Changes in Cooperation Among Strangers in Chinese Society: A Meta-Analysis of Social Dilemma Research (1999-2019)

Authors: Yuan Mingliang, Junhui Wu, Jin Shuxian, Lin Liang, Kou Yu, Paul A. M. Van Lange, Kou Yu

Date: 2023-12-07T00:00:00+00:00

Abstract

Cooperation among strangers is of great significance for addressing social public issues and responding to unprecedented global changes. This study employs a cross-temporal meta-analysis approach, based on data from 254 studies conducted between 1999 and 2019 using the social dilemma paradigm to investigate stranger cooperation in China (totaling 302 cooperation rates, 29,249 participants, mean age: 18–28 years), to explore the temporal changes in cooperation behavior in Chinese society and the explanatory role of certain social development indicators, and to compare the changing trends of cooperation behavior between China and the United States. The results indicate that the level of cooperation behavior among Chinese people has increased over time, and that certain social development indicators (per capita GDP, urbanization rate, higher education level, internet penetration rate, etc.) may constitute the socioeconomic underpinnings of this increase. Cooperation behavior in both China and the US exhibits a similar upward trend, but China's shows a greater magnitude of increase within a shorter time frame. The findings are of great significance for boosting public confidence.

Full Text

The Changing Nature of Cooperation Among Strangers in Chinese Society: A Cross-Temporal Meta-Analysis of Social Dilemmas (1999–2019)

YUAN Mingliang[1], WU Junhui[2],[3], JIN Shuxian[4], LIN Jing[5], KOU Yu[5], Paul A. M. Van Lange[6]

[1]Department of Psychology, School of Humanities and Social Sciences, Anhui Agricultural University, Hefei 230036, China

[2]CAS Key Laboratory of Behavioral Science, Institute of Psychology, Chinese Academy of Sciences, Beijing 100101, China
[3]Department of Psychology, University of Chinese Academy of Sciences, Beijing 100049, China
[4]School of Psychology, University of Sussex, Brighton BN19RH, United Kingdom
[5]Beijing Key Laboratory of Applied Experimental Psychology, National Demonstration Center for Experimental Psychology Education (Beijing Normal University), Institute of Developmental Psychology, Beijing Normal University, Beijing 100875, China
[6]Department of Experimental and Applied Psychology, Institute for Brain and Behavior Amsterdam (IBBA), VU Amsterdam, Amsterdam 1081BT, The Netherlands

Abstract

Cooperation among strangers is crucial for addressing public challenges and navigating unprecedented global changes. This study employs cross-temporal meta-analysis to examine changes in cooperation among strangers in Chinese society from 1999 to 2019, based on data from 254 studies using social dilemma paradigms (302 cooperation rates, 29,249 participants, mean age: 18–28 years). We investigate the temporal trends in Chinese cooperation and the explanatory role of several social development indicators, while comparing these trends with those in the United States. Results indicate that cooperation levels among Chinese individuals have increased over time, with social development indicators such as per capita GDP, urbanization rate, higher education level, and internet penetration rate serving as potential foundations for this rise. Both China and the U.S. show similar upward trends in cooperative behavior, though China's increase is more pronounced within a shorter timeframe. These findings carry significant implications for boosting public confidence.

Keywords: cooperation, social capital, social dilemmas, cross-temporal meta-analysis, social change

1. Introduction

Cooperation is typically defined as behavior through which individuals incur costs to benefit both themselves and their interaction partners (Van Lange & Rand, 2022) and represents a vital form of social capital. Addressing global climate change, pandemics, and building a global community of shared future all depend on mutual cooperation. Compared to cooperation among acquaintances, cooperation among strangers—unconstrained by existing relationships and more broadly generalizable—helps forge new social connections, expand social networks, promote generalized reciprocity, and achieve common social goals (Henrich, 2004; Putnam, 2000). This ultimately enhances governance efficiency, stimulates economic growth, improves public health and well-being (Putnam, 2000), and strengthens a society's overall competitive advantage (Francois et

al., 2018; Mesoudi, 2009).

Cooperative behavior and its social norms are not static but evolve alongside ecological and cultural changes such as economic development, urbanization, interpersonal trust, and individualism (Boyd & Richerson, 2009; Greenfield, 2016; Richerson et al., 2016; Yuan et al., 2022). Over the past several decades, Chinese society has undergone tremendous transformation, characterized by rapid economic growth, rising urbanization, expanded higher education, and rapid internet development, accompanied by increased residential mobility and broader social interaction networks. The acquaintance-based society has contracted while the stranger-based society has expanded, making interactions and cooperation among strangers more prominent and important than ever before. Meanwhile, interpersonal trust has declined (Xin, 2019) and individualism has increased (Cai et al., 2020; Hamamura & Xu, 2015). How, then, has cooperation—especially among strangers—changed in response to these societal shifts? Understanding the development and transformation of cooperation has long been an important theoretical question (Pennisi, 2005; Huang & Zhang, 2013). In contemporary Chinese society, comprehending changes in stranger cooperation and their societal foundations is crucial for effective social governance, enhancing social cohesion and competitiveness, and responding to unprecedented global changes.

To examine changes in stranger cooperation in Chinese society, this study conducts a cross-temporal meta-analysis of 254 studies using social dilemma paradigms with Chinese adult participants (mean age 18–28) collected between 1999 and 2019. Social dilemmas—situations where individual short-term interests conflict with collective long-term interests, such as prisoner's dilemmas and public goods dilemmas—have been widely used to study cooperation (Dawes, 1980; Van Lange et al., 2013). Cross-temporal meta-analysis can examine temporal trends in specific psychological or behavioral phenomena by comparing data from different historical periods for the same age group using identical measurement paradigms (Xin & Chi, 2008; Curran & Hill, 2019; Twenge et al., 2004). By analyzing experimental behavioral data with high internal validity from social dilemma paradigms, this study avoids self-report biases present in surveys and obtains reliable, direct evidence regarding changes in Chinese cooperation. Additionally, we examine how social indicators from 10 and 5 years prior predict cooperation, exploring potential societal foundations for these changes. We also compare trends in stranger cooperation between Chinese and American societies to better understand the characteristics of social change in China and reveal broader patterns of human cooperation across social development.

1.1 Cooperation and Its Measurement

Researchers most commonly use social dilemma paradigms to study cooperation (Van Lange et al., 2013). In social dilemmas, where personal and collective interests conflict, cooperation is defined as behavior that benefits the collective at

some cost to the individual (Rand & Nowak, 2013; Van Lange & Rand, 2022). Common paradigms include the prisoner's dilemma, public goods dilemma, and resource dilemma. The resource dilemma is a "take-some game" with distinct situations, payoff structures, and cooperation metrics compared to prisoner's and public goods dilemmas (Spadaro, Tiddi, et al., 2022). To maximize measurement consistency and control for methodological variance in our cross-temporal meta-analysis, this study focuses on prisoner's dilemmas and public goods dilemmas, which share highly similar structures.

A typical prisoner's dilemma (PD; Rand & Nowak, 2013; Van Lange & Rand, 2022) involves two decision-makers who simultaneously choose to cooperate or defect. If both cooperate, they receive payoff R, which exceeds payoff P when both defect. When one cooperates while the other defects, the defector receives the highest payoff T while the cooperator receives the lowest payoff S. The payoffs satisfy the relationship $T > R > P > S$.

In a public goods dilemma (PGD; Fehr & Fischbacher, 2004), N ($N \geq 2$) group members simultaneously decide how much of their initial endowment E to contribute (x, where $0 < x < E$) to a collective account, keeping the remainder in their personal account. The total contributed to the collective account is multiplied by a factor b ($1 < b < N$) and then divided equally among all members, while funds in personal accounts retain their original value. Regardless of their contribution, all members benefit from the collective account.

Due to their similar payoff structures, public goods dilemmas are sometimes called N-person prisoner's dilemmas ($N \geq 2$; Fehr & Fischbacher, 2004; Rand & Nowak, 2013). In both dilemmas, individuals face a conflict between defecting (or not contributing) to maximize personal gain versus cooperating (or contributing more) to maximize collective benefit. If everyone defects or contributes nothing, collective outcomes are poorest; if everyone cooperates or contributes their entire endowment, collective outcomes are maximized and each individual benefits more from the collective account.

