero-sum view of the world to be associated with more envy and stronger indigenous witchcraft beliefs: $\beta > 0$.²³

Table 2 reports the estimates of equation (8) using the 200-person sample (panel A), the 1,000-person sample (panel B), and the pooled sample combining both (panel C).²⁴ Our first outcome is envy, measured as the first principal component of four survey questions.²⁵ The first three questions inquire about feelings of frustration when people succeed easily, resentment towards a neighbor's success, and feelings of injustice towards those perceived as highly talented. The fourth question asks whether the respondent sometimes wishes that rich and powerful people would lose their advantage.²⁶

We find a positive and statistically significant relationship between zero-sum perceptions and envy in both samples, with or without ethnicity fixed effects (columns 1 and 2). The magnitudes are also meaningful. Since both variables are measured in indices without natural units, we interpret effect sizes using a one-standard-deviation increase in the zero-sum index. In the 200-person sample, this yields $0.191 \times 0.333 = 0.064$, which is 20.2% of the mean ($0.064/0.317$) and 33.0% of the standard deviation ($0.064/0.194$). In the 1,000-person sample, the effect is $0.189 \times 0.156 = 0.029$, equal to 19.1% of the mean ($0.029/0.152$) and 19.1% of the standard deviation ($0.029/0.152$). While sizable in both samples, the estimated effects are smaller in the 2019 data, a pattern that holds across specifications. This is consistent with our expectation.

²³The estimating equation assumes that any potential effects of σ from the model can be relegated to the regression residuals. We examine the empirical validity of this assumption below.

²⁴As we report in Table E8, the relationship between zero-sum perceptions and envy, beliefs in witchcraft, and beliefs in Christianity are of similar magnitude and significance when we use the ten-question zero-sum index, introduced in Section 3.B, which can be constructed for the 200-person sample.

²⁵The precise wording of each question is provided in Appendix S.I, with factor loadings for the first principal component reported in Table E4.

²⁶These variables capture respondents' feelings of envy rather than their belief about others' envy. We operate on the premise that a primary determinant of belief about others' behavior is one's own behavior. Therefore, we use respondents' feelings of envy as a proxy for their perceptions of others' envy.

The evolutionary model generates predictions based on long-run differences in environmental zero-sumness. By contrast, the 2019 aid surge was temporary and likely distributed in ways that were idiosyncratic and uncorrelated with the underlying structure of the environment. As a result, classical measurement error in the key independent variable may attenuate the observed relationship.

We next examine the relationship between zero-sum perceptions and traditional religious beliefs. The outcome in columns 3 and 4 is the intensity of witchcraft beliefs, measured as the first principal component of four questions assessing belief in traditional religion, frequency of prayer to ancestors, participation in ancestor rituals, and feelings of closeness to non-Christians in Kananga.²⁷ Consistent with Proposition 4, we find a strong positive relationship between zero-sum perceptions and witchcraft beliefs in the 200-person sample. Again, we find a weaker association in the 1,000-person sample. The estimate is much smaller in magnitude and is statistically insignificant.

An implication of Proposition 4 is that belief systems imposing less psychological tax on effort and success (i.e., low θ) should have a weaker hold in more zero-sum environments (i.e., high α). One such belief system is Christianity, which has gained prominence in recent decades across Africa, challenging yet coexisting alongside traditional religious beliefs (White, Muthukrishna and Norenzayan, 2021). Unlike traditional religions, Christianity teaches that everyone with faith can receive blessings from God (Norenzayan, 2013).²⁸ Moreover, many denominations promote versions of the gospel that encourage hard work and economic ambition (Ranger, 2008, Freeman, 2012). Interestingly, the link between zero-sum perceptions and Christianity is also found in Foster's account of Tzintzuntzan, where favors granted by saints were an accepted source of income that did not generate envy (Foster, 1965, p. 307). We, therefore, expect a negative relationship between zero-sum perceptions and the strength of Christian beliefs. Our survey included questions about the strength of belief in the Christian God, prayer frequency,

²⁷See Appendix S.I for the wording of the questions and Table E5 for the principal component factor loadings.

²⁸We empirically validate this using two survey questions about the perception that blessings from "one's ancestors" and "God" are limited (see Appendix S.II for the exact wording of each question). We find that respondents were twice as likely to strongly agree that blessings are not limited when asked about "God" rather than "ancestors." The results align with qualitative evidence from focus groups, where gains from witchcraft were often described as limited, coming at the expense of someone, and likely to induce envy. In contrast, blessings from God were generally described as resulting from individual devotion and God's grace, which is abundant, does not come at the expense of others, and is less likely to induce envy.

Table 2: Zero-Sum Perceptions, Envy, and Witchcraft in the DRC

	Dependent Variable: Principal-Component Based Measures of:							
	Envy of Others' Success		Witchcraft Beliefs		Christianity Beliefs		Difference Between Witchcraft & Christianity	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: 200 Person Sample (2015)								
Zero-sum index, 0-1	0.333*** (0.064)	0.345*** (0.077)	0.320*** (0.093)	0.273*** (0.091)	-0.146** (0.064)	-0.143** (0.067)	0.466*** (0.123)	0.416*** (0.123)
Mean dependent variable	0.317	0.317	0.223	0.223	0.750	0.750	-0.527	-0.527
Std. dev. dependent variable	0.194	0.194	0.264	0.264	0.192	0.192	0.385	0.385
Mean independent variable	0.371	0.371	0.373	0.373	0.373	0.373	0.373	0.373
Std. dev. independent variable	0.191	0.191	0.189	0.189	0.189	0.189	0.189	0.189
Observations	204	204	197	197	197	197	197	197
R squared	0.118	0.166	0.073	0.128	0.062	0.118	0.078	0.148
Panel B: 1,000 Person Sample (2019)								
Zero-sum index, 0-1	0.156*** (0.025)	0.154*** (0.026)	0.035 (0.027)	0.035 (0.027)	-0.051*** (0.016)	-0.051*** (0.016)	0.086*** (0.033)	0.087*** (0.033)
Mean dependent variable	0.152	0.152	0.020	0.020	0.871	0.871	-0.851	-0.851
Std. dev. dependent variable	0.152	0.152	0.108	0.108	0.109	0.109	0.171	0.171
Mean independent variable	0.158	0.158	0.158	0.158	0.158	0.158	0.158	0.158
Std. dev. independent variable	0.189	0.189	0.189	0.189	0.189	0.189	0.189	0.189
Observations	984	984	984	984	984	984	984	984
R squared	0.049	0.055	0.025	0.029	0.009	0.017	0.019	0.025
Panel C: Pooled Sample with Survey-Wave FE								
Zero-sum index, 0-1	0.188*** (0.024)	0.184*** (0.025)	0.085*** (0.026)	0.080*** (0.026)	-0.066*** (0.017)	-0.066*** (0.017)	0.151*** (0.034)	0.146*** (0.034)
Mean dependent variable	0.181	0.181	0.054	0.054	0.851	0.851	-0.797	-0.797
Std. dev. dependent variable	0.172	0.172	0.165	0.165	0.135	0.135	0.252	0.252
Mean independent variable	0.194	0.194	0.194	0.194	0.194	0.194	0.194	0.194
Std. dev. independent variable	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205
Observations	1,188	1,188	1,181	1,181	1,181	1,181	1,181	1,181
R squared	0.180	0.188	0.232	0.249	0.126	0.137	0.251	0.267
Demographic Controls	Y	Y	Y	Y	Y	Y	Y	Y
Ethnicity FE	N	Y	N	Y	N	Y	N	Y

