# Cross-Cultural Variation in Cooperation: A Meta-Analysis

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**Abstract**

Impersonal cooperation among strangers enables societies to create valuable public goods, such as infrastructure, public services, and democracy. Several factors have been proposed to explain variation in impersonal cooperation across societies, referring to institutions (e.g., rule of law), religion (e.g., belief in God as a third-party punisher), cultural beliefs (e.g., trust) and values (e.g., collectivism), and ecology (e.g., relational mobility). We tested 17 pre-registered hypotheses in a meta-analysis of 1,506 studies of impersonal cooperation in social dilemmas (e.g., the Public Goods Game) conducted across 70 societies ($k$ = 2,271), where people make costly decisions to cooperate among strangers. After controlling for 10 study characteristics that can affect the outcome of studies, we found very little cross-societal variation in impersonal cooperation. Categorizing societies into cultural groups explained no variance in cooperation. Similarly, cultural, ancestral, and linguistic distance between societies explained little variance in cooperation. None of the cross-societal factors hypothesized to relate to impersonal cooperation explained variance in cooperation across societies. We replicated these conclusions when meta-analyzing 514 studies across 41 states and nine regions in the United States ($k$ = 783). Thus, we observed that impersonal cooperation occurred in all societies – and to a similar degree across societies – suggesting that prior research may have overemphasized the magnitude of differences between modern societies in impersonal cooperation. We discuss the discrepancy between theory, past empirical research and the meta-analysis, address a limitation of experimental research on cooperation to study culture, and raise possible directions for future research.

*Keywords*: Cooperation, Culture, Institutions, Ecology, Meta-Analysis

## Cross-Cultural Variation in Cooperation: A Meta-Analysis

Cooperation among unrelated strangers is an essential feature of well-functioning societies. Many pressing societal challenges, such as conserving resources, preventing climate change, and suppressing the spread of a deadly disease, require individuals to cooperate with each other to address these challenges. Yet, cooperation can be difficult to achieve because individuals often have to transcend their short-term self-interest to engage in a behavior that benefits the collective (Van Lange et al., 2013). Societies seem to differ in the extent to which people cooperate with strangers – that is, impersonal cooperation – to create public goods. For example, societies differ in the degree to which citizens comply with tax regulations, contribute to shared community resources, and participate in politics, which could reflect cross-societal differences in impersonal cooperation (Henrich, Ensminger, et al., 2010). To date, there is no broad consensus about (a) the extent to which there is variation across modern societies in impersonal cooperation and (b) the institutional, cultural, and ecological factors that explain cross-societal variation in impersonal cooperation.

One prominent approach emphasizes the role of institutions, suggesting that societies with more efficient formal institutions, and which encourage interactions beyond kin, should display greater cooperation among strangers (Alesina & Giuliano, 2015; Enke, 2019; Henrich, Ensminger, et al., 2010; Keefer & Knack, 2008; Ostrom, 1990). A second approach suggests that the endorsement of certain beliefs and values shape the generalized expectations about others that can affect impersonal cooperation. Accordingly, more cooperation is expected in societies characterized by higher religiosity, specific cultural values, such as individualistic versus collectivist values, and higher trust (Balliet & Van Lange, 2013a; Norenzayan & Shariff, 2008; Sosis, 2000; Triandis, 1989). A third approach suggests that specific ecologies characterized by higher mobility, a historical independent subsistence style, and fewer historical threats (e.g., pathogens prevalence and environmental hazards) could have

facilitated cooperation among strangers (Fincher & Thornhill, 2012; Talhelm et al., 2014; Thomson et al., 2018).

Although there is extensive literature identifying potential institutional, cultural and ecological factors which may explain differences in cooperation, there is a limited number of studies that have tested these hypotheses across either small-scale societies (e.g., Henrich et al., 2001; Henrich, Ensminger, et al., 2010; Purzycki et al., 2016) or more industrialized societies (e.g., Buchan et al., 2009; Dorrough & Glöckner, 2016; Romano et al., 2021). In fact, much of this research compares cooperation between two societies (e.g., Bram Cadsby et al., 2007; Cason et al., 2002; Parks & Vu, 1994) or a limited number of societies (e.g., up to six, as done in Brandts et al., 2004; Cárdenas et al., 2009; Goerg & Walkowitz, 2010). Moreover, each study uses a very specific cooperation paradigm, and generally focuses solely on one of the three different approaches outlined above (e.g., Gächter & Herrmann, 2009; Herrmann et al., 2008; Romano et al., 2017). These conditions have limited our ability to estimate the extent of cross-societal variability in cooperation and resulted in a lack of comparison and integration of different theoretical approaches.

Fortunately, there is a long history of research on impersonal cooperation. This body of work applies a rigorous standardized set of paradigms to study cooperation, involving social dilemmas like the Prisoner's Dilemma and Public Goods Game (Van Lange et al., 2014). Here, we report a meta-analysis of six decades of studies on impersonal cooperation ($k$ = 2,271) conducted across 70 societies to address the following questions: (1) Is there variation in impersonal cooperation across societies?; (2) Which institutional, cultural, and ecological factors explain cross-societal variation in impersonal cooperation? Besides testing these cross-cultural hypotheses on a global sample, we analyzed variation in cooperation across regions within a single, large and diverse country – the United States. In this approach, some conditions that vary across societies remain constant across all regions in the United States (e.g., language, system of government), which can eliminate confounds when testing

whether variation on specific institutional, cultural, and ecological factors predict cooperation. These analyses included 514 studies conducted across 41 states and nine regions in the United States.

We begin by reviewing key predictions about cross-societal variation in cooperation, and which we test in this meta-analysis. We then present the paradigms that have been used in experiments to study cooperation – and which are included in the meta-analysis. Finally, we present our meta-analytic approach to address our questions.

**Variation in Cooperation Across Societies**

As human societies expanded from small-scale hunter gatherer societies, to large industrial societies, so did opportunities for impersonal cooperation, defined as cooperation between non-genetically related individuals with no shared history, or shadow of the future. Impersonal cooperation became a common feature of large-scale, industrial societies. Yet, impersonal cooperation poses several challenges because much of the information people use to regulate cooperation within small social networks (e.g., other's reputation, past history of interactions, group membership) are not present when making decisions to cooperate (or not). Previous research has indeed found variability in impersonal cooperation across small-scale societies (Henrich et al., 2001; Henrich, Ensminger, et al., 2010) and large-scale industrialized societies (Herrmann et al., 2008), which could indicate that changes in ecologies and cultures over time have shaped impersonal cooperation.

Prior research on cross-societal variation in cooperation have emphasized how processes that originated in the past have influenced current cross-societal variation in institutions, beliefs, and values that affect cooperation. In the present meta-analysis, we study the influence of both historical and present variation in ecologies and cultures across societies, and how this relates to cross-societal variation in cooperation. In so doing, we identified cross-societal indicators that could be used to test hypotheses about societal-level factors associated with cooperation, and which reflect (a) the occurrence of certain phenomena in the

past (e.g., historical subsistence styles and exposure to the Western Church), and (b) the current institutions, beliefs, values, and ecologies of societies (e.g., rule of law, trust, and relational mobility).

To date, there is no consensus about the factors that might underlie cross-societal variation in cooperation, and researchers have approached the topic with an emphasis on different features of societies and ecologies. Importantly, several aspects of culture and ecology which we discuss below can be inter-related in their relation to cooperation. For example, historical prevalence of pathogens and collectivistic values are both hypothesized to be associated with impersonal cooperation (e.g., Fincher & Thornhill, 2012; Marcus & Le, 2013), and furthermore, collectivist values are a distinctive feature of societies with higher historical prevalence of pathogens (Fincher et al., 2008). In the present analysis, our focus will remain on estimating and explaining variation in impersonal cooperation across societies, and we will examine specific theories and approaches that emphasize how different (in)formal institutions, cultural beliefs and values, and ecological conditions relate to cooperation (see Table 1 for an overview of the hypotheses).

**Table 1**

*Overview of the Pre-Registered Hypotheses*

| Predictor | # | Hypothesis |
|---|---|---|
| Formal institutions | 1a | Cooperation is significantly higher in societies with (a) effective and (b) democratic formal institutions (e.g., Hruschka & Henrich, 2013a). |
| | 1b | Cooperation is significantly higher in societies where (a) individuals have confidence that institutions enforce formal laws and (b) perceive rule of law as an effective means of achieving individual interests (e.g., Knight, 1998). |
| | 1c | Cooperation is significantly higher in societies with more developed market economies (e.g., Balliet & Van Lange, 2013b; Henrich et al., 2010). |
| Kin-Based Institutions | 2 | Cooperation is significantly lower in societies in which kin-based institutions have been historically more intensive (Schulz et al., 2019). |
| Religion | 3a | Cooperation is significantly higher in societies in which individuals (a) are currently more devout, (b) display costly religious rituals, (c) have supernatural beliefs (e.g., Henrich et al., 2010; Johnson & Krüger, 2004; Sosis, 2000). |
| | 3b | Cooperation is significantly higher in societies that have been historically more exposed to moralizing religion (e.g., Enke, 2019; Norenzayan et al., 2016). |
| Values | 4a | Cooperation is significantly higher in collectivistic, compared to individualistic, societies (e.g., Mead, 1976). |
| | 4b | Cooperation is significantly higher in individualistic, compared to collectivistic, societies (e.g., Marcus & Le, 2013). |
| | 4c | Cooperation is significantly higher in societies in which self-transcendent values (i.e., benevolence, universalism) are prevalent (e.g., Sagiv et al., 2011). |
| | 4d | Cooperation is more strongly related to universalism, than benevolence values (e.g., Gärling, 1999). |
| | 4e | Cooperation is significantly higher in societies in which self-expression values are prevalent (e.g., Inglehart & Welzel, 2005). |
| | 4f | Cooperation is significantly higher in societies with egalitarian values (e.g., Schwartz, 2007). |
| Trust | 5 | Cooperation is significantly higher in societies with higher trust in others (e.g., Balliet & Van Lange, 2013a). |
| Ecologies | 6a | Cooperation is significantly higher in societies with more (a) relational and (b) residential mobility (e.g., Oishi et al., 2015). |
| | 6b | Cooperation is significantly higher in societies with high and low levels of mobility (U-shaped) (e.g., Macy & Sato, 2002). |
| | 6c | Cooperation is significantly lower in societies with settled interdependent subsistence styles (e.g., Talhelm et al., 2014). |
| | 6d | Cooperation is significantly lower in societies with greater exposure to threats (i.e., (a) history of territorial conflicts, (b) demanding geoclimate, (c) pathogen threat, (d) parasite stress, (e) ecological threats, (f) resource scarcity) (e.g., Bauer et al., 2016; Oishi & Komiya, 2017; Fincher & Thornhill, 2012; Van de Vliert & Postmes, 2012). |

### *Formal Institutions*

Societies can vary in the quality of the formal institutions that affect trust and cooperation among strangers. Institutions are defined as rules of the games being played in a given society (Guala, 2018; North, 1990). These rules prescribe what is allowed, discouraged, or forbidden, and facilitate coordination through the creation of shared expectations about how people will behave in a certain situation (Knight, 1998). Indeed, research across disciplines has identified that institutions play a crucial role in establishing cooperation with strangers. Empirical evidence has been fostered by the "New Institutionalism" approach in political science (e.g., North, 1990; Rothstein & Stolle, 2008) and by experimental paradigms that implement centralized punishment mechanisms in experiments on cooperation (Andreoni et al., 2003; Yamagishi, 1988). More specifically, research has focused on different functions that institutions can serve to promote cooperative behavior, such as mitigating uncertainty and threats, and providing incentives for cooperation. These approaches predict that cooperation varies according to the quality of state institutions, such as the rule of law and rules facilitating free market exchange and competitiveness.

Institutions are highly relevant for dealing with the inherent uncertainty when cooperating with strangers (Yamagishi et al., 1998). More specifically, institutions have been argued to be crucial to sustain cooperation with the rise in complexity of societies, that increasingly demanded individuals to form exchange relations with people beyond their own tight-knit groups (Henrich, Ensminger, et al., 2010). Accordingly, strong impartial institutions would serve as a source of material security, providing assurance and a buffer against threats to safety (as posited by the material security hypothesis; Hruschka & Henrich, 2013a, 2013b), and reinforcing mutually beneficial exchanges and the internalization of fairness norms in occasional and anonymous interactions (Henrich et al., 2001; Henrich, Ensminger, et al., 2010). In small-scale societies, the degree of engagement in market institutions was related with greater impersonal cooperation, as the transition to market economies broadened the

frequency and the scope of social exchange (Henrich, Ensminger, et al., 2010). Similarly, in large-scale societies, which all involve market economies, norms of civic cooperation were associated with high society-level wealth and market competitiveness (Balliet & Van Lange, 2013b; Knack & Keefer, 1997).

A second key role of formal institutions is to create top-down incentives for cooperation. Institutions can impose a cost on defection by punishing noncooperative behaviors and offer rewards for behaviors that benefit the common good. Accordingly, institutions that provide incentives to cooperate can reduce the frequency of being victim of others' exploitative and opportunistic behavior (Cassar et al., 2014). If internalized, such incentives may shape beliefs and behaviors in unrelated situations beyond the reach of institutions (Peysakhovich & Rand, 2016; Stagnaro et al., 2017). For example, variation in the extent to which people expect others to cooperate in a given society was better explained by institutions that deal with impartial enforcement (e.g., the legal system and the police), rather than other political institutions (Rothstein & Stolle, 2008). Also, experiments have found that people learn to prefer to cooperate in groups that have costly sanctioning institutions, as opposed to those that do not, which can help groups promote and maintain cooperation (Gürerk et al., 2006).

The objective presence of institutions can affect cooperation, but how institutions are perceived to function can have important consequences too. Institutions can vary in how much individuals believe that the institutions work for the sake of the collective good (Knight, 1998). Individuals' perceptions of institutions as competent, benevolent, and at the service of the common interest (i.e., institutional trust; Devos et al., 2002) are crucial for institutions to promote cooperative behavior. If state institutions prove to be corrupt, individuals might start to consider them unable to maintain social order and develop a positive attitude toward dishonesty and rule violations, ending up justifying and reiterating their own dishonest behavior in the future (Drobak, 1998; Gächter & Schulz, 2016). Additionally, behavior from

institutional representatives (such as judges or the police) functions as a signal about the moral standards in place in a given society (Rothstein & Eek, 2009; Rothstein & Stolle, 2008). Thus, cooperation can be understood in relation to the degree to which societies can rely on efficient, strong, impartial institutions, but the perception of these institutions as being trustworthy might play an equally important role in explaining variation in cooperation.

### *Kin-Based institutions*

Institutions that regulate kinship have been hypothesized to play a role in determining the amount of impersonal cooperation in a society. Recently, the Western Church has been proposed to have had a crucial role in transforming the ongoing kinship structures through the implementation of kinship-regulating policies, ultimately promoting cooperation among strangers (Henrich, 2020; Schulz et al., 2019). More specifically, in the Middle Age, the Church changed the structure of society, previously based on clans, by enforcing prescriptions about marriage that prohibited consanguineous marriages, such as between cousins or even "spiritual relatives" (Goody, 1983). Historically, marriage between relatives was a common practice that strengthened family bonds (Greif, 2006) that, once loosened, allowed the development of broader social cohesion and impersonal cooperation (Enke, 2019; Fukuyama, 2011; Henrich, 2020).

There is indeed evidence that strong ties can reinforce a sense of security in social exchange, and that this can have detrimental effects on impersonal cooperation (Ermisch & Gambetta, 2010; Yamagishi et al., 1998). Schulz and colleagues used ethnographic data (Kirby et al., 2016) to create an index that measures societal kinship intensity (i.e., Kinship Intensity Index; Schulz et al., 2019), capturing the key dimensions of kin-based societies (i.e., cousin marriage, polygamy, co-residence of extended families, lineage organization, and community organization). They found that across 16 societies, the societies with less intensive kinship ties displayed greater trust and cooperation with strangers in a laboratory Public Goods Game.