Social dilemma paradigms thus reflect many real-world cooperation decisions, such as government funding for climate change mitigation, voluntary isolation during pandemics, or community donations. These paradigms measure actual cooperative behavior rather than attitudes, offering low measurement bias and high internal validity. They provide simplified models for studying complex social cooperation (Balliet et al., 2011; Murnighan & Wang, 2016; Thielmann et al., 2021) and demonstrate strong ecological validity (Galizzi & Navarro-Martinez, 2019). Cooperation in social dilemmas positively correlates with charitable donations (Benz & Meier, 2008), self-reported community cooperation (Soler, 2012), and blood donation and volunteering (Haesevoets et al., 2020).

Using historical data from social dilemma paradigms thus allows direct and accurate examination of behavioral changes across social contexts. All studies included in our meta-analysis involve interactions among strangers—participants

with no interaction history and no reputation information about partners—mirroring key features of many real-world cooperative situations involving unfamiliar individuals. Most historical social dilemma research also uses stranger interactions, allowing us to avoid data biases from relationship types and enhance conclusion reliability.

1.2 Changes in Stranger Cooperation in Chinese Society

Cooperation can shift with ecological and cultural environments (Chudek & Henrich, 2011; Richerson et al., 2016). Different socioeconomic and cultural environments shape individual psychological development, and cohorts born in different eras experience distinct socioeconomic conditions (e.g., wealth levels, urbanization, internet development), leading to generational differences in psychological characteristics, social attitudes, beliefs, and behaviors (Greenfield, 2016; Twenge & Campbell, 2001). China's dramatic transformations over the past four decades—especially the last twenty years—may have triggered changes in stranger cooperation.

No prior research has examined temporal changes in stranger cooperation in Chinese society, particularly using high-validity experimental behavioral data from social dilemmas. A recent cross-temporal meta-analysis found that cooperation among American strangers increased over 61 years (1956–2017) (Yuan et al., 2022). However, this conclusion applies only to American society. Given political, economic, and cultural differences between China and the U.S., particularly China's more rapid transformation in recent decades (Jing, 2015) and its critical juncture in achieving second centenary goals, understanding trends in cooperation and other social capital is essential. Comparing Chinese and American trends thus holds important theoretical and practical significance for understanding social change patterns in China and broader human cooperation across social development.

We next elaborate on how specific ecological and cultural changes may influence stranger cooperation in China, presenting two competing hypotheses: (1) stranger cooperation has decreased over time (Hypothesis 1), and (2) stranger cooperation has increased over time (Hypothesis 2).

1.2.1 Why Stranger Cooperation Might Have Decreased Mainstream perspectives suggest that modernization, intensified competition, and rising individualism weaken social connections and reduce trust and public engagement (Greenfield, 2016; Hamamura, 2012). We outline three mechanisms supporting this hypothesis: (1) increased urbanization, (2) rising individualism, and (3) declining social trust.

China's urbanization rate rose steadily from 34.78% in 1999 to 62.71% in 2019 (National Bureau of Statistics, 2021). Urbanization may reduce cooperation by decreasing reputation concerns. Research shows that concern for one's reputation promotes cooperation (Ge et al., 2019; Wu et al., 2016). Compared

to traditional rural life, urban residents inhabit stranger societies with unstable social connections and limited acquaintance interactions, making individual behavior and reputation harder to transmit through social networks. This reduces interpersonal monitoring of non-cooperative behavior and indirect benefits from cooperation. Rapid urban expansion also increases geographic segregation across functional zones, weakening community cohesion (Putnam, 2001). Highly commercialized urban life, fast work pace, intense competition, long commutes, and economic pressures reduce social participation and connection, squeezing time and energy for interactions with friends, neighbors, strangers, and public welfare projects (Putnam, 2000), potentially decreasing stranger cooperation.

Modernization also "boosts" autonomous independence and individualistic culture (Greenfield, 2016; Inglehart & Baker, 2000; Santos et al., 2017), weakening perceived interdependence—an important condition for cooperation (Columbus et al., 2021). With technological progress, industrialization, urbanization, social security systems, and higher education, Chinese modernity has improved dramatically, enabling more affluent and independent lives. Research shows Chinese individualism has increased over recent decades (Cai et al., 2020; Hamamura & Xu, 2015). Higher individualism means greater detachment from traditional social relations and values, more independent decision-making, and stronger emphasis on personal goals, reflected in rising divorce rates, more freelancers, and higher rates of living alone (National Bureau of Statistics, 2021). These trends may weaken social connection and interdependence, reducing willingness to cooperate with strangers.

Finally, rapid economic growth has intensified income inequality (Xie & Zhou, 2014), which may reduce trust in strangers (Lin et al., 2023). Indeed, studies find that general interpersonal trust has declined in China (Li & Wang, 2018; Xin, 2019; Xin & Xin, 2017). Interpersonal trust—willingness to accept risk based on positive expectations of others' behavior—is fundamental to cooperation (Balliet & Van Lange, 2013). Expectations of others' cooperation reflect trust levels and strongly predict cooperative behavior in social dilemmas (Pletzer et al., 2018). Declining trust during social development may weaken expectations of strangers' cooperative intentions, reducing cooperation.

1.2.2 Why Stranger Cooperation Might Have Increased Despite mainstream views and indirect evidence suggesting declining stranger cooperation, alternative theoretical perspectives and empirical findings indicate that Chinese cooperation may have increased.

First, modernization—especially after China's WTO entry—has created a highly industrialized society with increasingly complex division of labor, rising service sector 比重, rapid population migration, and expanded interaction scope. People increasingly depend on strangers to achieve personal and collective goals, which may enhance cooperation. Research suggests natural selection favors social division of labor, which promotes interdependence and cooperation among strangers (Cooper & West, 2018).

Second, rising individualism may increase trust and cooperation with strangers because individualists interact more with unfamiliar others (Oyserman et al., 2002). Evidence from the U.S. shows that states with higher individualism (e.g., higher rates of living alone, divorce-to-marriage ratios, freelancers) exhibit greater general trust, charitable donations, and volunteer time (Allik & Realo, 2004; Kemmelmeier et al., 2006). Cross-national studies also find higher individualism correlates with greater general trust (Beilmann et al., 2018; Jing et al., 2021; Van de Vliert & Van Lange, 2019). Individual freedom, autonomy, and loose social norms positively correlate with general trust (Gelfand et al., 2006; Gunia et al., 2011), and individualists are more likely to cooperate with strangers than collectivists (Berigan & Irwin, 2011; Chen & Li, 2005). Thus, despite potential declines in general trust attitudes, rising individualism in modern societies with complex division of labor may promote trust and cooperation in specific interdependent contexts.

Finally, higher education development and improved cognitive abilities may increase stranger cooperation. Complex cognitive abilities (e.g., numerical calculation, learning, memory, deception detection) facilitate cooperation (Moreira et al., 2013; Stevens & Hauser, 2004). Social dilemmas require understanding how decisions affect self and others, remembering partners' previous choices, anticipating future decisions, and making strategic choices that promote cooperation and prevent exploitation (Brosnan et al., 2010; Nowak & Sigmund, 1998). Research shows more intelligent individuals cooperate more in repeated prisoner's dilemmas (Jones, 2008; Proto et al., 2014). Average intelligence levels have risen in China and many countries over recent decades (Liu & Lynn, 2013; Pietschnig & Voracek, 2015), potentially enabling better understanding and resolution of social dilemmas and promoting increased stranger cooperation.

1.3 Purpose of This Study

This study uses cross-temporal meta-analysis to test whether stranger cooperation in Chinese society has decreased or increased over recent decades. Specifically, we examine the relationship between mean cooperation rates and year of data collection among young adult participants aged 18–28 (controlling for age effects) in social dilemmas (prisoner's dilemmas and public goods dilemmas). We also analyze how social development indicators predict cooperation and compare trends between Chinese and American societies to better understand the characteristics of social change in China and broader patterns of human cooperation across social development.

2. Method

All raw data, analysis code, and supplementary materials (including literature screening flowcharts, publication bias analysis, multicollinearity analysis, basic information tables for included studies, and reference lists) are available on the Open Science Framework (OSF) at https://osf.io/hxguw/.