Notes: This table examines the relationship between zero-sum views and an individual's self-reported envy of others, beliefs in witchcraft, and beliefs in Christianity, for the sample of about 200 respondents collected in 2015 in Kananga, DRC (panel A), the sample of about 1,000 respondents collected in 2019 in Kananga, DRC (panel B), and the pooled sample with survey-wave fixed effects (panel C). It reports OLS estimates of equation (8). In all columns, the explanatory variable is the first principal component of the six zero-sum statements. In columns 1 and 2, the dependent variables are the first principal component of the four survey questions measuring self-reported envy of others' success. The first three questions ask about experiencing frustration when people succeed in life easily, resentment when neighbors are successful, or feelings of injustice when some people seem to have all the talents. The fourth question asks if the respondent sometimes wishes that rich and powerful people lose their advantage. In columns 3 and 4, the dependent variables are the principal-component-based measure of beliefs in witchcraft using four survey questions that ask about the strength of belief in traditional religion, frequency of prayer to ancestors, frequency of participation in rituals devoted to ancestors, and how close they feel to non-Christians who live in Kananga. In columns 5 and 6, the dependent variables are the principal-component-based measure of beliefs in Christianity using four survey questions that ask about the strength of one's belief in the Christian God, frequency of prayer, frequency of attending church, and how close the respondent feels to Christians who live in Kananga. In columns 7 and 8, the dependent variables are the difference in the principal-component-based measure of beliefs in witchcraft and Christianity. All principal-component-based measures are normalized to fall between 0 and 1. We include controls for age, age squared, a gender indicator, and its interactions with age and age squared in all columns. Even columns also include ethnicity fixed effects. Coefficients are reported with robust standard errors in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent levels.

church attendance, and feelings of closeness to Christians in Kananga.²⁹ In both samples, a more zero-sum view of the world correlates negatively with Christian beliefs (columns 5 and 6). Since most individuals in this setting tend to hold Christian and traditional beliefs simultaneously, we also examine the relative strength of such beliefs, measured as the strength of witchcraft beliefs minus the strength of Christian beliefs. We find that zero-sum perceptions are associated with a stronger belief in witchcraft relative to Christianity (columns 7 and 8).

Finally, we examine the extent to which one views religious benefits as being zero-sum, holding the religion constant. This is particularly relevant for Christianity, which tends to view blessings from God as being available to all. We estimate a variant of equation (8) where the outcome is the extent to which blessings are perceived as zero-sum either within Christianity (from God) or within traditional religion (from ancestors).³⁰ We find that the zero-sum index is positively associated with a more zero-sum view of blessings, particularly within Christianity (Table D1).

Robustness and Sensitivity Checks

As a robustness check, we calculate clustered standard errors assuming that the group k varies across the intersection of neighborhoods and ethnicities (i.e., different ethnic groups in different neighborhoods face varying levels of zero-sumness); neighborhood and gender (i.e., different genders in different neighborhoods encounter distinct environments); and neighborhoods only (i.e., different individuals in different neighborhoods face different environments). We also produce randomization inference p -values, which do not assume any specific error structure. These alternative approaches, summarized in Table E7, lead to very similar standard errors compared to our baseline (Table 2).

We also test the assumption that relegating the effect of σ to the regression residuals does not bias our estimates. To measure the extent of assortativity (σ), we use the degree of homophily in each respondent's social network. In our 1,000-person survey, we ask respondents to list individuals they would go to (or who would come to them) in nine different situations, collecting information about their links to these individuals. We then create five variables that measure the fraction of connections listed that are for someone in the respondent's: (1) nuclear family, (2) extended family, (3) church, (4) tribe, and (5) religion. We create an aggregate measure of

²⁹The survey questions and variable construction mimic those about traditional religious beliefs (i.e., witchcraft) and are reported in Appendix S.I. The factor loadings are reported in Table E6.

³⁰Full details are provided in Appendix D.I.

homophily using the first principal component of the five measures.³¹ We also create a second similar measure that uses the first principal component using the five variables, but measured as the share of people (rather than connections) listed in each category. Using either measure, we find that controlling for σ does not influence our estimated coefficients for zero-sum perceptions (Table E10). The point estimates and statistical significance remain very similar.

Lastly, we also check how similar our estimates are when only one of the six zero-sum measures is used. Estimates, reported in Table E11 for the pooled sample, show that in general, we come to the same conclusion if any one zero-sum measure is used. The one exception is the question that asks about trade, where the estimates for the religion outcomes become underpowered. This may reflect the fact that most respondents in the sample may have limited familiarity with trade.

E. Experimental Evidence: Effects of a Zero-Sum Environment on Spiteful Behavior

To this point, our analysis has been purely correlational. We have presumed that the association between the zero-sumness of a respondent's environment and their demotivating beliefs reflects the causal relationship. In this subsection, we study a lab experiment manipulating the zero-sumness of each participant's environment, which allows us to observe the causal effects of zero-sumness on envy and spiteful behavior.

Using a sampling frame of participants from an ongoing study in Kananga, we invited a stratified random sample of 128 individuals in Kananga to make two visits to an experimental lab and participate in the following activities.³² Participants were randomly assigned to groups of eight. Each group visited the lab twice. During each visit, in random order, they participated in one of two treatments, which differed in how initial endowments were allocated. The order of the treatments was randomly assigned.

In the zero-sum treatment, participants took a French test, and their endowment was based on their *relative* ranking within the group. The highest-scoring participant received 15,000 CF, the second-highest received 5,000 CF, and the remaining participants received 1,000 CF. Thus,

³¹Details about the survey questions are provided in Appendix S.IV, and the factor loadings for the first principal component are reported in Table E9.

³²Specifically, we first restricted the sampling frame from Bergeron, Davoine, Granato, Ngoma, Robinson and Weigel (2025) to respondents who were under age 80 and had at least one valid phone number, dropping observations with missing age, sex, or education. From this eligible pool, we drew a stratified random sample of 128 individuals, allocating 64 women and 64 men proportionally across strata defined by education level and age quintiles (education $\times$ age strata).