***Religion***

Another cultural difference across societies is the degree to which individuals adhere to religious beliefs and practices. Religiosity has been proposed as one of the key factors associated with cooperation among strangers (Johnson & Krüger, 2004; Norenzayan, 2013; Norenzayan & Shariff, 2008). Different theories have been proposed to account for this relationship, such as the supernatural punishment theory (Johnson & Krüger, 2004), signaling theory (Irons, 1996), and cultural group selection (Richerson et al., 2016). These theories focus on different functions that religion can serve to sustain cooperation, such as providing supernatural punishment (Bering & Johnson, 2005), signaling commitment to the group (Sosis, 2000), and spreading cooperative norms (Henrich, Ensminger, et al., 2010).

One perspective proposes that the belief in supernatural punishing and moralizing agent(s) spread across human populations because it was a social monitoring mechanism (Rossano, 2007). These supernatural agents would monitor interactions and deter norm violations through the threat of punishment, or the promise of reward, either in people's future or afterlife (Norenzayan & Shariff, 2008). These beliefs have been hypothesized to offer adaptive advantages for individuals (i.e., by reducing the costs of punishment associated with defection) and groups (i.e., by inhibiting defection, especially when conditions for sustaining cooperation are not met) while maintaining cooperation in large groups of genetically unrelated individuals (Schloss & Murray, 2011). The belief in supernatural punishment can deter free-riding at no cost to individuals and societies, and originated prior to the establishment of formal modern institutions of law and order (Bering & Johnson, 2005; Johnson & Krüger, 2004). Accordingly, religion incentivized cooperation through establishing prescriptive norms, supernatural punishment and exclusion of norms violators (Johnson & Krüger, 2004).

Another perspective draws attention to a common feature of religions, that is practices and obligations which display devotion. Religious groups engage in rituals that are often

costly for individuals, ranging from inflicting bodily harm to food restrictions, volunteering and donations. Rituals have long been hypothesized to be a way to signal commitment, adherence to prosocial norms, and a willingness to confer benefits to the group (Sosis, 2000). Rituals that support supernatural beliefs, as compared to other forms of rituals, appear to increase cohesion within a group (Sosis & Bressler, 2003). In fact, religious (vs. secular) communes had significantly greater longevity, and the number of costly rituals was positively associated with longevity (Sosis, 2000; Sosis & Bressler, 2003).

A third perspective focuses on how modern world religions, such as Christianity and Islam, contributed to spreading norms of prosociality among strangers. Modern world religions are hypothesized to play an important role in making individuals internalize norms of fairness and prosociality (Atran & Henrich, 2010). Accordingly, world religions, including their norms of universal prosociality, were theorized to be culturally transmitted across generations because of their success in addressing the challenges and realizing the benefits of exchanges among non-relatives and, ultimately, enabling large-scale cooperation (Shariff et al., 2009). This perspective is supported by empirical evidence from cross-cultural studies, showing that the adherence to modern world religions was associated with more cooperation in ultimatum and dictator games across 15 small scale societies (Henrich, Ensminger, et al., 2010).

Ethnographic, historical, and experimental data support the hypothesis that religiosity is associated with cooperation. Supernatural punishment and rewards in the future (or afterlife) can be observed in a broad set of cultures (Whitehouse, 2008) and the emergence of the most ancient religious traits in archeologic records (e.g., ancestor worship, shamanism, and animistic beliefs) coincides with an increase in cooperation, social complexity, and scale of societies (Rossano, 2007). If religion develops in societies to sustain cooperation among unrelated individuals, then beliefs of moralizing gods should occur in societies with greater costs associated with free-riding. Indeed, societies characterized by resource scarcity (Snarey,

1996) and large societies, which are more complex and more exposed to threats, are more likely to report beliefs in moralizing gods (Roes & Raymond, 2003).

However, other empirical evidence coming from behavioral experiments is mixed, and does not provide support for the relationship between religiosity and cooperation. In these studies, participants' religious affiliation, beliefs, and attendance were not associated with cooperative behavior in economic games (Ahmed & Salas, 2009; Orbell et al., 1992; Tan, 2006). One possibility to explain these inconsistencies is the fact that in contemporary societies the influence of religion might be crowded out by other secular institutions, such as the state and judicial institutions (Norenzayan & Shariff, 2008; Norenzayan et al., 2016). That is, religion might have become redundant with the spread of other norm-enforcement mechanisms (Enke, 2019). Thus, cross-societal variation in impersonal cooperation in modern and secular societies may be better explained by the degree to which societies were *historically* exposed to religion, instead of current religious beliefs.

***Values***

The values that are predominant in a given society can be associated with variation in cooperation across different societies and cultures. Values are defined as trans-situational goals and principles that are considered important in a society and guide individuals' actions (Hitlin & Piliavin, 2004; Schwartz, 1992). Several theoretical frameworks have been proposed about the different values that exist across societies, such as the model of individualism-collectivism (Triandis, 1995), cultural values orientations theory (Schwartz, 2006), and modernization theory (Inglehart & Baker, 2000). Each of these frameworks identifies values that prescribe appropriate behavior in social interactions (e.g., Schwartz, 1992). Specifically, several different values have been proposed to be related to the tradeoffs people make in providing benefits to the self or to others in social interactions, and accordingly have been proposed to affect cooperation, including the values of (a) individualism-collectivism, (b)

self-enhancement vs self-transcendence, (c) egalitarianism, and (d) survival vs. self-expression.

One dimension of values that has gained particular attention in cultural psychology is individualism-collectivism (Triandis, 1995). Although each specific individualistic or collectivistic culture is likely to have its unique aspects (see Triandis, 1994), this concept has proven to be useful to capture properties of cultural contexts that incentivize individuals to adopt different self-conceptualizations, goals, and orientations toward social relationships (Brett & Kopelman, 2004; Triandis, 1995). Societies with collectivistic values emphasize interdependence; individuals are committed to group goals and define themselves in terms of belonging to stable closely knit groups. Societies with individualistic values, emphasize more independence and autonomy; individuals are encouraged to establish connections to multiple groups, based on their personal needs and goals. Accordingly, a general consensus emerged in earlier research that people from individualistic societies are expected to be less cooperative than people from collectivist societies (Mead, 1976), as cooperation requires prioritizing the collective interest above one's personal interests (Dawes, 1980). Indeed, collectivistic societies have been found to be more cooperative than individualistic societies (e.g., Parks & Vu, 1994; Wade-Benzoni et al., 2002). However, collectivistic societies have recently been hypothesized to exhibit less *impersonal* cooperation than individualistic societies. From this perspective, collectivistic societies can confine social exchange within the family and to members of a close ingroup and have distrust in interactions with people outside those groups (Yamagishi et al., 1998). In support of this perspective, individualistic compared to collectivistic societies display more prosocial behavior (e.g., Kemmelmeier et al., 2006; Luria et al., 2015) and cooperation when interacting with strangers (Marcus & Le, 2013).

Self-transcendent values reflect individuals' concern for the welfare of others. Individuals attributing importance to self-transcendent values prioritize tolerance, social justice, loyalty, and support for those in need (Schwartz, 1992), and have been found to be

more cooperative in interdependent situations (Sagiv et al., 2011). These values might reflect the motivation to promote others' welfare in a more or less narrow scope, either orienting loyalty and concern toward close others (i.e., benevolence) or, more generally, toward all people and nature (i.e., universalism). Thus, although both motivations should be related to cooperation (e.g., Sagiv et al., 2011), due to its broader focus, universalism could be more strongly associated with impersonal cooperation than benevolence (Gärling, 1999).

Similarly, the continuum between survival vs. self-expression values captures the extent to which members of a society value subjective well-being and quality of life and take material security for granted (Inglehart & Baker, 2000; Inglehart & Norris, 2003). According to Inglehart & Welzel (2005), self-expression values, unlike survival ones, have a "civic" nature that promotes generalized trust and prosocial behavior, such as engagement in collective action. Finally, egalitarianism is another value that can be hypothesized to be associated with cooperation among strangers. Egalitarianism responds to the need to preserve social order, interdependence, and coordination within society (Schwartz, 2006). In egalitarian societies, others are recognized as "morally equal". Accordingly, these societies strongly encourage internalizing norms that foster voluntary cooperation, promoting the welfare of others and transcending individual interests (Schwartz, 1999, 2007). Thus, societies with self-expression and egalitarianism values can be predicted to display greater cooperation among strangers.

***Trust***

Societies vary in beliefs about people's trustworthiness (Bond et al., 2004; Falk et al., 2015; Inglehart et al., 1998; Romano et al., 2017). Trust is considered to be an essential social lubricant that sustains cooperation and functioning of societies (Fukuyama, 1995; Luhmann, 1979). Interactions in high trust societies are characterized by a generalized expectation that others have benevolent intentions and will not take advantage of the vulnerability that trust exposes individuals to (Mayer et al., 1995; Rousseau et al., 1998). Societal differences in trust

can be particularly relevant for cooperation, as high levels of trust are associated with high contributions to public goods (Fischbacher & Gächter, 2010; Kocher et al., 2015), and can reflect underlying norms and expectations about others' contributions (Ostrom & Ahn, 2009; Yamagishi, 2011).

At the individual level, trust is among the strongest predictors of cooperation, both as a state contingent to the interaction (e.g., expectations about other's cooperation, Balliet & Van Lange, 2013a) and as a stable disposition (e.g., Thielmann et al., 2020; Yamagishi, 1988). At the societal level, individuals from high-trust societies display greater norms of civic cooperation (e.g., disapproving of avoiding a fare on public transportation and cheating on taxes; Knack & Keefer, 1997). We expect that high-trust societies will display more cooperation among strangers, than low-trust societies.

***Ecologies***

Cross-cultural differences in cooperative behavior can also be understood by analyzing how cooperation relates to specific distal ecological factors and environmental pressures[1]. Specifically, societies may have higher levels of cooperation among strangers either resulting from (a) higher relational and residential mobility, (b) historically independent subsistence style, and/or (c) lower ecological and historical threats, each of which are socio-ecological factors that can shape individuals' relationship opportunities.

Residential mobility is defined as the proportion of residents who have changed residence during a certain period in a given society (Oishi, 2010). This notion thus captures

[1] Notably, most research on ecologies did not make direct predictions about cooperation with strangers, but rather for cooperation with ingroup members (i.e., parochialism). In this case, our hypotheses followed a similar logic to the one adopted for kin-based institutions and individualism-collectivism. In societies and ecologies where people more strongly prefer to cooperate with ingroup members, we assume that there is less cooperation with members outside of one's ingroup (such as members of outgroups and even strangers with no known group affiliation). Indeed, previous research has found that parochialism occurs in absence of intergroup competition or comparison (Balliet et al., 2014), and that people can condition their cooperation on the presence or absence of cues of group membership. This assumption is also consistent with recent empirical work, showing that individualism and historical pathogen threat are correlated with impersonal cooperation across societies (Romano et al., 2021). That said, in some contexts greater cooperation with ingroup members could also co-occur with greater cooperation with outgroup members and strangers, especially when there is no conflict between groups (e.g., De Dreu et al., 2020). Future empirical research can further evaluate whether societies with greater ingroup favoritism tend to show less impersonal cooperation.

the extent to which social networks are settled or permeable, as highly mobile societies emerged with greater industrialization, that encouraged transactions and contractual relationships among strangers (Oishi, 2010). Relational mobility, on the other hand, refers to the degree to which a society affords individuals with the opportunity to form or terminate interpersonal relationships based on individual preferences (Yuki & Schug, 2012). Highly mobile ecologies allow individuals to engage in the relationships they perceive as beneficial.

The way mobility shapes one's social relationship opportunities is especially relevant to understand how individuals in these societies interact with strangers. In societies with high mobility, individuals are more frequently faced with exchanges with unknown others, instead of interacting with partners with whom they have well-established trust relations, such as close kin and ingroup members (Oishi et al., 2015). Therefore, people in societies with high mobility acquire a set of social skills which are beneficial for interactions with strangers (e.g., being able to interpret others' signals of cooperativeness, Macy & Sato, 2002) that allowed them to develop skills at selecting and retaining partners that confer greater benefits.

The possibility of choosing, and being chosen, based on one's ability to confer benefits to others is considered among the key factors that foster and sustain cooperation, as predicted by biological markets theory (Barclay, 2016). In economic games, cooperation is higher when people are provided with the ability to choose interaction partners (e.g., Barclay & Willer, 2007), walk away from partners (e.g., Aktipis, 2004), or ostracize uncooperative partners (e.g., Feinberg et al., 2014). In highly mobile societies, there are also greater levels of generalized trust (Yuki et al., 2007), as trusting beliefs encourage the emergence of new social exchange partners, and such beliefs are more adaptive for individuals living in a mobile area (Macy & Sato, 2002). Additionally, differences in residential mobility are associated with specific friendship strategies, such that more frequent movers display a preference for a person who would help a stranger, rather than a friend (Lun et al., 2012). Thus, individuals from highly mobile societies may display greater cooperation with strangers.

Other theoretical accounts related to ecology, such as the subsistence style theory (Nisbett et al., 2001) and the rice theory of culture (Talhem et al., 2014), focus on how social interaction has been shaped by the historically prevalent subsistence style, defined as the food production systems adopted in a given society. This research is based on the idea that some types of subsistence require more social coordination than others, which in turn created greater interdependence which could have led to a collectivist cultural orientation and, thus, greater tendency to cooperate with strangers (Talhelm et al., 2014; Witkin & Berry, 1975). For example, herders may independently manage only their own herd and experience greater mobility, which could have led to an individualistic orientation. Farmers, on the other hand, are more sedentary and require greater cooperation with community members, which could have historically led to collectivism (Nisbett et al., 2001). In addition, members of farming communities might present even more specific differences in terms of the amount of cooperation required for their subsistence. More specifically, according to the rice theory, rice farming required farmers to cooperate to build and share irrigation systems with close neighbors, while wheat farmers did not face the same environmental and social challenges to grow wheat (Talhelm et al., 2014). Accordingly, rice-growing areas in East Asia are characterized by highly reciprocal and tight relationships within close groups (Talhelm & Oishi, 2018). Thus, we expect less cooperation with strangers in societies historically characterized by settled subsistence styles that required more interdependence (e.g., farming)[2].

Lastly, the degree to which societies were exposed to ecological and historical threats has been hypothesized to have shaped individuals' social behavior, which might be at the heart of variation in cooperation. According to the parasite-stress theory of sociality, societies exposed to environmental hardships developed reliance on tight groups and closed networks

[2] In our analyses, we did not consider how each subsistence style relates to cooperation, and so we did not perform comparisons between rice and wheat farming. Rather, following the approach of Thomson et al. (2018), we used an index of interdependent subsistence style that may better represent how herding and farming can be operationalized along a continuum, since devoting land to one or the other form of subsistence can be mutually exclusive.

of kin as a strategy to mitigate such threats (Fincher & Thornhill, 2012). For example, under high prevalence of pathogens and parasite stress (e.g., malaria, tuberculosis, infectious mosquitos), limiting interactions within tight groups could have emerged as an adaptive strategy in response to risks of infections that can occur in interactions with strangers (Fincher et al., 2008). Indeed, it has been observed that ecologies with high historical pathogen prevalence were characterized by higher endorsement of collectivistic values (Fincher et al., 2008) and higher ingroup favoritism (Fincher & Thornhill, 2012). Harsh ecologies have been proposed to have similar effects as pathogen threats. Societies that experienced higher environmental threats, such as harsher climates (e.g., Van de Vliert & Postmes, 2012), environmental hazards (e.g., Oishi & Komiya, 2017), resource scarcity (e.g., Cashdan, 2001; Triandis, 1995), and a history of conflict and warfare (Bauer et al., 2016) have been associated with the endorsement of collectivistic values and ingroup favoritism. Hence, it is possible to expect more cooperation with strangers in societies historically characterized by lower levels of threats posed by pathogens and environmental hardships.