2.1 Literature Search

We searched Chinese and English databases for empirical studies on social dilemmas. Data from 2017 and earlier came from the Cooperation Databank (CoDa; Spadaro, Tiddi, et al., 2022; see https://cooperationdatabank.org), which includes all social dilemma cooperation studies (English, Chinese, and Japanese; our meta-analysis included only English and Chinese articles). Systematic literature searches were completed in September-October 2015 and January 2018 (supplementing 2016–2017 literature), with Chinese literature searched in November-December 2017 (Spadaro, Tiddi, et al., 2022; see https://cooperationdatabank.org for database history and search details). English literature was drawn from PsycINFO, Web of Science, Google Scholar, and databases of VU Amsterdam and Leiden University libraries, using keywords: 'Public goods dilemma*', 'Public good*', 'Public good* game*', 'Prisoner's dilemma*', 'Voluntar* contribut* experiment*', 'Voluntary contribution mechanism', 'Social dilemma', 'Mixed-motive game*', 'Resource dilemma*', 'Matrix games', 'Cooperation' AND 'Experiment', 'Common pool game', 'Give-some dilemma', 'Take-some dilemma', 'Give-some game', 'Take-some game'. Chinese literature came from CNKI, Wanfang, and VIP databases, using keywords: "囚徒困境" or "囚徒两难" or "公共物品困境" or "公共物品两难" or "公共品" or "社会困境" or "社会两难" or "行为决策" or "合作决策" or "合作行为" or "亲社会行为". Search results included published papers, working papers, master's/doctoral dissertations, and conference papers. The database also incorporated references from books, empirical studies, reviews, and meta-analyses related to social dilemmas, plus data solicited from researchers via email. Chinese and English literature after 2017 was supplemented using the same search methods in July 2020.

2.2 Inclusion Criteria

Studies were included if they met the following criteria: (1) data collected in mainland China; (2) Chinese adult participants with mean age 18–28, including university students and general adults; (3) social dilemma paradigm was prisoner's dilemma or public goods dilemma; (4) interactions occurred among strangers (excluding interactions with family, friends, or acquaintances; studies typically report relationship status in instructions or manipulate stranger vs. acquaintance relationships); (5) overall mean cooperation rate was available; (6) to increase homogeneity, studies using non-linear payoff structures (where collective benefits decline after contributions exceed a threshold) were excluded. Based on these criteria, we initially included 255 studies with 304 cooperation rates (effect sizes) and 29,290 participants. After excluding 2 outliers ($|Z| > 3.29$; Tabachnick & Fidell, 2007), the final meta-analysis included 254 studies with 302 cooperation rates from 29,249 participants, spanning 1999–2019.

2.3 Data Coding Procedure

Multiple researchers (mostly graduate students or faculty) completed coding using a unified codebook (detailed at https://cooperationdatabank.org/codebook-

2/). Each variable in every study was independently coded by two coders. Inter-coder reliability was high to adequate: Krippendorff's α for continuous variables ranged from 0.91 to 0.98, and agreement rates for categorical variables ranged from 82.90% to 96.60%. Discrepancies were resolved through discussion and consensus.

2.4 Coding of Data Collection Year

If a study reported the data collection year directly, we coded that year (k = 58). Otherwise, we estimated the year using these principles (Konrath et al., 2011; Twenge et al., 2004): (1) for conference papers or working papers, use the presentation or publication year (k = 9); (2) for articles with submission year, use that year (k = 58); (3) for articles with acceptance year, use that year minus 1 (k = 3); (4) for master's/doctoral dissertations, use the defense year minus 1 (k = 18); (5) for articles with online publication or print year, use that year minus 2 (k = 156). Data collection years ranged from 1999 to 2019 (Mdn = 2014).

2.5 Coding of Cooperation Rates (Effect Sizes)

We used the overall mean cooperation rate as our cooperation measure, with higher rates indicating greater cooperation, ranging from 0 to 1.

In dichotomous-choice public goods and prisoner's dilemmas, participants choose between cooperation (contributing all initial endowment to the collective account or to their partner) or defection (contributing nothing) (Dawes, 1980; Shank et al., 2019). The mean cooperation level is the proportion of cooperative choices: p = mean cooperation frequency / total decisions.

In continuous-choice dilemmas, participants decide how much of their initial endowment to contribute (Fehr & Fischbacher, 2004). The mean cooperation rate is calculated as pcont = (M - ELL) / (EUL - ELL), where M is mean contribution, and ELL and EUL are lower and upper limits of the endowment. For example, with an endowment of 10 and minimum contribution of 1, if mean contribution is 4, then pcont = (4 - 1) / (10 - 1) = 0.33. In all included studies, ELL = 0 (minimum contribution started at 0), so pcont = mean contribution (M) / initial endowment (EUL).

2.6 Transformation of Cooperation Rates (Effect Sizes)

For proportion-based effect sizes, researchers should apply logit transformation before analysis (Lipsey & Wilson, 2001). Following previous meta-analyses (Yuan et al., 2022), we logit-transformed cooperation rates and analyzed the transformed effect sizes yi, then converted back to proportions for description and interpretation.

For dichotomous dilemmas, cooperation rates were transformed using yi(coop) = loge[p/(1-p)], with variance vi(coop) = 1/np + 1/(n-np), where p is the raw

cooperation rate and n is sample size.

For continuous dilemmas, transformation used yi(cont) = loge[pcont/(1-pcont)], with variance calculated using Formula 1, where pcont is raw cooperation rate, n is sample size, M is mean contribution, and SD is standard deviation of mean contributions.

(1) ( ) = ^{2} × (1 -)^2 / (× SD^2)

For continuous dilemmas without reported SD, we imputed using the median coefficient of variation (CV = SD/M). Specifically, we calculated CV for each study reporting SD, then used vi(cont) = CV^2 / [(1-pcont)^{2}n] for studies without SD. Among 160 studies (186 samples) reporting SD, the median CV was 0.42 (M = 0.45, SD = 0.24). We used this median CV for imputation.

2.7 Coding for Studies Manipulating Dilemma Features

We coded important dilemma characteristics (e.g., conflict of interest, communication mechanisms) as control variables. For studies manipulating dilemma features, we coded cooperation rates and transformed effect sizes yi in two ways: (1) For between-subjects designs reporting cooperation rates per condition, we coded each condition separately and logit-transformed each. For example, a study examining punishment effects with one group having punishment and another without would be split into two samples, with punishment coded accordingly. This created a multilevel data structure with some effect sizes nested within studies. (2) For studies reporting only overall cooperation rates or using within-subjects designs, we used the overall rate as the effect size. This procedure yielded 304 effect sizes (N = 29,290) from 255 studies. After excluding 2 outliers (|Z| > 3.29), the final meta-analysis included 254 studies with 302 effect sizes (N = 29,249).

2.8 Coding of Study Characteristics

We coded important social dilemma characteristics as control variables in the meta-analysis (Jin et al., 2021). Key coded characteristics and effect size counts (k) include:

(1) **Dilemma type**: prisoner's dilemma coded as 0 (k = 93), public goods dilemma as 1 (k = 209).

(2) **Proportion of male participants**: continuous variable ranging 0–1. After excluding samples not reporting gender (k = 63), mean proportion was 0.43 (k = 239, SD = 0.16).

(3) **Interaction repetitions**: single-round interaction coded as 0 (k = 131), multi-round interaction as 1 (k = 164). Studies manipulating repetitions without reporting per-condition rates were coded as mixed (k = 7, coded as 0.5). All mixed-level dilemma features (including communication and

sanction mechanisms) were coded as 0.5 and dummy-coded in regression models, comparing levels 0.5 and 1 against 0.

(4) **Group size**: number of interacting group members, coded as continuous variable. For studies manipulating group size without per-condition rates, we coded the median. Group size ranged from 2 to 9 (Mode = 2, Mdn = 4, M = 3.32). Due to skew toward dyads, we log-transformed group size for analysis.

(5) **Conflict of interest**: measured by K-index in prisoner's dilemmas (Rapoport, 1967), where K = (R - P) / (T - S), with payoffs satisfying T > R > P > S, thus 0 < K < 1. Higher K-index (cooperation index) indicates greater incentive to cooperate (Balliet & Van Lange, 2013).