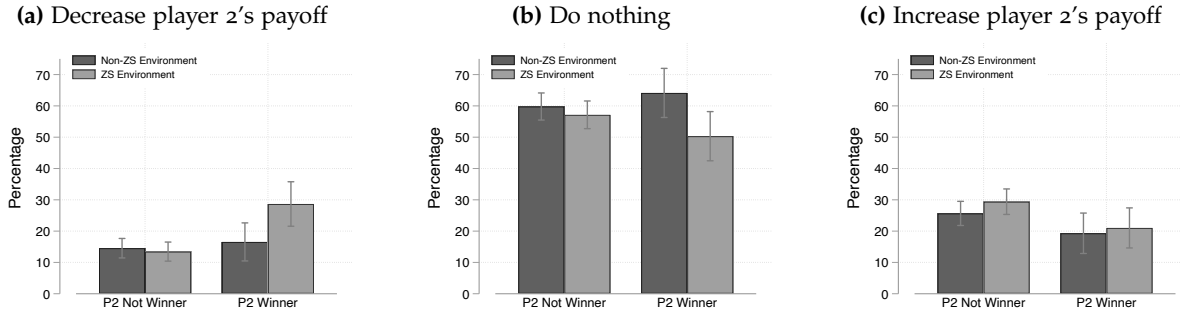
endowments were zero-sum: only one participant could obtain each of the large endowments. In the non-zero-sum treatment, endowments were determined by drawing marbles from a basket *with replacement*. The basket contained 6 grey marbles worth 1,000 CF, one black marble worth 5,000 CF, and one red marble worth 15,000 CF, giving all participants an equal ex-ante probability of winning, independent of others' outcomes. In this arm, endowments were not zero-sum. One participant's winning did not affect the likelihood of others winning, and all participants could obtain the large endowments. The distribution of marbles was chosen to balance the share of winners (and average endowments) across the two treatment arms.

A shortcoming of the experiment is that earnings in the zero-sum arm are based on effort, while in the non-zero-sum arm, they are based on luck, a difference that should be kept in mind when interpreting the results. An alternative design would be to select marbles in both cases – either with replacement (non-zero-sum) or without (zero-sum). However, this would diverge from Foster's theory, in which the image of limited good applies to *effortful* tasks but not necessarily to chance-based ones. As noted, Foster argued that "treasure" lies outside the zero-sum framework. If one person discovers treasure, it does not negatively impact others. Thus, our priors were that selecting marbles without replacement would also be viewed as a non-zero-sum environment because it is a chance event that does not involve personal effort. By contrast, the zero-sum arm aligns closely with Foster's notion of the "image of limited good" because it involves effort that shapes one's payoffs and those of others.

To measure behavior related to envy and spite, we administered the Joy of Destruction (JOD) game. The game was designed to measure individuals' willingness to harm others at a personal cost (Zizzo and Oswald, 2001). Each player went one at a time into a room with an enumerator and played several rounds of the game. In each round, participants received 1,000 CF and an envelope containing a form to mark their decision on and a photo of the other player. When the enumerator left the room, the participant chose among three options: (i) do nothing, (ii) pay 100 CF to *increase* the payoff of the other player by 500 CF, or (iii) pay 100 CF to *decrease* the payoff of the other player by 500 CF. Participants played the game in a random order against five randomly selected other players from the group. This setup allows us to observe whether individuals engage in costly, spiteful actions, particularly against winners with high endowments from the first activity.

While not needed to test the relationship between zero-sum and envy, the "increase" option

Figure 1: The Effect of Zero-Sumness on Spiteful Behavior: Joy of Destruction Game – Raw Data



Notes: The figure reports the proportion of player 1's decisions (decrease, do nothing, increase) as a function of their endowment treatment and whether player 2 was a winner. With 16 groups of 8 individuals who made two visits each, we have a total sample size of 1,280. The x -axis indicates whether player 2 was a winner or not. The bar shading indicates the endowment treatment: i.e., whether the environment was zero-sum or not. Means are reported along with 95% confidence intervals. Data are from the lab experiment conducted in Kananga, DRC in 2025.

is important to have since otherwise the “decrease” option will tend to be chosen by individuals who simply prefer doing something rather than nothing. The symmetric design of the increase/decrease options helps ensure that choices to reduce others' payoffs can be interpreted as reflections of envy or spite. It also allows us to test whether a zero-sum environment affects altruism towards the other player as well.

The experimental results are summarized in Figure 1, which reports the proportion of decisions made of each type (decrease, do nothing, increase) depending on whether player 2 was either a first- or second-place winner in the endowment activity and whether the environment was zero-sum or not. The raw data show a clear pattern: when matched with another player who won, participants were more likely to decrease the other player's payoff in the zero-sum arm but not in the non-zero-sum arm (Figure 1a). The zero-sum endowment activity appears to cause a sizable share of participants to shift from doing nothing to decreasing winners' payoffs.

We also more formally test this relationship with the following equation:

$$\begin{aligned}
 I_{ijt}^{\text{Reduce}} = & \alpha I_{ijt}^{\text{ZeroSum}} + \beta I_{jt}^{\text{Winner}} + \delta I_{ijt}^{\text{ZeroSum}} \times I_{jt}^{\text{Winner}} \\
 & + \gamma I_t^{\text{Visit Round}} + \lambda I_{ij}^{\text{Coethnic}} + \mathbf{X}_i \boldsymbol{\Gamma} + \mathbf{X}_{it} \boldsymbol{\Omega} + \mathbf{X}_j \boldsymbol{\Psi} + \varepsilon_{ijt},
 \end{aligned} \tag{9}$$

where i indexes participants, j their partner in the JOD, and t the round of the visit (1 or 2). I_{ij}^{Reduce} is an indicator that equals 1 if player i (player 1) chose to reduce the payoff of player j (player 2). I_{ijt}^{ZeroSum} indicates whether players i and j were in the zero-sum treatment arm in round t , and I_{jt}^{Winner} indicates whether player j was a “winner” in round t , receiving 15,000 CF or 5,000 CF in the endowment activity. $I_t^{\text{Visit Round}}$ is an indicator that captures the round of the visit (i.e.,

Table 3: The Effect of Zero-Sumness on Spiteful Behavior in the Joy of Destruction Game

	Dependent Variable: Chose to Decrease Player 2's Payoff, 0-1					
	(1)	(2)	(3)	(4)	(5)	(6)
Player 2 is Winner	0.019 (0.035)	0.017 (0.034)	0.024 (0.034)	0.023 (0.033)	0.045 (0.036)	0.043 (0.036)
Player 2 is Winner $\times$ Zero Sum	0.132** (0.052)	0.131** (0.051)	0.135*** (0.051)	0.146*** (0.052)	0.113** (0.053)	0.119** (0.053)
Zero Sum Environment	0.052 (0.075)	0.061 (0.070)	0.055 (0.071)	0.053 (0.071)	0.060 (0.065)	0.055 (0.065)
Mean dependent variable (control)	0.15	0.15	0.15	0.15	0.15	0.15
Observations	1,280	1,280	1,280	1,280	1,280	1,280
Clusters (individuals)	128	128	128	128	128	128
R squared	0.023	0.063	0.072	0.074	0.440	0.441
Visit Round FE	Y	Y	Y	Y	Y	Y
Coethnic FE	Y	Y	Y	Y	Y	Y
Player 1 Endowment Amount FE	Y	Y	Y	Y	Y	Y
Player 1 Endowment Amount FE $\times$ Zero Sum	Y	Y	Y	Y	Y	Y
Player 1 Controls	N	Y	Y	Y	N	N
Player 2 Controls	N	N	Y	Y	Y	Y
Player 2 Controls $\times$ Zero Sum	N	N	N	Y	N	Y
Player 1 FE	N	N	N	N	Y	Y