In summary, there are numerous theoretical perspectives and studies that identify mechanisms that account for variation in impersonal cooperation across societies. The current study aims to test a set of hypotheses from these accounts (see Table 1) by meta-analyzing studies using economic games to measure cooperation within social dilemmas.

## A Method to Measure Impersonal Cooperation: Economic Games

There is a long-standing experimental tradition of using economic social decision-making tasks (i.e., economic games) to test theories of human cooperation. Games can be used as parsimonious models of complex human interactions (Murnighan & Wang, 2016). Since the mid-1950's, researchers from many disciplines have consistently applied economic games to model social dilemmas in which to study cooperation. A primary benefit of games is internal validity – these games present to participants situations involving a conflict of interest between doing what is best for oneself (regardless of what others do) and costly contributions

to the collective good (Dawes, 1980; Spadaro et al., in press). In these situations, it is always possible that one's cooperation can be exploited by a non-cooperative partner, which results in the worse possible outcome for the person who cooperates, but the best possible outcome for the free-rider. Moreover, with some exceptions (for a review, see Galizzi & Navarro-Martinez, 2019), empirical evidence supports the external validity of these paradigms. Indeed, prior research has found comparable amounts of cooperation in economic games and outside of the lab, such as charity donations (Benz & Meier, 2008), social engagement as indicated in applicants' resumes (Heinz et al., 2018), returning misdirected letters (Franzen & Pointner, 2013), and self-reported cooperative acts toward members of the community (Soler, 2012).

In the current meta-analysis, we include studies using the Prisoner's Dilemma and the Public Goods Game. The two games have highly comparable payoff structures, with each having the options to cooperate or defect (i.e., freeride). In the Prisoner's Dilemma, participants decide independently whether to cooperate or defect by transferring any portion of an individual endowment to the partner, which is then multiplied by a constant and added to the partner's endowment. In a Public Goods Game, participants are assigned to a group and decide how much to contribute by transferring any portion of an individual endowment to a group account. Then, contributions are multiplied by a constant and equally divided among the group members, irrespective of their individual contributions. In both games, the rational strategy is to defect, resulting in an inefficient outcome for the collective (Gangadharan & Nikiforakis, 2009). Traditionally, Public Goods Games and Prisoner's Dilemmas differ in the number of individuals involved in the interaction (with the latter generally involving two players) and by the number of choice options (with the former involving multiple options). Importantly, however, in both games contributing the maximum or minimum amount of endowment can be equivalent to making a fully cooperative or defective choice, respectively. Indeed, linear Public Goods Games are often referred to as "n-person Prisoner's Dilemmas".

Experiments using economic games have allowed researchers to vary structural components of the situation to manipulate, isolate, or minimize specific features of the environment in which such decisions are made. For instance, some studies might constrain interactions as one-shot or in large groups in order to control for the potential effect of direct reciprocity (Boyd & Richerson, 1988; Gächter & Falk, 2002), or might allow group members to have a discussion prior to making their choices (Balliet, 2010; Sally, 1995). Also, the payoff structures might pose different degrees of conflicting interests and marginal benefit from the public good, which can affect the fear of being exploited by others and the temptation to defect (Steele & Tedeschi, 1967; Vlaev & Chater, 2006). Moreover, studies vary by the presence of incentives to cooperate, such as punishment or rewards, that are known to effectively encourage cooperation (Balliet et al., 2011; Fehr & Gächter, 2000; Yamagishi, 1986). The studies included in the meta-analysis vary according to these aspects, and we control for these characteristics of experiments when testing hypotheses.

**Overview of the Meta-Analysis**

We conducted a systematic search for all studies that observed interactions between strangers in either a Prisoner's Dilemma or Public Goods Dilemma. We found 1,506 studies (published between 1958 and 2017) conducted in 70 societies and involving 183,697 participants. We then conducted a meta-analysis to (1) estimate the extent of variation in impersonal cooperation that can be accounted for by cross-societal differences (i.e., between societies and cultural groups) and (2) test pre-registered hypotheses about the institutional, cultural and ecological variables that can explain variation in cooperation across societies (see Table 1).

We take three approaches to estimate whether there is variation in cooperation across societies and cultures. First, we estimate cooperation observed in each society through a multi-level meta-regression model which statistically controls for 10 features of the social dilemma that can differ between the studies (e.g., group size, degree of conflicting interests,

and iterations). Based on this information, we estimate the amount of variation in cooperation across societies. Second, we lumped societies into cultural groups based on the classification from the World Values Survey (Inglehart & Baker, 2000) and then estimated the variance in cooperation due to differences between the cultural groups. Third, we used indices of ancestral and cultural distance, which estimates the cultural similarity of societies (Muthukrishna et al., 2020; Spolaore & Wacziarg, 2018), to predict any differences in cooperation.

We then examined the factors that may account for any observed variation in cooperation across societies and cultures. Specifically, we tested our pre-registered hypotheses with a multi-level meta-regression model in which (1) several control variables are included to explain differences in cooperation across studies, and then (2) cross-societal indices are added to the model, which can be used to test predictions about the institutional, cultural, and ecological variables associated with cooperation. As we explain in detail below, the estimates of cooperation can be nested within studies, which can further be nested within societies.

Finally, we apply these approaches when (1) analyzing 1,506 studies conducted across 70 societies and (2) analyzing 514 studies conducted across nine regions of the United States. The first approach harnesses the full power of the dataset to estimate and explain variance in cooperation across societies and cultures. The latter approach, on the other hand, provides a further test of our hypotheses, with the advantage of holding constant several variables in which societies can differ (e.g., language and form of government). Additionally, a broadening of the focus of cross-cultural psychology beyond the predominant focus on ethnicity and nationality has revealed that other forms of grouping (e.g., different regions) can have psychological consequences that parallel those of ethnicity and nationality (e.g., Cohen & Varnum, 2016; Vandello & Cohen, 1999).

## Methods

This section details how estimates of cooperation were retrieved from the studies, as well as the coding of study characteristics and societal-level indicators. These procedures, together with the hypotheses and the analytic strategy, were pre-registered prior to data analysis.

### Search for Studies

Relevant studies were selected from all the records included in the Cooperation Databank (CoDa; Spadaro et al., in press). CoDa contains annotated studies on human cooperation reported in published articles, working papers, dissertations, theses, and book chapters written in English, Japanese, and Chinese. These documents were retrieved as a result of a systematic literature search conducted by a team of researchers working at a Dutch university in September and October 2015, as well as in January 2018, using PsychInfo, Web of Science, Google Scholar, and two online University library repositories for English documents. The search for Chinese documents was conducted in November and December 2017 using CNKI, Wangfang Data, and CQVIP. Japanese documents were searched from July to December 2018 using CiNii and Google Scholar.

The search was performed up to publication year 2017 using the following key terms: 'Public goods dilemma*', 'Public good*', 'Public good* game*', 'Prisoner's dilemma*', 'Voluntar* contribut* experiment*', 'Voluntary contribution mechanism', 'Social dilemma', 'Mixed-motive game', 'Mixed-motive game*', 'Cooperation game' (up to 2015), 'Resource dilemma*', 'Conditional cooperation' (up to 2015), 'Interpersonal bargaining AND Experimental games' (up to 2015), 'Matrix games', 'Cooperation AND Experiment'. For documents published between 2016 and 2017, we additionally used the following terms: 'Common pool game', 'Give-some dilemma', 'Take-some dilemma', 'Give-some game', 'Take-some game'. Equivalent terms were used for Japanese and Chinese searches. Additional articles were retrieved performing a backward search by reviewing articles cited

by published reviews, meta-analyses, and books on social dilemmas, or cited in papers found using the above-mentioned search strategies. Finally, more published data was included as a result of a call on the Economic Science Association (ESA), European Association of Social Psychology (EASP), Judgement and Decision Making (JDM), European Association for Decision Making (EADM) listservs and on Twitter in August 2019. Additional details about the search for literature and studies included in CoDa are reported in Spadaro et al. (in press).

**Inclusion and Exclusion Criteria**

To be included in the meta-analysis, studies had to fulfill the following criteria:

(a) Cooperative behavior was either assessed in the Prisoner's Dilemma (PD) or a linear Public Goods Game (PGG). Variations of these games, such as the use of different incentives and asymmetrical payoff structures, were included, while non-linear PGG and intergroup games (e.g., the intergroup PDG; Bornstein, 2003) were excluded.

(b) Participants in the studies were at least 18 years old.

(c) Participants interacted with strangers. If acquaintance between participants was a factor of the study design but an experimental condition in which participants interacted with strangers was in place, only data from the latter treatment were included in analyses.

(d) Cooperation rates were reported over all trials of the game or during the first trial.

(e) Society of data collection was identifiable[3] and unique for each study.

Applying these criteria to select relevant studies uncovered a total of 1,139 documents that contained 1,506 studies including 183,697 participants published between 1958 and 2017. The vast majority of cooperation rates were retrieved from published articles (94%), followed by doctoral dissertations (2%), working papers (2%), and master's theses (2%). Most studies in our sample were conducted in a laboratory setting (88%) and involved participants recruited from a student population (85%). Overall, the studies were conducted in 70 societies

[3] For a small number of studies, the society of data collection was not clearly identifiable from the information reported in the paper. Thus, e-mail requests for clarifications were sent to the lead authors.

433 from 8 different cultural groups (see Table 2 for additional details and Figure S1 for a
434 flowchart that details outcomes of the search and inclusion criteria).
435

436 **Table 2**

437 *Societies and Cultural Groups Included in the Meta-Analysis and their Estimates of Cooperation*

| Cultural Group | Society | *k* | P(C) | 95% *CI* |
|---|---|---|---|---|
| *African-Islamic* | | 50 | 0.36 | [0.33,0.40] |
| | Ghana | 1 | 0.33 | [0.17,0.53] |
| | Indonesia | 7 | 0.54 | [0.39,0.68] |
| | Iran | 1 | 0.36 | [0.20,0.57] |
| | Kazakhstan | 1 | 0.55 | [0.34,0.74] |
| | Kenya | 4 | 0.29 | [0.18,0.43] |
| | Liberia | 2 | 0.21 | [0.11,0.34] |
| | Mali | 3 | 0.65 | [0.47,0.80] |
| | Morocco | 1 | 0.59 | [0.38,0.77] |
| | Nigeria | 1 | 0.21 | [0.10,0.39] |
| | Oman | 2 | 0.36 | [0.20,0.54] |
| | Palestinian Territory | 1 | 0.39 | [0.21,0.60] |
| | Saudi Arabia | 2 | 0.24 | [0.13,0.41] |
| | Senegal | 1 | 0.43 | [0.24,0.63] |
| | South Africa | 13 | 0.31 | [0.21,0.44] |
| | Tanzania | 1 | 0.40 | [0.22,0.61] |
| | Turkey | 2 | 0.20 | [0.10,0.35] |
| | Uganda | 2 | 0.43 | [0.27,0.59] |
| | Uzbekistan | 1 | 0.55 | [0.34,0.74] |
| | Zambia | 2 | 0.30 | [0.17,0.46] |
| | Zimbabwe | 2 | 0.41 | [0.26,0.58] |
| *Catholic Europe* | | 171 | 0.35 | [0.32,0.38] |
| | Austria | 15 | 0.33 | [0.22,0.45] |
| | Belgium | 23 | 0.36 | [0.25,0.48] |
| | Czech Republic | 4 | 0.41 | [0.27,0.56] |
| | France | 36 | 0.35 | [0.25,0.47] |
| | Hungary | 1 | 0.74 | [0.55,0.87] |
| | Italy | 38 | 0.32 | [0.22,0.44] |
| | Poland | 4 | 0.33 | [0.20,0.49] |
| | Portugal | 1 | 0.48 | [0.29,0.68] |
| | Spain | 49 | 0.36 | [0.25,0.48] |
| *Confucian* | | 296 | 0.35 | [0.32,0.38] |
| | China mainland | 146 | 0.37 | [0.26,0.49] |
| | Hong Kong SAR | 9 | 0.31 | [0.21,0.44] |
| | Japan | 135 | 0.33 | [0.23,0.44] |
| | Republic of Korea | 5 | 0.38 | [0.25,0.54] |
| | Taiwan, China | 1 | 0.41 | [0.22,0.62] |
| *English-Speaking* | | 1189 | 0.36 | [0.33,0.40] |
| | Australia | 30 | 0.31 | [0.21,0.43] |
| | Canada | 39 | 0.35 | [0.25,0.47] |
| | Great Britain | 163 | 0.40 | [0.29,0.52] |
| | New Zealand | 3 | 0.40 | [0.26,0.55] |
| | United States | 954 | 0.37 | [0.27,0.49] |
| *Latin America* | | 46 | 0.33 | [0.29,0.37] |
| | Argentina | 2 | 0.34 | [0.24,0.46] |
| | Bolivia | 3 | 0.31 | [0.20,0.46] |
| | Brazil | 1 | 0.29 | [0.15,0.49] |
| | Chile | 2 | 0.37 | [0.23,0.54] |
| | Colombia | 30 | 0.33 | [0.23,0.45] |
| | Costa Rica | 1 | 0.20 | [0.10,0.37] |
| | Guatemala | 1 | 0.71 | [0.50,0.86] |
| | Mexico | 3 | 0.45 | [0.28,0.63] |
| | Peru | 1 | 0.20 | [0.10,0.37] |
| | Uruguay | 1 | 0.21 | [0.10,0.38] |
| | Venezuela | 1 | 0.42 | [0.24,0.63] |
| *Orthodox* | | 17 | 0.38 | [0.32,0.44] |
| | Bulgaria | 5 | 0.20 | [0.12,0.33] |
| | Belarus | 2 | 0.44 | [0.26,0.63] |
| | Georgia | 1 | 0.27 | [0.13,0.47] |
| | Greece | 2 | 0.19 | [0.10,0.34] |
| | Russia | 7 | 0.56 | [0.42,0.69] |
| *Protestant Europe* | | 443 | 0.39 | [0.36,0.42] |
| | Denmark | 14 | 0.45 | [0.32,0.58] |
| | Finland | 7 | 0.34 | [0.23,0.47] |
| | Germany | 211 | 0.38 | [0.27,0.50] |
| | Netherlands | 163 | 0.36 | [0.26,0.48] |
| | Norway | 7 | 0.41 | [0.29,0.55] |
| | Sweden | 20 | 0.50 | [0.38,0.63] |
| | Switzerland | 21 | 0.36 | [0.25,0.49] |
| *West and South Asia* | | 59 | 0.38 | [0.34,0.42] |
| | Cambodia | 1 | 0.33 | [0.18,0.53] |
| | India | 8 | 0.32 | [0.21,0.44] |
| | Israel | 32 | 0.37 | [0.26,0.50] |
| | Malaysia | 4 | 0.44 | [0.29,0.59] |

| Cultural Group | Society | *k* | P(C) | 95% *CI* | Cultural Group | Society | *k* | P(C) | 95% *CI* |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Papua New Guinea | 5 | 0.43 | [0.27,0.62] |
| | | | | | | Singapore | 3 | 0.32 | [0.20,0.47] |
| | | | | | | Thailand | 2 | 0.44 | [0.28,0.61] |
| | | | | | | Vietnam | 4 | 0.53 | [0.38,0.68] |

*Note*. *k* = number of independent samples; P(C) = meta-analytic estimates of cooperation, obtained from a mixed-effect meta-regression with society as fixed effect and controlling for study characteristics. Cultural groups were based on the classification from the World Values Survey (Inglehart & Baker, 2000).

