Cooperative Behavior in Intergenerational Dilemmas: Influencing Factors and Promotion Strategies

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Abstract

Intergenerational dilemmas reflect situations where conflicts arise between current self-interest and the interests of future others. How individuals weigh these interests in intergenerational dilemmas concerns the welfare of individuals, organizations, and even all of humanity. Compared to traditional social dilemmas, intergenerational dilemmas possess three distinctive features—power asymmetry, absence of direct returns for cooperative behavior, and greater psychological distance—which constitute the primary obstacles to intergenerational cooperation. Based on the three categories of factors influencing intergenerational cooperation that are widely examined in current research—personal traits, decision-making contexts, and social norms—this paper proposes that intergenerational cooperative behavior can be promoted through cultivating gratitude and prosocial qualities, expanding the reputational impact of intergenerational cooperation, increasing closeness with future generations, and reducing uncertainty about future outcomes. Future research should further investigate the ecological validity of research paradigms, the influence of reputational cues on intergenerational cooperation, and conduct extensive cross-cultural studies to provide more robust theoretical and practical foundations for promoting intergenerational cooperative behavior.

Full Text

Cooperation in the Intergenerational Dilemma: Influencing Factors and Promotion Strategies

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Abstract: Intergenerational dilemmas involve conflicts between one's current self-interest and the interests of future others. How people weigh these competing interests has profound implications for individual, organizational, and even global human welfare. Compared to traditional social dilemmas, intergenerational dilemmas are characterized by three distinctive features: power asymmetry, lack of direct reciprocity, and greater psychological distance. These features constitute the primary obstacles to intergenerational cooperation. Building on research examining three major categories of influences—personal traits, decision contexts, and social norms—this paper proposes several strategies for promoting intergenerational cooperation: cultivating gratitude and prosocial qualities, expanding the reputational impact of intergenerational cooperation, increasing affinity with future generations, and reducing uncertainty about future outcomes. Future research should further investigate the ecological validity of existing paradigms, the effects of reputation cues on intergenerational cooperation, and conduct more cross-cultural studies to provide stronger theoretical and practical foundations for promoting intergenerational cooperation.

Keywords: intergenerational cooperation, prosocial trait, social norm, reputation, nudge

1 Introduction

"Plant bamboo this year, eat bamboo shoots next year; predecessors plant trees, successors enjoy the shade."
—Qing Dynasty, Zhai Hao, *Popular Compilation, Volume 1, Folk Proverbs*

The United Nations Environment Programme's 2021 report *Making Peace with Nature* highlights that humanity faces three interconnected crises—climate change, ecosystem degradation and biodiversity loss, and pollution and waste management—that seriously threaten Earth's ecological balance and human health (United Nations Environment Programme, 2021). Addressing these crises requires individuals to make trade-offs in daily decisions, sacrificing immediate benefits to enhance the welfare of future generations through actions such as returning farmland to forest, sorting waste, and reducing private vehicle use. Situations involving conflicts between current decision-makers and future others are commonly referred to as intergenerational dilemmas (Wade-Benzoni & Tost, 2009).

In intergenerational dilemmas, people must weigh their own immediate interests against the interests of future others. Behavior that sacrifices one's current welfare for the benefit of future generations is typically termed intergenerational cooperation[1], also known as intergenerational beneficence (Bosetti et al., 2022). Because decisions made by the current generation affect future others' interests while future others' decisions cannot affect the current generation, this asymmetry between "present self" and "future others" often leads to pronounced

self-interested preferences (Hauser et al., 2014; Lohse & Waichman, 2020; Shahen et al., 2021). For instance, in organizational contexts, people facing resource allocation decisions tend to reserve resources for their present selves rather than for future organizational members, even when allocating to the latter would increase the resource value by 1.5 times (Wade-Benzoni et al., 2012). Similarly, in group experiments framed around climate change, researchers found that cooperation levels drop significantly when cooperative behavior benefits only future generations rather than the decision-makers themselves (Jacquet et al., 2013).

As social and environmental problems stemming from intergenerational dilemmas intensify, these dilemmas have attracted increasing scholarly attention. How to promote cooperation in intergenerational dilemmas has become an urgent issue. Based on recent advances in intergenerational dilemma research, this paper examines the defining characteristics of intergenerational dilemmas and research paradigms for studying cooperative behavior, summarizes major factors influencing intergenerational cooperation, proposes feasible strategies for promoting such cooperation, and identifies directions for future research. These syntheses and recommendations can provide valuable guidance for both theoretical research and intervention practice regarding intergenerational dilemmas.

2.1 Defining Characteristics of Intergenerational Dilemmas

Intergenerational dilemmas refer to situations where individuals' current self-interest conflicts with the interests of future others (Wade-Benzoni & Tost, 2009). The term "generation" here broadly encompasses individuals or groups occupying a particular role within a limited time period; a new generation emerges when that role is passed to others. Thus, "generation" includes both groups defined by birth cohorts or organizational structures and different individuals occupying the same role across time periods (Wade-Benzoni, 2002). For example, successive occupants of a particular position in an organization can be considered different "generations" (Tost et al., 2008).