Notes: This table examines how random variation in the zero-sumness of the endowment creation activity shapes spiteful action in the “joy of destruction” game. The table reports OLS estimates of equation (9). An observation is a participant’s decision in the game. In all columns, the dependent variable is an indicator variable that equals one if the participant chose to reduce the payoff of the other player by 500 CF at a cost of 100 CF. The explanatory variables are indicator variables for (i) whether player 2 was a winner in the endowment activity (i.e., received 15,000 or 5,000 CF), (ii) whether the endowment activity was zero-sum, and (iii) the interaction of the two. In all columns, we include visit-round fixed effects (since participants came to the lab twice), coethnic fixed effects (using participants’ territory of origin as a proxy for their ethnicity), player 1 endowment fixed effects, and player 1 endowment fixed effects interacted with treatment arm. Player controls include gender, age, age squared, education, and an indicator for having a salaried job. ‘Mean dependent variable (control)’ is the mean of the outcome variable for all decisions in the non-zero-sum treatment arm. Standard errors are clustered at the player 1 level. ***, **, and * indicate significance at the 1, 5, and 10 percent levels.

first or second). All respondents visit twice with the same group and which round features the zero-sum treatment arm is randomized. I_{ij}^{Coethnic} is an indicator that equals one if the two players belong to the same ethnic group. The vector $\mathbf{X}_{it}$ comprises fixed effects for the amount won by player i in the round’s endowment activity interacted with an indicator that equals one if that round’s endowment activity was zero-sum.³³ The vector $\mathbf{X}_i$ contains gender, age, age squared, education, and an indicator for having a salaried job, and $\mathbf{X}_j$ includes similar covariates of player 2: gender, age, age squared, education, and an indicator for having a salaried job. Our coefficient of interest is δ , which reflects whether winners are targeted more with spiteful behavior when the environment is zero-sum.

OLS estimates of equation (9) are presented in Table 3. We find that, in the non-zero-sum environment, participants were not more likely to reduce the payoff of winners. However, in the zero-sum environment, participants reduced the payoff of winners significantly more often, even though they incurred a personal cost by doing so. According to the column 1 estimates,

³³Fixed effects for the amount and manner of winnings for player i are motivated by the fact that the amount and manner in which player i received their endowment might affect their subsequent behavior (e.g., Cherry, Frykblom and Shogren, 2002).

participants were 13.2% more likely to decrease the payoff of winners when the environment was zero-sum (rather than non-zero-sum). This is a sizeable effect, especially relative to a baseline mean of 15% for all decisions in the non-zero-sum treatment arm.

The estimates are similar when we also include controls for player 1 characteristics (column 2), player 2 characteristics (column 3), and the interaction between player 2 characteristics and a zero-sum treatment indicator (column 4). Accounting for player 2's characteristics is important because winning a French test could signal status, creating another potential motivation to reduce player 2's payoff (beyond their zero-sum gain in the endowment activity). Reassuringly, when we control for player 2's characteristics, which include their education and employment status, the coefficient for the interaction term of interest remains significant and increases slightly in magnitude. This remains true when we allow the characteristics to differ by zero-sum treatment. Lastly, since participants visited the lab twice, each time with a different endowment activity (zero-sum or not), our most demanding specification includes participant (i.e., player 1) fixed effects. The magnitude of the effect remains sizable and statistically significant, without or with player 2 characteristics interacted with the zero-sum indicator (columns 5 and 6).

We also check the sensitivity of the findings to considering all three choices simultaneously (increase, reduce, do nothing) using a multinomial logit model. The estimates show that, consistent with the OLS estimates, a zero-sum environment significantly increases the likelihood participants reduce the payoff of winners (Table E1).

In all, the experimental results show patterns that are consistent with a zero-sum environment triggering envy and spiteful behavior toward those who succeed. This is consistent with Proposition 4 of the model, which predicts a positive relationship between the zero-sumness of an environment and the presence of demotivating beliefs. Although this lab experiment is by no means perfect — it is admittedly artificial, and there are other differences between the endowment activities aside from the degree of zero-sumness — it nonetheless provides the first causal estimates of how a zero-sum environment can shape envy and spite.

F. Zero-Sum Perceptions and Material Welfare

The model predicts that a more zero-sum environment, and the resulting stronger demotivating beliefs, will be associated with lower material welfare (Propositions 5 and 7). Testing these relationships in the DRC is challenging since measured material welfare exhibits little variation.

This is because most of the sample lives close to subsistence, do not earn a formal wage, and when they do, employment is temporary and highly variable. With these caveats, for completeness, we construct a proxy of material welfare using measures of employment, self-reported relative wealth, and educational attainment.³⁴ The logic of this index is that the subjective wealth and education measures help capture longer-run dimensions of material welfare given the idiosyncratic nature of employment.

The index is created using the first principal component, which loads positively (with similar weights) on all three variables (Table E2). Consistent with Proposition 5, we observe a negative relationship between zero-sum perceptions and material welfare (Table 4, panel A). Consistent with Proposition 7, there are negative relationships between envy or witchcraft beliefs and material welfare (panels B and C). The estimates of some relationships are slightly underpowered, but all are consistent with the predicted negative relationship between zero-sum perceptions or demotivating beliefs and material welfare.³⁵

4. Global Evidence from the Integrated Values Surveys

The DRC samples allow us to empirically validate Propositions 4–7, which concern the relationships between the zero-sumness of the environment, demotivating beliefs, and material welfare in a pre-industrial society comparable to the one Foster studied. However, because of the limited cross-society variation, we could not test Propositions 2 and 3, which require analyzing subsets of observations that face the same zero-sumness of their environment and testing for a non-linear relationship between demotivating beliefs and material welfare and a monotonic relationship between subjective well-being. We now turn to the global analysis which has sufficient data to test all propositions. It also allows us to ask whether Foster’s insights hold more generally and not only in small-scale pre-industrial societies.

³⁴The employment question directly asks the respondent if they “currently have a job, of any kind, for which you earn money.” The perceived relative wealth variable comprises integer values from 1 to 5 (i.e., quintiles in the wealth distribution). Respondents are shown a visual aid that illustrates the steps and asked “Imagine 5 steps, where on the bottom, the first step, stand the poorest people, and on the highest step, the fifth step, stand the richest. Which step are you on today?” The educational attainment variable takes a value of 0 if the respondent never attended school, 1 if they attended kindergarten, 2 if they attended primary school, 3 if they attended secondary school, and 4 if they attended university.

³⁵Estimates using each component of the index separately reveal that the signs of nearly all estimates are as expected, although precision decreases slightly (Table E3).