In public goods dilemmas, conflict is typically measured by marginal per-capita return (MPCR; Isaac et al., 1984), where MPCR = b/N (b is the multiplication factor, 1 < b < N). Larger MPCR increases per-person benefits from contributions, typically increasing cooperation.

K-index can also be calculated for public goods dilemmas as N-person prisoner's dilemmas (Thielmann et al., 2020) using K' = (CN - D0) / (DN-1 - C1) (Balliet & Van Lange, 2013; Komorita, 1976), where CN is payoff when all cooperate, D0 when all defect, DN-1 when one defects while others cooperate, and C1 when one cooperates while others defect. In continuous dilemmas, cooperation means contributing the entire endowment and defection means contributing nothing. MPCR and K-index were highly correlated in our public goods dilemma studies (k = 210, r = 0.50, p < 0.001), so we used K-index uniformly across all dilemmas (Thielmann et al., 2020; Yuan et al., 2022). For studies manipulating K-index without per-condition rates, we coded the median. For all studies with calculable K-index (k = 297), values ranged from 0.03 to 0.85 (Mdn = 0.50, M = 0.44, SD = 0.13).

(6) **Communication**: studies without communication mechanisms coded as 0 (k = 294), those allowing any form of communication (face-to-face discussion, note-passing, online) as 1 (k = 5). Studies manipulating communication without per-condition rates were coded as mixed (k = 3, coded as 0.5).

(7) **Sanctions**: studies without reward/punishment mechanisms coded as 0 (k = 242), those with sanctions as 1 (k = 39). Studies manipulating sanctions without per-condition rates were coded as mixed (k = 21, coded as 0.5).

(8) **Period of cooperation**: for single-round studies or multi-round studies reporting overall cooperation, coded as 0 (k = 274); for multi-round studies reporting cooperation for specific rounds, coded as 1 (k = 28, including 2 effect sizes for first-round only).

2.9 Societal Indicators

Based on our hypotheses, we obtained relevant societal indicators from the National Bureau of Statistics' China Statistical Yearbook and National Data (http://www.stats.gov.cn/tjsj/): (1) economic conditions (per capita GDP, social security rate), (2) urbanization rate, (3) social mobility/relational mobility (population with separated household registration, tertiary industry employment ratio, average travel frequency), (4) social connection (proportion living alone, crude divorce rate), (5) higher education level, and (6) internet penetration rate. Table 1 reports descriptive information for each indicator.

Table 1. Descriptive Information for Societal Indicators

Indicator	Description	M (SD)	Year Range
Per capita GDP	Log-transformed per capita GDP	9.46 (1.17)	1989–2019
Social security rate	Urban pension insurance participants / total population	0.15 (0.08)	1989–2019
Urbanization rate	Urban population / total population (%)	42.34 (11.93)	1989–2019
Population with separated household registration	Separated household population / total population	0.14 (0.06)	1998; 2000; 2002–2019
Tertiary industry employment ratio	Tertiary sector employees / total employees	0.31 (0.08)	1989–2019
Average travel frequency	Domestic tourist trips / population	1.58 (1.18)	1994–2019
Proportion living alone	One-person households / total households	0.12 (0.04)	1998–1999; 2002–2009; 2011–2019
Crude divorce rate (‰)	Annual divorces / average annual population × 1000‰	1.60 (0.88)	1989–2019
Higher education level	University students per 100,000 population	6.98 (0.85)	1989–2019
Internet penetration rate	Internet users / total population	0.26 (0.22)	1997–2019

2.10 Meta-Analytic Procedure

We conducted analyses using the metafor package in R (R Core Team, 2019; Viechtbauer, 2010). Because splitting studies with manipulated features created non-independent effect sizes nested within studies, we used a three-level mixed-effects meta-regression model (Assink & Wibbelink, 2016), accounting for sampling variance (Level 1), within-study variance (Level 2), and between-study variance (Level 3). We used the mice package for multiple imputation of missing values (Van Buuren & Groothuis-Oudshoorn, 2011), which integrates with metafor to handle different variable types.

In all meta-regression models, year of data collection was the predictor and logit-transformed cooperation rate the outcome. We controlled for all coded study characteristics. Following previous research (Curran & Hill, 2019; Twenge et al., 2004), we estimated cooperation rates for 1999 and 2019 using the regression equation y = bx + c (b = unstandardized coefficient, x = year, c = intercept, y = cooperation rate) and calculated the magnitude of change. Finally, we examined correlations between societal indicators and cooperation by matching indicators from 10 years prior, 5 years prior, and the same year as the cooperation data (Twenge, 2000), predicting cooperation in separate meta-regressions while controlling for study characteristics. This lagged matching helps explore potential societal foundations of temporal change.

3. Results

3.1 Preliminary Analyses

We standardized logit-transformed cooperation rates (yi) and excluded 2 outliers ($|Z| > 3.29$). The final meta-analysis included 254 studies with 302 cooperation rates (N = 29,249). Table 2 shows the overall mean cooperation rate was 0.51.

Table 2. Overall Mean Effect Size for Cooperation Rate

Statistic	Value
Mean cooperation rate	0.51
95% CI	[0.49, 0.52]
τ^2 (Level 2)	0.44
τ^2 (Level 3)	0.55
I^2 (Level 2)	91.73%
I^2 (Level 3)	5.84%

Note: k = 302. τ^2 = estimated total heterogeneity; I^2 = proportion of heterogeneity; Level 2 = within-study variance; Level 3 = between-study variance. Heterogeneity test significant, Qresidual(301) = 19369.66, $p < 0.001$.

3.2 Main Analyses

We used three-level mixed-effects meta-regression to estimate temporal effects on cooperation, magnitude of change, and relationships with societal indicators, and compared Chinese and American trends.

3.2.1 Temporal Trend in Cooperation Model 1, with only year as predictor, showed stranger cooperation in Chinese society increased over time, b = 0.018, SE = 0.008, p = 0.029, $\beta = 0.12$ (see Table 3 and Figure 1 [Figure 1: see original paper]), supporting Hypothesis 2 and contradicting Hypothesis 1. To test for curvilinear trends, we added year and year-squared as predictors. Year remained a significant positive predictor, b = 0.022, SE = 0.009, p = 0.016, $\beta = 0.15$, while year-squared was non-significant, b = 0.002, SE = 0.002, p = 0.323, $\beta = 0.06$, indicating a linear increase.

Model 2 added all coded study characteristics as controls (dilemma type, male proportion, repetitions, group size, K-index, communication, sanctions, cooperation period). After controlling for these, cooperation still increased over time, b = 0.024, SE = 0.009, p = 0.006, $\beta = 0.16$ (see Table 3). Communication, sanctions, and higher K-index positively predicted cooperation. Even including the 2 outliers, time remained a significant positive predictor, b = 0.022, SE = 0.009, p = 0.013, $\beta = 0.13$.

Table 3. Meta-Regression Results for Time Predicting Cooperation

Predictor	Model 1 (b)	95% CI	Model 2 (b)	95% CI
Year	0.018*	[0.002, 0.035]	0.024**	[0.007, 0.041]
Dilemma type	—	—	0.16	[-0.04, 0.36]
Male proportion	—	—	0.31	[-0.22, 0.84]
Repetitions	—	—	0.73**	[0.25, 1.21]
Group size	—	—	-0.06	[-0.12, 0.16]
K-index	—	—	1.19***	[0.33, 1.34]
Communication	—	—	0.83**	[0.24, 0.64]
Sanctions	—	—	0.44***	[0.24, 0.64]
Cooperation period	—	—	0.00	[-0.22, 0.22]

Note: k = 302. 0 = prisoner's dilemma, 1 = public goods dilemma. Reference = single-round. Reference = no communication. Reference = no sanctions. 0 = all rounds, 1 = partial rounds. $p < 0.05$, **$p < 0.01$,** *$p < 0.001$.*

Figure 1 [Figure 1: see original paper] shows the historical trend of mean cooperation rates among Chinese strangers in social dilemmas. The non-standardized coefficient b and p-value come from Model 1 without controls. The blue line shows model predictions back-transformed to raw cooperation rates. Each data point represents a sample's mean cooperation rate, with point size

indicating weight in the regression (larger points = smaller variance = greater weight). The gray area shows the 90% confidence interval for model predictions.