Intergenerational dilemmas share similarities with and differences from traditional social dilemmas (situations where individual self-interest conflicts with group interest; Van Lange et al., 2013). Both involve conflicts between self-interest and others' or group interests, and both require cooperation from all members to maximize group (or intergenerational) welfare. However, social dilemmas involve members of the same group in the same time and space, whereas intergenerational dilemmas have both cross-temporal and cross-group attributes. Specifically, in traditional social dilemmas, beneficiaries of cooperative behavior include the decision-maker among all group members, whereas in intergenerational dilemmas, beneficiaries exclude the decision-maker. Moreover, decision-makers and future others in intergenerational dilemmas never occupy the same time and space.

Compared to traditional social dilemmas, intergenerational dilemmas feature three important distinctive characteristics: power asymmetry, lack of direct

reciprocity, and greater psychological distance (Van Lange & Huckelba, 2021; Wade-Benzoni, 2002, 2008; Wade-Benzoni & Tost, 2009). These features explain why self-interested preferences are so pronounced in intergenerational dilemmas.

First, power is asymmetrically distributed across generations in intergenerational dilemmas: the earlier generation's actions affect the later generation's welfare, but not vice versa. Consequently, the earlier generation holds absolute power to control and allocate resources, while later generations cannot directly intervene in the decision-making process, leading to lower levels of intergenerational cooperation. Second, earlier generations cannot obtain direct returns from sacrifices made for later generations. Specifically, beneficiaries of future gains exclude the decision-maker, meaning cooperators cannot benefit from their own cooperative behavior. Additionally, because successive generations cannot interact repeatedly in the same time and space, direct reciprocity opportunities are absent, hindering the cooperative-promoting effect of direct reciprocity (Henrich & Muthukrishna, 2021; Trivers, 1971).

Finally, psychological distance between generations is greater in intergenerational dilemmas. According to construal level theory, psychological distance comprises four dimensions—temporal distance, social distance, spatial distance, and uncertainty—relative to one's immediate here-and-now experience, and how individuals treat others depends on perceived psychological distance (Trope et al., 2007). Compared to the present self, future others are psychologically more distant: temporally, delays between decisions and outcomes cause people to discount future gains and losses, making them more self-interested (Wade-Benzoni et al., 2012); socially, individuals and future others exist in different times and spaces with lower interdependence, familiarity, and intimacy, reducing concern for future others (Wade-Benzoni, 2008); in terms of uncertainty, future outcomes involve high uncertainty regarding timing, beneficiaries, and value, which reduces intergenerational cooperation (Wade-Benzoni et al., 2008).

2.2 Research Paradigms for Studying Cooperation in Intergenerational Dilemmas

Researchers typically measure intergenerational cooperation using two paradigms: hypothetical scenarios and game tasks, quantifying cooperation through behavioral intentions in hypothetical scenarios and actual behavior in game tasks. Hypothetical scenarios usually draw on real-world intergenerational problems, primarily resource use issues involving natural and organizational resources. For example, in an ocean fishing scenario, participants imagine themselves as fishery company decision-makers who must determine next year's catch before retirement; higher catches yield higher pensions, while the marine fisheries bureau recommends a 50% reduction to prevent resource depletion and losses for future fishermen. Lower proposed catch levels indicate higher intergenerational cooperation (Bang et al., 2017; Wade-Benzoni, 2002). Similar to the ocean fishing scenario, organizational resource scenarios require individuals to weigh their own immediate interests against those of future organizational

members. In Wade-Benzoni et al.'s (2012) experiment, participants imagined being vice presidents of a subsidiary company with access to a new energy source; another subsidiary with more advanced technology could double the energy utilization efficiency. Because sharing the energy source would directly reduce current profits, the proportion participants were willing to allocate to the other subsidiary served as a measure of intergenerational cooperation. To enhance ecological validity, researchers have also created scenarios based on everyday topics. In a gasoline tax scenario, although tax increases impose greater economic costs on taxpayers, they yield better ecological conditions for future generations (higher taxes reduce gasoline consumption and greenhouse gas emissions). Thus, individuals' willingness to support gasoline tax increases is treated as an indicator of intergenerational cooperation (Wade-Benzoni, 2002).