Table 4: Zero-Sum Perceptions, Demotivating Beliefs, and Material Welfare in the DRC

	Dependent Variable: Principal Component-Based Measure of: Education, Employment, and Perceived Relative Wealth					
	200 Person Sample (2015)		1,000 Person Sample (2019)		Pooled Sample with Survey-Wave FE	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Zero-Sum Thinking						
Zero-sum Index, 0-1	-0.042 (0.058)	-0.047 (0.062)	-0.056* (0.029)	-0.047 (0.029)	-0.053** (0.026)	-0.050* (0.026)
Mean independent variable	0.372	0.372	0.158	0.158	0.195	0.195
Std. dev. independent variable	0.191	0.191	0.189	0.189	0.206	0.206
Mean dependent variable	0.607	0.607	0.546	0.546	0.557	0.557
Std. dev. dependent variable	0.173	0.173	0.168	0.168	0.170	0.170
Observations	205	205	984	984	1,189	1,189
R squared	0.197	0.231	0.098	0.132	0.125	0.145
Panel B: Envy						
Envy of others' success, 0-1	-0.130** (0.056)	-0.143** (0.057)	-0.176*** (0.034)	-0.160*** (0.034)	-0.165*** (0.029)	-0.153*** (0.029)
Mean independent variable	0.315	0.315	0.158	0.158	0.187	0.187
Std. dev. independent variable	0.193	0.193	0.156	0.156	0.174	0.174
Mean dependent variable	0.606	0.606	0.546	0.546	0.557	0.557
Std. dev. dependent variable	0.172	0.172	0.167	0.167	0.170	0.170
Observations	224	224	1,019	1,019	1,243	1,243
R squared	0.236	0.272	0.117	0.148	0.146	0.164
Panel C: Witchcraft						
Witchcraft beliefs, 0-1	-0.188*** (0.040)	-0.203*** (0.041)	-0.050 (0.050)	-0.043 (0.051)	-0.121*** (0.033)	-0.117*** (0.034)
Mean independent variable	0.217	0.217	0.020	0.020	0.054	0.054
Std. dev. independent variable	0.255	0.255	0.107	0.107	0.162	0.162
Mean dependent variable	0.607	0.607	0.546	0.546	0.556	0.556
Std. dev. dependent variable	0.174	0.174	0.167	0.167	0.170	0.170
Observations	217	217	1,019	1,019	1,236	1,236
R squared	0.284	0.319	0.091	0.127	0.131	0.151
Demographic Controls	Y	Y	Y	Y	Y	Y
Ethnicity FE	N	Y	N	Y	N	Y

Notes: This table examines the relationship between zero-sum views, envy of others, witchcraft beliefs, and material welfare in two samples in Kananga, DRC. The dependent variable is the first principal component of education, employment, and perceived relative wealth relative to others in Kananga. In Panel A, the explanatory variable is the first principal component of the six zero-sum statements. In Panels B and C, the explanatory variables are the same measures of envy and witchcraft beliefs studied in Table 2. All principal-component-based measures are normalized to fall between 0 and 1. We include controls for age, age squared, gender, and its interactions with age and age squared in all columns and fixed effects for the respondent's ethnicity in even columns. We also include survey-wave fixed effects in columns 5 and 6. Coefficients are reported with robust standard errors in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent levels.

A. Data

We measure the zero-sumness of a person’s environment using a question from the World Values Survey (WVS) and European Values Study (EVS), which has a similar structure to our zero-sum questions from the DRC. Respondents are given two opposing statements, one that is zero-sum – “People can only get rich at the expense of others” – and the other positive-sum – “Wealth can grow so there’s enough for everyone.” The respondents are asked to report their views on a ten-point scale between the two extremes. We normalize the variable to lie between zero and one, and increase in zero-sumness. Across the samples, and for all waves, we see substantial variation in the extent to which individuals view wealth as zero-sum (Figure E2).

We begin by again validating that the measure reflects the true zero-sumness of individuals’ environments. Because economic stagnation results in a fixed pie and a more zero-sum environment, we examine the relationship between respondents’ zero-sum perceptions and the rate of economic growth in a respondent’s country during the first 20 (or 30) years of their life (see Appendix C.II for full details). Conditional on country fixed effects, birth year fixed effects, and demographic controls, lower economic growth is associated with a more zero-sum view of the world (Table C2).

B. Zero-Sum Perceptions and Demotivating Beliefs

We first examine the relationship between zero-sum views and demotivating beliefs that reduce effort, again motivated by Proposition 4 of the model. Demotivating beliefs differ across countries. In some, they might take the form of beliefs in witchcraft or the evil eye. In others, a dislike for greed and individual accumulation or a belief that hard work does not result in success. In industrialized countries, the best proxies for θ are beliefs about the importance of hard work, economic success, and individual achievement, which are available in the IVS.

We estimate the following equation:

$$Y_{ict} = \alpha_{ct} + \beta \text{ZeroSum}_{ict} + \mathbf{X}_{ict}\mathbf{\Gamma} + \varepsilon_{ict}, \quad (10)$$

where i indexes individuals, c country of residence, and t the year of the survey. ZeroSum_{ict} is our measure of zero-sum for individual i . α_{ct} denotes country-by-survey-year fixed effects. Y_{ict} denotes a measure of the strength in which person i holds a particular demotivating belief. The vector $\mathbf{X}_{ict}$ includes the following individual-level demographic controls: a gender indicator, age,

age squared, and interactions between the gender and age measures. We report standard errors clustered at the country level.

We begin by considering beliefs about whether hard work brings success. Respondents report their answers on a 1-10 integer scale. We reorder and normalize the variable so that zero equals full agreement with “in the long run, hard work usually brings a better life,” and one equals full agreement with “hard work doesn’t generally bring success.”³⁶ The measure thus increases in the belief that hard work does not pay off. Consistent with Proposition 4, zero-sum perceptions are associated with a stronger belief that hard work is unlikely to bring success (Table 5, column 1).

We next look at two related measures that capture respondents’ views of whether low effort explains why some people are poor. The first survey question is: “Why, in your opinion, are there people in this country who live in need?” We create a variable that takes on the value of zero if they choose the answer “because of laziness and lack of willpower,” and the value of one if they choose the answer “because of an unfair society.” The second measure captures views about whether the poor can escape poverty through effort: “In your opinion, do most poor people in this country have a chance of escaping from poverty, or is there very little chance of escaping?” We create a variable that takes on the value of zero if the respondent chooses the answer “They have a chance” and one if they choose “There is very little chance.” Thus, both questions measure the belief that effort and hard work fail to explain economic success. Zero-sum views again correlate with the belief that poverty does not arise from a lack of effort (columns 2 and 3).

We consider three additional demotivating beliefs. The first is the extent to which people get disutility from asking others for money. In a setting where it is shameful to be helped by others, individuals will try their hardest to provide for themselves. The survey question asks respondents if they agree with the statement: “It is humiliating to receive money without having to work for it.” Respondents can choose “strongly agree,” “agree,” “neither,” “disagree,” or “strongly disagree.” We normalize the measure to lie between zero and one and to increase in the respondent’s disagreement with the statement. Again, the more zero-sum view of the world is associated with feeling less humiliation from receiving money (column 4). The last two questions measure the perceived importance of achievement and work. The first question asks whether it is important to be “very successful...to have people recognize one’s achievement.” The second question asks respondents how important work is to them. Respondents choose

³⁶The exact wording of this and all other WVS and EVS variables used in the paper are reported in Appendix S.VII.

