Restraint or Repair?

Restoration Opportunities in an Intergenerational Commons*

Michela Boldrini† Valentina Bosetti‡ Salvatore Nunnari§

October 16, 2026

Abstract

Many shared resources can be repaired after they have been damaged, at a cost: carbon dioxide can be removed from the atmosphere, forests replanted, fisheries restocked. Such *restoration opportunities* promise a fail-safe against over-exploitation, but they may also erode the restraint that protects the resource in the first place. We study how people respond to them in a pre-registered online experiment where 3,213 participants play a restorable common-pool resource game across non-overlapping generations. Each participant plays a scenario in which depletion is irreversible and a scenario in which a depleted resource can be restored by collective investment, with restoration available, across conditions, either with certainty or with probability one half. Reliable restoration shifts behavior from *restraint* to *repair*: participants extract more, but commit enough to restoration that the resource is passed on to the next generation more often (in 81 rather than 58 percent of groups) and, counting the generations that lose access to the resource, earnings across generations rise by 15 percent. Unreliable restoration erodes restraint without delivering repair: extraction rises and investment is committed, but neither conservation nor earnings improve, and earnings become more unequal within generations. Participants nonetheless prefer having the restoration opportunity in both conditions (80 and 73 percent) and are willing to pay for it. They also overestimate its benefits, and those who overestimate them most demand it most: demand tracks beliefs about the consequences of restoration rather than the consequences themselves.

Keywords: Common-Pool Resource, Restoration, Intergenerational Cooperation
JEL Codes: C92, D91, H41, Q54

*We gratefully acknowledge funding from MIUR PRIN 2017 (201782J9R9), Horizon Europe Research and Innovation Programme (101081521, UPTAKE) and NextGenerationEU in the framework of the GRINS project (PE000018, CUP B43C22000760006). We are grateful to Marco Casari, Massimo Tavoni, Severine Toussaert, Sigrid Suetens, Christopher Stapenhurst, and audiences at the 2023 BEEN Meeting at the University of Venice, the 2023 ESA World Meeting in Lyon, the CIVICA Conference on "Advancing Climate Economics" at IE University, the 2024 EAERE Annual Conference, the Vienna Workshop on "The Political Economy of the Environment", the 2026 WCERE Annual Conference, University of Pisa, and LMU Munich for helpful comments. The experiment was pre-registered on AsPredicted (`https://aspredicted.org/3gn32g.pdf`) and approved by the Bocconi University Research Ethics Committee.

†Bocconi University; RFF-CMCC EIEE; `michela.boldrini@unibocconi.it`.
‡Bocconi University; RFF-CMCC EIEE; `valentina.bosetti@unibocconi.it`.
§Bocconi University; CEPR; CESifo; `salvatore.nunnari@unibocconi.it`.

1 Introduction

Many of the resources that societies share can be repaired after being overexploited. Carbon dioxide can be removed from the atmosphere and stored in soils, materials, geological formations, and oceans; forests can be replanted, fisheries restocked, aquifers recharged, and wetlands rebuilt. Repair is never free, and its effectiveness is rarely certain. Yet the mere prospect of it changes the problem that the current users of a resource face. A restoration opportunity is a *fail-safe*: if restraint fails, the damage may be undone. It is also a temptation: if the damage can be undone, restraint is less necessary. This tension is at the heart of the debate on negative emission technologies. Almost all the emission pathways compatible with the temperature targets of the Paris Agreement require large-scale carbon dioxide removal (Rogelj et al. 2018; Riahi et al. 2022). The same technologies are criticized for *mitigation deterrence*: if they are perceived as a substitute for costly emission reductions rather than as a complement to them, they may delay or crowd out current abatement (McLaren 2020; Grant et al. 2021). An analogous concern arises in waste management, where the availability of recycling may encourage greater material consumption, potentially undermining efforts to prevent waste at source (Catlin and Wang 2013).

Whether this concern is warranted is a question about behavior, not about technology. When a restoration opportunity exists, do people substitute repair for restraint? Does the opportunity leave the resource better or worse off, once the response of behavior is accounted for? And do the people who would use it want it, and do they foresee its consequences? The answers are hard to obtain from the field, where restoration opportunities are neither randomly assigned nor comparable across settings, and where actors' responses to restoration opportunities are difficult to disentangle from ecological conditions, institutional arrangements, and the behavior of others. In this paper, we answer these questions in a controlled setting that isolates the behavioral response to a restoration opportunity from the technology it stands for.

We conduct a pre-registered experiment with 3,213 participants recruited online, who play a *restorable common-pool resource game* across non-overlapping generations. A group of three participants inherits a resource, each member chooses how much to extract from it, and the group's total extraction determines whether the resource is passed on to a new group of three, freshly recruited participants. Each participant makes a single extraction decision and then leaves. In a Baseline scenario, extraction above a known threshold depletes the resource irreversibly, and all later generations earn nothing. In a Restoration scenario, each member also commits an investment that, if the group over-extracts, restores the resource when the group's total investment reaches a second threshold. Every participant whose

resource is still available under both scenarios plays both, which gives a within-subject measure of the response to the restoration opportunity. Between subjects, we vary the reliability of restoration: in the *Certain* condition, the technology always works, in the *Uncertain* condition it works with probability one half. We calibrate the environment so that, without restoration, conservation frequently, but not invariably, fails, leaving room for restoration to extend or shorten the resource life. After playing both scenarios, participants choose, in an incentivized task, which scenario should determine everyone's earnings and how much of their own money they are willing to give up for their preferred scenario. We also elicit incentivized beliefs about the extraction and investment of groupmates, incentivized beliefs about the average earnings and resource life under each scenario, survey measures of risk, time, and social preferences, and open-ended accounts of the reasoning behind their choices.

Three features of the design are chosen with our questions in mind. First, generations do not overlap, so a period of the game has a concrete meaning: it is the tenure of one group of decision makers, whose choices determine what the next group inherits. Each decision is first-time play, without reputation or learning from feedback within a group, and the benefit of restraint accrues to people the decision maker will never meet. Second, the same participant faces both scenarios, and the same pre-drawn potential length of the game applies to both scenarios of a resource. The effect of the restoration opportunity is identified within participant and within resource, holding fixed the person, her groupmates, and the length of the sequence. Third, we measure the objects through which behavior might respond (beliefs about others, beliefs about outcomes, preferences, and stated reasons) rather than infer them from choices alone.

To organize the analysis, we extend the standard infinite-horizon common-pool resource game by adding a restoration stage and successive generations who can play only if their predecessors leave the resource viable. A player's utility is her own material payoff plus a weighted term reflecting altruistic concern for the material payoff of the player who will take her place in the next generation. This *intergenerational altruism*, combined with the probability that a next generation exists, plays the role that the discount factor plays for long-lived players, and the equilibrium analysis carries over with one substantive difference. In the symmetric stationary equilibria of the game, each generation either limits extraction to what the resource can sustain, a profile we call *restraint*, or extracts fully, and either commits to restoration or does not. Restraint requires enough altruism. With a reliable restoration technology and our parameters, restraint survives only for a narrow band of altruism; for players altruistic enough to restore the resource alone, the only symmetric stationary equilibrium in which restoration does not depend on one's own extraction prescribes

full extraction followed by restoration, a profile we call *repair*, and repair is more efficient than restraint. With an unreliable technology, repair conserves the resource only when the technology works, restraint is more efficient, and both survive as equilibria. The theory thus predicts that a restoration opportunity raises extraction, more so when it is reliable, and it identifies the conditions under which the opportunity should help.

We present three sets of results. First, a reliable restoration opportunity converts restraint into repair. Under Certain Restoration, individual extraction rises by 2.2 units on a scale from 0 to 20, the share of groups that extract beyond the sustainable threshold rises from 42 to 72 percent, and yet the resource is passed on to the next generation more often, in 81 rather than 58 percent of groups, because most groups that over-extract also commit enough to restore it. The resource survives about one generation longer, and total earnings per potential participant, a measure that counts as zero the earnings of the generations that lose access, rise by 15 percent, even though the participants who face both scenarios earn less. The mitigation-deterrence concern is borne out in behavior, but it does not translate into harm to the resource: when repair is reliable and cheap relative to restraint, participants move toward the more efficient profile, though imperfectly, and the gain accrues to later generations through more frequent survival.

Second, an unreliable restoration opportunity erodes restraint without delivering repair. Under Uncertain Restoration, extraction rises by less than half as much as under certainty, but the share of groups that extract beyond the threshold still rises by 19 percentage points, and committed investments are as large as under certainty. With a 50 percent failure rate, we detect no statistically significant increase in the share of groups passing on the resource: about 65 percent of groups pass on the resource in both scenarios, and the 95 percent confidence interval excludes any gain larger than 5 percentage points against each group's own Baseline. Resource life and total earnings do not improve either. In both conditions, earnings become more unequal within a generation, because some members extract more and others do not. Participants rely less on the unreliable technology than on the reliable one, but not enough to offset the fact that it fails half the time.