Unlike hypothetical scenarios, game tasks for measuring intergenerational cooperation primarily involve modified versions of public goods games and resource dilemma games (Hauser et al., 2014; Lange, 2022; Wade-Benzoni et al., 2008). Public goods games require n group members to contribute portions of their initial endowment E to a public account, where contributions are multiplied by k and distributed equally among all members (Wu et al., 2016). Resource dilemma games require n members to extract resources from a common pool with fixed size E; when total extraction exceeds a threshold, all members receive nothing (Ahsanuzzaman et al., 2022). Because future others' interests in intergenerational dilemmas include money, resources, and opportunities for sustainable survival and development (Lohse & Waichman, 2020; Wade-Benzoni & Tost, 2009), researchers adapt these paradigms to create intergenerational sustainability contexts for measuring intergenerational cooperation. These adapted paradigms are often called intergenerational sustainability dilemma games (Kamijo et al., 2017; Shahen et al., 2021). In such paradigms, future others may be the next generation in real life experiencing intergenerational consequences or experimentally defined "future generations," whose benefits or survival opportunities derive from sacrifices made by current individuals (the present generation). The degree of sacrifice current individuals make for future others thus serves as the measure of intergenerational cooperation (Bosetti et al., 2022; Burton-Chellew & West, 2013; Shahen et al., 2021; Shahrier et al., 2017). For example, in Jacquet et al.'s (2013) modified public goods game, each participant received a fixed number of tokens plus a bonus. In each round, they decided whether to contribute tokens to a "climate change account" for climate change advocacy. If total contributions after 10 rounds reached a preset standard, the bonus was retained for tree planting to protect the next generation's environment; otherwise, each participant faced a probability of losing the bonus. Other researchers have divided participants into groups representing different generations, with all participants playing a public goods game sequentially by generation. If the previous generation's total contributions failed to meet the preset standard, all subsequent generations would be unable to participate and benefit from later rounds (Hauser et al., 2014; Lohse & Waichman, 2020).

Although both hypothetical scenarios and game tasks are widely used to measure intergenerational cooperation, each has distinct advantages and limitations. Hypothetical scenarios ask participants to imagine facing specific real-world intergenerational dilemmas and report their behavioral intentions (e.g., willingness to support gasoline tax increases). They involve no real interaction between individuals, allowing strict control of extraneous variables and thus high internal validity. However, because self-reported behavioral intentions require no real sacrifice and have no real-world consequences, they may not accurately reflect actual intergenerational cooperation. Additionally, social desirability may cause individuals to report higher cooperation levels than they would actually exhibit.

In contrast, game tasks simulate real-world conflicts of interest through abstract behavioral tasks. In these paradigms, intergenerational cooperation requires participants to pay real costs, and their behavior directly affects both their own experimental earnings and future others' benefits or survival chances (Bosetti et al., 2022; Hauser et al., 2014; Lohse & Waichman, 2020). Real costs elicit more genuine behavior than hypothetical costs (徐四华 et al., 2013; Hinvest & Anderson, 2010). However, because game tasks oversimplify real-world conflicts and participants' cooperation levels may be influenced by their game experience, behavior in game tasks may differ from real-world behavior. For example, research using public goods games found that time pressure increased contributions to the public account, but only among inexperienced participants (Rand et al., 2012); as participants gained experience, this effect diminished (Rand et al., 2014). In summary, hypothetical scenarios and game tasks each have strengths and weaknesses in measuring intergenerational cooperation, and future research should select appropriate paradigms based on specific research questions.

3 Influencing Factors of Cooperation in Intergenerational Dilemmas

Research shows that in both everyday life and laboratory settings, most people become more selfish when facing intergenerational dilemmas, preferring to protect their immediate interests (Lohse & Waichman, 2020; Nishimura et al., 2020). To maintain intergenerational sustainability and promote cooperation, it is essential to identify factors that facilitate or hinder intergenerational cooperation. Current research focuses on three main categories: personal traits, decision contexts, and social norms.

3.1.1 Prosocial Traits

Because cooperative decisions in intergenerational dilemmas require individuals to consider future others' interests, prosocial traits play a critical role. Prosocial traits refer to relatively stable individual characteristics that predict willingness to incur personal costs to benefit others, including social value orientation and honesty-humility (Thielmann et al., 2020). Social value orientation refers to stable preferences regarding the distribution of outcomes between oneself and oth-

ers, typically classified as prosocial or proself (Van Lange, 1999). Meta-analytic evidence shows that social value orientation significantly predicts cooperation in social dilemmas, with a moderate effect size (Pletzer et al., 2018; Thielmann et al., 2020), and this predictive relationship is stronger in high-conflict situations (Thielmann et al., 2020). In intergenerational sustainability dilemma games, prosocial individuals are more likely than proself individuals to choose options benefiting future generations (Kamijo et al., 2017; Shahen et al., 2021), and intergenerational sustainability improves as the proportion of prosocial individuals increases (Shahrier et al., 2017). Additionally, honesty-humility predicts pro-environmental attitudes and behaviors (Gibbon & Douglas, 2021; Pavalache-Ilie & Cazan, 2018). One meta-analysis found small-to-moderate correlations between honesty-humility and pro-environmental attitudes ($r = .20$) and behaviors ($r = .25$) (Soutter et al., 2020). In summary, prosocial traits such as prosocial social value orientation and honesty-humility are important factors promoting cooperation in intergenerational dilemmas.

3.1.2 Generalized Reciprocity and Gratitude

The norm of reciprocity forms the foundation of social relationships and underpins human cooperation. In social interactions, people exhibit clear reciprocity preferences, repaying kindness with kindness after receiving benefits from others (Fehr & Schmidt, 2003). However, unlike typical social interactions, intergenerational dilemmas lack direct reciprocity opportunities: the earlier generation cannot receive direct returns from the later generation for cooperative behavior, nor can it be directly punished by the later generation for non-cooperation (Wade-Benzoni, 2002). Nevertheless, people can still achieve intergenerational transmission of cooperation through generalized reciprocity.