3.2.2 Magnitude of Change Using meta-regression equations, we estimated cooperation rates for 1999 and 2019. Based on Model 2 (with controls), cooperation increased from 0.33 in 1999 to 0.45 in 2019, a 34.21% increase over 20 years. Based on Model 1 (without controls), predicted cooperation rose from 0.44 in 1999 to 0.53 in 2019, a 20.48% increase.

3.2.3 Relationships Between Societal Indicators and Cooperation To examine societal foundations, we matched cooperation data with indicators from 10 years prior, 5 years prior, and the same year, predicting cooperation in separate meta-regressions while controlling for study characteristics. Results showed per capita GDP, social security rate, urbanization rate, and other indicators were significantly positively correlated with cooperation (see Table 4), particularly indicators from 10 and 5 years prior, suggesting they may underlie rising cooperation.

Table 4. Relationships Between Societal Indicators and Cooperation

Indicator	10 Years Prior (b)	5 Years Prior (b)	Same Year (b)
Per capita GDP	0.20**	0.17**	0.16**
Social security rate	4.12**	2.35**	1.24*
Social mobility/Relational mobility			
Population with separated household registration	0.02**	0.02**	0.02**
Tertiary industry employment ratio	7.06***	7.53**	2.97*
Average travel frequency	3.99**	2.89**	1.82**
Social connection			
Proportion living alone	0.35**	0.16**	0.10**
Crude divorce rate	2.33***	2.32**	2.12**
Higher education level	0.19**	0.21*	0.16**
Internet penetration rate	4.47**	0.69**	0.48*

Note: $k = 302$. Each model controls for study characteristics. $p < 0.05$, $\mathbf{p < 0.01}$, $p < 0.001$.

3.2.4 Comparison of Chinese and American Cooperation Trends We compared Chinese trends with American data to better understand China's unique patterns and broader human cooperation dynamics. A recent cross-temporal meta-analysis examined American cooperation (k = 660, N = 63,342, mean age: 18–28, years: 1956–2017) in prisoner's and public goods dilemmas (Yuan et al., 2022), controlling for study characteristics. American stranger cooperation increased over 61 years, b = 0.005, SE = 0.002, p = 0.012, rising 19.67%. In contrast, Chinese stranger cooperation increased 34.21% in just 20 years, showing a larger increase in a shorter period.

4. Discussion

Has cooperation in Chinese society changed during two decades of dramatic social transformation? Using cross-temporal meta-analysis of high-validity social dilemma experimental data, this study directly addresses this question. Results show that stranger cooperation in Chinese society increased linearly from 1999–2019, rising 34.21% (302 effect sizes, N = 29,249, mean age: 18–28). Societal indicators from 10 and 5 years prior—per capita GDP, social security rate, urbanization, social mobility (separated household population, tertiary employment, travel frequency), proportion living alone, divorce rate, higher education, and internet penetration—were all positively correlated with cooperation, suggesting they may underlie this increase. Chinese and American societies show similar upward cooperation trends, but China's increase is more pronounced within a shorter timeframe.

4.1 Rising Stranger Cooperation in Chinese Society

As discussed, China's modernization and increasingly complex division of labor enhance perceived interdependence and shared interests among strangers, promoting cooperation. Higher education and cognitive development enable better understanding and resolution of social dilemmas, partially explaining why economic development, tertiary employment, and higher education correlate positively with stranger cooperation.

Individualism also facilitates trust and cooperation with strangers (Berigan & Irwin, 2011; Chen & Li, 2005; Jing et al., 2021). Autonomy and independence mean greater reliance on strangers in daily life (Allik & Realo, 2004; Durkheim, 2019), especially in modern societies with complex division of labor. Higher individualism may promote trust and cooperation in interdependent contexts. Individualistic societies also exhibit higher relational mobility—more opportunities to interact with and form relationships with new strangers (Yuki & Schug, 2020). Urbanization and internet technology have greatly expanded interaction scope and residential mobility. Research shows relational mobility positively correlates with trust and cooperation among strangers (Romano et al., 2021; Thomson et al., 2018), as people need trust, friendliness, and cooperation to build and maintain relationships in high-mobility societies (Yuki & Schug, 2020). This explains why social security, urbanization, separated household population, travel frequency, living alone, divorce rates, and internet penetration correlate positively with stranger cooperation. Thus, even if general trust attitudes decline, state-based trust in interdependent contexts may be more predictive of cooperation than general trust (Acedo-Carmona & Gomila, 2014; Balliet & Van Lange, 2013; Pletzer et al., 2018). Rising individualism may therefore promote rather than inhibit trust and cooperation with strangers in specific interdependent situations.

Our sample primarily comprised young adults, mostly university students. Previous research shows social dilemma studies often use social and behavioral sci-

ence majors (Balliet et al., 2021), whose textbooks discuss benefits of prosocial behavior, potentially increasing cooperation. Chinese university students also receive more education about national policies, social cooperation norms, and cooperative consciousness. As more young Chinese receive higher education and are exposed to national development concepts like "openness, inclusiveness, cooperation, and win-win," the Belt and Road Initiative, and "building a global community of shared future," they may increasingly internalize cooperative norms and exhibit more cooperative behavior.

In summary, views predicting declining stranger cooperation based on urbanization, rising individualism, and declining trust may reflect an "illusion." While these changes may reduce reputation concerns, increase self-focus, and decrease trust at the cognitive level, they do not necessarily reduce actual cooperative behavior. Urbanization, refined division of labor, and population mobility increase opportunities to interact with strangers. Reduced dependence on acquaintances may increase dependence on strangers. People may distrust others generally yet must cooperate in interdependent situations for social adaptation, promoting increased cooperation. The discrepancy between Hypothesis 1 and our results reflects a divergence between social cognition and actual behavior. This suggests researchers should focus more on behavioral changes, which have been neglected or difficult to examine, to clarify potential "illusions" about behavior based on cognitive changes and achieve more comprehensive understanding of Chinese social change and its psychological and behavioral impacts.

4.2 Comparing Chinese and American Stranger Cooperation

Despite institutional and cultural differences, both societies show upward cooperation trends, suggesting convergence. Research shows limited cross-national variation in cooperation levels (Spadaro, Graf, et al., 2022), and sociocultural changes may follow similar directions with comparable modernization processes (Greenfield, 2013; Inglehart & Baker, 2000). Similar modernization processes in China and the U.S. (e.g., rising individualism, declining trust) may produce convergent cooperation trends, as technological development (internet, social media) and complex division of labor increase dependence on and interaction with strangers, promoting cooperation within and across societies. From evolutionary and social change perspectives, cooperation remains a key strategy for solving adaptive problems (Boyd & Richerson, 2009). Future research should test whether rising cooperation is globally universal.

China's larger increase in a shorter period reflects unique aspects of its modernization. China experienced more rapid industrialization, urbanization, and globalization in a compressed timeframe (Jing, 2015). Over the past 20 years, China's economic growth, urbanization, and higher education enrollment rates have significantly exceeded America's (World Bank: https://data.worldbank.org/), as have internet user growth and industry development (Fang & Chen, 2019). Additionally, Chinese individualization is state-managed—individuals develop autonomy within boundaries set by the

state for collective benefit, internalizing socialist frameworks for individual development (Gao et al., 2022; Yan, 2012). State-promoted core socialist values and win-win cooperation concepts may amplify individualism's positive effects on cooperation. These factors may produce more pronounced cooperation increases in China. In cultural group selection, more cohesive and cooperative groups outperform less cooperative ones (Mesoudi, 2009). China's rapid cooperation increase reflects enhanced internal cohesion and social capital, demonstrating positive impacts of systemic reforms. This has important implications for China's future development, competitiveness, navigating global changes, and achieving national rejuvenation.