Third, demand for the restoration opportunity is high and tracks beliefs rather than consequences. After playing both scenarios, 80 percent of participants in the Certain condition and 73 percent in the Uncertain condition prefer that the Restoration scenario determine everyone's earnings, and those who prefer it are willing to give up, on average, about one dollar of a four-dollar bonus for it, more than the sixty cents that a participant earns in a scenario. Participants in both conditions believe that Restoration raises average earnings and extends resource life relative to Baseline. Under certainty, these perceived gains substantially exceed the realized gains. Under uncertainty, participants perceive gains even though

the realized changes are zero or negative. Beliefs about these advantages are the strongest correlate of demand: a ten-point higher believed earnings advantage is associated with a roughly 8 percentage-point higher probability of preferring Restoration in both conditions, while own behavior, beliefs about groupmates, and risk, time, and social preferences explain little. Stated altruism is unrelated to the binary preference for Restoration, but predicts how much people pay for it under uncertainty. In the Uncertain condition, therefore, a large majority pays for an institution with no detectable benefit, and the participants who pay most are those who most overestimate how much it helps.

We also document the channels through which behavior responds. Own extraction rises markedly with the expected extraction of groupmates in every scenario, and own investment rises with the expected investment of groupmates, the pattern of conditional cooperation. Participants also expect their groupmates to extract more when restoration is available, and more so under certainty, so that part of the response runs through expectations about others. Beliefs about groupmates, however, predict one's own behavior far better than they predict what groupmates actually do. The participants' own accounts confirm that the rise in extraction is a conscious response to the opportunity. Asked whether restoration shaped their extraction, 23 percent in the Certain condition and 18 percent in the Uncertain condition say that they took more because the resource could be restored, and their choices match their words: they extract five units more under Restoration than under the Baseline, while those who say that restoration was not relevant to their choice do not change their extraction at all.

Our paper contributes to three literatures. The first is the experimental literature on cooperation in dynamic social dilemmas that mimic the key features of environmental problems, from dynamic public goods and common-pool resource games (e.g., Battaglini et al. 2016; Gächter et al. 2017; Tasneem et al. 2017; Calzolari et al. 2018; Cason and Zubrickas 2019; Vespa 2020; Lohse and Waichman 2020; Nockur et al. 2020) to games played by successive generations (Fischer et al. 2004; Hauser et al. 2014; Sherstyuk et al. 2016; Kamijo et al. 2017).[1] These studies explore how the evolution of a durable public good or a common resource is shaped by group size, the persistence of actions, the action space, and the institutions through which decisions are made. Our Baseline is the intergenerational goods game of Hauser et al. (2014) with groups of three and a random termination rule. The key innovation of our design is the introduction of *reversible actions*: a restoration stage in which players can make a costly investment to undo previous, excessive extraction. The closest contribution in this respect is Battaglini et al. (2016), who study the accumulation

[1]Less directly related are experiments using static public good or common-pool resource games to study environmental sustainability (e.g., Ostrom 2008; Gächter et al. 2022; Manara et al. 2025).

of a durable public good through voluntary contributions and, in some treatments, allow negative contributions that reverse earlier virtuous actions. We study the reversal of selfish and hazardous behavior rather than of cooperative behavior, and we vary the reliability of the reversal, which they do not.

The second is the growing literature that uses experiments and surveys to study attitudes and behavior toward climate change and its remedies (e.g., Dechezleprêtre et al. 2025; Tannenbaum et al. 2022; Fabre et al. 2025; Andre et al. 2024), including the willingness to engage in voluntary carbon offsetting and its sensitivity to the cost and effectiveness of offsets (Rodemeier 2026; Bernard et al. 2023; Woerner et al. 2024; Pace et al. 2025), and experiments on solar geoengineering, in which deployment can offset the damages from emissions (Abatayo et al. 2020; Cherry et al. 2023; Cherry et al. 2024). These studies concern individual decisions or the strategic deployment of a technology by countries. We model the repair of a shared resource as a cooperation problem among its users, and we measure both the behavioral response to the repair option and the demand for it. The moral hazard that we study, mitigation deterrence, has been examined with integrated assessment models that synthesize climate science, engineering, and economics (e.g., Emmerling et al. 2019; Bosetti 2021; Giannousakis et al. 2021; Grant et al. 2021). These models assume optimal decision making by a social planner and therefore abstract from the voluntary provision and coordination problems that are central to our design.

The third is the literature on the demand for institutions and policies whose equilibrium consequences people fail to anticipate. Dal Bó et al. (2018) show that voters demand a policy that is harmful once the equilibrium response of other players is taken into account, because they evaluate it as if behavior did not respond. Our participants demand a restoration opportunity whose consequences depend on how everyone responds to it, and, in the condition where the response leaves the resource no better off, they expect it to help. Unlike a policy chosen by a vote, a restoration technology is often chosen by the same people whose restraint it affects, which makes the wedge between believed and realized consequences directly relevant to how such technologies will be adopted.

The rest of the paper is organized as follows. Section 2 presents the restorable common-pool resource game with generations and its equilibria. Section 3 describes the experiment and Section 4 discusses its design and the theoretical predictions. Section 5 reports the results, and Section 6 concludes. The appendices contain the equilibrium analysis and proofs, supporting tables and figures, the analysis of the open-ended answers, and the survey instrument.

2 The Restorable Common-Pool Resource Game

We model the problem as an infinite-horizon common-pool resource game played by a sequence of non-overlapping generations, with one addition: a stage in which a generation that has depleted the resource can restore it at a cost. We call the result the *restorable common-pool resource game*.

A common-pool resource is used by a sequence of generations $t = 1, 2, \ldots$. Each generation consists of $n \geq 2$ homogeneous players who live for one period. Each period features an *Extraction* and a *Restoration Phase*; Figure 1 summarizes the timing of a period.
In the **Extraction Phase**:

- The common-pool resource counts $K > 0$ units.
- Each player i receives an endowment $w > 0$.
- Each player i makes simultaneously an individual extraction choice $e_{it} \in \left[0, \frac{K}{n}\right]$.
- If $\sum_i e_{it} \leq T_E$, the resource is conserved, and the game continues to another period.
- If, instead, $\sum_i e_{it} > T_E$, the game continues to the Restoration Phase with probability $\rho \in [0, 1]$; the resource is exhausted and the game ends with probability $(1 - \rho)$.

In the **Restoration Phase** (if reached):

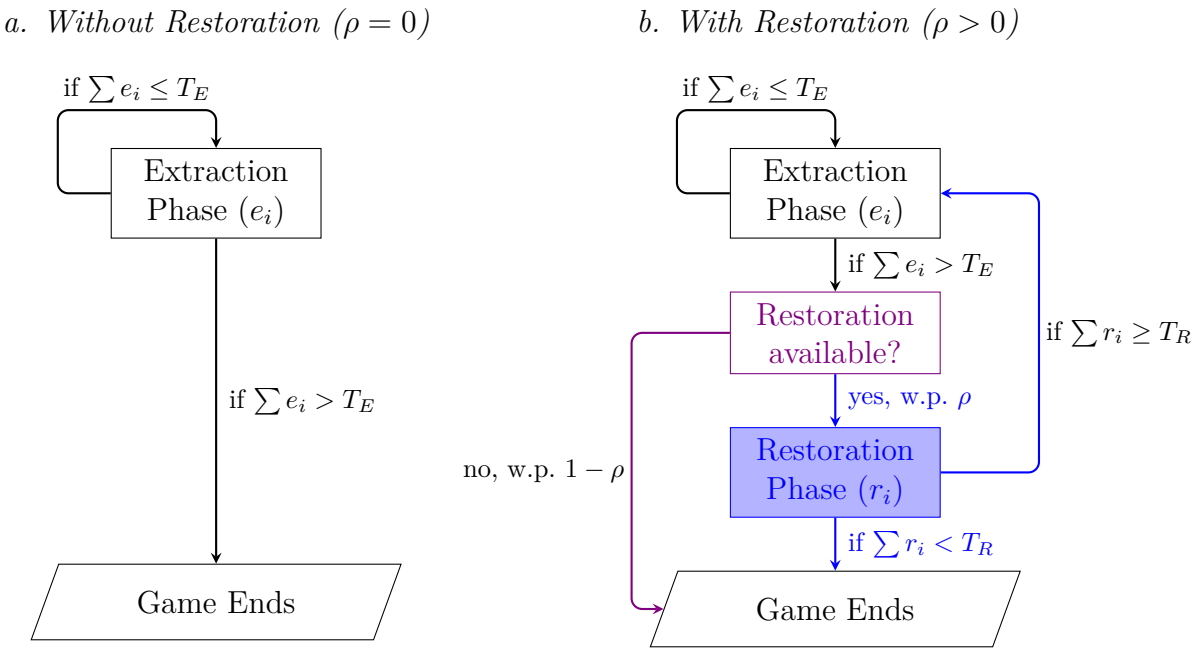
- Each player makes simultaneously an individual restoration choice $r_{it} \in [0, w]$.
- If $\sum_i r_{it} \geq T_R > 0$, the resource is restored, and the game continues to another period.
- If, instead, $\sum_i r_{it} < T_R$, the resource is exhausted and the game ends.