**Coding of Logit-Transformed Cooperation Rates**

Our effect size (i.e., cooperation estimate) reflects the amount of cooperative behavior observed in the game (i.e., cooperation rate) and is thus calculated differently for cooperation resulting from dichotomous and continuous choice game settings. For each game, the lowest possible value indicates the lowest possible amount of cooperation (i.e., free-riding, defection), while the highest possible value indicates the highest possible amount of cooperation.

For studies with dichotomous choices, cooperation estimates ($yi_{dich}$) and variance ($vi_{dich}$) are calculated using the standard formula for the proportions ($p$) (Lipsey & Wilson, 2000) as:

$$y_{i(dich)} = \log_e\left[\frac{p}{1-p}\right]$$

$$v_{i\,(dich)} = \frac{1}{np} + \frac{1}{n(1-p)}$$

For studies involving continuous choices as the measure of cooperation, cooperation estimates were calculated using percentage of endowment contributed ($P_{cont}$). More specifically, the mean endowment contributed $M$ will be divided by the range of the endowment that participants could potentially contribute $[E_{LL},E_{UL}]$. Thus, as for proportions, the value of $P_{(cont)}$ will range between 0 and 1.

$$P_{cont} = \frac{M - E_{LL}}{E_{UL} - E_{LL}}$$

Cooperation estimates ($yi_{cont}$) and variance ($vi_{cont}$) are calculated accordingly as:

$$y_{i(cont)} = \log_e \left[ \frac{P_{cont}}{(1 - P_{(cont)})} \right]$$

$$v_{i(cont)} = \frac{SD^2}{M^2} \times \frac{1}{n(1 - P_{(cont)})^2}$$

Some studies allowed us to compute multiple cooperation estimates (1-12, with 75% reporting 1 cooperation estimate). This was the case for studies in which (a) received asymmetric endowments within the group and could contribute according to different choice ranges, and (b) one or more of the study characteristics of interest (see the following section) were manipulated. In these instances, we included a cooperation estimate for each of these samples, if the study reported cooperation separately for each of these instances. For example, for cross-cultural studies, we coded as many cooperation estimates as number of societies involved, while for a study comparing a communication treatment with a control treatment, we coded two cooperation estimates, one for each level of this variable. Given that these cooperation estimates were not independent, we applied a multilevel extension of a mixed-effects meta-analytic model (Van den Noortgate et al., 2013). More details about how dependent cooperation estimates are handled in the model are presented in the results section. Overall, we coded 2,271 cooperation estimates for the 1,506 eligible studies.

**Coding of Study Characteristics**

The studies included in the meta-analysis involved two game paradigms with similar payoff properties that would make them strictly comparable. Indeed, the linear Public Goods Game is often referred to as a "n-person Prisoner's Dilemma". In both situations, a rational strategy to maximize self-interest leads to total defection, which results in an inefficient outcome for the collective (Gangadharan & Nikiforakis, 2009). That said, the studies varied

along a number of study characteristics that are hypothesized to influence cooperative behavior (Ledyard, 1995; Zelmer, 2003), namely the degree of conflict of interests, group size, communication opportunities, repeated interactions over time, the number of choice options, the decision protocol, and the presence of sanctions. Although examining the impact of structural features of the situation was not the goal of the current research (for a meta-analysis, see Jin et al., 2021), we coded these study characteristics, as described below, and controlled for these differences while conducting our analyses.

Inter-rater agreement for the variables included in the model was estimated through Krippendorff's α (Hayes & Krippendorff, 2007; Krippendorff, 2011) on a subset of studies that were re-coded by two independent annotators (for more information about the efforts made to enhance data quality, see Spadaro et al., in press). We found a medium-to-high inter-rater agreement $0.66 < \alpha < 0.96$ for these variables. Moreover, the variables that had lowest inter-rater agreement using Krippendorff's α actually displayed a percentage of agreement higher than 90%, which suggests that the low α could be due to the little variation in the sample on each of these variables.

***Conflict of Interests***

We coded the degree of conflict of interests using the K index (Rapoport, 1967; Rapoport & Chammah, 1965a). This index represents the extent to which participants' payoffs in the game are non-correspondent in a Prisoner's Dilemma and it is formally expressed as:

$$K = \frac{(R - P)}{(T - S)}$$

The K index is computed by dividing the difference between the best payoff resulting from mutual cooperation *(R*) and the worst payoff resulting from mutual defection (*P*) by the difference between the best payoff resulting from unilateral defection (*T*) and the worst payoff resulting from unilateral cooperation (*S*). The K index ranges between 0 and 1, with higher numbers indicating less conflict of interests. Consistent with previous research (e.g.,

Thielmann et al., 2020), we also calculated the K index for continuous choice Prisoner's Dilemmas and Public Goods Games, given that contributing the maximum or minimum amount of endowment can be equivalent to making a fully cooperative or defective choice, respectively. K index was calculable for 88% of the studies ($M$ = 0.44, $Mdn$ = 0.42, $SD$ = 0.17).

***Group Size***

We coded group size as the overall number of people affected by the choices in the game. In our analyses, we used a logarithmic transformation of this variable, given that it is highly skewed (i.e., the vast majority of the selected studies involves relatively small group sizes, with only a few exceptions of large groups). Group size was reported in 99% of the studies and ranged from 2 to 324 participants interacting together in the social dilemma ($Mdn$ = 3.5).

***Communication***

In some of the studies participants were allowed to communicate before or during the game, while in most other studies communication was strictly forbidden. Our coding of communication included both unidirectional (e.g., sent or received messages) and bidirectional (e.g., face-to-face discussion) exchanges between participants and was reported in 99% of the studies. The sample of cooperation estimates includes estimates gained from studies or treatments in which communication was allowed ($k$ = 203), not allowed ($k$ = 2,036), or manipulated within a study (i.e., the cooperation rate is calculated by aggregating treatments in which communication was and was not allowed, $k$ = 31).

***Repetitions***

Participants could interact only once or could make repeated decisions being matched with the same partner(s) for multiple rounds in the game. We coded repetitions as a dichotomous variable, with the sample of cooperation estimates including both one-shot interactions ($k$ = 863),

repeated interactions ($k$ = 1,372), or this was manipulated within a study ($k$ = 33). This information was coded for 99% of studies.

***Number of Choice Options***

Across these cooperative decision-making paradigms, participants could either make dichotomous choices, or were presented a range of possible contribution decisions. In a typical dichotomous choice setting, participants are asked to choose between a cooperative and a non-cooperative option (i.e., defection, free-riding). In a continuous choice setting, participants typically receive an endowment and are asked to contribute an amount to a group account (i.e., the public good). We treated the number of choice options as a dichotomous variable, including cooperation estimates from both dichotomous ($k$ = 1,064) and continuous choice games ($k$ = 780) and coded this variable in all studies.

***Decision Protocol***

We coded for whether participants made their decision simultaneously or sequentially and treated it as a dichotomous variable. Most of the estimates come from studies or treatments with simultaneous decisions, in which participants were not aware of other's decisions before making their own decision ($k$ = 2,075), while a few other games involved situations in which participants made their decisions sequentially, either as first or subsequent players ($k$ = 141), or it was manipulated within the study ($k$ = 55). Information about decision protocol was reported in all studies.

***Sanctions***

Some of the studies included a sanctioning mechanism, according to which participants could be punished or rewarded based on their behavior in the game. In these studies, sanctions could be imposed by individuals who participate in the game themselves or by entities external to the social dilemma, such as the experimenter or other authority figures. The sample of cooperation estimates includes cooperation rates retrieved from studies or treatments in which sanctions were implemented ($k$ = 281), sanctions were not implemented ($k$ = 1,950), or sanctions were manipulated within a study ($k$ = 40). Information about sanctions was reported in all studies.

***Symmetry***

We coded for whether the structure of the game was the same across participants (i.e., symmetrical) or not[4]. Features of the game that could be asymmetric are, for example, the reward obtained from the game. The sample of cooperation estimates includes mostly estimates from symmetric games ($k$ = 2076), and only a minority were asymmetric games ($k$ = 147), or games in which symmetry was manipulated within a study ($k$ = 37). This information was coded in 99% of the studies.

***Society of Data Collection and Source of Society Information***

Overall, the studies were conducted in 70 societies. This information was inferred for all the studies according to the following criteria: the society was specified in the text ($k$ = 1,873), all authors ($k$ = 348) or most authors ($k$ = 39) of the paper are affiliated with the same institution from a specific society, or the paper specifies that most participants come from a given society, but that a smaller percentage comes from different societies ($k$ = 11). See Table 2 for an overview of how the sample of cooperation estimates are distributed across societies. A number of recent studies recruited participants via the online crowdsourcing platform Amazon's Mechanical Turk (MTurk). When this was the case, we only included studies that reported to have restricted their pool of participants to one clearly identifiable society ($k$ = 55).

**Coding of Cross-Societal Indicators**

To test our hypotheses, we coded cross-societal variation in formal institutions, kin-based institutions, religion, beliefs, values, and ecologies. To do so, we retrieved several cross-societal indicators for each society in our dataset. Additionally, we matched the indicators as close as possible to the year of data collection if multiple time points were available (e.g., GDP per capita, rule of law). This method allowed us to account for temporal variation within the same society. Some indicators (e.g., history of territorial threats, relational mobility) do not present multiple data points across different years, thus they were only matched to the studies by society. Table 3

[4] The inclusion of this covariate was not anticipated in the pre-registration phase. See the SI for a detailed list of all the deviations from the pre-registration plan.

provides an overview of all the indicators included in the analysis and the range of years for which the data was available.

Several indicators operationalize the same construct and this can present a problem of multicollinearity. We therefore performed separated principal component analyses (PCA) on the z-scored indicators belonging to the same construct. For example, three separate indicators were selected to operationalize trust, namely two single items extracted from the Global Preferences Survey (Falk et al., 2018) and the World Values Survey (Inglehart et al., 2014), and a composite index of societal cynicism (Leung & Bond, 2004). However, after performing the PCA these indicators resulted in two components that cumulatively explained 90.7% of variance. This approach allowed us to extract a smaller set of linearly uncorrelated components to be eventually used in the analysis. The number of components for each set of items was determined based on a cumulative proportion of explained variance criterion, by retaining as many components as needed to explain ~80% of variance. Principal components were extracted using the *prcomp()* function in R (R Core Team, 2019). More details about correlations between the indicators and results of the PCA can be found in Table S2 and Table S7.

**Table 3**

*Operationalization of Society-Level Variables*

| Predictor | Indicator | Description | Range | Source | Years range (number of time points) |
|---|---|---|---|---|---|
| *Formal Institutions* | | | | | |
| | Confidence in the Armed Forces* | How much confidence you have in the Armed Forces? | 1 (A great deal) - 4 (None at all) | World Values Survey (WVS) | 1981 - 2016 (28) |
| | Confidence in the Justice System* | How much confidence you have in the Justice System? | 1 (A great deal) - 4 (None at all) | WVS | 1981 - 1991 (6) |
| | Confidence in the Legal System* | How much confidence you have in the Legal System? | 1 (A great deal) - 4 (None at all) | WVS | 1994 - 1999 (7) |
| | Trust in the Legal System | How strongly you personally trust the Legal System | 0 (No trust at all) - 10 (Complete trust) | European Social Survey (ESS) | 2002 - 2016 (8) |
| | Confidence in the Government* | How much confidence you have in the Government? | 1 (A great deal) - 4 (None at all) | WVS | 1999 - 2016 (16) |
| | Confidence in the Courts* | How much confidence you have in the Courts? | 1 (A great deal) - 4 (None at all) | WVS | 2010 - 2016 (6) |
| | Confidence in the Parliament* | How much confidence you have in the Parliament? | 1 (A great deal) - 4 (None at all) | WVS | 1981 - 2016 (28) |
| | Trust in the Parliament | How strongly you personally trust the Parliament | 0 (No trust at all) - 10 (Complete trust) | ESS | 2002 - 2016 (8) |
| | Confidence in the Police* | How much confidence you have in the Police? | 1 (A great deal) - 4 (None at all) | WVS | 1981 - 2016 (28) |
| | Trust: The Police | How strongly you personally trust the Police | 0 (No trust at all) - 10 (Complete trust) | ESS | 2002 - 2016 (8) |
| | GDP per capita | Gross Domestic Product per capita (Current US dollars) | N/A | World Bank | 1960 - 2017 (58) |

| Predictor | Indicator | Description | Range | Source | Years range (number of time points) |
|---|---|---|---|---|---|
| | GNI | Gross National Income per capita (Constant 2010 US Dollar) | N/A | World Bank | 1960 - 2017 (58) |
| | Gini coefficient | GINI index (World Bank Estimate) | 0-100 | World Bank | 1979 - 2017 (39) |
| | Government effectiveness | Government effectiveness (World Bank Estimate) | -2.5 - 2.5 | World Bank | 1996 - 2017 (19) |
| | Corruption control | Control of corruption (World Bank Estimate) | -2.5 - 2.5 | World Bank | 1996 - 2017 (19) |
| | Shadow economy | Size of shadow economy (World Bank Estimate) | 0-100 | World Bank | 1999 - 2007 (9) |
| | Rule of Law | Rule of Law (Estimate) | -2.5 - 2.5 | World Bank | 1996 - 2017 (19) |
| | Market competitiveness | Global competitiveness index | 0-100 | World Economic Forum | 2007 - 2018 (11) |
| | Historical GDP per capita | GDP per capita (1990 International Geary-Khamis dollars) for the year 1950 | N/A | Maddison (2013) | 1950 (1) |
| | Democracy index | Composite index of: (1) Pluralism, (2) Functioning of government (3) Political participation, (4) Political culture, (5) Civil liberty | 0-100 | Economist Intelligence Unit | 2006 - 2018 (13) |
| *Kin-based Institutions* | | | | | |
| | Kinship intensity index | Composite index of: (1) Preferences for cousin marriage, (2) Polygamy, (3) Co-residence of extended families, (4) Community organization, (5) Presence of unilineal descent | N/A | Schulz et al. (2019) | N/A |
| | Cousin marriage index | Log cousin marriage prevalence in 20th century | N/A | Schulz et al. (2019) | N/A |
| *Religion* | | | | | |
| | Importance of God | How important is God in your life? | 1 (Not at all important) - 10 (Very | WVS | 1981 - 2016 (29) |

| | | | important) | | |
|---|---|---|---|---|---|
| Predictor | Indicator | Description | Range | Source | Years range (number of time points) |
| | Importance of religion* | How important is religion in your life? | 1 (Very important) - 4 (Not at all important) | WVS | 1989 - 2016 (26) |
| | Frequency of praying* | How often do you pray to God outside of religious services? | 1 (Often) -5 (Never) | WVS | 1999 - 2004 (6) |
| | Religious attendance* | How often do you attend religious services? | 1 (More than once a week) -7 (Never, practically never) | WVS | 1981 - 2016 (29) |
| | | How often do you attend religious services? | 1 (Every day) - 7 (Never) | ESS | 2002 - 2016 (8) |
| | Religious volunteering | Voluntary work: Unpaid work religious or church organization* | 1 (Yes) - 2 (Not mentioned) | WVS | 1990 - 2003 (7) |
| | | Voluntary work: Unpaid work religious or church organization (last 12 months) | 0 (No) - 1 (Yes) | ESS | 2002 (1) |
| | Belief in heaven* | Do you believe in heaven? | 1 (Yes) - 2 (No) | WVS | 1981 - 2004 (18) |
| | Belief in hell* | Do you believe in hell? | 1 (Yes) - 2 (No) | WVS | 1981 - 2016 (24) |
| | Belief in life after death* | Do you believe in life after death? | 1 (Yes) - 2 (No) | WVS | 1981 - 2004 (18) |
| | Belief in soul* | Do you believe people have a soul? | 1 (Yes) - 2 (No) | WVS | 1981 - 2004 (18) |
| | Western Church exposure | Calculated as the number of centuries each country was under the sway of either the Western Church prior to 1500 CE (adjusted for population movements that have occurred after the year 1500) | N/A | Schulz et al. (2019) | N/A |