Table 5: Zero-Sum Perceptions and Demotivating Beliefs

	Dependent Variable: Demotivating Belief:					
	Hard work brings success, 0 = fully agree to 1 = fully disagree	People are poor because of laziness, 0 = agree or 1 = disagree	People have a chance to escape poverty, 0 = agree or 1 = disagree	Humiliating to receive money without working for it, 0 = strongly agree to 1 = strongly disagree	Important to me to be successful, 0 = very much to 1 = not at all	How important is work, 0 = very important to 1 = not at all
	(1)	(2)	(3)	(4)	(5)	(6)
Zero-sum index, 0-1	0.118*** (0.014)	0.077*** (0.013)	0.121*** (0.014)	0.023** (0.010)	0.024*** (0.005)	0.034*** (0.004)
Mean dependent variable	0.367	0.697	0.602	0.352	0.391	0.163
Std. dev. dependent variable	0.319	0.459	0.489	0.296	0.290	0.247
Mean independent variable	0.404	0.393	0.394	0.406	0.416	0.405
Std. dev. independent variable	0.307	0.317	0.315	0.297	0.305	0.307
Observations	277,798	55,871	59,052	60,856	151,270	273,803
Clusters	99	50	49	47	78	99
R squared	0.117	0.125	0.178	0.096	0.171	0.116
Demographic Controls	Y	Y	Y	Y	Y	Y
Wave-country FE	Y	Y	Y	Y	Y	Y

Notes: The table reports OLS estimates that are relevant for Proposition 4 of the model. Data are from the WVS and EVS. An observation is an individual. All specifications include survey-wave by country fixed effects. The independent variable is a scale variable ranging from zero to one, with one representing “People can only get rich at the expense of others,” and zero representing “Wealth can grow so there’s enough for everyone.” The dependent variables are categorical variables appearing as column heads. Demographic controls include age, age squared, gender, age interacted with gender, and age-squared interacted with gender. Coefficients are reported with standard errors clustered at the level of country in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent levels.

responses ranging from “not at all important” to “very important.” Both measures are coded to be decreasing in the importance placed on achievement and work – i.e., increasing in the extent to which the beliefs are demotivating. The estimates, reported in columns 5 and 6, show that individuals with a more zero-sum worldview hold beliefs that place less importance on their success and their work.

C. Zero-Sum Perceptions, Effort, and Economic Outcomes

We next consider Proposition 5, which predicts that zero-sum environments, by creating demotivating beliefs, will result in less effort and lower material welfare. We consider multiple measures of material welfare. The first is self-reported income on a 1-10 integer scale. The second is the respondent’s self-reported economic class: (1) Lower class; (2) Working class; (3) Lower middle class; (4) Upper middle class; and (5) Upper class. The measure takes on the reported integer values. The third is from a question about the net savings of the respondent’s family. All three measures are normalized to lie between zero and one and to increase in material welfare. Individuals with more zero-sum perceptions also have lower incomes, lower self-reported socioeconomic class, and less savings (Table 6, columns 1–3). Consistent with the model’s prediction, a more zero-sum environment is associated with lower material welfare.

We also examine education, an investment that requires effort but can enhance productivity.

Table 6: Zero-Sum Perceptions and Economic Welfare

	Dependent Variable: Measures of Economic Welfare:					
	Income decile, 0 = bottom decile to 1 = top decile	Class, 0 = lower class to 1 = upper class	Family savings, 0 = borrowed to 1 = saved	Educational attainment, 0 = primary school or less to 1 = university or more	Cognitive vs. manual work tasks, 0 = manual to 1 = cognitive	Supervising someone at work, 0 = no to 1 = yes
	(1)	(2)	(3)	(4)	(5)	(6)
Zero-sum index, 0-1	-0.038*** (0.005)	-0.045*** (0.005)	-0.032*** (0.005)	-0.030*** (0.005)	-0.049*** (0.007)	-0.046*** (0.007)
Mean dependent variable	0.410	0.421	0.625	0.522	0.446	0.327
Std. dev. dependent variable	0.258	0.245	0.309	0.337	0.346	0.469
Mean independent variable	0.403	0.409	0.406	0.405	0.416	0.415
Std. dev. independent variable	0.306	0.307	0.308	0.309	0.301	0.302
Observations	256,944	207,165	203,716	219,524	116,885	119,888
Clusters	99	90	90	91	79	79
R squared	0.163	0.111	0.091	0.175	0.087	0.109
Demographic Controls	Y	Y	Y	Y	Y	Y
Wave-country FE	Y	Y	Y	Y	Y	Y

Notes: The table reports OLS estimates that are relevant for Proposition 5 of the model. Data are from the WVS and EVS. An observation is an individual. All specifications include survey-wave by country fixed effects. The independent variable is a scale variable ranging from zero to one, with one representing "People can only get rich at the expense of others," and zero representing "Wealth can grow so there's enough for everyone." The dependent variables are categorical variables appearing as column heads. Demographic controls include age, age squared, gender, age interacted with gender, and age-squared interacted with gender. Coefficients are reported with standard errors clustered at the level of country in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent levels.

Again, consistent with the model's predictions, respondents who view the world as more zero-sum have lower levels of education (column 4). We also observe a similar negative association with jobs that require investments in human capital accumulation. Stronger zero-sum perceptions are associated with being less likely to be employed in cognitively demanding occupations (column 5) and being less likely to supervise someone at work (column 6).

Finally, we test the prediction from (i) of Proposition 7: that demotivating beliefs should be associated with lower material welfare. Consistent with the prediction, we almost universally find a negative and statistically significant relationship between each of the six measures of demotivating beliefs and measures of material welfare (Tables E12 and E13). More zero-sum environments are associated with stronger demotivating beliefs and with lower material welfare, and stronger demotivating beliefs are associated with lower material welfare.

D. Zero-Sum Perceptions, Demotivating Beliefs, and Happiness

As explained by Proposition 6, the model does not predict a relationship between zero-sum environments and subjective well-being that holds under all conditions. However, if the conditions laid out in the proposition are satisfied, then the relationship is expected to be negative. Turning to the data, we examine two measures of subjective well-being: "happiness" and "life satisfaction." The raw (binscatter) cross-individual relationship between zero-sum beliefs and happiness or life satisfaction, conditional on country-by-survey-wave fixed effects, is reported in Figure E3. We find