When the game continues to another period, a new generation of n players takes the place of the current one with probability $p \in (0, 1]$, and the game ends for exogenous reasons with probability $1 - p$.

Payoffs and preferences. Player i's material payoff in period t is $u_{it} = w + e_{it} - r_{it}$, where w is the endowment, e_{it} is the individual benefit from extraction, and r_{it} is the individual cost of restoration, which is paid only if the Restoration Phase is reached. Assuming $r_{it} \leq w$ guarantees $u_{it} \geq 0$, which is useful for the experimental implementation. Players live for one period but care about their successors. Specifically, player i in generation t maximizes

$$U_{it} = u_{it} + \alpha \, \mathbb{E}\left[U_{i,t+1}\right], \tag{1}$$

Figure 1: Dynamics of the Restorable Common-Pool Resource Game



Notes. Panel a: Without restoration technologies, a period has a single phase, the Extraction Phase, in which each member of the current generation makes an extraction choice (e_i). If total extraction does not exceed the threshold ($\sum e_i \leq T_E$), the resource is passed on and the next generation starts a new period; otherwise, the resource is exhausted and the game ends. *Panel b:* With restoration technologies, a period in which total extraction exceeds the threshold continues to the Restoration Phase with probability ρ (restoration is available) and ends with probability $1-\rho$ (restoration is not available). In the Restoration Phase, each member makes a restoration choice (r_i): if total restoration reaches the threshold ($\sum r_i \geq T_R$), the resource is restored and passed on; otherwise, it is exhausted and the game ends. In both panels, when the resource is passed on, a new generation is recruited with probability p and the game ends for exogenous reasons with probability $1-p$. In the experiment, restoration choices are made before the availability draw and are deducted only if restoration is available (Section 3), which is strategically equivalent to the timing shown here.

where $U_{i,t+1}$ is the objective of the player who occupies position i in generation $t+1$, equal to zero when no such generation exists, and $\alpha \in [0,1]$ is the weight the player puts on her successor, which we call *intergenerational altruism*.[2] Since a next generation exists with probability p whenever the resource is passed on, and the resource is passed on only if it is conserved or restored, the objective in (1) coincides with the objective of an infinitely lived player who faces the same transitions and discounts the future with the factor

$$\delta \equiv \alpha p \in [0,1]. \tag{2}$$

[2]This is the recursive, or dynastic, formulation of intergenerational altruism (Barro 1974). An equivalent formulation assigns to the material payoffs of the successors k generations ahead the weight α^k. Under symmetric strategies, caring about the player in one's own position is equivalent to caring about the average member of the next generation.

We refer to δ as the *intergenerational discount factor*. It combines how much a player cares about her successors with how likely it is that they will exist. When $\alpha = 0$, each generation plays a one-shot game in which the future of the resource is irrelevant; when $\alpha = 1$, the game is strategically identical to a game played by long-lived players who discount the future at the continuation probability p. In what follows, the analysis is carried out in terms of δ, and the experimental parameters fix p, so that every condition on δ can be read as a condition on the altruism of the players.

Assumptions. We denote by $W \equiv nw$ the total endowment of a generation and make one assumption.

Assumption 1 (No Unilateral Conservation) *We assume that* $\left(\frac{n-1}{n}\right) K > T_E > 0$*, that is, a single group member cannot unilaterally conserve the resource in the Extraction Phase if everybody else is extracting maximally.*

We do not make the analogous assumption for the Restoration Phase. When $T_R > w$, a single group member cannot restore the resource if nobody else makes any restoration effort. When $T_R \leq w$, as in our experiment, a single member can restore the resource on her own by investing T_R, and, as we show below, this possibility limits the set of equilibria in which nobody restores.

2.1 Equilibrium Analysis

We focus on symmetric and stationary subgame perfect Nash equilibria (SPNEs) of the game, in which all players of all generations choose the same actions in the Extraction Phase and in the Restoration Phase. We note that there can only be (at most) four symmetric and stationary SPNEs:[3]

[3]Payoffs in a period are strictly increasing in e_{it} and strictly decreasing in r_{it}. Moreover, transition probabilities across periods and phases within a period are insensitive to marginal changes in e_{it} unless $\sum e_{it} = T_E$, and insensitive to marginal changes in r_{it} unless $\sum r_{it} = T_R$. It follows that, in any period of any symmetric and stationary equilibrium, players must choose either $e_{it} = \frac{K}{n}$ (i.e., maximal extraction) or $e_{it} = \frac{T_E}{n}$ (i.e., the largest symmetric extraction which ensures conservation). Similarly, they must choose either $r_{it} = 0$ (i.e., minimal restoration) or $r_{it} = \frac{T_R}{n}$ (i.e., the minimal symmetric restoration which avoids exhaustion). No other strategy can be part of a symmetric and stationary equilibrium because, if that were the case, each player could unilaterally deviate and extract marginally more (thus increasing the payoff in the current period) without changing the transition between periods or between phases within the same period (thus, leaving the continuation value of the game unchanged). Throughout, we restrict attention to profiles in which the restoration choice does not depend on the player's own extraction. Profiles in which it does can sustain restraint by the threat of a self-financed repair: under certain restoration, "extract T_E/n; if one's own extraction exceeded T_E/n and k members' extraction did, invest T_R/k; otherwise invest nothing" is an equilibrium whenever $\delta \geq nT_R/(W + T_E + nT_R)$ and $T_R \geq (K - T_E)/n$; the second condition holds with our parameters, so that the profile is an equilibrium for $\delta \geq 1/3$. We do not observe this profile in the data: committed investments cluster at the fair share T_R/n, not at T_R.

1. (*Extract, Don't Restore*) where, in each period, $e_i^\star = \frac{K}{n}$ and $r_i^\star = 0$;

2. (*Conserve, Don't Restore*) where, in each period, $e_i^\star = \frac{T_E}{n}$ and $r_i^\star = 0$;

3. (*Extract, Restore*) where, in each period, $e_i^\star = \frac{K}{n}$ and $r_i^\star = \frac{T_R}{n}$;

4. (*Conserve, Restore*) where, in each period, $e_i^\star = \frac{T_E}{n}$ and $r_i^\star = \frac{T_R}{n}$.

We refer to the second profile, in which each generation limits its extraction to what the resource can sustain, as *restraint*, and to the third profile, in which each generation depletes the resource and then restores it, as *repair*.

In Appendix A, we characterize conditions on the game's parameters for each of these four potential equilibria to exist. Three features of the characterization matter for what follows. First, when players do not care about their successors ($\delta = 0$), the unique symmetric and stationary equilibrium is (Extract, Don't Restore): a one-shot player extracts as much as she can and invests nothing, whatever the availability of restoration. Any other outcome requires intergenerational altruism. When players believe others are conserving or restoring, an equilibrium with (perpetual or temporary) resource preservation is feasible as long as players care enough about their successors to give up the immediate gratification of greater resource exploitation and smaller restoration investment for the delayed benefit, to others, of a longer resource life. As the sustainable level of extraction (T_E) grows, the degree of altruism needed to support restraint decreases; as the investment required for restoration (T_R) grows, the degree of altruism needed to support repair increases.

Second, when a single player can restore the resource on her own ($T_R \leq w$), the profiles in which nobody restores survive only if altruism is limited. An altruistic player who finds the resource depleted, and who expects nobody else to invest, prefers to pay the full restoration cost rather than let her successors inherit nothing, whenever δ times the value of the game for the next generation exceeds T_R. Under (Extract, Don't Restore), this happens when $\delta > nT_R/(W + K)$; under (Conserve, Don't Restore), which promises a longer resource life, when $\delta > nT_R/(W+T_E+nT_R)$. Above these thresholds, symmetric and stationary equilibria must involve restoration.

Third, (Conserve, Restore) has the same path and the same efficiency as restraint, since restoration is never used on the path. It is nonetheless harder to sustain: it can require more altruism than restraint and, when restoration is certain, it exists only if restoring costs at least as much as the extra extraction that depletion allows ($T_R \geq K - T_E$). Otherwise, a generation that expects to be bailed out by its own restoration commitment prefers to deplete the resource and restore it. This is the moral hazard, or mitigation deterrence, discussed in the Introduction.