| Predictor | Indicator | Description | Range | Source | Years range (number of time points) |
|---|---|---|---|---|---|
| | Eastern Church exposure | Calculated as the number of centuries each country was under the sway of either the Eastern Church prior to 1500 CE (adjusted for population movements that have occurred after the year 1500) | N/A | Schulz et al. (2019) | N/A |
| *Values* | | | | | |
| | Individualism-Collectivism | 6-D model of National Culture (Individualism-Collectivism) | 0-100 | Hofstede et al. (2010) | N/A |
| | Universalism* | Composite index of: (1) Importance of equal opportunities; (2) Importance of listening to different people; (3) Importance of caring for nature | 1 (Very much like me) - 6 (Not like me at all) | ESS | 2002 - 2016 (8) |
| | Benevolence* | Composite index of: (1) Importance of others' well-being; (2) Importance of loyalty toward friends. | 1 (Very much like me) - 6 (Not like me at all) | ESS | 2002 - 2016 (8) |
| | Survival vs. Self-Expression | Composite index of: | | | |
| | | (1) Can homosexuality always be justified, never be justified, or something in between; | 1 (Never justifiable) - 10 (Always justifiable) | WVS | 1981 - 2016 (28) |
| | | (1) Gay men and lesbians should be free to live their own life as they wish;* | 1 (Agree strongly) -5 (Disagree strongly) | ESS | 2002 - 2016 (8) |
| | | (2) Post-materialist index (4-items): Composite index of (1) Maintaining order in the nation; (2) Giving people more to say in important government decisions; (3) Fighting rising prices; (4) Protecting freedom of speech; | 1-3 | WVS | 1981 - 2016 (29) |
| | | (3) Taking all things together, would you say you are happy?;* | 1 (Very happy) - 4 (Not at all happy) | WVS | 1981 - 2016 (29) |

| Predictor | Indicator | Description | Range | Source | Years range (number of time points) |
|---|---|---|---|---|---|
| | | (3) Taking all things together, how happy would you say you are?; | 0 (Extremely unhappy) - 10 (Extremely happy) | ESS | 2002 - 2016 (8) |
| | | (4) I'd like you to tell me whether you have actually done any of these things, whether you might do it or would never do: signing a petition* | 1 (Have done) - 3 (Would never do) | WVS | 1981 - 2016 (29) |
| | | (4) During the last 12 months, have you signed a petition?* | 1 (Yes) - 2 (No) | ESS | 2002 - 2016 (8) |
| | Egalitarianism | Egalitarianism index | −1(Opposed to my values) - 7 (Of supreme importance) | Schwartz (2004) | N/A |
| *Trust* | | | | | |
| | Trust | I assume that people have only the best intentions. | 0 (Does not describe me at all) - 10 (Describes me perfectly) | Global Preference Survey (GPS) | 2012 (1) |
| | | Most people can be trusted* | 1 (Most people can be trusted), 2 (Need to be very careful) | WVS | 1981 - 2016 (29) |
| | Societal cynicism* | Negative view of human nature, a view that life produces unhappiness, that people exploit others, and a mistrust of social institutions. | 48.2 - 64.3 | Extracted from Leung & Bond (2004) | N/A |
| *Mobility* | | | | | |
| | Relational mobility | How much freedom and opportunity a society affords individuals to choose and dispose of interpersonal relationships based on personal preference | 1-6 | Thomson et al. (2018) | 2014 - 2016 (3) |
| | Residential mobility | Five-year Aggregate Crude Migration Intensity index (ACMI) | 0-100 | Bell et al. (2015) | N/A |

| Predictor | Indicator | Description | Range | Source | Years range (number of time points) |
|---|---|---|---|---|---|
| *Historical and Ecological Threats* | | | | | |
| | History of territorial threats | Number of territorial threats | N/A | International Crisis Behavior Archives | N/A |
| | Historical prevalence of pathogens | Prevalence of leishmanias, schistosomes, trypanosomes, leprosy, malaria, typhus, filariae, dengue, and tuberculosis | 0-3 | Extracted from Murray & Schaller (2010) | N/A |
| | Years of life lost to communicable disease | Years of life lost to communicable disease | N/A | World Health Organization | 1990 - 2017 (28) |
| | Natural disasters vulnerability* | Composite index of: (1) frequency of natural disasters; (2) severity of disasters; (3) number of deaths caused by natural disasters | N/A | Environmental Sustainability Index | N/A |
| | Food deprivation* | Composite index of: (1) Food supply (kcal/capita/day); (2) Protein supply quantity (g/capita/day); (3) Fat supply quantity (g/capita/day) | N/A | FAOSTAT | 1961 - 2013 (53) |
| | Real population density in AD 1500 | Population per square kilometer of arable land in a country | N/A | McEvedy & Jones (19778) | N/A |
| *Subsistence Style* | | | | | |
| | Interdependence Subsistence Index | Composite index of: Wheat agriculture + Rice agriculture - Herding | -1 - 2 | | 2000 (1) |
| | Rice agriculture | Amount of irrigated harvested rice relative to country's amount of cereal land | 0-1 | FAO/IIASA (2010) Global Agro-ecological Zones; World Bank | 2000 (1) |

| Predictor | Indicator | Description | Range | Source | Years range (number of time points) |
|---|---|---|---|---|---|
| | Herding | Amount of permanent pasture land relative to country area | 0-1 | FAOSTAT | 2000 (1) |
| | Wheat agriculture | Amount of irrigated harvested wheat relative to country's amount of cereal land | 0-1 | FAO/IIASA (2010) Global Agro-ecological Zones; World Bank | 2000 (1) |

*Notes*. Item marked as * were reverse scored for easier interpretation. Wording or scale anchors of some items extracted from the WVS or the ESS could vary across waves.

### Testing Hypotheses Across States and Regions within the United States

To provide a further test of these hypotheses, we additionally explored sources of variation in studies conducted across states and regions within the United States. First, we selected studies conducted in the United States from our sample of eligible studies. Second, we performed an additional coding of cultural indicators for each study to operationalize cross-cultural variation in formal institutions, kin-based institutions, religion, beliefs, values, and ecologies at the state level. Some indicators were not available at the state level (e.g., variables extracted from the General Social Survey; GSS), but only for entire regions of the United States. See Table S23 for an overview of the state and region-level indicators. Overall, analyses on the United States were performed on a total of 514 studies from 41 states ($k$ = 783) (see Table S24).

### Transparency and Openness

Our pre-registration, data, and R scripts used in the analyses can be accessed on the Open Science Framework (https://osf.io/kusgd). These data are also made openly available via the Cooperation Databank (CoDa): cooperationdatabank.org.

## Results

### Analytic Strategy

All analyses were conducted using the *metafor* package (Viechtbauer, 2010) in R (R Core Team, 2019). To obtain overall estimates of cooperative behavior for each society, we fitted our data in a mixed effects meta-regression. Given that the game paradigms of the studies differed for a number of study characteristics, the model included both fixed effect (i.e., societies[5] and study characteristics) and random effect (i.e., estimates, studies) components. Predictor variables to be entered in the meta-regression were selected a priori according to theory and documented in the pre-registration. We fitted a three-level model in which multiple cooperation estimates are nested in studies. This multi-level approach

[5] The inclusion of societies as fixed effects only occurred to obtain meta-analytic estimates of cooperation for each society. In all the other analyses, societies are included as random effects.

accounts for the sampling covariance between multiple cooperation estimates per study without the need to know or estimate the correlations among them (Cheung, 2014b; Van den Noortgate et al., 2014).

To examine cultural variation in cooperation, we extended the meta-regression model to a four-level model by adding the additional random effect of society in which the study was conducted. This reflects the assumption that cooperation estimates reported in studies within the same society are likely to be more similar than those observed in studies conducted in other societies (Cheung, 2014b; Konstantopoulos, 2011). With this approach, we were able to analyze the different variance components distributed across the four levels of the model. The following set of equations represent our four-level model, in which $y_{ijl}$ denote the *i*th observed cooperation estimates *y* originating from study *j* across *l* societies (note that the first level is the individual participant level):

$$(1)\ \widehat{y_{ijl}} \sim N(\beta_{ijl}, \sigma^2_{\epsilon_{ijl}})$$

$$(2)\beta_{ijl} \sim N(\beta_{0jl}, \sigma^2_{\epsilon_{0jl}})$$

$$(3)\beta_{0jl} \sim N(\beta_{00l}, \sigma^2_{\epsilon_{00l}})$$

$$(4)\beta_{00l} \sim N(\beta_{000}, \sigma^2_{\epsilon_{000}})$$

Equation 1 indicates that each observed cooperation estimate originates from a normal distribution centered around a true effect size with a sampling variance. The observed effect size is treated as an estimator of the true effect size, and the observed standard error is treated as the true sampling variance. Equation 2 indicates that the true effect size is a function of a study-specific true effect size plus variance across effect sizes within studies. Equation 3 indicates that study-specific true effect sizes are a function of society-specific true effect sizes plus variance across studies within societies. Equation 4 indicates that society-specific true effect sizes are a function of a true effect size plus between-society variance.

The inclusion of study-level and society-level moderators is possible with a specification of the above-mentioned equations. In the single-level equation that follows, *S* denotes a total of *p* predictors included at the second level (between cooperation estimates from the same study):

$$(5)\ \beta_{ik} = \theta_{0k} + \theta_{1k}S_{1k} + \cdots + \theta_{pk}S_{pk} + \omega_{ik}$$

Last, in the single-level equation that follows, *C* denotes a total of *p* predictors included at the third level (between studies from the same society):

$$(6)\ \theta_{k} = \delta_{0k} + \delta_{1k}C_{1k} + \cdots + \delta_{pk}C_{pk} + \beta_{ik})$$

We examined the variation in the distribution of the cooperation estimates using the $I^2$ index obtained for each level of the model. This allows for an interpretation of heterogeneity in terms of the proportion of variance ascribed to within-society variation (level 3) and between-society variation (level 4) compared to the total variation in cooperation estimates, respectively. Additionally, we tested for cultural differences in cooperation by using non-parametric tests to compare variation within and between cultural groups (as classified by Inglehart & Baker, 2000). To this end, we first computed cooperation estimates for each cultural group, and then, following Gächter and colleagues (2010), we used a Kruskall-Wallis test to compare them within and across cultural groups.

Our data contained missing information for several studies, including (a) the standard deviation of endowment contributed in the game, (b) study characteristics, and (c) societal-level indicators. For studies that did not report the standard deviation for contributions ($k$ = 648), we imputed the median value of the coefficient of variation to calculate the variance (Weir et al., 2018). The imputed coefficient of variation was based on using all the other studies that reported the standard deviation in continuous choice games ($k$ = 745). More information is reported in the online Supplemental Information (SI). We used two multiple imputation methods (Van Buuren & Groothuis-Oudshoorn, 2011) to estimate missing values for the study characteristic and the cultural indicator variables. Imputed values for continuous

variables (e.g., religious attendance and group size) were estimated via predictive mean matching, which selects imputed values from all complete cases that have predicted values closest to the missing information. This method is robust against misspecification and works under the assumption that missing values and the observed values used to predict them follow a similar distribution (Van Buuren, 2018). Imputed values for categorical variables (e.g., sanctions) were estimated via polytomous logistic regressions, that impute by the Bayesian polytomous regression model and provide reliable estimates for variables with a limited number of categories (Van Buuren, 2018).

The same analytic strategy has been applied to analyze data from studies conducted in the United States, with one exception. For the United States, some cultural indicators were only available for entire regions, and not available at the state-level, and so we used a combination of predictors at the state-level and the region-level in the models. Therefore, the multilevel model for the United States included an additional level specifying a random effect of region, and in which cooperation estimates were nested in studies, which are nested within states, and which are nested in regions.

**Cross-Cultural Variation in Cooperation Around the Globe**

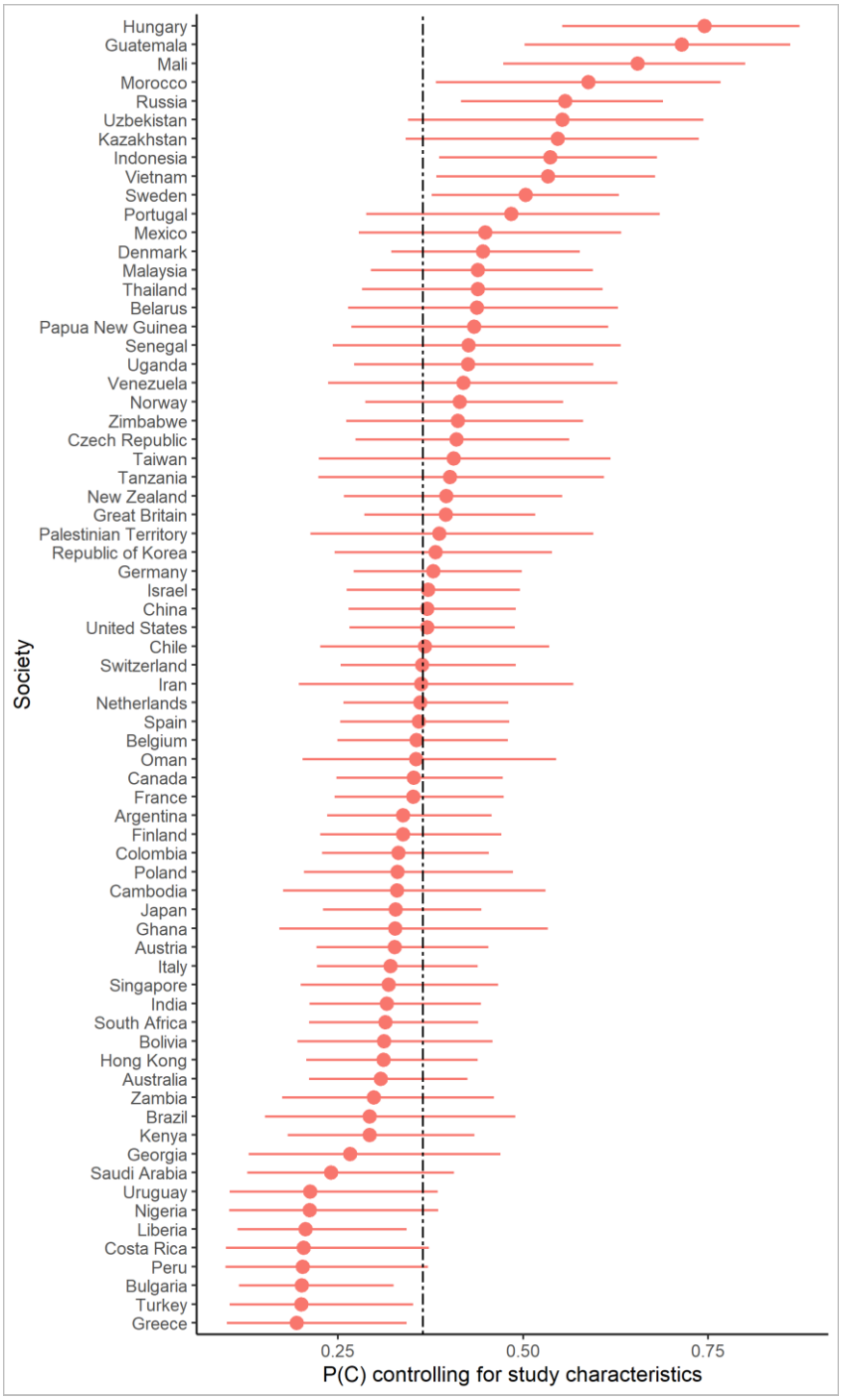
To estimate the amount of variation in cooperation due to cross-societal differences, we first tested the significance of the between-society variance component, to determine whether it is at all necessary to account for between-society variance in the meta-analytic model. Thus, we performed a one-sided log-likelihood ratio test that compared the fit of an intercept-only model (i.e., a model without predictors but including all random effects) to the fit of a model in which there were also no predictors, but where between-society variance was additionally not modelled (i.e., manually constrained to zero). The results of this test showed that the model in which between-society variance was freely estimated did not have a significantly better fit than the model in which between-society variance was not modeled (LRT = 2.374, $p$ = .123), indicating that there is not significant between-society variability.