4.3 Limitations and Future Directions

This study has several limitations. First, the effect size for time is modest. Although cooperation increased significantly over 20 years, time explains only 1% of variance, or 3% after controlling for study characteristics. However, similar small-to-medium effect sizes appear in other cross-temporal meta-analyses on perfectionism (Curran & Hill, 2019), empathy (Konrath et al., 2011), and American cooperation (Yuan et al., 2022), especially for behavioral outcomes. Time is a distal predictor, and other manipulated variables (e.g., emotions) may attenuate its effects. Nevertheless, small increases can accumulate and self-reinforce over time, producing significant societal impacts, especially when sustained. Sustained increases may gradually strengthen cooperative norms and values, creating positive feedback loops.

Second, like previous research (Yuan et al., 2022), our data structure and methods cannot rule out confounding variables or establish causality. Positive correlations between societal indicators and cooperation may reflect spurious associations from linear growth over time. Future research should use longitudinal or time-series designs for cross-validation. Additionally, while all indicators positively predict cooperation, we cannot determine which has the strongest unique effect because economic, urbanization, mobility, and education indicators are interwoven and may operate through different mechanisms. Future research should clarify unique relationships and compare relative impacts.

Third, we cannot identify specific psychological processes (e.g., cooperative values) underlying temporal changes or distinguish whether rising cooperation reflects instrumental (strategic) versus prosocially-motivated cooperation (Sommet et al., 2023). Both forms enhance social cohesion, and sustained increases may gradually strengthen cooperative norms and intrinsic motivations. Future research should examine specific psychological pathways linking social change to cooperation.

Fourth, our sample primarily comprised young adults, mostly university students. While social dilemma research commonly uses this population, and young people are more susceptible to social norms and trends (Sears, 1986), results may not generalize to all age groups. However, research shows no sig-

nificant cooperation differences between university students and non-students that would affect trends (Yuan et al., 2022). Young adults are mainstream, "connecting" generations who must constantly interact with strangers in modern high-mobility societies, making their cooperation trends representative of broader societal changes.

5. Conclusion

This study reveals that despite expanding stranger societies, rising individualism, and declining trust in China, stranger cooperation—a key indicator of social capital—has increased during modernization. This provides new behavioral evidence for understanding social capital changes in China and signals enhanced internal cohesion for navigating global challenges. Modernization and technological innovation do not necessarily weaken connections; they can promote stranger interactions and cooperation within and across societies. As urbanization, living alone, and relational mobility increase, future populations will interact more with strangers and depend on them to achieve goals. Cooperation may thus continue rising across societies, helping us optimistically address public challenges and build a global community of shared future through win-win cooperation.

References

Acedo-Carmona, C., & Gomila, A. (2014). Personal trust increases cooperation beyond general trust. *PLOS ONE*, 9(8), Article e105559. https://doi.org/10.1371/journal.pone.0105559

Allik, J., & Realo, A. (2004). Individualism-collectivism and social capital. *Journal of Cross-Cultural Psychology*, 35(1), 29–49. https://doi.org/10.1177/0022022103260381

Assink, M., & Wibbelink, C. J. (2016). Fitting three-level meta-analytic models in R: A step-by-step tutorial. *The Quantitative Methods for Psychology*, 12(3), 154–174. https://doi.org/10.20982/tqmp.12.3.p154

Balliet, D., Li, N. P., Macfarlan, S. J., & Van Vugt, M. (2011). Sex differences in cooperation: A meta-analytic review of social dilemmas. *Psychological Bulletin*, 137(6), 881–909. https://doi.org/10.1037/a0025354

Balliet, D., Spadaro, G., Markovitch, B., & Beek, W. (2021, July). How did cooperation research change over time? Cooperation Databank. https://data.cooperationdatabank.org/coda/-/stories/change-over-time

Balliet, D., & Van Lange, P. A. M. (2013). Trust, conflict, and cooperation: A meta-analysis. *Psychological Bulletin*, 139(5), 1090–1112. https://doi.org/10.1037/a0030939

Beilmann, M., Kööts-Ausmees, L., & Realo, A. (2018). The relationship between social capital and individualism–collectivism in Europe. *Social Indicators*

Research, 137(2), 641–664. https://doi.org/10.1007/s11205-017-1614-4

Benz, M., & Meier, S. (2008). Do people behave in experiments as in the field?—Evidence from donations. *Experimental Economics*, 11(3), 268–281. https://doi.org/10.1007/s10683-007-9192-y

Berigan, N., & Irwin, K. (2011). Culture, cooperation, and the general welfare. *Social Psychology Quarterly*, 74(4), 341–360. https://doi.org/10.1177/0190272511422451

Boyd, R., & Richerson, P. J. (2009). Culture and the evolution of human cooperation. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 364(1533), 3281–3288. https://doi.org/10.1098/rstb.2009.0134

Brosnan, S. F., Salwiczek, L., & Bshary, R. (2010). The interplay of cognition and cooperation. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 365(1553), 2699–2710. https://doi.org/10.1098/rstb.2010.0154

Cai, H. J., Huang, Z. H., Lin, L., Zhang M. Y., Wang X. O., Zhu, H. J., … Jing, Y. M. (2020). The psychological change of the Chinese people over the past half century: A literature review. *Advances in Psychological Science*, 28(10), 1599–1688. [蔡华俭, 黄梓航, 林莉, 张明杨, 王潇欧, 朱慧珺, … 敬一鸣. (2020). 半个多世纪来中国人的心理与行为变化——心理学视野下的研究. 心理科学进展, 28(10), 1599–1688.]

Chen, X. P., & Li, S. (2005). Cross-national differences in cooperative decision-making in mixed-motive business contexts: The mediating effect of vertical and horizontal individualism. *Journal of International Business Studies*, 36(6), 622–636. https://doi.org/10.1057/palgrave.jibs.8400169

Chudek, M., & Henrich, J. (2011). Culture–gene coevolution, norm-psychology and the emergence of human prosociality. *Trends in Cognitive Sciences*, 15(5), 218–226. https://doi.org/10.1016/j.tics.2011.03.003

Columbus, S., Molho, C., Righetti, F., & Balliet, D. (2021). Interdependence and cooperation in daily life. *Journal of Personality and Social Psychology*, 120(3), 626–650. https://doi.org/10.1037/pspi0000253

Cooper, G. A., & West, S. A. (2018). Division of labour and the evolution of extreme specialization. *Nature Ecology & Evolution*, 2(7), 1161–1167. https://doi.org/10.1038/s41559-018-0564-9

Curran, T., & Hill, A. P. (2019). Perfectionism is increasing over time: A meta-analysis of birth cohort differences from 1989 to 2016. *Psychological Bulletin*, 145(4), 410–429. https://doi.org/10.1037/bul0000138

Dawes, R. M. (1980). Social dilemmas. *Annual Review of Psychology*, 31, 169–193. https://doi.org/10.1146/annurev.ps.31.020180.001125

Durkheim, E. (2019). The division of labor in society. In *Social stratification* (pp. 178–183). Routledge.

Fang, X. D., & Chen, S. (2019). Twenty-five years of internet in China. *Modern Communication (Journal of Communication University of China)*, 41(4), 1–10.

[方兴东, 陈帅. (2019). 中国互联网 25 年. 现代传播 (中国传媒大学学报), 41(4), 1–10.]

Fehr, E., & Fischbacher, U. (2004). Social norms and human cooperation. *Trends in Cognitive Sciences*, 8(4), 185–190. https://doi.org/10.1016/j.tics.2004.02.007

Francois, P., Fujiwara, T., & Van Ypersele, T. (2018). The origins of human prosociality: Cultural group selection in the workplace and the laboratory. *Science Advances*, 4(9), Article eaat2201. https://doi.org/10.1126/sciadv.aat2201

Galizzi, M. M., & Navarro-Martinez, D. (2019). On the external validity of social preference games: A systematic lab-field study. *Management Science*, 65(3), 976–1002. https://doi.org/10.1287/mnsc.2017.2908

Gao, H. Y., Wang, P., & Tan, K. R. (2022). Chinese social value change and its relevant factors: An age-period-cohort effect analysis. *Sociological Studies*, 37(1), 156–178. [高海燕, 王鹏, 谭康荣. (2022). 中国民众社会价值观的变迁及其影响因素——基于年龄—时期—世代效应的分析. 社会学研究, 37(1), 156–178.]