Finally, multiple equilibria coexist for a wide range of parameters, including ours, and which one players select is an empirical question. One criterion that can be used to refine predictions ex ante is the efficiency of equilibrium outcomes. We evaluate efficiency by the expected sum of material payoffs over all the generations that the resource could serve, each weighted by the probability that it exists, that is, the criterion of a planner who weights all generations equally and takes exogenous termination as given. First, when they exist, both restraint and repair dominate (Extract, Don't Restore). Second, when restoration is available with certainty, repair is more efficient than restraint if and only if $K - T_R > T_E$, that is, when the extra extraction that depletion allows exceeds the cost of restoring the resource. Third, when restoration is uncertain, repair keeps the resource alive for $1/(1-\rho p)$ generations in expectation, against $1/(1-p)$ under restraint, and is less efficient than restraint unless restoration is very cheap or very likely to be available.[4]

3 Experimental Design

We ran the experiment online between July and September 2026 with participants recruited on Prolific, restricting recruitment to residents of the United States whose first language is English and whose approval rate on the platform was within the range of 95 to 100 percent; each participant took part once.[5] The instructions use a neutral framing: they speak of a common resource passed from one group to the next, of points, and of restoration technologies, and never mention the climate or the environment.

The game. Generations are groups composed of $n = 3$ members, which act one after the other, in a sequence. There is a common resource that is passed from one generation to the next. At the beginning of the sequence, when the first generation is called to play, this common resource counts $K = 60$ points. Each member receives a private endowment of $w = 20$ points and chooses simultaneously and independently how many points to take from the resource, between 0 and $K/n = 20$. The sum of the private endowment and total points taken out of the resource constitutes members' earnings. If the total extraction within a generation is at most $T_E = 30$, the resource regenerates to 60 points for the next generation, which will play exactly the same game. If it exceeds 30, the resource is exhausted: the members of the current generation keep their earnings, but the members of all later

[4] The expected sum of material payoffs is $(W + T_E)/(1-p)$ under restraint and $(W + K - \rho T_R)/(1-\rho p)$ under repair, so that restraint is more efficient if and only if $(W + T_E)(1-\rho p) > (W + K - \rho T_R)(1-p)$.

[5] The study was approved by the Bocconi University Research Ethics Committee and pre-registered on AsPredicted on June 29, 2026 (#299349, `https://aspredicted.org/3gn32g.pdf`). The survey instrument is reproduced in Appendix E.

Table 1: Experimental Parameters

Scenario	ρ	n	K	w	T_E	T_R	p
Baseline (both conditions)	0	3	60	20	30	–	0.8
Restoration, Certain condition	1	3	60	20	30	15	0.8
Restoration, Uncertain condition	0.5	3	60	20	30	15	0.8

Notes. ρ denotes the probability that restoration is available; n the group size; K the size of the resource; w the endowment of each member; T_E and T_R the thresholds for total group extraction and total group restoration investment; p the probability that a new generation is recruited when the resource is available. Every participant whose resource is available under both scenarios plays the Baseline scenario and the Restoration scenario of the condition to which the resource was assigned.

generations earn nothing. After each generation, whenever the resource is still available, the computer rolls a ten-sided die: if the die lands on 1 or 2, the sequence ends; otherwise, a new generation is recruited, so that $p = 0.8$.[6]

Each generation plays the game under two *scenarios*. In the ***Baseline*** scenario, exhaustion is irreversible. In the ***Restoration*** scenario, each member also chooses, after the extraction choice and before learning what the other members did, how many points of the endowment to commit to restoration technologies, between 0 and 20. If the total extraction exceeds 30, the committed investments are deducted from the endowments and, if their sum is at least $T_R = 15$, the resource is restored to 60 points for the next generation; otherwise, the resource is exhausted. Restoration investments are elicited with the strategy method (Brandts and Charness 2011; Fischbacher et al. 2012): every participant makes a restoration choice, but the choice is payoff-relevant only if there is over-extraction.

Between subjects, we vary the reliability of the technology. In the ***Certain*** condition, restoration works whenever the group invests enough ($\rho = 1$). In the ***Uncertain*** condition, the technologies are described as being "still in their trial phase": whenever the group over-extracts, the computer flips a coin, and the resource is restored only if the group invests enough and the coin lands on heads ($\rho = 0.5$); when it lands on tails, the resource is exhausted. As in the game of Section 2, the committed points are deducted only if the Restoration Phase is reached, that is, if the group over-extracts and, in the Uncertain condition, the coin lands on heads. Table 1 summarizes the parameters. Below, we refer to the Restoration scenario of the two conditions as *Certain Restoration* and *Uncertain Restoration*.

[6]The random termination rule is the standard implementation of an infinite horizon in the laboratory (Fréchette and Yuksel 2017). Here it determines whether a new group of participants (a generation) is recruited, rather than whether the same participants play again.

Generations and resources. The design is organized around *resources*, each corresponding to a sequence of generations of three participants who share access to the same common resource over time. For each resource, we drew in advance a potential length based on the random termination rule with continuation probability 0.8. The potential length corresponds to the maximum number of generations that would have access to the resource if the resource were never exhausted due to participants' behavior. We used 200 resources per condition and the same sequence of 200 potential lengths in both conditions, so that the i-th resource of the Certain condition has the same potential length as the i-th resource of the Uncertain condition. The mean potential length is 5.16 generations, 45 resources per condition have a potential length of one, and the longest potential length is 23 generations.

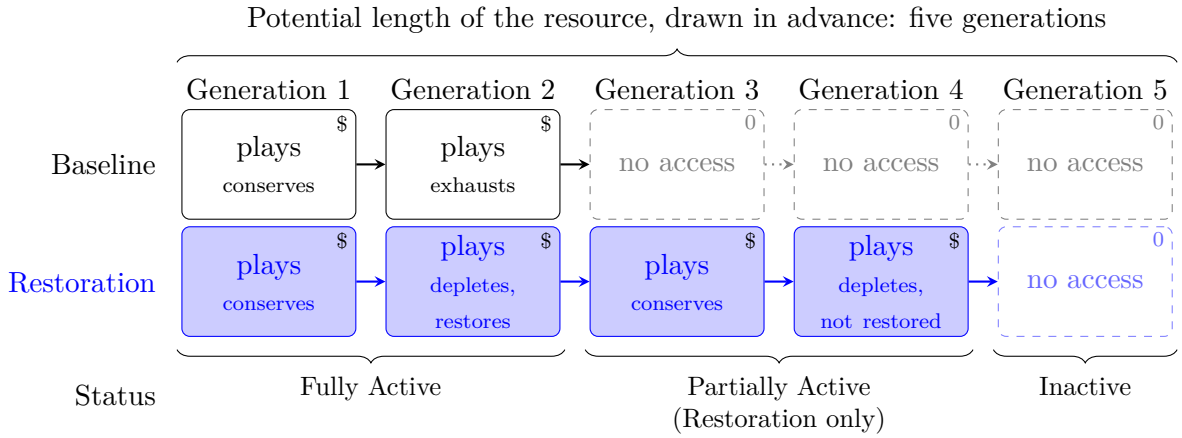
Within a resource, the same potential length applies to both scenarios, but the resource evolves separately under each, according to the choices of successive generations (Figure 2). The first generation always has access to the resource under both scenarios. A later generation has access under a scenario only if the previous generation did not exhaust the resource under that scenario; once the resource is exhausted under a scenario, later generations cannot play it and earn nothing from it.

Generations' recruitment happens sequentially. Only participants in the first generation are informed of their position in the sequence; participants in later generations are told that earlier groups had made decisions before them, and that their choices had influenced the current status of the resource, without being told their position in the sequence.

We define as *Fully Active* the generations that have access to the resource under both scenarios, whatever their position in the sequence: their members play both scenarios and complete the elicitation tasks described below, including the choice between the two scenarios. Every first generation is Fully Active by construction. *Partially Active* generations have access under exactly one scenario: their members play only that scenario, and are told that they make no decision and earn nothing in the other because earlier groups exhausted the resource. *Inactive* generations have access under neither scenario: their members are told that earlier groups exhausted the resource under both scenarios, make no decision, and receive only a completion fee. There are 448 such generations in the Certain condition and 543 in the Uncertain condition (2,973 participants). A generation's status can only worsen along the sequence: in the resource shown in Figure 2, generations 1 and 2 are Fully Active, generations 3 and 4 are Partially Active, and generation 5 is Inactive.

Part 1 and 2 - Game. The order in which each generation plays the two scenarios is randomized at the level of the resource: in half of the resources of each condition, all generations play the Baseline scenario first (as "Part 1") and the Restoration scenario second (as "Part

Figure 2: Evolution of a Resource and Status of Its Generations: One Resource of the Certain Condition



Notes. Resource 121 of the Certain condition, which played the Baseline scenario first and has a potential length of five generations. Each row is a scenario and each column a generation. The same potential length applies to both scenarios, but the resource evolves separately under each. A cell describes a generation's period under a scenario: if the resource is available, the generation plays, earns points ($) and the cell names what it did; if an earlier generation exhausted it, the generation has no access and earns nothing (0). A generation's status follows from what it inherits: Fully Active if the resource is available under both scenarios, Partially Active if under one, Inactive if under neither; a status can only worsen along the sequence. Here generation 2 exhausts the Baseline resource and generation 4 the Restoration resource; the later generations are Inactive and count as zero in the earnings per potential participant slot of Section 5. The resource was chosen for illustration: both scenarios are exhausted before the potential length in 40.5 percent of the Certain and 53.0 percent of the Uncertain resources, and exactly one of the two in 24.0 and 11.5 percent.