We tested for asymmetry in the funnel plot using a modified Egger's regression approach (Egger et al., 1997). This modified test included the sample size as a predictor of the cooperation estimates in a multilevel meta-regression model, allowing to (a) account for the dependence among cooperation estimates (Rodgers & Pustejovsky, 2020), and (b) improve accuracy in detecting publication bias when using logit transformations of the proportion as an outcome measure (Macaskill et al., 2001). This approach can detect the degree to which studies with small samples may affect the analyses and, potentially, publication bias. We found a statistically significant positive association between sample size and the cooperation estimate ($b$ = 0.0002, $z$ = 2.223, $p$ = .026, $R^2$ = .004), which indicates asymmetry of the funnel plot. To account for between-study heterogeneity, we additionally entered the study characteristics as covariates in the regression (Sterne & Egger, 2005). Again, sample size had a statistically significant positive association with the cooperation estimates ($b$ = 0.0003, $z$ = 3.043, $p$ = .002, $R^2$ = .004). Overall, these results suggest that our sample might be affected by publication bias. That said, there is only a very small association between the sample size and cooperation estimates, and our sample of studies is very large and capable of detecting a wide range of effect sizes.

We therefore proceeded by estimating meta-analytic estimates of cooperation observed in each society through a multi-level meta-regression model that controlled for the heterogeneity in the different study characteristics and took into account the multilevel structure of the data. A test for multicollinearity of variables through the Generalized Variance Inflation Factor (GVIF) (Fox & Monette, 1992) revealed no multicollinearity among the study characteristics (see SI for more detail). Table 2 displays the estimates for each of the 70 societies included in the meta-analysis. Across all studies included in the meta-analysis, cooperation at the society-level ranged from 0.19 to 0.74, with a mean cooperation rate of 0.36 (95% *CI* [0.339, 0.391]) meaning that participants contributed on average 36% of their endowment in the game (see Figure 1).

**Figure 1**

*Society-Level Cooperation Rates*




*Note*. The plot displays logit transformed cooperation estimates converted back to proportions. Estimates are obtained from a mixed-effect meta-regression with society as fixed effect and controlling for study characteristics.

Then, we examined which of the study characteristics had significant effects on cooperation. We proceeded with fitting a four-level meta-regression that included the ten study characteristics as covariates, and in which cooperation estimates were nested in studies and in societies. The results of the meta-regression model showed that, among all study characteristics included in the model, K index ($b$ = 0.737, $p$ < .001), communication ($b$ = 0.532, $p$ < .001), sanctions ($b$ = 0.459, $p$ < .001), and number of choice options ($b$ = 0.128, $p$ = .001) were significantly associated with cooperation ($R^2$ = .0882) (Table 4). Cooperation was higher in social dilemmas that (a) had lower (versus higher) conflict of interests, (b) when communication was present (versus absent) among the people interacting in the experiment, (c) when punishments and/or rewards for behavior were present (versus absent), and (d) in which participants made continuous (versus dichotomous) choices. The intercorrelations between study characteristics covariates and cooperation are displayed in Table S1.

To estimate cultural differences in cooperation, we classified societies into cultural groups and then (1) test for whether cultural groups (instead of societies) explain a significant amount of variance in cooperation, and (2) compare the amount of variation within and between cultural groups. Societies were classified as belonging to a specific cultural group according to the World Values Survey Cultural Map (Inglehart et al., 2014), which aggregates societies based on their scores along the two dimensions of traditional vs. secular-rational values and survival vs. self-expression values. If classification for a society was not available, then we assigned cultural group based on the next older version of the cultural map. A one-sided log-likelihood ratio test compared the fit of an intercept-only model to the fit of a model where between-group variance was not modelled. The model in which between-group variance was freely estimated did not show a statistically significant improved fit, compared to the other model (LRT = 0.992, $p$ = .319). Results of a meta-regression predicting cooperation estimates and controlling for the study characteristics also revealed no significant differences in cooperation between cultural groups ($p$-*values* ≥ .337) (Table S22). Moreover,

we employed the Kruskall-Wallis as a further test to examine whether there is variation in cooperation within and across cultural groups. The first set of tests was performed separately for each cultural group, using society as a grouping variable. The second test was performed using cultural group as a grouping variable. Both tests used cooperation estimates as dependent variables. Results showed that cooperation across societies within cultural groups is significantly different only in two out of nine cultural groups ($p$ = .028, $p$ = .034), and cooperation was not significantly different across cultural groups ($p$ = .274) (see the SI for the complete report of the results). Altogether, these analyses suggest there is little variation in cooperation both within and between societies and cultural groups.

As a further test to estimate cross-societal variation in cooperation, we analyzed whether cooperation was associated with a measure of ancestral (i.e., genetic and linguistic distance) and cultural distance between pairs of societies. These measures were included as independent variables in three simple regression models predicting absolute differences in cooperation between each pair of societies. Society-level scores of cooperation were meta-analytic estimates obtained through a model that controlled for study characteristics (see SI for more details about the analyses and for results of the regression models using raw society-level cooperation). Results of this regression showed that linguistic distance ($b$ = 0.041, $p$ = .028, $R^2$ = .002) and cultural distance ($b$ = 0.080, $p$ = .038, $R^2$ = .002) had a significant positive association with cooperation. These findings indicate that as linguistic and cultural distance increases between two societies, the absolute differences in cooperation also become larger. However, genetic distance was not statistically associated with differences in cooperation between societies ($b$ = 0.111, $p$ = .352, $R^2$ = .001). Overall, the amount of variance in cooperation explained by the linguistic, cultural, and genetic distance between societies was extremely low.

**Table 4**

*Estimates from the Multi-Level Meta-Regression Models Predicting Cooperation Estimates*

| Variable | Model 1 | | Model 2 | | Model 3 | |
|---|---|---|---|---|---|---|
| | *b* | *p* | *b* | *p* | *b* | *p* |
| Symmetry (mixed) | -0.252 | .095 | -0.235 | .122 | -0.224 | .141 |
| Symmetry | 0.032 | .673 | 0.031 | .676 | 0.032 | .667 |
| Repetitions (mixed) | -0.003 | .982 | -0.026 | .864 | 0.015 | .921 |
| Repetitions (one-shot) | 0.034 | .343 | 0.013 | .725 | 0.015 | .689 |
| Group size log | -0.042 | .186 | -0.035 | .286 | -0.034 | .314 |
| K Index | 0.737 | <.001 | 0.757 | <.001 | 0.752 | <.001 |
| Communication (mixed) | 0.421 | .010 | 0.403 | .015 | 0.374 | .028 |
| Communication (present) | 0.532 | <.001 | 0.538 | <.001 | 0.525 | <.001 |
| Decision protocol (mixed) | -0.071 | .609 | -0.074 | .591 | -0.087 | .531 |
| Decision protocol (simultaneous) | 0.012 | .860 | 0.007 | .921 | 0.000 | .995 |
| Sanction (mixed) | 0.204 | .109 | 0.185 | .148 | 0.198 | .120 |
| Sanction (present) | 0.459 | <.001 | 0.461 | <.001 | 0.478 | <.001 |
| Choice options (continuous) | 0.128 | .001 | 0.097 | .024 | 0.078 | .081 |
| Source of society (different societies) | -0.144 | .516 | -0.161 | .471 | -0.139 | .538 |
| Source of society (all authors) | -0.033 | .530 | -0.018 | .733 | -0.014 | .789 |
| Source of society (most authors) | -0.002 | .986 | -0.009 | .949 | -0.005 | .972 |
| Period of cooperation (first) | 0.017 | .882 | 0.016 | .891 | 0.021 | .860 |
| Formal institutions (PC2) | | | -0.045 | .179 | -0.059 | .113 |
| Formal institutions (PC3) | | | -0.045 | .484 | -0.001 | .992 |
| Kinship intensity (PC1) | | | -0.052 | .542 | -0.115 | .397 |
| Religion (PC1) | | | 0.019 | .682 | -0.009 | .867 |
| Exposure to Western Church | | | -0.043 | .705 | -0.117 | .470 |
| Exposure to Eastern Church | | | -0.129 | .387 | -0.334 | .086 |
| Egalitarianism | | | -0.097 | .376 | 0.019 | .889 |
| Individualism | | | -0.064 | .639 | -0.163 | .308 |
| Universalism | | | -0.011 | .861 | 0.006 | .943 |
| Benevolence | | | 0.032 | .650 | 0.023 | .717 |
| Self-expression | | | -0.045 | .612 | 0.004 | .970 |
| Beliefs - Societal cynicism (PC1) | | | 0.074 | .393 | 0.026 | .809 |
| Beliefs - Trust (PC2) | | | -0.053 | .361 | -0.089 | .257 |
| Interdependent subsistence (index) | | | 0.013 | .856 | 0.028 | .779 |
| Relational mobility | | | -0.010 | .934 | -0.021 | .894 |
| Residential mobility | | | -0.026 | .767 | 0.028 | .832 |
| Pathogens prevalence | | | -0.178 | .116 | -0.164 | .201 |
| Threats (PC1) | | | -0.002 | .990 | -0.009 | .932 |
| $R^2$ | .0882 | | .0882 | | .0799 | |

*Note*. Model 1: based on 70 societies and includes study characteristics covariates. Model 2: based on 70 societies and includes study characteristics covariates and societal-level indicators. Model 3: based on 32 societies ($k \geq 4$) and includes study characteristics covariates and societal-level indicators.

Next, we consider how the 19 societal-level indicators covary with cross-societal variation in cooperation. We first consider the simple correlations between the indicators and found that the intercorrelations between indicators were high ($-.82 > r > .82$), and that cooperation only had a significant positive association with trust ($r = .45$) (see Table S2). A test for multicollinearity using the Generalized Variance Inflation Factor (GVIF) (Fox & Monette, 1992) identified a collinear variable (formal institutions PC1), which was removed from the set of variables included in the meta-regression model (see SI for more detail). An analysis of the intraclass correlation of the mixed effect meta-regression showed small between-society variation in cooperation ($ICC_{level4} = 0.02$). The analysis of $I^2$ statistics obtained for each level of the model showed that 51.48% of the observed variance was due to between-study (within-society) variation (level 3) and a negligible proportion (1.94%) was due to between-society variation (level 4) (Table 5). The results of the meta-regression revealed that all the society-level indicators failed to significantly predict cooperation observed in the studies ($p$-values $\geq .116$). The study characteristics (i.e., K index, communication, sanctions, and number of choice options), however, remained significant ($p$-values $\leq .024$), ($R^2 = .0882$). This pattern of findings was replicated when fitting several different meta-regression models in which each indicator was included as society-level moderator without being previously aggregated through PCA (Tables S11-S19).

As some of the societies included in the meta-analysis had only a single observation, we replicated the analyses by setting a threshold that imposed a higher number of minimum observations per society ($k \geq 4$). This threshold ensured that we retained at least 30 societies which, based on Maas and Hox's (2005) rules of thumb for multilevel linear models, are required to obtain unbiased estimates of both fixed regression parameters and variance estimates. Thus, in all subsequent analyses, only societies with $k \geq 4$ were included, resulting in a final set of 32 societies. Results from the meta-regression model including 32 societies fully replicated what we observed with 70 societies. We observed that the between-society

variance component was not significant (LRT = 2.509, $p$ = .113), as also suggested by the small intraclass correlation ($ICC_{level4}$ = .033). The analysis of $I^2$ statistics obtained for each level of the model showed that 50.41% of the observed variance was due to between-study (within-society) variation (level 3), while only 3.22% was due to between-society variation (level 4) (Table 5). Importantly, none of the societal-level indicators significantly predicted cooperation ($p$-values ≥ .086), while some study characteristics did ─ except for the number of choice options, which now became non-significant ($p$ = .081), ($R^2$ = .080) (Table 4).

As a robustness check, we additionally estimated six separate models that included study characteristics and only the indicators relevant to test a single theoretical account. The results of the six models are displayed in Table S20 and largely correspond to the findings obtained by including the entire set of indicators. Again, all the societal-level indicators did not significantly predict cooperation ($p$-values ≥ .075), except for historical prevalence of pathogens ($b$ = -0.092, $p$ = .044) and quality of formal institutions (third principal component) ($b$ = -0.051, $p$ = .029). The direction of these later two relationships are in line with our pre-registered hypotheses. However, we recommend a cautious interpretation of these results due to the small size of the estimate, and the fact that both results are not replicated in the complete (pre-registered) models (see Table 4). The eigenvalues, explained variance, and correlations between the societal-level indicators of institutional quality are reported in Tables S7-S8. This pattern of findings was replicated when fitting the same six separate meta-regression models including 70 societies with no imputation of missing data (Table S21).

**Table 5**

*Overall Meta-Analytic Estimates of Cooperation and Heterogeneity*

| | Overall ES | | Overall Model Estimates | | | Heterogeneity Estimates | | | |
|---|---|---|---|---|---|---|---|---|---|
| Models | Cooperation rate | 95% *CI* | $R^2$ | ICC level 3 | ICC level 4 | $\tau^2$ | $I^2$ level 2 | $I^2$ level 3 | $I^2$ level 4 |
| Model 1 | 0.36 | [0.339, 0.391] | .0882 | 0.533 | 0.014 | 0.465 | 44.221 | 51.998 | 1.317 |
| Model 2 | 0.38 | [0.342, 0.427] | .0882 | 0.529 | 0.020 | 0.465 | 43.923 | 51.483 | 1.944 |
| Model 3 | 0.42 | [0.355, 0.485] | .0799 | 0.518 | 0.033 | 0.472 | 43.651 | 50.409 | 3.224 |
| Model 4 Institutions | 0.36 | [0.341, 0.396] | .0858 | 0.523 | 0.024 | 0.469 | 44.087 | 50.998 | 2.346 |
| Model 5: Kin-based institutions | 0.37 | [0.343, 0.397] | .0916 | 0.53 | 0.013 | 0.466 | 44.478 | 51.56 | 1.307 |
| Model 6: Religion | 0.35 | [0.320, 0.382] | .0838 | 0.523 | 0.025 | 0.47 | 44.035 | 50.963 | 2.441 |
| Model 7: Values | 0.36 | [0.330, 0.391] | .0799 | 0.521 | 0.293 | 0.472 | 43.827 | 50.721 | 2.856 |
| Model 8: Trust | 0.37 | [0.339, 0.393] | .0877 | 0.527 | 0.019 | 0.468 | 44.304 | 51.299 | 1.828 |
| Model 9: Ecology | 0.37 | [0.338, 0.398] | .0838 | 0.523 | 0.025 | 0.470 | 44.063 | 50.897 | 2.435 |

*Note*. ICC = Intraclass correlation. Cooperation rate = obtained through inversion of the logit transformation of cooperation rates (i.e., cooperation estimates). Model 1: based on 70 societies and includes study characteristics covariates. Model 1: based on 70 societies and includes study characteristics covariates and societal-level indicators. Model 3: based on 32 societies ($k \geq 4$) and includes study characteristics covariates and societal-level indicators. Models 4 through 9: based on 32 societies ($k \geq 4$) and includes study characteristics covariates and hypothesis-relevant societal-level indicators.