Generalized reciprocity refers to behavior where individuals who receive help pass the benefit on to a third party: A helps B, B helps C, C helps D, and so on (余俊宣 & 寇彧, 2015; Gray et al., 2012). Both selfish and altruistic behaviors in social interactions have transmission effects, as individuals' behavior is influenced by how others have previously treated them (Chernyak et al., 2019; Leimgruber, 2018). Intergenerational dilemmas exhibit similar patterns, where people "repay" good or bad outcomes received from previous generations by passing benefits or burdens to future generations, thereby achieving intergenerational reciprocity (Wade-Benzoni, 2002). In other words, the more kindness people receive from previous generations, the more kindness they show to future generations.

Gratitude is an important psychological mechanism underlying generalized and intergenerational reciprocity (Simpson et al., 2018). Gratitude can be categorized as state gratitude—feelings of thankfulness and pleasure experienced when receiving benefits in specific situations—or trait gratitude, which reflects stable cross-situational and cross-temporal tendencies to feel grateful in daily life (丁凤琴 & 赵虎英, 2018; Tam, 2022). Individuals high in trait gratitude more readily experience state gratitude (Tam, 2022). Empirical research and meta-analyses

show that both trait and state gratitude promote generalized reciprocity and increase prosocial behavior (Ma et al., 2017; Simpson et al., 2018). Trait gratitude also enhances people's sense of responsibility toward future generations and increases their concern about climate change (Syropoulos et al., 2020), and it promotes sustainable consumption by reducing temporal discounting of future outcomes (Liang & Guo, 2021). Moreover, reflecting on sacrifices made by previous generations can evoke gratitude toward them, thereby strengthening responsibility toward future generations (Watkins & Goodwin, 2019).

In summary, as a lubricant for generalized reciprocity, gratitude is a key trait for enhancing intergenerational cooperation. In uncertain situations, when people perceive kindness from the previous generation—regardless of actual outcomes—they become more generous to future generations in intergenerational resource allocation decisions (Bang et al., 2017).

3.1.3 Future Orientation

Future orientation refers to the tendency for individuals' thoughts and behaviors to focus on future goals and outcomes, manifested in pursuing and planning for the future to achieve future objectives (刘霞 et al., 2010). Research shows that individuals high in future orientation are more likely to oppose environmentally harmful offshore drilling (Strathman et al., 1994), adopt green lifestyle habits (Corral-Verdugo et al., 2006), and prefer public transportation (Joireman et al., 2004). Future orientation also negatively predicts household electricity consumption (Enzler et al., 2019). Furthermore, when perceiving scarcity of natural resources, individuals with higher future orientation show stronger intentions to make environmental donations (Gu et al., 2020). These findings indicate that future orientation helps promote cooperation in intergenerational dilemmas.

As noted earlier, intergenerational dilemmas require individuals to weigh immediate self-interest against future others' interests. Future orientation may promote cooperation through two pathways: increasing reputation concern and reducing perceived temporal distance. First, cooperative behavior in intergenerational dilemmas can earn individuals good reputations, which bring indirect material and non-material benefits such as rewards from others and preference from potential partners (Roberts et al., 2021). Individuals high in future orientation are more willing to pay costs to maintain their reputations (Vonasch & Sjåstad, 2019) and thus more likely to cooperate in intergenerational dilemmas. Consistent with this, research shows that prompting individuals to think about the future in public contexts increases their concern for reputation, leading to more cooperative behavior (Sjåstad, 2019). Second, temporal distance causes people to discount the value of future others' gains and losses (Wade-Benzoni, 2008), but individuals high in future orientation think more about the future, which reduces perceived temporal distance to future outcomes and increases concern for others' welfare, thereby promoting cooperation.

3.2.1 Decision Frames

When the same decision problem is presented through different descriptions, individuals' choice preferences change—a phenomenon known as the framing effect, first discovered in risky decision-making (Tversky & Kahneman, 1981). Recent social decision-making research has also found framing effects, where problem description influences cooperative tendencies (Cartwright et al., 2019; Goerg et al., 2020). Framing types in intergenerational dilemmas can be broadly categorized as positive-negative frames based on decision outcomes, and give-take frames based on decision behaviors (Cartwright & Ramalingam, 2019).

Positive-negative frames emphasize either the positive impact of contributing to the collective or the negative consequences of not contributing, and these different descriptions produce behavioral differences. Research shows that intergenerational cooperation is affected by positive-negative framing. For example, regarding behaviors affecting global warming, thinking about how such behaviors burden future generations (negative frame) rather than benefit them (positive frame) intensifies moral concerns and strengthens feelings of guilt and shame, thereby evoking stronger responsibility and closeness toward future generations (Wade-Benzoni et al., 2010). Additionally, people are more willing to choose sustainable green products (Chang & Wu, 2015) and donate to protect species diversity (Vogdrup-Schmidt et al., 2019) under negative frames.