2"); in the other half, the order is reversed. Within each scenario, extraction always precedes the restoration choice. Participants made their decisions individually and asynchronously; groups were formed at random among the participants of the same generation of a resource after their decisions had been collected. Participants received no feedback between decisions and learned the outcomes of the sequence, and their earnings, only after all generations of their condition had played. There is therefore no learning from own experience within the game, and the only information that a later generation has about the past is that the resource survived to it.

Part 3 - Elicitation Tasks Fully Active participants proceed to a third part with four tasks. (i) After a recap of the two scenarios and one comprehension question on their key difference, participants state which scenario they would like to determine everyone's bonus if both were available at no cost. This *preference* is incentivized through a decider mechanism: in each condition, one Fully Active participant is selected at random as the decider and given a bonus of $4; the computer flips a coin and, if it lands on heads, the decider's no-cost choice

determines which scenario is used to compute the bonus of every participant in the condition. (ii) Participants then complete a ten-row multiple price list in which their preferred scenario is implemented at a fee deducted from the \$4 decider bonus, from \$0.25 to \$4, while the other scenario is implemented at no cost; the interface allows a single switching point, and the highest fee at which a participant still chooses the preferred scenario is our measure of *willingness to pay* (Andersen et al. 2006). If the decider's coin lands on tails, one of the ten rows is drawn at random and the decider's choice in that row determines both the scenario used for everyone's bonus and the fee deducted from the decider's bonus. Participants explain the reason for their choice in an open-ended question. (iii) Participants state their *beliefs about outcomes*, namely realized earnings and actual resource duration across scenarios. In particular they are asked by how many points, (from -40 to 40) they think average earnings across all groups of the sequence were higher under Restoration than under Baseline, and by how many generations, from -10 to 10, the resource survived longer. (iv) Participants state their *beliefs about groupmates*: the total extraction by the other two members of their group under Baseline, and the total extraction and total restoration investment by the other two members under Restoration, all on a scale from 0 to 40. All beliefs are incentivized: one belief is drawn at random at the end of the study, and the participant earns 20 points if it is within 2 points, or 1 generation, of the realized value.[7]

Partially Active participants skip tasks (i) to (iii) and state their beliefs about groupmates for the only scenario they played.

Finally, all participants answer an open-ended question on whether and how the presence of restoration technologies shaped their extraction choice, and the three qualitative questions on risk tolerance, patience, and altruism of the preference survey module of Falk et al. (2023) (Falk et al. 2018).

Earnings. Participants received a completion fee[8] and a bonus equal to their earnings in the scenario selected by the decider mechanism, converted at 50 points per dollar, plus 20 points if their randomly selected belief was accurate. In addition, the two randomly selected deciders, one per condition, received the decider bonus (4\$) net of any fee paid if the multiple price list mechanism was implemented. The median participant completed the study in 13 minutes (16 minutes among Fully Active participants) and earned 2.19\$ on average (2.63\$ among Fully Active participants).

[7]To determine the belief bonuses to be paid, realized differences in average earnings and resource durations across scenarios were computed by averaging outcomes across all resources in each condition.

[8]The completion fee was equal to 2\$ for Fully Active participants, 1\$ for Partially Active participants, and 0.10\$ for Inactive participants.

Comprehension. After the instructions of the first scenario, participants answered three comprehension questions and had two attempts to answer all of them correctly; 26.7 percent of the participants in our sample needed the second attempt, and those who failed twice were screened out.[9] After the instructions of the second scenario, participants answered further comprehension questions, and before the preference-elicitation task one question on the key difference between the two scenarios; those who failed twice were shown the correct answers and continued. As pre-registered, these participants are retained in the main analyses (61 of the 2,022 Fully Active participants), and a robustness check excludes them. A further question on the payment mechanism, asked once after the instructions of the price list, was followed by the correct answer.

Sample and Implementation. Table 2 describes the sample of participants who played at least one scenario: 3,213 participants, for a total of 1,071 generations. We pre-registered a target of approximately 316 Fully Active generations per condition, to be reached by initializing resources in batches.Two hundred resources per condition were initialized and played out in full, which yielded 340 Fully Active groups in the Certain condition and 334 in the Uncertain condition.[10]

4 Discussion of Experimental Design and Predictions

The game reduces a resource management problem with intertemporal and uncertain dynamics to a handful of choices. This section explains the design choices that serve our questions, the simplifications they entail, and the predictions of the model for the experimental parameters.

What is a period? A period of the game is the tenure of one generation: a group of decision makers inherits the resource, decides once, and hands over whatever is left. This gives the dynamic linkage between periods a concrete meaning. The benefit of restraint, or of a costly restoration investment, accrues entirely to people the current decision makers will never meet and who cannot reciprocate, retaliate, or negotiate. It also means that every decision in our data is first-time play: participants have no experience of the game, no history with their groupmates, and no feedback on the consequences of their own choices before

[9] In total, 594 participants failed twice and were screened out, 262 in the Certain condition and 332 in the Uncertain condition.

[10] With 200 resources per condition, the design detects, with 80 percent power at the 5 percent level, a change of about 8 percentage points in the share of groups that pass on the resource within a condition, and a difference of about 12 points in that change between the two conditions (2.8 standard errors of the estimates in Table C1).

Table 2: Design and Sample

	Certain		Uncertain	
	Groups	Participants	Groups	Participants
Fully Active (played both scenarios)	340	1,020	334	1,002
Partially Active, Baseline only	28	84	72	216
Partially Active, Restoration only	215	645	82	246
All groups that made decisions	583	1,749	488	1,464
Generation 1 groups (all Fully Active)	200	600	200	600
Groups that played Restoration	555	1,665	416	1,248
of which restoration was available (%)		100.0		45.7
Resources (Baseline first / Restoration first)		100 / 100		100 / 100
Mean potential length of a resource (generations)		5.16		5.16

Notes. A group is one generation of three participants. Fully Active groups inherit a resource that is alive under both scenarios and play both; Partially Active groups play only the scenario under which the resource survived. Generation 1 always has access under both scenarios. The same sequence of 200 potential resource lengths, drawn with continuation probability 0.8, is used in both conditions. Restoration is available with probability one half in the Uncertain condition; the availability draw is made after choices.

they decide. We chose this structure because it isolates the intergenerational externality that makes restoration opportunities contentious. When the same players interact for many periods, restraint can be sustained by self-interest alone, and the observed behavior confounds concern for the future of the resource with concern for one's own future payoffs. With non-overlapping generations, restraint and restoration can only be motivated by concern for others.[11]

Room for restoration to help or harm. With one-period players, conservation cannot be supported by continuation values. In the experiment, about six in ten Baseline groups pass on the resource, and a resource survives for about two of its five potential generations on average. There is therefore ample room for a restoration opportunity to improve outcomes, and equally ample room for it to make them worse.

The manipulation. Restoration opportunities can differ in many respects: cost, reliability, speed, and the extent of the damage they can undo. We hold the cost fixed and vary reliability. The cost is low relative to restraint: restoring the resource requires 15 points from the group, while restraint requires giving up 30 points of extraction. Under a reliable

[11] Our Baseline scenario is the intergenerational goods game of Hauser et al. (2014), with groups of three instead of five and a random termination rule that determines whether a new generation is recruited. Sherstyuk et al. (2016) compare games with dynamic externalities played by infinitely lived players and by successive generations and find that cooperation is markedly harder to sustain in the latter.

technology, repair is therefore the more efficient of the two routes to conservation, and any crowding out of restraint is not, in itself, a loss. Reliability is the dimension along which real restoration technologies most differ from the fail-safe they are sometimes presented as: negative emission technologies may not be deployable at scale, may not undo damages that have triggered irreversible processes, and may not store carbon permanently (Fuss et al. 2018; Drouet et al. 2021; Schleussner et al. 2024). An unreliable technology is also the case in which the model predicts that repair is inefficient, so that any crowding out of restraint is costly. Comparing the two conditions tells us whether people calibrate their reliance on restoration to its reliability.

Within-subject scenarios. Every participant plays both scenarios, and both scenarios of a resource share the same potential length. The effect of the restoration opportunity is thus identified by comparing the same person, the same group, and the same resource with and without it. The price of this design is a possible order effect, which we address by randomizing the order at the resource level and by reporting the results separately by order and for the scenario played first. The two restoration conditions, in contrast, are compared between subjects.

The strategy method. Restoration investments are elicited from every participant before they learn whether their group over-extracted. This yields an observation of the restoration margin for every participant, and not only for the groups that deplete the resource. In a repeated setting, a group with a history of conservation would know that its restoration choices are unlikely to matter; here, there is no such history: a participant's only information when committing to restoration is her own extraction choice, and, in later generations, the fact that the resource survived to her. The commitment is nevertheless made in the knowledge of one's own extraction, so that it describes what a participant is willing to pay to undo depletion given how much she contributed to it.