Table 7: Zero-Sum Perceptions, Demotivating Beliefs, and Subjective Well-Being

	Measure of demotivating beliefs used:						
	Hard work brings success, 0 = fully agree to 1 = fully disagree	People are poor because of laziness, 0 = agree or 1 = disagree	People have a chance to escape poverty, 0 = agree or 1 = disagree	Humiliating to receive money without working for it, 0 = strongly agree to 1 = strongly disagree	Important to me to be successful, 0 = very much to 1 = not at all	How important is work, 0 = very important to 1 = not at all	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Self-Reported Happiness (0-1) as Dependent Variable							
Zero-sum index, 0-1	-0.051*** (0.004)						
Demotivating belief, θ		-0.047*** (0.004)	-0.045*** (0.004)	-0.043*** (0.004)	-0.022*** (0.003)	-0.045*** (0.004)	-0.046*** (0.005)
Mean dependent variable	0.686	0.693	0.653	0.653	0.687	0.707	0.688
Std. dev. dependent variable	0.247	0.245	0.255	0.254	0.237	0.244	0.243
Mean independent variable	0.404	0.370	0.701	0.599	0.366	0.394	0.169
Std. dev. independent variable	0.307	0.321	0.458	0.490	0.299	0.292	0.251
Observations	276,913	381,232	62,055	64,833	261,518	156,835	610,474
Clusters	99	110	53	51	86	78	116
R squared	0.149	0.138	0.187	0.181	0.122	0.123	0.135
Panel B: Subjective Life Satisfaction (1-10) as Dependent Variable							
Zero-sum index, 0-1	-0.641*** (0.039)						
Demotivating belief, θ		-0.482*** (0.040)	-0.620*** (0.058)	-0.549*** (0.058)	-0.239*** (0.035)	-0.522*** (0.061)	-0.340*** (0.042)
Mean dependent variable	6.706	6.790	6.177	6.205	6.873	6.791	6.805
Std. dev. dependent variable	2.360	2.338	2.626	2.600	2.336	2.278	2.370
Mean independent variable	0.405	0.371	0.705	0.600	0.367	0.395	0.169
Std. dev. independent variable	0.307	0.321	0.456	0.490	0.299	0.292	0.251
Observations	277,456	382,023	60,594	64,415	263,495	157,059	615,058
Clusters	99	110	51	50	86	78	116
R squared	0.172	0.159	0.247	0.242	0.157	0.132	0.163
Demographic Controls	Y	Y	Y	Y	Y	Y	Y
Wave-country FE	Y	Y	Y	Y	Y	Y	Y

Notes: The table reports OLS estimates that are relevant for Propositions 6 and 7 of the model. This is the relationship between zero-sum perceptions or demotivating beliefs and happiness (panel A) or life satisfaction (panel B). Data are from the WVS and EVS. An observation is an individual. In panel A, the dependent variable is happiness, which is measured based on a scale variable reporting respondents' answers to the question "Taking all things together, would you say you are," with zero indicating "Not at all happy" and one indicating "Very happy." In panel B, the dependent variable is life satisfaction, which is measured based on respondents' answers to the question "All things considered, how satisfied are you with your life as a whole these days?," with 1 indicating "Completely dissatisfied" and 10 indicating "Completely satisfied." The independent variables are a scale ranging from zero to one, with one representing "People can only get rich at the expense of others," and zero representing "Wealth can grow so there's enough for everyone" (column 1), and categorical variables, ranging from 0, representing agreement, to 1, indicating disagreement with the sentence – except the sentence "How important is work," where 0 means "very important" and 1 means "not at all" – (columns 2–7). All specifications include country-wave fixed effects and demographic controls (age, age squared, gender, age interacted with gender, and age-squared interacted with gender). The estimates reported use all available data. Table E14 reports estimates but only using observations that have a non-missing zero-sum measure, which is relevant for the estimates of columns 2–7. ***, **, and * indicate significance at the 1, 5, and 10 percent levels.

a negative relationship between viewing the world as zero-sum and reported happiness or life satisfaction. Estimates of equation (10) confirm this negative and significant relationship (Table 7, column 1).

We also explore the relationship between demotivating beliefs and subjective well-being. As outlined in Proposition 7, this relationship is also theoretically ambiguous. However, for a wide range of parameter values and for much of the domain of θ , subjective well-being is predicted to be decreasing in demotivating beliefs. Consistent with this, we find a negative relationship between each of the six measures of demotivating beliefs and both measures of subjective well-being (Table 7, columns 2–7).³⁷

³⁷The reported estimates use all available observations. If one restricts the sample to observations for which we also have the zero-sum measure, the patterns are qualitatively identical (Table E14).

E. Demotivating Beliefs and Economic Outcomes in a Fixed Zero-Sum Setting

While the preceding analysis focused on relationships across groups in environments of varying zero-sumness (α), we now explore the strength of demotivating beliefs, material welfare, and subjective well-being *within a group k* (with a fixed zero-sum environment).

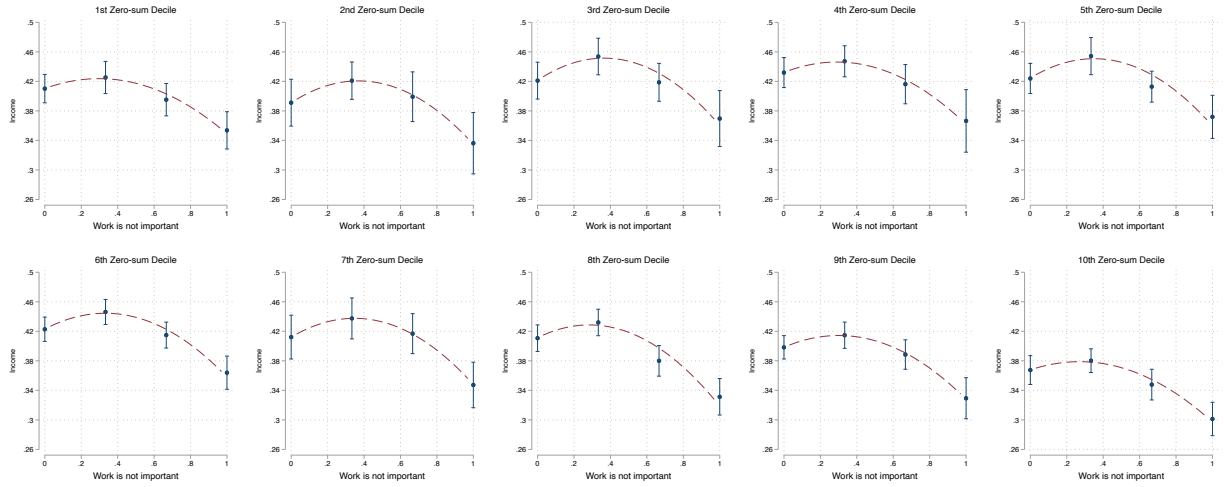
Proposition 2 predicts an optimal strength of demotivating beliefs θ^* within a group k in an environment of zero-sumness α . Material welfare should be hump-shaped in the strength of demotivating beliefs θ . To test this, we divide the sample into deciles based on respondents' perceived zero-sumness. We interpret a decile as being analogous to a group k , with a fixed level of α , in the model. To account for differences in language, gender, and age, we first net out country-wave fixed effects and demographic controls before creating the zero-sum deciles. Within each decile, we examine the relationship between demotivating beliefs and income levels. We report estimates for the two measures of demotivating beliefs with the largest sample and multiple possible responses – i.e., not just agree/disagree – and thus allow us to test for the predicted hump-shaped relationship. The two questions are whether “hard work brings success” ($N = 254,693$) and “how important is work” ($N = 251,018$).