Give-take frames differ by comparing "contributing to the collective" versus "extracting from the collective." Research shows that in negotiation tasks, parties are more likely to reach agreement when deciding how to allocate shared resources among themselves (take frame) than when deciding how much to contribute to the collective (give frame) (Majer et al., 2022). In give frames, individuals possess initial resources and experience only losses when deciding how much to contribute, whereas in take frames, individuals start with zero resources and experience only gains when deciding how much to extract. Prior research confirms the existence of "loss aversion" (Kahneman & Tversky, 1979), where people are more sensitive to losses and thus cooperate less in loss frames (Sun et al., 2021). Therefore, even when final outcomes are identical, loss aversion may lead people to exhibit higher intergenerational cooperation in take frames than in give frames.

3.2.2 Resource Structure

The degree of inequality and uncertainty in resource structures that individuals face in intergenerational dilemmas affects their behavior. On one hand, high inequality in group members' resources inhibits intergenerational cooperation. For example, researchers using a threshold public goods game to investigate intergenerational cooperation found that when group members' resources were highly unequal and the poor bore greater risk, overall cooperation levels decreased substantially (Burton-Chellew & West, 2013). Additionally, in high-income countries, higher income inequality among residents correlates with higher carbon

emissions (Knight et al., 2017). Evidence from social dilemmas indicates that resource inequality inhibits cooperation only when resource distribution is visible to group members (Nishi et al., 2015). That is, when members do not know others' resource endowments, inequality does not affect cooperation or group outcomes. This may be because visible economic inequality triggers upward social comparison and stronger feelings of relative deprivation (Hastings, 2019), which are important causes of low cooperation (Callan et al., 2017; Zhang et al., 2016).

On the other hand, resource uncertainty also affects intergenerational cooperation. First, uncertainty about resource quantity makes people more selfish in intergenerational dilemmas because they tend to overestimate actual resource amounts (van Dijk et al., 2004), leading them to extract more, an effect especially pronounced among proself individuals who prioritize their own interests (De Kwaadsteniet et al., 2006). Second, uncertainty about resource dynamics (including growth and decay rates) inhibits intergenerational cooperation. Real-world intergenerational dilemmas often involve unpredictable future outcomes, such as the uncertain impacts of greenhouse gas emissions, making it difficult for people to clearly recognize climate change dangers. This may cause them to underestimate future negative consequences and the positive effects of intergenerational cooperation, leading them to prioritize immediate self-interest. In intergenerational sustainability games, when the growth rate of contributions to the public account is uncertain and may increase or decrease, people are more inclined to protect their own interests rather than collective interests (Zhang et al., 2021). Similar results have been found in hypothetical scenarios about preventing overfishing: greater perceived uncertainty about future outcomes leads to fewer resources left for future others (Wade-Benzoni et al., 2008). From a motivational perspective, resource uncertainty creates "desirable outcome bias," where people overestimate the likelihood of more attractive outcomes, believing resources are more abundant, grow faster, or decay slower than they actually are, thereby justifying pursuit of immediate personal interests (Rapoport et al., 1992; van Dijk et al., 2004; Wade-Benzoni & Tost, 2009; Wit & Wilke, 1998).

3.3 Social Norms

Because intergenerational cooperation involves social interaction between individuals, social norms play an important role in guiding such cooperation. Social norms are typically divided into descriptive norms, which reflect what most group members actually do, and injunctive norms, which refer to behavioral standards that group members generally approve (Cialdini et al., 1990). Numerous studies show that others' behavior in social situations influences people's responses (傅鑫媛 et al., 2019; Cialdini & Trost, 1998). When situations are highly uncertain and individuals lack clear decision preferences, descriptive norms provide a reference for decision-making. For example, descriptive norms about how most people behave (e.g., most people use energy-saving light bulbs) can promote pro-environmental behavior (Castro-Santa et al., 2023; Niemiec

et al., 2020). Field studies in the United States, Switzerland, Germany, and Australia found that descriptive norm information about towel reuse rates significantly increased the proportion of hotel guests who reused towels compared to standard environmental messages (Goldstein et al., 2008; Gössling et al., 2019; Reese et al., 2014). Research shows that when most group members cooperate, individuals experience stronger social identity and are thus more likely to follow descriptive norms and cooperate (Irwin & Simpson, 2013). This suggests that social identity is an important psychological mechanism explaining how descriptive norms promote cooperation.