Dynamic linkage and reversibility. The only link between periods is whether the resource is still available. If it is, each generation inherits the same resource whatever earlier generations extracted, and a restored resource is as good as a conserved one. This stationarity keeps the predictions of Section 2 sharp, and it is the optimistic case for repair. If extraction degraded what successors inherit even below the threshold, or if restoration undid the damage only in part, repair, which extracts twice as much as restraint, would leave successors worse off than restraint even when restoration succeeds; in the model, this works like a higher cost or a lower reliability of restoration, and it reinforces the case for restraint.

We have not extended the theory to that case.

Sequential decision stages. Extraction and restoration are decided in two separate stages, and each is aggregated separately, rather than being folded into a single choice. This structure mirrors the separation between decisions about how much to exploit a resource and decisions about how much to invest in its recovery, which in the climate context is advocated by both natural and social scientists (McLaren et al., 2019; Brad and Schneider, 2023; Andreoni et al., 2024). It also makes repair a collective action problem in its own right. The two stages differ in one respect: no single member can conserve the resource when the others extract fully (Assumption 1), whereas we set the restoration cost low enough that a single, sufficiently altruistic member can restore it alone, which lets us observe whether anyone is willing to shoulder the repair.

Deterministic thresholds. In our setting, resource conservation depends on whether collective actions meet known and deterministic thresholds: failure to meet these thresholds results in sudden and extreme changes in resource status, regardless of the magnitude of the deviation. This approach simplifies the decision environment and avoids the interaction of multiple uncertainties in the condition where restoration may not be available. While this simplification captures a critical aspect of environmental damages, it does not reflect the gradual transformations that can occur when thresholds are exceeded in reality.[12] At the same time, recent experimental evidence underscores the relevance of threshold thinking in environmental problems, reflecting how many people conceptualize them despite their scientific imprecision (Semken 2026).

Theoretical predictions. Table 3 lists, for the experimental parameters, the conditions on the intergenerational discount factor $\delta = 0.8\alpha$ under which each symmetric and stationary equilibrium exists in each scenario, together with the expected resource life and the expected total earnings of a resource in each equilibrium. Three predictions follow. First, players who care little about their successors deplete the resource in every scenario: (Extract, Don't Restore) is the unique equilibrium when $\delta < 1/8$, and restraint in the Baseline requires $\delta \geq 1/4$, that is, an altruism weight of at least 5/16. Second, a reliable restoration opportunity should raise extraction. In the Certain condition, restraint is an equilibrium only for $1/4 \leq \delta \leq 1/3$, because a more altruistic player would restore the resource alone rather than let it die, and for $\delta > 3/8$ repair is the unique symmetric and stationary equilibrium: every

[12] Barrett and Dannenberg (2012) show that introducing uncertainty about the threshold in a static public good game reduces contributions relative to a deterministic threshold.

Table 3: Symmetric Stationary Equilibria with the Experimental Parameters

	Baseline ($\rho = 0$)		Certain ($\rho = 1$)		Uncertain ($\rho = 1/2$)	
Equilibrium	Exists if	Life; Earnings	Exists if	Life; Earnings	Exists if	Life; Earnings
(Extract, Don't Restore)	always	1; 120	$\delta \leq 3/8$	1; 120	$\delta \leq 3/8$	1; 120
(Conserve, Don't Restore): restraint	$\delta \geq 1/4$	5; 450	$1/4 \leq \delta \leq 1/3$	5; 450	$1/4 \leq \delta \leq 1/3$	5; 450
(Extract, Restore): repair	–	–	$\delta \geq 1/8$	5; 525	$\delta \geq 1/8$	1.67; 187.5
(Conserve, Restore)	–	–	never	–	$\delta \geq 1/3$	5; 450

Notes. Conditions from Propositions 1 to 5 in Appendix A with $n = 3$, $K = 60$, $w = 20$ ($W = 60$), $T_E = 30$, $T_R = 15$ and $p = 0.8$; $\delta = 0.8\alpha$, where α is the weight a player puts on her successor. "Life" is the expected number of generations with access to the resource, including the first, and "Earnings" the expected sum of material payoffs over all generations of a resource, in points, both computed with continuation probability $p = 0.8$: $1/(1-p)$ and $(W + T_E)/(1-p)$ under restraint, $1/(1-\rho p)$ and $(W + K - \rho T_R)/(1-\rho p)$ under repair. In the Uncertain condition, (Conserve, Restore) requires restoration investments only off the equilibrium path.

member takes her full share of 20 points from the resource and commits 5 points of her endowment to restoration, and the resource is always passed on. Repair is also the efficient profile, with expected total earnings of 525 points per resource against 450 under restraint. Players altruistic enough to restore the resource alone should therefore switch from restraint to repair when a reliable technology is available, and the resource should be conserved at least as often. Third, an unreliable restoration opportunity should raise extraction by less. In the Uncertain condition, repair exists for $\delta \geq 1/8$ but keeps the resource alive for 1.67 generations in expectation and yields 187.5 points per resource, well below the 450 points of restraint; (Conserve, Restore), which conserves the resource and adds a restoration commitment as insurance, exists for $\delta \geq 1/3$. Whether the opportunity helps or harms the resource depends on which equilibrium players select: a shift to repair lowers conservation, a shift to (Conserve, Restore) leaves it unchanged, and any mixture between the two leaves it in between.

Behavioral channels. The equilibrium analysis takes altruism as the only reason to restrain or restore, and it is silent on which equilibrium players select. Several behavioral channels can affect both, and the design measures the objects through which they operate. First, beliefs about others. Restraint pays only if others also restrain, and repair only if others also restore; a participant who expects her groupmates to extract more, or to invest less, when restoration is available may respond by extracting more herself, whether or not she values the resource. We elicit beliefs about groupmates' extraction and investment in each scenario, which allows us to document conditional cooperation and to ask whether the response to the restoration opportunity runs through expectations. Second, coordination. The restoration opportunity expands the set of equilibria and of ways to conserve the resource, and coordination may fail even among players who all wish to conserve: a member

who restrains while another extracts fully and invests in restoration leaves the group short of the extraction threshold with a wasted investment, or short of the restoration threshold with a depleted resource. Dispersion of choices and of earnings within a generation is our measure of this channel. Third, heterogeneity in altruism. Because a single member can restore the resource alone, a sufficiently altruistic participant can substitute for the missing contributions of others; the distribution of restoration investments tells us how many are willing to do so. Fourth, the reliability of the technology. In the model, the investment needed to sustain repair does not depend on ρ, because the cost is paid only when restoration is available, so committed investments need not differ between conditions; extraction, by contrast, should respond to ρ through the selection between repair and (Conserve, Restore). If participants in the Uncertain condition behaved as if restoration were certain, extraction would not differ between conditions; if they discounted an unreliable technology entirely, the Uncertain condition would resemble the Baseline. Finally, the same beliefs and preferences shape the *demand* for the restoration opportunity, which we elicit directly. A participant may want restoration because she expects it to raise earnings or lengthen the life of the resource, because she values a safety net for her successors, or because it lets her extract more without harming them; the open-ended answers and the beliefs about outcomes let us tell these motives apart, and the comparison between believed and realized outcomes tells us whether demand rests on an accurate assessment of the consequences.

5 Experimental Results

We first analyze the effects of introducing a restoration opportunity by looking at within-subjects and within-groups changes in extraction and restoration behavior, hence resource survival, across scenarios. To do so, we focus on the sample of Fully Active participants, who played both scenarios. Resource outcomes use all 200 resources per condition.