Figures 2 and 3 report the estimated relationships between demotivating beliefs and income. Consistent with Proposition 2, we observe a hump-shaped relationship between demotivating beliefs and material welfare measured by income for virtually all zero-sum deciles. We tend to find similar results when we do not account for demographic controls or country-wave fixed effects before constructing the zero-sum deciles (Figures E4 and E5) and when using alternative measures of demotivating beliefs only available in smaller samples (Figures E6 and E7).³⁸

In contrast to the patterns for material welfare, Proposition 3 predicts that, for a given zero-sumness of the environment α , subjective well-being is maximized at the true (non-demotivating) belief $\theta = 0$ and is strictly convex in demotivating beliefs. Figures E8 and E9 confirm that subjective well-being, measured by happiness, is highest for the least demotivating belief and is generally decreasing in demotivating beliefs. Thus, as predicted by our model, the patterns for subjective well-being do not show the same hump-shaped relationship that we found for material welfare. This remains the case if we measure subjective well-being using life satisfaction (Figures E10 and E11), omit demographic controls or country-wave fixed effects when creating the

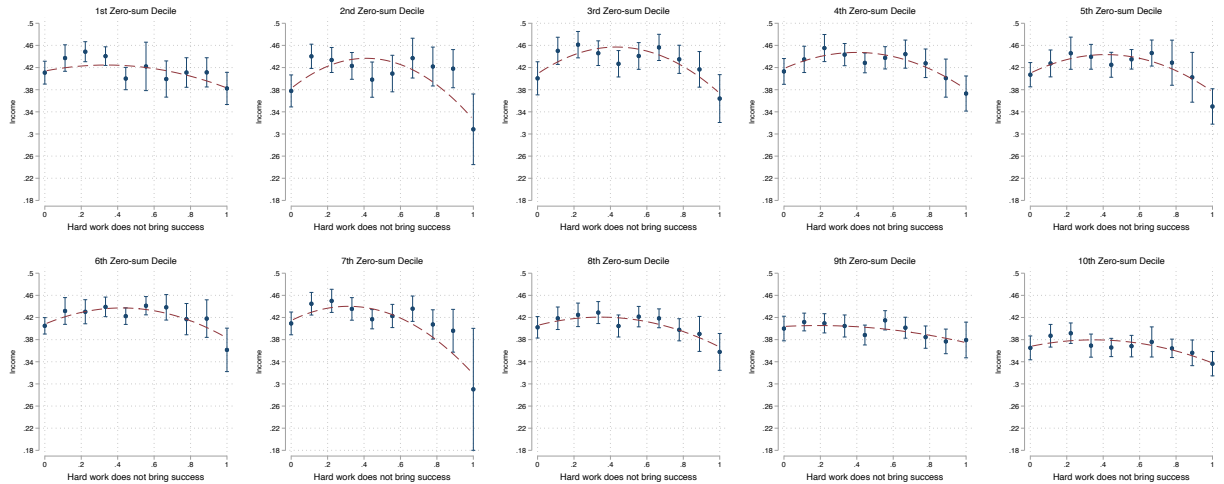
³⁸We do not report the estimates for the two demotivating belief questions “People have a chance to escape poverty” and “People are poor because of laziness” because they only have two possible responses (agree or disagree), which prevents us from testing for a hump-shaped relationship.

Figure 2: Relationship Between Demotivating Belief (Work Is Not Important) and Income – Holding Constant Zero-Sumness



Notes: The figure reports estimated relationships relevant for Proposition 2 of the model. It shows the relationship between respondents' demotivating belief (work is not important) and level of self-reported income (0-1 scale) for each zero-sum decile. Also shown is a fitted quadratic and 95% confidence intervals (based on clustering at the level of country) for each point. Country-wave fixed effects and demographic controls are netted out before creating the zero-sum deciles. Data are from the WVS and EVS. The demotivating belief in this figure is reported based on respondents' answers to the version of the following question that asks about work: "For each of the following, indicate how important it is in your life. Would you say it is," with the options: "1 Very important, 2 Rather important, 3 Not very important, 4 Not at all important." The responses are rescaled to range from zero to one to achieve the demotivating belief used in the figure, "Work is not important" ($N = 251,018$).

Figure 3: Relationship Between Demotivating Belief (Hard Work Does Not Bring Success) and Income – Holding Constant Zero-Sumness



Notes: The figure reports estimated relationships relevant for Proposition 2 of the model. It shows the relationship between respondents' demotivating belief (hard work does not bring success) and level of self-reported income (0-1 scale) for each zero-sum decile. Also shown is a fitted quadratic and 95% confidence intervals (based on clustering at the level of country) for each point. Country-wave fixed effects and demographic controls are netted out before creating the zero-sum deciles. Data are from the WVS and EVS. The demotivating belief in this figure is reported based on how much respondents agree with the statement "In the long run, hard work usually brings a better life" on a scale of one to ten, with one indicating complete agreement with the statement and ten indicating "Hard work doesn't generally bring success – it's more a matter of luck and connections." These responses are rescaled to range from zero to one to achieve the demotivating belief used in the figure, "Hard work does not bring success" ($N = 254,693$).

zero-sum categories (Figures E12 and E13), or use alternative measures of demotivating beliefs (Figures E14 and E15).

5. Conclusions

This paper studied the evolution of demotivating belief systems and their relationship with economic development. In an evolutionary model inspired by Foster's "image of limited good," we showed that demotivating beliefs can spread in environments where economic interactions are zero-sum. We also showed that the effects of zero-sum production are very different within or across populations. Within a population, an intermediate demotivating belief can improve material welfare by reducing excessive competition, but well-being decreases monotonically with demotivating beliefs. Across populations, there is a positive relationship between zero-sumness of the environment and demotivating beliefs, and both negatively affect material welfare and subjective well-being.

We tested these theoretical predictions in the data. In two samples from the Democratic Republic of the Congo, respondents with a more zero-sum view of the world appear to hold stronger demotivating beliefs, including envy of the success of others and witchcraft beliefs that cast success as suspicious. In a lab experiment, we provided causal evidence that a more zero-sum environment causes more spiteful behavior toward more successful participants.

Turning to the global Integrated Values Survey sample, we checked the generality of our findings from the DRC and also tested the model's cross-societal predictions. We found a robust positive relationship between perceived zero-sumness and demotivating beliefs, including skepticism about the return to effort and the value of hard work. Also consistent with the model, we found that zero-sum perceptions and the resulting demotivating beliefs are associated with less happiness and lower life satisfaction. Lastly, we showed evidence of the divergence between material welfare and subjective well-being predicted by the model. When holding the degree of zero-sumness in the environment constant, income is hump-shaped in demotivating beliefs, while happiness is convex in the strength of demotivating beliefs and typically maximized at the (true) non-demotivating belief.

The paper leaves many important questions unanswered regarding the evolution of demotivating belief systems and their interactions with economic development. Under what conditions do zero-sum perceptions over- or under-estimate the true degree of rivalry in the environment? To

what extent was the Great Divergence partly triggered by a cultural shift in Western Europe away from demotivating belief systems that suppressed effort? Has the intensification of economic rivalry and scarcity in the past decade increased the effective zero-sumness of the environment in many countries? If so, does this increase help explain the global increase in populism, nativism, and anti-elite sentiment (Guriev and Papaioannou, 2022), the turn away from meritocracy in the United States (Sandel, 2020), or the rise of incels in dating markets (Brooks, Russo-Batterham and Blake, 2022)? We view these questions as fertile ground for future work.

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