Injunctive norms, as widely approved behavioral standards, are generally considered effective in promoting norm-compliant behavior. Individuals who violate injunctive norms (e.g., cooperation norms) often face exclusion and direct or indirect punishment (Molho et al., 2020), and people across cultures endorse punishing norm violators to varying degrees (Eriksson et al., 2021). Therefore, to avoid negative consequences of norm violation, people are more likely to comply when they perceive that their group strictly enforces a norm. However, a recent study found that introducing peer punishment in intergenerational dilemmas only increased the likelihood of intergenerational continuity without increasing total group benefits (Lohse & Waichman, 2020), suggesting that injunctive norms are not always followed. Moreover, when descriptive and injunctive norms conflict, only descriptive norms predict individual behavior (Bicchieri & Xiao, 2009). A recent meta-analysis also found that descriptive norms have a significantly stronger effect than injunctive norms on promoting conservation behavior intentions (Niemiec et al., 2020). Nevertheless, a field study found that when low-energy-consuming households were presented with descriptive norm information about average energy savings, their consumption rebounded; adding injunctive norm information (e.g., communicating social approval) suppressed this negative effect (Schultz et al., 2007). Thus, combining both types of norms may be more effective for promoting intergenerational cooperation.

4 Strategies for Promoting Cooperation in Intergenerational Dilemmas

Most current research focuses on factors influencing intergenerational cooperation rather than intervention strategies. As social and environmental problems derived from intergenerational dilemmas become increasingly prominent, enhancing intergenerational cooperation has become an important practical issue. Nudge and boost are widely used intervention approaches for promoting positive behavior and rational decision-making. Nudge aims to change behavior in desired directions by adjusting choice architecture without eliminating options or significantly altering economic incentives (Thaler & Sunstein, 2008), whereas boost seeks to improve decision-making capacity by changing people's cognition and problem-solving approaches (Hertwig & Grüne-Yanoff, 2017). The former emphasizes guiding immediate decision behavior, while the latter focuses more on developing long-term capacities; combining both yields better intervention

effects. Based on two distinctive features of intergenerational dilemmas—lack of direct reciprocity and greater psychological distance—this paper proposes strategies to promote cooperation by integrating nudge and boost approaches.

4.1 Breaking the Barrier of No Direct Return for Cooperative Behavior

In intergenerational dilemmas, earlier generations cannot directly benefit from their own cooperative behavior or obtain returns from future generations through repeated interactions, which contributes to low cooperation levels. To break this barrier, two interventions can be implemented: (1) strengthening the cultivation of gratitude and prosocial qualities to boost intergenerational cooperation, and (2) improving social norm enforcement strategies to nudge intergenerational cooperation through reputation concerns.

4.1.1 Cultivating Gratitude and Prosocial Qualities As discussed earlier, prosocial traits such as gratitude and prosocial value orientation are important factors enhancing prosocial and intergenerational cooperation. Therefore, cultivating gratitude and prosocial qualities can help promote intergenerational sustainable behavior. Research shows that although evoking state gratitude can enhance intergenerational cooperation, this effect is not robust (Tam, 2022), whereas trait gratitude is considered a key trait for enhancing intergenerational cooperation (Syropoulos et al., 2020).

Evidence indicates that gratitude experiences emerge in preschool children, who show higher cooperation when observing others' gratitude (Vaish & Savell, 2022). Therefore, targeted cultivation and intervention for gratitude and prosocial qualities starting in early childhood may help enhance intergenerational sustainability. Common gratitude interventions include: (1) regularly writing gratitude journals listing things to be thankful for; (2) expressing gratitude to specific people through concrete actions; and (3) organizing focus groups for in-depth discussion on gratitude themes (Davis et al., 2016). Additionally, interventions at cognitive (e.g., mindfulness and meditation training), emotional (e.g., peer emotional support), and behavioral (e.g., cooperative games, expressing praise to others) levels can promote prosocial behavior and qualities in children and adolescents (Laguna et al., 2020).

Intervention studies and meta-analyses show that these methods effectively strengthen gratitude and prosocial qualities (Shin & Lee, 2021; Locklear et al., 2021; O'Connell et al., 2018), providing important foundations for promoting generalized reciprocity and intergenerational cooperation.

4.1.2 Expanding the Reputational Impact of Intergenerational Cooperation In real life, those who violate injunctive norms may face punishment (e.g., verbal or physical aggression) or risk having their negative reputation spread (Giardini & Wittek, 2019). Although punishment mechanisms can promote cooperation (Balliet et al., 2011; Fehr & Schurtenberger, 2018), they may

also undermine intrinsic cooperative motivation and reduce cooperation after punishment is removed (Mulder et al., 2006).

Compared to direct punishment, reputation spreading is an informal, low-cost, and low-retaliation-risk form of indirect punishment that serves as another important means of promoting cooperation (Wu et al., 2016). When people know their behavior can be observed by others, they exhibit higher cooperation levels out of concern for future reputation (Jordan et al., 2016; Wedekind & Milinski, 2000). Although cooperative behavior in intergenerational dilemmas cannot obtain direct returns from future generations, it can help individuals gain good reputations, social approval, and subsequent cooperation opportunities. Research shows that individuals donate more money to environmental organizations in public than in anonymous contexts, and when they must compete for good reputations to secure cooperation with others, they behave more generously (Barclay & Barker, 2020). Additionally, subtle reputation cues such as eye images can evoke reputation concerns and increase prosocial behavior (时慧颖 et al., 2022; Bateson et al., 2013). Thus, compared to direct punishment with economic costs, reputation spreading may have lower costs and higher benefits for promoting intergenerational cooperation. Therefore, future efforts to address intergenerational dilemmas should expand the reputational impact of intergenerational cooperation. For example, increasing the public visibility of behavior in intergenerational dilemmas or presenting subtle reputation cues during decision-making can enhance reputation concerns and thereby promote intergenerational cooperation.