**Cross-Cultural Variation in Cooperation in the United States**

Following the approach used for the global sample, we performed a one-sided log-likelihood ratio test to assess the significance of the between-state variance component in order to estimate the amount of variation in cooperation in the United States due to differences between states. Similar to what we observed across societies, the results suggest that the between-state variance in the estimates of cooperation is small. Specifically, the model in which between-state variance was freely estimated did not have a statistically significant improved fit, compared to the model in which between-state variance was not modeled (LRT = 0.194, $p$ = .660). Table S24 displays the estimates for each of the 41 states included in the meta-analysis.

To examine which of the study characteristics had a significant relationship with cooperation, we fitted a meta-regression that included the nine study characteristics as covariates, with cooperation estimates nested in studies, U.S. states, and U.S. regions. In line with what we observed in the global sample, the results of the meta-regression model show that, among all study characteristics included in the model, K index ($b$ = 0.559, $p$ < .001), communication ($b$ = 0.527, $p$ < .001), sanctions ($b$ = 0.489, $p$ < .001), and number of choice options ($b$ = 0.207, $p$ = .005) had a significant association with cooperation ($R^2$ = .1362). However, some additional study characteristics, namely symmetry (symmetric and asymmetric treatments) ($b$ = -0.502, $p$ = .043), repetitions ($b$ = 0.192, $p$ = .004), simultaneous decision protocol ($b$ = 0.274, $p$ = .048), also displayed significant associations with cooperation (Table S34). These additional variables suggest that, in the U.S. sample, cooperation was higher in games (a) with symmetric (versus both symmetric and asymmetric) structures, (b) involving one-shot (versus repeated) interactions, and (c) in which participants made simultaneous (versus sequential) decisions.

To estimate cultural differences in cooperation, we (1) tested for whether U.S. regions explain a significant amount of variance in cooperation, and (2) compared the amount of

variation within and between regions. A one-sided log-likelihood ratio test compared the fit of an intercept-only model to the fit of a model where between-region variance was not modelled. The model in which between-region variance was freely estimated showed a statistically significant improved fit, compared to the other model (LRT = 4.689, $p = .030$). Results of a meta-regression predicting cooperation and controlling for the study characteristics revealed no significant differences in cooperation between most U.S. regions (*p-values* $\geq .058$), except for the South Atlantic region (in which higher cooperation was observed compared to the East North Central region as baseline, $p = .001$) (Table S37). As done for the global data, we employed the Kruskall-Wallis test to examine variation in cooperation within and across U.S. regions. Results confirmed that cooperation within U.S. regions is significantly different only within the South Atlantic region ($p = .004$), and cooperation also varied across regional groups ($p = .003$) (see the SI for the complete report of the results). Altogether, these tests suggest mixed evidence for variation in cooperation across the different U.S. regions.

Next, we consider how the 19 region and state-level indicators are associated with cooperation. We first consider the correlations between the indicators and found that the intercorrelations between indicators were high ($-.75 > r > .76$) (see Table S25 for the entire set of correlations), and that no indicator was significantly associated with cooperation (*p*-values $\geq .118$). A test for multicollinearity identified a collinear variable (cultural tightness), which was removed from the set of variables included in the meta-regression model (see SI for more detail). An analysis of the intraclass correlation of the mixed effect meta-regression showed small between-state variation in cooperation ($ICC_{level4} = 0.01$). The analysis of $I^2$ statistics obtained for each level of the model showed that 40.33% of the observed variance was due to between-study (within-state) variation (level 3) and a negligible proportion (0.47%) was due to between-state variation (level 4) (Table S36). The results of the meta-regression revealed that all the state and region-level indicators failed to significantly predict cooperation

observed in the studies ($p$-values $\geq .401$), ($R^2 = .0854$). The study characteristics (i.e., K index, communication, sanctions, number of choice options, symmetry, repetitions, and simultaneous decision protocol), however, remained significant ($p$-values $\leq .045$) (Table S35).

Following the same approach used for the global sample, we replicated the analyses by setting a threshold of $k \geq 4$ for each state to be included in the meta-analysis, resulting in a final set of 30 U.S. states. We observed that the between-state variance component was not significant (LRT = 0.285, $p = .593$), as also suggested by the small intraclass correlation ($ICC_{level4} = .007$). Results from the meta-regression models including 30 U.S. states fully replicated what we observed with 41 U.S. states and are reported in detail in the SI. None of the state and region level indicators significantly predicted cooperation ($p$-values $\geq .088$), while some specific characteristics of the studies did ($p$-values $\leq .031$). Thus, as found in the global sample, there was little variation in cooperation across states and regions in the United States, and no institutional, cultural, or ecological differences across states (or regions) in the United States was associated with variation in cooperation.

## Discussion

Humans cooperate within multiple domains in daily life, such as sharing common pool resources and producing large-scale public goods. Cooperation can be expressed in many ways, including strategies to favor kin (Hamilton, 1964), allies and coalitional members (Balliet et al., 2014; Yamagishi et al., 1999), and it can even occur in interactions among strangers with no known future interactions (Delton et al., 2011; Macy & Skvoretz, 1998). Here, we focused on this later kind of impersonal cooperation, in which people interact for the first time, they have no knowledge of their partner's reputation, and no known possibilities of future interaction outside the experiment. Impersonal cooperation can enable societies to develop, expand, and compete, impacting wealth and prosperity. Although impersonal cooperation occurs in all modern, industrialized, market-based societies, prior research has documented cross-societal variation in impersonal cooperation (Henrich, Ensminger, et al.,

2010; Hermann et al., 2008; Romano et al., 2021). To date, several perspectives have been advanced to explain why and how impersonal cooperation varies across societies.

The present meta-analysis aimed to (1) estimate the extent of cross-societal variation in impersonal cooperation, and (2) to test hypotheses about the institutional, cultural, and ecological factors that have been proposed to account for this variation. To answer these questions, we meta-analyzed observations of cooperation obtained from 1,506 studies using economic games (i.e., Prisoner's Dilemma and Public Goods Game), which were conducted across 70 societies. We took several approaches to estimate cross-cultural variation in cooperation, including comparisons across societies, cultures, and states/regions within a single large country (i.e., the United States). We found that cooperation did not differ much at all between regions, societies and cultures. Furthermore, we didn't find any support for theories that explain variation in impersonal cooperation across societies. Below, we relate these findings to existing theory and research, and discuss the strengths and limitations of the meta-analysis.

**Variation Across Societies in Impersonal Cooperation**

Past research investigating variation in impersonal cooperation across societies has mostly used either surveys or experiments. Perhaps the best example of survey research is the World Value Survey, in which respondents report how acceptable it is to engage in some non-cooperative action (e.g., not paying taxes; Knack & Keefer, 1997). However, societies and cultures may have norms and institutions that regulate these specific behaviors differently and self-reports may not provide the most optimal method of measuring impersonal cooperation. Experiments, on the other hand, provide an internally valid setting in which people make costly decisions to cooperate with others, and may be better suited to test hypotheses about cross-societal differences in impersonal cooperation. Yet, most earlier research adopting an experimental approach only compared cooperation between two societies (e.g., Bram Cadsby et al., 2007; Cason et al., 2002), or a relatively small number of societies (e.g., Cárdenas et al.,

2009; Goerg & Walkowitz, 2010), which severely limits the ability to estimate the degree of variation in cooperation across societies and cultures.

In the last two decades, several studies were conducted to understand whether impersonal cooperation in economic games varies across multiple small-scale and large-scale societies. In a pioneering study across 15 small-scale societies, Henrich and colleagues (2010) reported high behavioral variability in economic games, with substantial differences in endowment offered between the least to most cooperative societies (i.e., 26% to 47% in a Dictator Game, 25% to 51% in an Ultimatum Game, and then in a limited set of 7 societies they found 22% to 65% in a Public Goods Game). In a sample of 16 industrialized societies, Hermann and colleagues (2008) found that average contributions to a standard Public Goods Game differed significantly between societies (i.e., 25% to 58% of the endowment). Gächter and colleagues (2010) then classified these 16 societies into six cultural groups and found that average levels of contributions ranged between 29% to 50% of the endowment and were significantly different between cultural groups ($R^2$ = .0039). Other studies also found evidence for cross-cultural variation in cooperation (e.g., Buchan et al., 2009; Lamba & Mace, 2011; Romano et al., 2021).

However, some studies detected no significant cross-societal variation (e.g., Brandts et al., 2004; Kocher et al., 2008; Okada & Riedl, 1999)[6]. To illustrate, a meta-analysis of Ultimatum Games conducted across 25 societies found no differences in the percentage of endowment offered by proposers in the game (Oosterbeek et al., 2004). Similarly, other studies using the Trust Game reported no difference in behavior across two Western and two Non-Western societies (Buchan et al., 2006). Therefore, past research has been mixed about cross-societal variation in impersonal cooperation when using experimental economic games.

[6] The referenced studies that identified (or not) cross-cultural differences in cooperation all measured cooperation using different economic games (e.g., trust games, dictator games, and ultimatum games) than those included in the meta-analysis (i.e., Prisoner's Dilemma and Public Goods Games). Nevertheless, these games can also be used to measure cooperative behavior (Thielmann et al., 2020), and prior research has found that cooperative behaviors are positively correlated across these different games (Peysakhovich et al., 2014; Yamagishi et al., 2013).

In the present meta-analysis, we found little variation in impersonal cooperation across 70 societies and 8 cultural groups. In fact, we found no significant differences in cooperation between cultural groups, which suggests there is little variation both within *and* between cultures. Moreover, linguistic and cultural distance between each pair of societies were only weakly related to differences in cooperation between societies, and genetic distance was not significantly associated with cooperation. If there existed substantial, systematic differences between societies in impersonal cooperation, we would expect a strong association between cultural distance and cooperation. Furthermore, we gathered all the societal indicators that have been hypothesized to explain cross-societal variation in impersonal cooperation and found that none of these were associated with cooperation. We also analyzed variation in cooperation across U.S. states and regions and found mixed evidence for variation in cooperation across the US. Contrary to what we observed within the global data, we found some variation in cooperation across U.S. regions, but only in one out of eight comparisons (i.e., South Atlantic region vs. East North Central region). That said, we did not find evidence for any between-state variation in cooperation.

Many of the previous cross-cultural studies present limitations that the current meta-analysis aimed to address. Some prior research sampled only a few societies (e.g., Brandts et al., 2004), while this meta-analysis includes 70 societies. Further, much prior research relied on a single, limited participant pool within each society (e.g., a subject pool at one university, Buchan et al., 2006; Gächter et al., 2005). This might introduce bias in making cross-cultural inferences, especially in societies in which within-society differences are as large as the between-society differences (e.g., the United States). Accordingly, any observed variation might wrongly be attributed to cultural differences, instead of differences between subject pools, which could produce inconsistent findings (Lamba & Mace, 2011; Oosterbeek et al., 2004). In principle, the meta-analytic approach can be used to analyze cooperation from multiple samples within the same society, and across a large set of societies and cultures.

Despite this strength of the meta-analysis, the majority of previous research has been conducted in WEIRD societies (Henrich, Ensminger, et al., 2010), and several societies only had a limited number of observations. Nonetheless, we still found similar results when restricting the analyses to only include societies with multiple observations.

One possible conclusion from the present meta-analysis is that the variation in impersonal cooperation across societies and cultures, if existent, is small. This evidence is supported by some previous empirical findings. For example, in a recent study observing cooperation in a Prisoner's Dilemma across 42 societies, the least and the most cooperative society merely differed by 15% of the endowment contributed to their partner (Romano et al., 2021). In that study, even if absolute differences in cooperation between pairs of societies were positively associated with their cultural distance, the effect was relatively small ($R^2$ = .021). Additionally, although past research identified cultural differences in contributions in a standard linear Public Goods Game (Herrmann et al., 2008), the cultural background of the participant pools only explained 3.9% of variation in cooperation (Gächter et al., 2010).

If there is, indeed, very little variation in impersonal cooperation across societies, then the meta-analysis may not be the most suitable method to estimate this small amount of variation. The meta-analysis does not have the same degree of experimental control of previous studies that applied the same method across each society (e.g., Hermann et al., 2008; Romano et al., 2021). To mitigate the heterogeneity in cooperation due to variation across experimental paradigms, we annotated a set of situational features of social dilemmas that have been found to influence cooperative behavior (for a meta-analysis, see Jin et al., 2021). We found that cooperation was higher in studies with less conflicting interests, with the possibility to communicate, and that included sanctions for behavior. These factors explained 8.8% of variance in cooperation. Thus, there remained substantial variation in cooperation across studies after controlling for these factors. Still, none of this variance was accounted for

by society or culture in which the study took place. Instead, most variance in behavior was due to differences between the studies.

This is not to say that all forms of cooperation do not vary across cultures. Prior evidence suggests there are differences in the extent of cross-societal variation of specific forms of cooperation. For example, parochial cooperation – that is, a greater willingness to cooperate with ingroup members – has been found to be expressed to a similar extent across 42 societies (Romano et al., 2021). On the other hand, when punishment opportunities are present, then there exist substantial cultural differences in impersonal cooperation (i.e., 21.3%), compared to when punishment is absent (i.e., 3.9%; Gächter et al., 2010). Norms and norm enforcement are a key feature of how societies can establish and maintain cooperation (Boyd & Richerson, 2002). Societies may differ in how they enforce norms and respond to being punished (Balliet et al., 2013b), which may allow these aspects of culture to be expressed in experiments. Therefore, as opposed to studying cooperation in the absence of any mechanism to promote it, future research may focus on the study of how cultures vary in the use of the mechanisms known to affect cooperation, such as direct reciprocity (Nowak, 2006), indirect reciprocity (i.e., gossip and reputation; Balliet, Wu, et al., 2020), partner selection (Barclay, 2013), network structures (Fehl et al., 2011), and sanctioning institutions (Fehr & Gächter, 2002).

**Evaluating Theories of Cross-Societal Variation in Cooperation**

Prominent research on human cooperation highlight that the quality of institutions can mitigate uncertainty and threats (e.g., Yamagishi et al., 1998), provide incentives for cooperation (e.g., Cassar et al., 2014), and loosen kinship ties (e.g., Henrich, 2020; Schulz et al., 2019), all of which are hypothesized to promote impersonal cooperation. Other accounts have focused on how cultural beliefs and values that vary across societies could affect impersonal cooperation, such as religiosity (e.g., Johnson & Krüger, 2004), beliefs that others are trustworthy (e.g., Balliet & Van Lange, 2013a), and specific value orientations, such as

collectivism (e.g., Sagiv et al., 2011; Triandis, 1995). Furthermore, some other perspectives have emphasized the role of ecological factors, such as mobility (e.g., Oishi, 2010; Yuki & Schug, 2012), subsistence style (e.g., Talhelm et al., 2014), and exposure to threats (e.g., Fincher et al., 2008), which determined the degree to which individuals could benefit from opportunities of interactions with strangers or, instead, to develop reliance on groups and closed networks.

These perspectives and hypotheses have developed across different disciplines and have been tested using a multitude of methods, which vary in the operationalization of cooperation. Economic games are one of the most widely used methods to measure cooperation across societies, due to their rigorous standardized approach to measuring cooperation. However, other studies have used measures of people's willingness to cooperate (e.g., norms of civic cooperation measured in surveys; Knack & Keefer, 1997) or even success in collective action (e.g., commune's longevity, engagement in the community, and political involvement; Bauer et al., 2016; Sosis, 2000). Additionally, cooperation is often measured through a variety of proxies of social capital, which capture trust, social norms of cooperation, and the willingness to enforce norms of cooperation (Coleman, 1988; Yuan et al., 2021). This diversity of theory and methods provides a challenge to understanding an equivalent diversity of research findings about cross-societal variation in cooperation.