Ge, E., Chen, Y., Wu, J., & Mace, R. (2019). Large-scale cooperation driven by reputation, not fear of divine punishment. *Royal Society Open Science*, 6, Article 190991. https://doi.org/10.1098/rsos.190991

Gelfand, M. J., Nishii, L. H., & Raver, J. L. (2006). On the nature and importance of cultural tightness-looseness. *Journal of Applied Psychology*, 91(6), 1225–1244. https://doi.org/10.1037/0021-9010.91.6.1225

Greenfield, P. M. (2013). The changing psychology of culture from 1800 through 2000. *Psychological Science*, 24(9), 1722–1731. https://doi.org/10.1177/0956797613479387

Greenfield, P. M. (2016). Social change, cultural evolution, and human development. *Current Opinion in Psychology*, 8, 84–92. https://doi.org/10.1016/j.copsyc.2015.10.012

Gunia, B. C., Brett, J. M., Nandkeolyar, A. K., & Kamdar, D. (2011). Paying a price: Culture, trust, and negotiation consequences. *Journal of Applied Psychology*, 96(4), 774–789. https://doi.org/10.1037/a0021986

Haesevoets, T., Van Hiel, A., Dierckx, K., & Reinders Folmer, C. (2020). Do multiple-trial games better reflect prosocial behaviour than single-trial games?. *Judgment and Decision Making*, 15(3), 330–345. http://hdl.handle.net/1854/LU-8691547

Hamamura, T. (2012). Are cultures becoming individualistic? A cross-temporal comparison of individualism–collectivism in the United States and Japan. *Personality and Social Psychology Review*, 16(1), 3–24. https://doi.org/10.1177/1088868311411587

Hamamura, T., & Xu, Y. (2015). Changes in Chinese culture as examined through changes in personal pronoun usage. *Journal of Cross-Cultural Psychology*, 46(7), 930–941. https://doi.org/10.1177/0022022115592968

Hayes, A. F., & Krippendorff, K. (2007). Answering the call for a standard reliability measure for coding data. *Communication Methods and Measures*,

1(1), 77–89. https://doi.org/10.1080/19312450709336664

Henrich, J. (2004). Cultural group selection, coevolutionary processes and large-scale cooperation. *Journal of Economic Behavior & Organization*, 53(1), 3–35. https://doi.org/10.1016/S0167-2681(03)00094-5

Huang, S. A., & Zhang, S. (2013). How did cooperative behavior evolve: A summary and review. *Social Sciences in China*, (7), 79–91. [黄少安, 张苏. (2013). 人类的合作及其演进研究. 中国社会科学, (7), 79–91.]

Inglehart, R., & Baker, W. E. (2000). Modernization, cultural change, and the persistence of traditional values. *American Sociological Review*, 65(1), 19–51. https://doi.org/10.2307/2657288

Isaac, R. M., Walker, J. M., & Thomas, S. H. (1984). Divergent evidence on free riding: An experimental examination of possible explanations. *Public Choice*, 43(2), 113–149. https://doi.org/10.1007/BF00140829

Jin, S., Spadaro, G., & Balliet, D. (2021). Institutions and cooperation: A meta-analysis of rules in social dilemmas [Manuscript submitted for publication]. Department of Experimental and Applied Psychology, VU Amsterdam.

Jing, T. K. (2015). The time-space compression and social construction in China. *Journal of Lanzhou University (Social Sciences)*, 43(5), 1–9. [景天魁. (2015). 时空压缩与中国社会建设. 兰州大学学报: 社会科学版, 43(5), 1–9.]

Jing, Y., Cai, H., Bond, M. H., Li, Y., Stivers, A. W., & Tan, Q. (2021). Levels of interpersonal trust across different types of environment: The micro–macro interplay between relational distance and human ecology. *Journal of Experimental Psychology: General*, 150(7), 1438–1457. https://doi.org/10.1037/xge0000997

Jones, G. (2008). Are smarter groups more cooperative? Evidence from prisoner's dilemma experiments, 1959–2003. *Journal of Economic Behavior & Organization*, 68(3–4), 489–497. https://doi.org/10.1016/j.jebo.2008.06.010

Kemmelmeier, M., Jambor, E. E., & Letner, J. (2006). Individualism and good works: Cultural variation in giving and volunteering across the United States. *Journal of Cross-Cultural Psychology*, 37(3), 327–344. https://doi.org/10.1177/0022022106286927

Komorita, S. S. (1976). A model of the N-person dilemma-type game. *Journal of Experimental Social Psychology*, 12(4), 357–373. https://doi.org/10.1016/S0022-1031(76)80004-2

Konrath, S. H., O'Brien, E. H., & Hsing, C. (2011). Changes in dispositional empathy in American college students over time: A meta-analysis. *Personality and Social Psychology Review*, 15(2), 180–198. https://doi.org/10.1177/1088868310377395

Li, L. L., & Wang, P. (2018). Changing social attitudes in China in transition (2005–2015). *Social Sciences in China*, (3), 83–101. [李路路, 王鹏. (2018). 转型中国的社会态度变迁 (2005–2015). 中国社会科学, (3), 83–101.]

Lin, J., Li, W., Guo, Z., & Kou, Y. (2023). When and why does economic inequality predict prosocial behaviour? Examining the role of interpersonal trust among different targets. *European Journal of Social Psychology*. Advance online publication. https://doi.org/10.1002/ejsp.3007

Lipsey, M. W., & Wilson, D. B. (2001). *Practical meta-analysis*. Sage Publications, Inc.

Liu, J., & Lynn, R. (2013). An increase of intelligence in China 1986–2012. *Intelligence*, 41(5), 479–481. https://doi.org/10.1016/j.intell.2013.06.017

Mesoudi, A. (2009). How cultural evolutionary theory can inform social psychology and vice versa. *Psychological Review*, 116(4), 929–952. https://doi.org/10.1037/a0017062

Moreira, J., Vukov, J., Sousa, C., Santos, F. C., d'Almeida, A. F., Santos, M. D., & Pacheco, J. M. (2013). Individual memory and the emergence of cooperation. *Animal Behaviour*, 85(1), 233–239. https://doi.org/10.1016/j.anbehav.2012.10.030

Murnighan, J. K., & Wang, L. (2016). The social world as an experimental game. *Organizational Behavior and Human Decision Processes*, 136, 80–94. https://doi.org/10.1016/j.obhdp.2016.02.003

National Bureau of Statistics. (2021). *China statistical yearbook*. Beijing: China Statistics Press. [国家统计局. (2021). 中国统计年鉴. 北京：中国统计出版社.]

Nowak, M. A., & Sigmund, K. (1998). Evolution of indirect reciprocity by image scoring. *Nature*, 393(6685), 573–577. https://doi.org/10.1038/31225

Oyserman, D., Coon, H. M., & Kemmelmeier, M. (2002). Rethinking individualism and collectivism: Evaluation of theoretical assumptions and meta-analyses. *Psychological Bulletin*, 128(1), 3–72. https://doi.org/10.1037/0033-2909.128.1.3

Pennisi, E. (2005). How did cooperative behavior evolve?. *Science*, 309(5731), 93–93. https://doi.org/10.1126/science.309.5731.93

Pietschnig, J., & Voracek, M. (2015). One century of global IQ gains: A formal meta-analysis of the Flynn effect (1909–2013). *Perspectives on Psychological Science*, 10(3), 282–306. https://doi.org/10.1177/1745691615577701

Pletzer, J. L., Balliet, D., Joireman, J., Kuhlman, D. M., Voelpel, S. C., & Van Lange, P. A. M. (2018). Social value orientation, expectations, and cooperation in social dilemmas: A meta-analysis. *European Journal of Personality*, 32(1), 62–83. https://doi.org/10.1002/per.2139

Proto, E., Rustichini, A., & Sofianos, A. (2014). Higher intelligence groups have higher cooperation rates in the repeated prisoner's dilemma. *IZA Discussion Paper No. 8499*. Available at SSRN: https://ssrn.com/abstract=2505361

Putnam, R. D. (2000). *Bowling alone: The collapse and revival of American community*. New York: Simon & Schuster.