4.2 Overcoming the Obstacle of Greater Psychological Distance

In intergenerational dilemmas, decision-makers must weigh their immediate interests against future others' interests. However, compared to the present self, future others are temporally and socially more distant, and future outcomes are more uncertain, leading to lower intergenerational cooperation. To overcome this obstacle, interventions can be implemented through two approaches: (1) increasing affinity with future generations to nudge intergenerational cooperation, and (2) reducing uncertainty about intergenerational dilemma outcomes to improve information processing capacity and thereby boost cooperation.

4.2.1 Increasing Affinity with Future Generations Events affecting future others may seem abstract and unreal compared to those affecting oneself, involving greater psychological distance. Affinity with future generations refers to the perceived closeness of connection between one's present self and future generations, and higher affinity helps reduce psychological distance between decision-makers and future others (Wade-Benzoni, 2008). Research shows that affinity with future others can evoke legacy motivation and promote intergenerational cooperation, manifested in allocating more resources to future others and stronger willingness to support gasoline tax increases (Wade-Benzoni, 2008). Therefore, increasing affinity with future others can promote intergenerational

cooperation.

Specific measures include asking people to record future life risks caused by climate change, predict future others' possible behaviors, or write letters to future others (Bosetti et al., 2022; Lee et al., 2020; Shrum et al., 2021) to evoke more concrete imagination of the future. Additionally, when individuals think about and write down the positive impacts they can have on future generations, they show higher tendencies toward environmental protection and are willing to donate more money to environmental organizations (Zaval et al., 2015). Indirect evidence also suggests that interactive tasks (e.g., using immersive virtual reality to show people their aged faces and interact with them) can enhance future self-continuity and thereby promote more future-oriented pro-environmental behavior (Hershfield, 2011).

In summary, adding imagination-writing tasks and interactive tasks to decision-making processes can promote current decision-makers' empathy, imagination, and reflection on how their actions affect future others, thereby increasing affinity with future generations and nudging intergenerational cooperation.

4.2.2 Reducing Uncertainty About Future Outcomes In real life, the final outcomes of many intergenerational dilemmas depend not only on individuals' own behavior but also on other group members' behavior and many uncontrollable factors (e.g., natural disasters, breakthrough technologies), creating high uncertainty that inhibits intergenerational cooperation. However, in some contexts, the specific impacts of individual behavior are relatively clear. For example, forgoing one long-distance round-trip flight can reduce per capita annual CO_2 emissions by 1.9 tons, and for high-income households, using renewable electricity can reduce per capita annual CO_2 emissions by 1.5 tons (United Nations Environment Programme, 2020). Therefore, governments and relevant organizations should enhance publicity and provide the public with specific numerical information about the carbon emission and reduction effects of different behaviors, clarifying the impacts of low-carbon actions to reduce uncertainty about energy conservation effects and thereby stimulate pro-environmental behavior. Similar measures can be applied to any context where effects can be calculated and quantified, such as negative impact indicators of white plastics on ecological environments or positive impact indicators of tree planting on vegetation and water conservation.

Most citizens have limited ability to process and understand numbers, making it difficult for them to accurately weigh the costs and benefits of different actions, leading them to underestimate the impact of their pro-environmental behavior on mitigating climate change (Capstick et al., 2019; Wynes et al., 2020). Therefore, while providing precise numerical information, governments and relevant organizations should also work to boost citizens' "numeracy" through multiple approaches to improve understanding and judgment accuracy. These approaches include using better educational methods, creating simpler and more understandable promotional messages, and representing numerical effects in

more vivid ways (Gigerenzer, 2014). For example, when presenting automobile fuel efficiency information, changing the unit from "miles per gallon" to "gallons per mile" greatly improves people's accuracy in judging vehicle fuel consumption and helps them better perceive the benefits of low-fuel-consumption vehicles (Larrick & Soll, 2008). Many similar findings from behavioral science can provide a powerful knowledge base and inspiration for nudging and boosting intergenerational cooperation.

5 Summary and Outlook

This paper has reviewed and analyzed the important characteristics of intergenerational dilemmas. Although these features hinder intergenerational cooperation and make self-interested preferences salient, research shows that individuals' prosocial traits, gratitude, and future orientation can enhance their cooperative behavior, and specific decision contexts and social norms also influence cooperation to varying degrees. Based on two features of intergenerational dilemmas—lack of direct reciprocity and greater psychological distance—this paper proposes strategies to promote cooperation by integrating nudge and boost approaches.

Although research on intergenerational dilemmas has accumulated considerably, many directions remain to be explored due to the complexity of the issues and their close connection to real society. We consider the following three directions particularly important and urgent.