This section reports the pre-registered outcomes in the order of the pre-registration. Analyses added after the data were collected are marked as such in the notes to the appendix tables; three of them enter the main text: the survival and hazard analyses of Section 5.2, the conservation rate that participants' choices would have produced had restoration always been available (Table C2), and the accuracy of beliefs about the consequences of restoration in Section 5.5. Standard errors are clustered at the resource level throughout, the level at which the scenario order is randomized and at which successive generations share a history; clustering at the individual or group level gives the same conclusions (Table C3).[13]

[13]Non-parametric tests, Wilcoxon signed-rank tests for within-subject comparisons and Mann-Whitney tests for comparisons between conditions, accompany every estimate in Tables C1 and C2. They lead to

5.1 Extraction and Restoration Investment

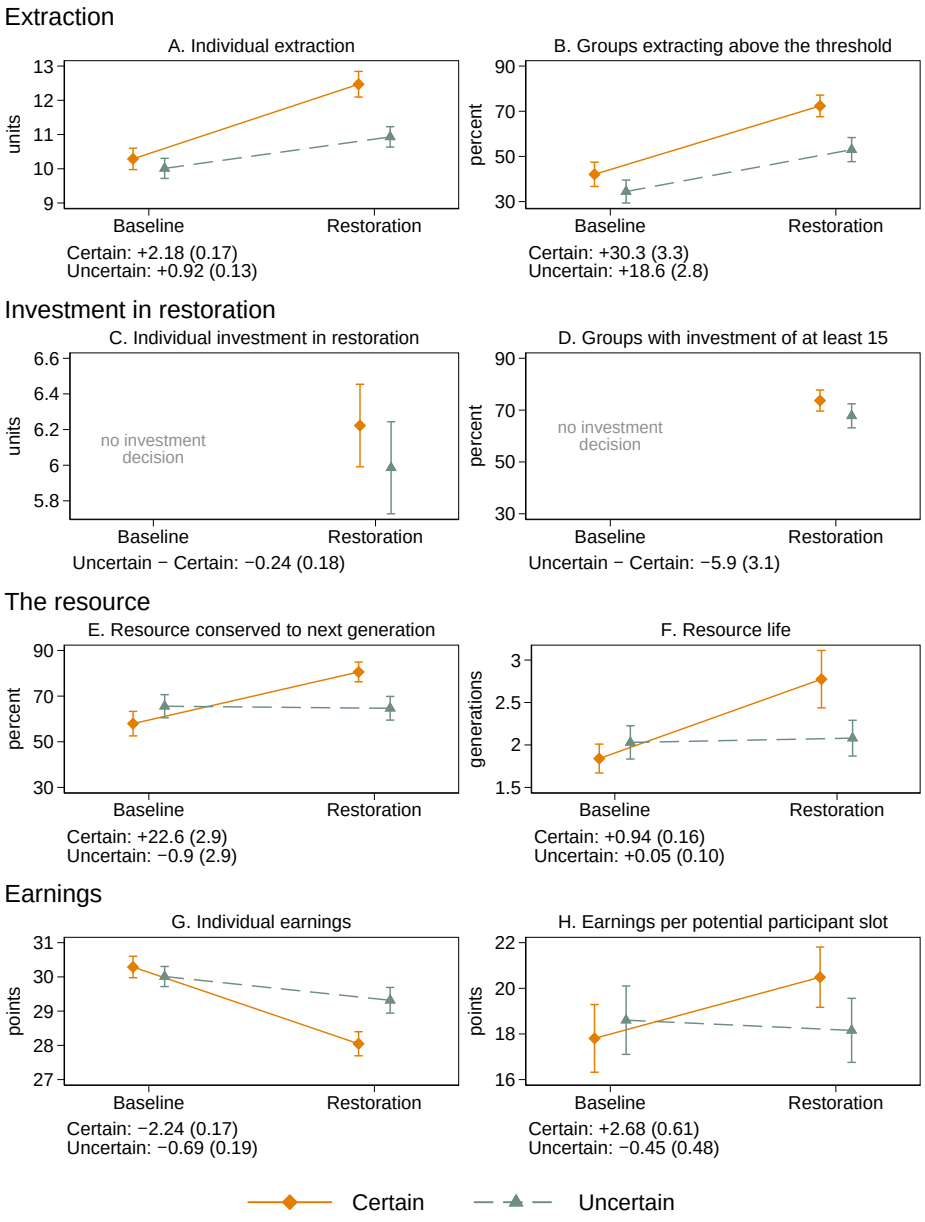
In the Baseline scenario, more than half of the participants restrain their extraction to the sustainable share. Among Fully Active participants, mean extraction is 10.29 units in the Certain condition and 10.01 in the Uncertain condition, on a scale from 0 to 20 (Figure 3, Panel A, and Table C1); exactly 10 units, the symmetric allocation that keeps the group at the threshold of 30, is chosen by 48.2 and 49.3 percent of them, and the maximum of 20 by 14.5 and 12.6 percent (Figure C1 shows the distributions for all participants who played each scenario). Because one member who extracts 20 is enough to push a group of restrained members over the threshold, 42.1 percent of the Certain and 34.4 percent of the Uncertain Fully Active groups extract more than 30 units under the Baseline. Restraint by a majority does not protect the resource from a minority, a point we return to below.

The restoration opportunity raises extraction in both conditions, and more than twice as much when restoration is certain (Figure 3, Panels A and B; Table C1). Under Certain Restoration, the same participants extract 12.47 units, 2.18 more than under the Baseline (standard error 0.17); under Uncertain Restoration they extract 10.93 units, 0.92 more (standard error 0.13). The difference between the two effects is -1.26 units (standard error 0.21, $p < 0.001$). At the group level, the share of groups extracting beyond the threshold rises by 30.3 percentage points under certainty and by 18.6 points under uncertainty. Figure 3 collects the main outcomes of Results 1 to 3, with the paired effect of each condition printed under each panel; Table C1 reports the same estimates with p-values and the non-parametric tests.

Figure 4 shows how individual participants change their extraction between scenarios and what they commit to restoration. Relative to their Baseline choice, 40.4 percent of Certain and 29.1 percent of Uncertain participants extract more under Restoration, 13.0 and 15.1 percent extract less, and 46.6 and 55.8 percent extract the same amount. The participants who extract more almost always commit at least 5 units, the fair share of the restoration threshold of 15: only 3.5 percent of Certain and 1.5 percent of Uncertain participants raise their extraction and invest less than that. Among participants who change their extraction, the typical response to the restoration opportunity is thus not to free ride on others' restoration but to move from restraint to repair: to take more and pay for the resource to be restored. The single most common pair of choices, however, keeps

the same conclusion as the parametric tests at the 5 percent level in all but three comparisons, which we note where they arise: the difference between conditions in the share of groups whose investment reaches the restoration threshold (Table C2) and in signed willingness to pay (Table 4), where the parametric test does not reject and the Mann-Whitney test does, and the difference between conditions in the level of earnings per potential participant slot under Restoration (Table C2), where the reverse holds. With 200 resource clusters per condition, cluster-robust inference is reliable and we do not use bootstrap corrections.

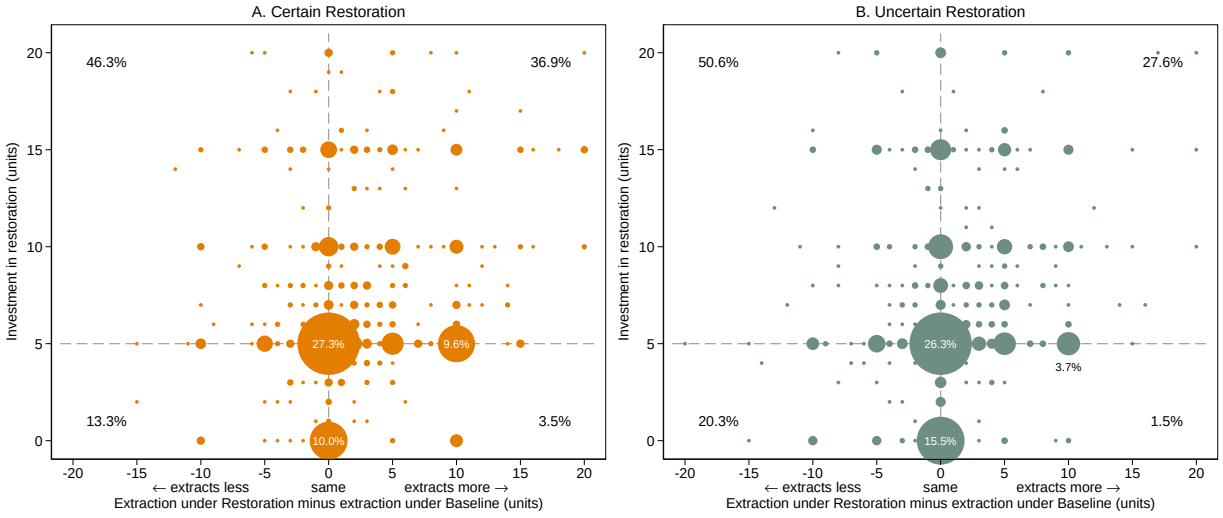
Figure 3: Main Outcomes by Scenario and Condition



Notes. Means with 95% confidence intervals, standard errors clustered at the resource; the rows group the outcomes by what they measure. Panels A, B, E and G use Fully Active participants and groups, who played both scenarios; Panels F and H use all 200 resources per condition; Panels C and D use all participants and groups that played Restoration, since investment is chosen only under that scenario. Under each panel, the paired Restoration-minus-Baseline effect of each condition with its standard error or, in Panels C and D, the Uncertain-minus-Certain difference. Resource life, the number of generations with access to the resource, summarizes the survival outcome over the whole history of a resource. Earnings per potential participant slot, the total earnings of a resource divided by three times its potential length, so that generations that lose access count as zero, captures across-generation earnings. Vertical axes do not start at zero; the three percent panels share one scale. Table C1 reports the estimates of Panels A, B and E to H, together with the variances of earnings, and Table C2 those of Panels C and D, with sample sizes, p-values and the non-parametric tests.

extraction unchanged and commits exactly 5 units (27.3 percent of Certain and 26.3 percent of Uncertain participants, most of them at an extraction of 10 in both scenarios: 20.4 and 20.0 percent). This is in line with the (Conserve, Restore) profile, in which the restoration commitment is an insurance that is never used if everyone restrains; it is an equilibrium under Uncertain Restoration but not, as Table 3 shows, under Certain Restoration, where it invites depletion followed by repair. The second most common pair keeps extraction unchanged and commits nothing, and it is more frequent under Uncertain Restoration (155 of 1,002 participants, 15.5 percent) than under Certain Restoration (102 of 1,020, 10.0 percent; $p < 0.001$). The difference comes from participants who stay at an extraction of 10 and ignore the technology, the restraint profile: 7.5 percent of Uncertain against 2.9 percent of Certain participants.