Putnam, R. D. (2001). Civic disengagement in contemporary America. *Government and Opposition*, 36(2), 135–156. https://www.jstor.org/stable/44482937

R Core Team. (2019). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. http://www.r-project.org/

Rand, D. G., & Nowak, M. A. (2013). Human cooperation. *Trends in Cognitive Sciences*, 17(8), 413–425. https://doi.org/10.1016/j.tics.2013.06.003

Rapoport, A. (1967). A note on the "index of cooperation" for prisoner's dilemma. *Journal of Conflict Resolution*, 11(1), 100–103. https://doi.org/10.1177/002200276701100108

Richerson, P., Baldini, R., Bell, A. V., Demps, K., Frost, K., Hillis, V., … & Ross, C. (2016). Cultural group selection plays an essential role in explaining human cooperation: A sketch of the evidence. *Behavioral and Brain Sciences*, 39, 1–46. https://doi.org/10.1017/S0140525X1400106X

Romano, A., Sutter, M., Liu, J. H., & Balliet, D. (2021). Political ideology, cooperation and national parochialism across 42 nations. *Philosophical Transactions of the Royal Society B*, 376(1822), Article 20200146. https://doi.org/10.1098/rstb.2020.0146

Santos, H. C., Varnum, M. E., & Grossmann, I. (2017). Global increases in individualism. *Psychological Science*, 28(9), 1228–1239. https://doi.org/10.1177/0956797617700622

Sears, D. O. (1986). College sophomores in the laboratory: Influences of a narrow data base on social psychology's view of human nature. *Journal of Personality and Social Psychology*, 51(3), 515–530. https://doi.org/10.1037/0022-3514.51.3.515

Shank, D. B., Kashima, Y., Peters, K., Li, Y., Robins, G., & Kirley, M. (2019). Norm talk and human cooperation: Can we talk ourselves into cooperation? *Journal of Personality and Social Psychology*, 117(1), 99–123. https://doi.org/10.1037/pspi0000163

Soler, M. (2012). Costly signaling, ritual and cooperation: Evidence from Candomblé, an Afro-Brazilian religion. *Evolution and Human Behavior*, 33(4), 346–356. https://doi.org/10.1016/j.evolhumbehav.2011.11.004

Sommet, N., Weissman, D. L., & Elliot, A. J. (2023). Income inequality predicts competitiveness and cooperativeness at school. *Journal of Educational Psychology*, 115(1), 173–191. https://doi.org/10.1037/edu0000731

Spadaro, G., Graf, C., Jin, S., Arai, S., Inoue, Y., Lieberman, E., Rinderu, M. I., Yuan, M., Van Lissa, C. J., & Balliet, D. (2022). Cross-cultural variation in cooperation: A meta-analysis. *Journal of Personality and Social Psychology*, 123(5), 1024–1088. https://doi.org/10.1037/pspi0000389

Spadaro, G., Tiddi, I., Columbus, S., Jin, S., ten Teije, A., & Balliet, D. (2022). The Cooperation Databank: Machine-readable science accelerates research synthesis. *Perspectives on Psychological Science*, 17(5), 1472–1489. https://doi.org/10.1177/17456916211053319

Stevens, J. R., & Hauser, M. D. (2004). Why be nice? Psychological constraints on the evolution of cooperation. *Trends in Cognitive Sciences*, 8(2), 60–65. https://doi.org/10.1016/j.tics.2003.12.003

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Allyn & Bacon.

Thielmann, I., Böhm, R., Ott, M., & Hilbig, B. E. (2021). Economic games: An introduction and guide for research. *Collabra: Psychology*, 7(1), 19004. https://doi.org/10.1525/collabra.19004

Thielmann, I., Spadaro, G., & Balliet, D. (2020). Personality and prosocial behavior: A theoretical framework and meta-analysis. *Psychological Bulletin*, 146(1), 30–90. https://doi.org/10.1037/bul0000217

Thomson, R., Yuki, M., Talhelm, T., Schug, J., Kito, M., Ayanian, A. H., … & Ferreira, C. M. (2018). Relational mobility predicts social behaviors in 39 countries and is tied to historical farming and threat. *Proceedings of the National Academy of Sciences*, 115(29), 7521–7526. https://doi.org/10.1073/pnas.1713191115

Twenge, J. M. (2000). The age of anxiety? The birth cohort change in anxiety and neuroticism, 1952–1993. *Journal of Personality and Social Psychology*, 79(6), 1007–1021. https://doi.org/10.1037/0022-3514.79.6.1007

Twenge, J. M., & Campbell, W. K. (2001). Age and birth cohort differences in self-esteem: A cross-temporal meta-analysis. *Personality and Social Psychology Review*, 5(4), 321–344. https://doi.org/10.1207/S15327957PSPR0504_3

Twenge, J. M., Zhang, L., & Im, C. (2004). It's beyond my control: A cross-temporal meta-analysis of increasing externality in locus of control, 1960-2002. *Personality and Social Psychology Review*, 8(3), 308–319. https://doi.org/10.1207/s15327957pspr0803_5

Van Buuren, S. & Groothuis-Oudshoorn, K. (2011). Mice: Multivariate imputation by chained equations in R. *Journal of Statistical Software*, 45(3), 1–67. https://doi.org/10.18637/jss.v045.i03

Van de Vliert, E., & Van Lange, P. A. M. (2019). Latitudinal psychology: An ecological perspective on creativity, aggression, happiness, and beyond. *Perspectives on Psychological Science*, 14(5), 860–884. https://doi.org/10.1177/1745691619858067

Van Lange, P. A. M., Joireman, J., Parks, C. D., & Van Dijk, E. (2013). The psychology of social dilemmas: A review. *Organizational Behavior and Human Decision Processes*, 120(2), 125–141. https://doi.org/10.1016/j.obhdp.2012.11.003

Van Lange, P. A. M., & Rand, D. G. (2022). Human cooperation and the crises of climate change, COVID-19, and misinformation. *Annual Review of Psychology*, 73, 370–402. https://doi.org/10.1146/annurev-psych-020821-110044

Viechtbauer, W. (2010). Conducting meta-analyses in R with the metafor package. *Journal of Statistical Software*, 36(3), 1–48. https://doi.org/10.18637/jss.v036.i03

Wu, J., Balliet, D., & Van Lange, P. A. M. (2016). Reputation management: Why and how gossip enhances generosity. *Evolution and Human Behavior*, 37(3), 193–201. https://doi.org/10.1016/j.evolhumbehav.2015.11.001

Xie, Y., & Zhou, X. (2014). Income inequality in today's China. *Proceedings of the National Academy of Sciences*, 111(19), 6928–6933. https://doi.org/10.1073/pnas.1403158111

Xin, Z. Q. (2019). Marketization and interpersonal trust decline in China. *Advances in Psychological Science*, 27(12), 1951–1966. [辛自强. (2019). 市场化与人际信任变迁. 心理科学进展, 27(12), 1951–1966.]

Xin, Z. Q., & Chi, L. P. (2008). Cross-temporal meta-analysis: Linking social change to psychological development. *Journal of East China Normal University (Educational Sciences)*, 26(2), 44–51. [辛自强, 池丽萍. (2008). 横断历史研究: 以元分析考察社会变迁中的心理发展. 华东师范大学学报 (教育科学版), 26(2), 44–51.]

Xin, Z., & Xin, S. (2017). Marketization process predicts trust decline in China. *Journal of Economic Psychology*, 62, 120–129. https://doi.org/10.1016/j.joep.2017.07.001

Yan, Y. X. (2012). *The individualization of Chinese society* (p.344) (Y. Lu et al., Trans.). Shanghai: Shanghai Translation Publishing House. [阎云翔. (2012). 中国社会的个体化 (p.344) (陆洋等译). 上海: 上海译文出版社.]

Yuan, M., Spadaro, G., Jin, S., Wu, J., Kou, Y., Van Lange, P. A. M., & Balliet, D. (2022). Did cooperation among strangers decline in the United States? A cross-temporal meta-analysis of social dilemmas (1956–2017). *Psychological Bulletin*, 148(3–4), 129–157. https://doi.org/10.1037/bul0000363

Yuki, M., & Schug, J. (2020). Psychological consequences of relational mobility. *Current Opinion in Psychology*, 32, 129–132. https://doi.org/10.1016/j.copsyc.2019.07.029

Note: Figure translations are in progress. See original paper for figures.