First, future research needs to compare different research paradigms for intergenerational cooperation and examine the extent to which measures from different paradigms reflect real-world intergenerational cooperation. Although commonly used hypothetical scenarios and game tasks each have advantages, both lack high ecological validity. The former measures behavioral intentions without requiring real sacrifices, while the latter cannot fully reflect real-life decision contexts. No research has directly examined whether intergenerational cooperation measured by these two paradigms is correlated, or whether either corresponds to real-life behavior. Some studies and meta-analyses on prosocial behavior have found weak correlations between behavior measured by game tasks and everyday prosocial behavior (Gurven & Winking, 2008), and inconsistent conclusions across studies using self-reports, hypothetical choice tasks, and game tasks (Wu et al., 2020). These findings suggest that distinguishing between intergenerational cooperation measures from different paradigms and testing their correspondence with real-world behavior is necessary. Clarifying this issue will help us more accurately identify solutions to real-life intergenerational dilemmas.

Second, future research needs to examine how reputation cues affect cooperation in intergenerational dilemmas. Although intergenerational dilemmas lack direct reciprocity opportunities, indirect reciprocity based on reputation cues may also promote cooperation. Previous research has explored how reputation cues (e.g., public vs. anonymous contexts) affect environmental behavior (Yoeli

et al., 2013), but their role in intergenerational dilemmas remains underexamined. Indirect reciprocity theory and costly signaling theory suggest that high cooperation levels earn individuals good reputations, and people are more likely to help those with good reputations and prefer them as cooperation partners (Roberts et al., 2021). Thus, reputation plays an important role in social interaction and partner selection, serving as a benchmark for regulating individual behavior. Whether individuals in intergenerational dilemmas care about their reputation when weighing immediate self-interest against future others' interests remains unclear. Some researchers view intergenerational dilemmas as intertemporal intergroup cooperation dilemmas, suggesting that current decision-makers tend to treat future others across time and space as outgroup members while treating contemporaneous others as ingroup members (Meleady & Crisp, 2017). However, evidence shows that people care equally about evaluations from ingroup and outgroup members and adjust their behavior based on reputation cues (Romano et al., 2017). Moreover, research finds that direct punishment only slightly increases the likelihood of intergenerational continuity without increasing total group benefits (Lohse & Waichman, 2020), and that reputation spreading is a more effective means of promoting cooperation than direct punishment due to its lower cost and retaliation risk (Wu et al., 2016). Therefore, future research should focus on examining the role of reputation cues in intergenerational dilemmas and identifying the contexts in which they can promote intergenerational cooperation, providing strong evidence for developing more cost-effective measures to promote intergenerational sustainability.

Finally, in an era of urgent global climate change, promoting intergenerational cooperation and sustainable development is a challenge faced by all countries. However, due to cultural background differences across nations, conclusions from single-cultural contexts cannot be directly generalized to different cultural groups, making cross-cultural research on intergenerational cooperation necessary. Different cultures may have different understandings of and emphasis on intergenerational relationships and future generations, which directly affect cooperation in intergenerational dilemmas. Some evidence suggests that rural residents in less capitalized areas have stronger collective consciousness than urban residents in highly capitalized areas (Voronov & Singer, 2002) and are more cooperative in intergenerational sustainability tasks (Shahrier et al., 2017). These differences may have cultural roots. For example, collectivistic cultures emphasize interdependence, social embeddedness, and obligations to maintain ingroups, whereas individualistic cultures emphasize independence, uniqueness, and freedom of choice (黄梓航 et al., 2018; Oyserman et al., 2002). Therefore, people in collectivistic cultures may be more likely to view sacrifices for future generations as their duty and thus have stronger motivation for intergenerational cooperation. Additionally, cultural tightness-looseness reflects a society's tolerance for norm violations and norm enforcement (Gelfand et al., 2011; Stamkou et al., 2019). Compared to loose cultures, tight cultures are less tolerant of norm violations, so individuals in tight cultures may be more likely to comply with social norms to avoid punishment and thus exhibit higher intergenerational

cooperation. Future research should test these hypotheses and systematically examine cross-cultural differences in intergenerational cooperation and the effects of macro-level sociocultural variables (e.g., individualism-collectivism, cultural tightness-looseness). Such cross-cultural research will not only provide culturally specific guidance for promoting intergenerational cooperation but also help us understand the important role of culture in shaping solutions to intergenerational dilemmas.

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[1]Although some researchers argue that cooperation requires mutual collaboration among group members to achieve common interests or goals—meaning different individuals must engage in joint actions (Pennisi, 2005)—psychological research in recent years has typically adopted a broader definition, viewing cooperation as "behavior where individuals sacrifice their own interests to benefit

others" (Kurzban et al., 2015; Rand & Nowak, 2013). This definition has been accepted in intergenerational dilemma research (Hauser et al., 2014; Lohse & Waichman, 2020). Therefore, this paper refers to individuals' sacrifice of immediate self-interest to benefit future others in intergenerational dilemmas as "intergenerational cooperative behavior."

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