In the current meta-analysis, we regressed cooperation observed in Prisoner's Dilemmas and Public Goods Games on societal-level indicators that were selected to operationalize institutional, cultural, and ecological variables that have been proposed to be associated with cross-societal variation in impersonal cooperation. Our meta-regression model took into account the multi-level structure of our data, and revealed no significant association between cooperation and any of the cross-cultural indicators. Weak associations between cooperation and the indicators are also displayed by the society-level raw correlations patterns, in which only trust (PC2) was significantly positively related to cooperation ($r$ = .45)

(see Table S2). Overall, cooperation was mostly explained by features of the situation (e.g., the possibility to communicate and the presence of sanctions) rather than cultural variables. Including the cultural indicators in the model did not increase the overall explained variance beyond what was already explained by the study characteristics ($R^2$ = .0882). The lack of differences in cooperation between societies was replicated using a within-group analysis which only focused on differences across states within the United States.

The fact that the meta-analytic estimates of cooperation were not associated with any of the institutional, cultural, and ecological indicators is a stark violation of expectations built on decades of research. That said, such a finding is consistent with evidence from several recent studies. Indeed, the quality of institutions (e.g., rule of law, GINI, GDP per capita, market competitiveness, and government effectiveness) was not found to be associated with contributions to public goods across 10 societies (Frey, 2019), or with cooperation in the Trust Game across 17 societies (Romano et al., 2017). Similarly, societal trust and values (e.g., individualism, power distance, egalitarianism, and globalization) were found to be unrelated to cooperation, as measured using a variety of economic games to measure cooperation (Buchan et al., 2009; Frey, 2019; Oosterbeek et al., 2004; Romano et al., 2021). Furthermore, previous studies have failed to detect any association between cooperation and features of the ecology (e.g., parasite stress and relational mobility; Romano et al., 2017). Therefore, our findings are supported by some past research that has documented mixed evidence in support of cross-societal differences in cooperation.

Our results imply that all modern societies under analysis display a very similar tendency for impersonal cooperation. Interactions in large scale modern societies take place with high levels of anonymity in relatively mobile settings, mostly regulated by formal institutions. Cultural evolution could have resulted in these societies displaying similarly high degrees of cooperation with strangers, as a result of the competitive selection of cooperative norms that permitted the formation of market institutions (Henrich, Ensminger, et al., 2010).

Indeed, market exchange and the division of labor produce substantial benefits to incurring the risk to establish mutually beneficial cooperative exchange with strangers (Bowles, 1998; Powers et al., 2016). Accordingly, the mechanisms established to effectively sustain cooperation could be similar across these societies. For instance, large-scale societies all increasingly rely on institutional rules to reduce conflicting interests and solve the free-rider problem, while other strategies based on direct and indirect reciprocity (e.g., gossip) could be relatively more efficient and effective at promoting cooperation in smaller communities (Powers et al., 2016). A possible method to test this prediction would be to compare these findings with data from small-scale societies, that are characterized by greater diversity in exposure to market exchange, relational mobility, and (in)formal institutions (Henrich et al., 2005; Henrich & Muthukrishna, 2021). Indeed, prior research has shown that studies conducted across small-scale societies detect greater variability in cooperative behavior than what is observed in large-scale societies (Henrich et al., 2005). For example, while mean offers in the Ultimatum Game in large-scale societies range typically between 40% and 50% of endowment (e.g., Camerer, 2003; Roth et al., 1991), there is relatively greater variation in the mean offers in the Ultimatum Game across small scale societies (26%-58% of endowment offered), that were positively and strongly related to societal-level market integration (Henrich et al., 2001).

Currently, many small-scale societies are facing a transition to more integrated economies and modern lifestyles. Thus, analyzing within-society temporal variation in beliefs and behaviors displayed across time can provide insights on how exposure to more modern cultural institutions affects impersonal cooperation. To illustrate, recent empirical evidence on the Hadza population suggests that, compared to a decade before (Apicella et al., 2012), their participation in market exchanges might have increased the value Hadza currently place on others' cooperative traits in partners' choice (Smith & Apicella, 2020). Additionally, greater exposure to market exchange within a small-scale community has resulted in less reliance on

kin as exchange partners (Kasper & Mulder, 2015). Hence, studying small-scale societies would help testing theories and speak to the question of how differences in impersonal cooperation have evolved as societies grew in size and complexity.

### *Recommendations for Future Cross-Cultural Investigations*

Given the mixed evidence in support of theories about cross-cultural variation in impersonal cooperation, it is critical to identify conceptual and methodological recommendations to address the fundamental question of whether impersonal cooperation varies across societies. The current meta-analysis specifically focused on behavior in interactions involving conflicting interests between personal and collective welfare (i.e., social dilemmas). In these situations, the incentives are structured so that defecting (and exploiting others' cooperation) is the most rewarding outcome for the self. However, situations that involve such conflicting interests may represent only a small portion of the interdependent situations individuals *actually* face in daily life, and restricting observations to these kinds of situations might be insufficient for understanding how impersonal cooperation varies across societies (Balliet et al., 2022). Indeed, recent research found that, more often than not, individuals perceive social interactions as having corresponding – rather than conflicting – interests (Columbus et al., 2020). Thus, it is important to study across cultures how strangers coordinate with each other to achieve mutually beneficial outcomes.

Additionally, the results of the meta-analysis provide some methodological recommendations in designing future studies to investigate cross-cultural differences in cooperation. First, as differences in cooperation across large, industrialized societies are likely small, future research should obtain adequate statistical power to detect this small effect size by including a sufficient number of participants and societies. Second, future work should rely on highly standardized paradigms to minimize error due to the heterogeneity of methods across studies conducted in different cultures (e.g., Herrmann et al., 2008; Romano et al., 2021) and to enhance comparability and generalizability of the findings. Then, future research

could benefit from cross-validating findings from standardized experiments with alternative operationalizations of impersonal cooperation observed in the field, especially those involving tangible incentives, such as donating blood (Schulz et al., 2019), paying taxes (Alm & Torgler, 2006) , participating in political life (Fowler & Kam, 2007), and behaviors curbing disease transmission and a pandemic (Romano et al., 2021).

**Experimental Social Dilemmas and Culture**

Experimental economic games have a long-standing tradition in the study of individual decision making, as they offer a precise and parsimonious setting to measure actual cooperative behavior (Dawes, 1980; Murnighan & Wang, 2016). These structured and standardized tasks provide highly internally valid observations about how individuals make decisions in different interdependent contexts (Thielmann et al., 2021; Van Dijk & De Dreu, 2021). Experimental economic games also mitigate social desirability concerns that can emerge when studying conflict and antisocial behavior (Coleman, 1982). Crucially, the standardization of economic games facilitates comparison of behaviors across societies and cultures. Indeed, these paradigms have been frequently used in both industrialized and small-scale societies to test hypotheses about cross-cultural variation in cooperative behavior (Henrich et al., 2005; Herrmann et al., 2008; Romano et al., 2021). Such rigor in making cross-societal comparisons would be otherwise challenging to achieve through other methods, such as surveys, participant observations, and analysis of archival data (Holmes, 2020). Although these latter methods provide more ecologically valid data on the populations of interest, these methods raise issues of comparability and might result in heterogeneous operationalization of cooperative behaviors.

Although the abstract nature of the games is convenient to conduct comparative research, this advantage can carry the cost of being *too* abstract. Accordingly, it becomes challenging to determine whether the observed behavior (a) resembles cooperative behavior participants display in real-world contexts, and (b) the cross-societal differences result from

different interpretations (i.e., framing) of the game. One strategy to assess external validity of economic games is to relate cooperation observed in these contexts with alternative indicators of cooperative behavior. Previous evidence is mixed in this regard (Pisor et al., 2020), and a recent meta-analysis revealed a weak positive association between cooperation elicited in economic games and cooperative behavior observed in the field (e.g., donations to charity, $\rho$ = .14; Galizzi & Navarro-Martinez, 2019). An additional challenge for the interpretation of the observed behavior across different cultures comes from the intentional lack of explicit framing in the games. Here, decisions in the game might be influenced by the frames that individuals apply to make sense of the situation. To date, no systematic research has been conducted on the cultural equivalence of games across societies. Anecdotal evidence suggests that individuals draw from their cultural norms and experience to interpret these abstract situations (Gerkey, 2013; Hagen & Hammerstein, 2006). For example, Orma participants interacting in an abstract Public Goods Game in Kenya labeled the situation as "the harambee game" ─ associating the Public Goods Game with a local institution that coordinates individual contributions to community work (Henrich et al., 2005). Taken together, these results suggest that, at least to some extent, the decisions in these experimental contexts do reflect culturally relevant expressions of cooperation (Gerkey, 2013).

However, to advance our scientific understanding of how cooperation varies across societies, it is valuable to complement the insights obtained from lab studies with observations of cooperation in the field. Field experiments can be designed in naturalistic environments and allow observation of behavior in a given context directly as it unfolds, with no artificial constraints to the set and stakes of individuals' choices (Harrison & List, 2004). For example, prior field studies have examined whether individuals (a) reduce their energy consumption when their choices are observable by others (e.g., Yoeli et al., 2003), and (b) decide to help a person who they witnessed violate a social norm (e.g., Balafoutas et al., 2014). These field studies have involved structured settings that allowed the researchers to test factors that affect

cooperation (e.g., reciprocity) within a naturalistic setting. However, field experiments are often situation-specific which could present a challenge to making comparisons across cultural contexts, such as there being substantial variability in the setting of the study. Alternatively, lab-in-the-field studies (e.g., Gneezy & Imas, 2017) and experience sampling methods (e.g., Columbus et al., 2020) could provide more optimal tradeoffs between making observations of social behavior within its natural context, but still gathering data in a structured and comparable format. These methods could also allow researchers to observe cooperation across the full range of interdependent situations people experience, as they occur in daily interactions among kin, romantic partners, allies, coalitional members, and even among strangers, within cultures around the world (Balliet et al., 2022).

**Strengths and Limitations**

We applied a meta-analytic approach to test whether cooperation varies across societies, and which institutional, cultural, and ecological factors can explain this variation. We meta-analyzed a total of 2,271 cooperation estimates obtained from 1,506 empirical studies that involved 183,697 participants across 70 societies. The unprecedented scale of the meta-analyzed evidence, reflected by the number of studies, samples, and societies involved, allowed us to provide insights into fundamental questions about cross-cultural variation in impersonal cooperation. However, some limitations ought to be acknowledged. Despite the fact that our systematic search included documents published in English, Chinese, and Japanese, our review was biased toward research conducted in Western societies, as is commonly the case in the psychological sciences (Henrich, Heine, et al., 2010). Indeed, most of the studies were conducted in the United States (42%) and, more generally, in societies that can be classified as belonging to the “English speaking” cultural group (52%) (Inglehart et al., 2014). Also, there were remarkable imbalances in the number of cooperation estimates among the included societies, with very few observations in some societies, thus limiting the generalizability of our findings. Nevertheless, this overview can still provide valuable

information to guide future empirical work to target societies that are currently under-represented in cooperation research.

Relatedly, the study samples included in the meta-analysis are not nationally representative of each society, which could affect our ability to make general claims about cross-societal variation in cooperation. Student samples represent the majority of the available evidence (85% of the studies included in the meta-analysis), although there has been a decrease in the use of student samples in the last two decades (Balliet, Spadaro, et al., 2020). Importantly, several hypotheses tested in the meta-analysis have previously been tested on student samples across different societies (e.g., Buchan et al., 2006; Gächter & Schulz, 2016; Sagiv et al., 2011; Schulz et al., 2019; Yamagishi et al., 1998), because this recruitment strategy has been argued to minimize sociodemographic variability across the samples (Herrmann et al., 2008). Importantly, a recent meta-analysis found that student samples are not more or less cooperative than non-student samples in social dilemmas (Jin et al., 2021). Additionally, even if the samples within societies in the current meta-analysis are not representative of the society's population, the abundance of studies conducted within the United States allowed us to extend our findings by analyzing variation in behavior across 41 states and 9 regions in the US. These analyses largely replicated the findings obtained with the set of 70 societies, showing that cooperation did not vary much across states in the US and was not significantly associated with any of the institutional, cultural, and ecological indicators.

Moreover, although we limited our meta-analysis to Prisoner's Dilemmas and Public Goods Games to maximize comparability of the observed cooperative behavior, the studies could still present substantial heterogeneity due to specific variables that were manipulated within the study, as well as other differences among the study characteristics. This is a limitation of the current approach, that could be mitigated by conducting a large-scale cross-cultural empirical study. However, we took this heterogeneity into account by annotating ten

variables for each study and including them in the meta-regression model. This allowed us to (a) control for the specific study characteristics while drawing inferences about differences between societies, and (b) predict within-society variance in cooperation. Furthermore, a recent meta-analysis on institutional rules configurations and cooperation in social dilemmas has analyzed several additional variables that differ across studies, and which were found to be unrelated to variation in cooperation across studies, including known end game, asymmetry of the dilemma structure, decision protocol, proportion of males, (non) student sample and student discipline (Jin et al., 2021).

Finally, the cooperation-related data and the cultural indicators included in the meta-analysis are currently provided open access through the Cooperation Databank (CoDa) (Spadaro et al., in press). This is a machine-readable databank that includes an ontology of human cooperation studies, and which can be used to search studies for on-demand meta-analysis. CoDa enables researchers to replicate these findings and explore the dataset by using alternative methods. Indeed, future research can extend the current meta-analysis by including more studies from different societies that will be subsequently included in CoDa as the literature expands.

## Concluding Remarks

Decades of research have posited that societies differ in people's willingness to engage in impersonal cooperation. Different perspectives have emphasized the roles of institutions, religion, cultural values, and ecologies in creating variation in impersonal cooperation across societies – and past research has resulted in mixed findings supporting predictions from these theories. We conducted a large-scale meta-analysis of available studies that used the Prisoner's Dilemma and Public Goods Game to observe cooperation among strangers. We found that people around the world display impersonal cooperation, and we did not find evidence that impersonal cooperation varies across the societies included in our analysis. Therefore, the meta-analysis did not provide support for any of these accounts to explain

cross-societal differences in impersonal cooperation. This conclusion was further bolstered by an analysis that found little evidence that cooperation varies across states and regions in the US.

Cooperative exchange between strangers produces substantial benefits for societies. Indeed, cooperation between strangers may be an essential characteristic of large-scale modern societies that involve globalized market economies, in which transactions with strangers are frequent, valued, and regulated by institutions. In these societies, cultural norms and institutions may have evolved to promote similarly high levels of impersonal cooperation (Henrich, Ensminger, et al., 2010). Alternatively, it could be that humans have a psychology that is adapted to small-scale societies, which operates to establish cooperative exchange in large, modern societies (Delton et al., 2011). Future research can test these alternative explanations by studying how cooperation has changed during the transition from small, kin-based societies to large, modern societies (Powers et al., 2020).

Finally, it is well known that humans can deploy many different strategies of cooperation – as well as approaches to impose costs on non-cooperators. These strategies of cooperation could each vary in different ways across societies. For example, cooperation does vary across societies in the presence of punishment opportunities (Herrmann et al., 2008), although no variation has been observed across societies in parochial cooperation (Romano et al., 2021). From this perspective, our current understanding of whether and how strategies of cooperation vary across societies has just begun. Future work should systematically investigate which strategies of cooperation and the punishment of non-cooperators vary across societies by relying on paradigms that can effectively isolate or manipulate specific features of the situation, culture, or ecology that produces any observed variation across societies.

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