Figure 4: Individual Strategies under Restoration: Change in Extraction and Committed Investment



Notes. Fully Active participants (1,020 Certain, 1,002 Uncertain), who choose under both scenarios. Each marker is one pair of choices, with area proportional to the share of participants: on the horizontal axis the extraction under Restoration minus the extraction of the same participant under Baseline, on the vertical axis the investment committed to restoration. The dashed lines mark an unchanged extraction and an investment of 5, the fair share of the group threshold of 15; the corner percentages are the shares of participants in the four regions, where a marker on the vertical line counts as not extracting more and a marker on the horizontal line as investing at least 5. The percentages printed on or below three markers are the shares of participants who choose that pair: unchanged extraction with an investment of 5, unchanged extraction with no investment, and an extraction 10 units higher with an investment of 5. Investment is a strategy-method commitment, made before the group's extraction is known.

Committed restoration investments are similar in the two conditions. Among all participants who played Restoration, mean investment is 6.22 units in the Certain condition and 5.99 in the Uncertain condition, a difference of -0.24 units ($p = 0.177$; Figure 3, Panel C, and Table C2). Exactly 5 units are committed by 48.3 and 45.1 percent of participants, and

nothing by 12.9 and 18.1 percent; 9.6 and 9.7 percent commit 10 units, and 10.1 and 10.3 percent commit 15 units or more, enough to restore the resource on their own. As a result, 27.0 percent of the Certain and 27.4 percent of the Uncertain groups contain a member whose commitment alone reaches the threshold, and the group investment reaches the threshold of 15 in 73.7 and 67.8 percent of groups, respectively, a difference of -5.9 percentage points (Panel D; $p = 0.060$; Mann-Whitney $p = 0.045$). Among groups that do over-extract, the threshold is reached in 71.4 and 66.2 percent of cases ($p = 0.203$). Participants, therefore, commit to restoration almost as readily when the technology works half of the time as when it always works, while extracting less. Under the Restoration scenario, participants in the Uncertain condition extract 1.29 units less than participants in the Certain condition (standard error 0.20), and 1.52 units less in the first generation.

These effects are robust (Table C3). The increase in extraction is 2.44 and 1.08 units in the first generation, where no selection through earlier survival has occurred, 1.84 and 0.86 when Partially Active participants are added in an unpaired comparison, and 2.19 and 0.89 when participants who failed a comprehension check twice are excluded. Comparing only the scenario each participant played first, which removes any carry-over between scenarios at the cost of a between-resource comparison, gives 1.58 and 0.88 units. The order of the scenarios does matter for the size of the extraction response (Table C19): the paired increase is 2.73 units when the Baseline is played first and 1.69 when Restoration is played first in the Certain condition ($p = 0.002$), and 1.40 and 0.43 units in the Uncertain condition ($p < 0.001$). The ranking of the two conditions holds within each order, and the conservation effect does not depend on the order ($p = 0.539$ and $p = 0.130$). The between-condition difference in extraction under Restoration is present within each scenario order and with controls (Table C4). Later generations behave much like the first (Figure C3); as reaching a later generation depends on the choices of earlier ones, we treat these comparisons as descriptive.

RESULT 1: *The restoration opportunity raises extraction in both conditions, and more than twice as much when restoration is certain. Participants who extract more almost always commit at least their share of the restoration cost. Committed investments are about as large under Uncertain as under Certain Restoration.*

5.2 Conservation and Resource Life

Whether the resource is passed on to the next generation, either because the group's extraction stays within the threshold or because the group restores it, is our main group-level outcome; we call this *conservation*. Under the Baseline, 57.9 percent of the Certain and 65.6 percent of the Uncertain Fully Active groups pass on the resource (Figure 3, Panel E; Table

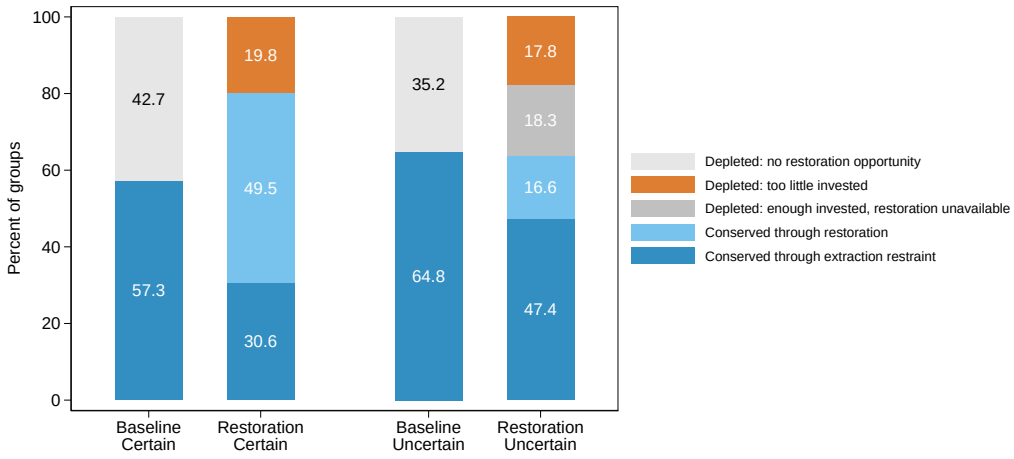
C1). Certain Restoration raises this share to 80.6 percent, an increase of 22.6 percentage points (standard error 2.9). Uncertain Restoration leaves it unchanged: 64.7 percent of the same groups pass on the resource, a change of −0.9 percentage points (standard error 2.9, $p = 0.759$), whose 95 percent confidence interval, from −6.7 to 4.9 points, excludes a gain of a quarter of the size observed under certainty. The difference between the two effects is −23.5 points (standard error 4.1).

Figure 5 decomposes what happens to the resource. Under the Baseline, restraint is the only route to conservation, and 57.3 percent of the Certain and 64.8 percent of the Uncertain groups take it. The restoration opportunity replaces restraint with repair. In the Certain condition, the share of groups that conserve through restraint falls to 30.6 percent, 49.5 percent deplete the resource and restore it, and 19.8 percent deplete it and invest too little to restore it: restraint falls by 27 percentage points and repair more than makes up for it. In the Uncertain condition, the share that conserves through restraint falls less, to 47.4 percent, 16.6 percent deplete and restore, 18.3 percent deplete and commit enough to restore but draw an unavailable technology, and 17.8 percent deplete and invest too little: restraint falls by 17 points and successful repair adds back only as much, with the rest lost to the failures of the technology. Restoration succeeds in 71.4 percent of the Certain groups that deplete the resource and in 31.5 percent of the Uncertain ones (Table C2).[14] The two conditions thus reach the same share of groups whose choices would conserve the resource if restoration were available, 80.2 and 82.2 percent (Table C2, "conserved if restoration had been available"). Participants in the Uncertain condition extract less than those in the Certain condition, and this additional restraint would be enough to conserve the resource as often as under certainty if the technology always worked. With the actual technology, which fails half of the time, it is not enough. Put differently, participants rely less on an unreliable technology, but they do not discount it by as much as its unreliability warrants, and the resource ends up no better protected than without the opportunity.

Resource life tells the same story over the whole sequence of generations. Under the Baseline, a resource is accessed by 1.84 generations on average in the Certain condition and 2.03 in the Uncertain condition, out of a mean potential length of 5.16. Certain Restoration adds 0.94 generations (standard error 0.16); Uncertain Restoration adds 0.05 (standard error 0.10, $p = 0.634$; Figure 3, Panel F). The Kaplan-Meier survival curves of Figure 6 show that the gap under certainty opens at the first generation and persists: the hazard of depletion in a generation is 59 percent lower under Certain Restoration than under the Baseline, and

[14] Restoration was available in 45.7 percent of the Uncertain groups that played the scenario. We keep the realized draws in all outcome analyses; with an availability rate of exactly one half and the same choices, the resource would have been conserved in 64.9 percent of Uncertain groups (the 47.4 percent conserved through restraint plus half of the 34.9 percent that committed enough to restore it), against 63.9 percent observed.

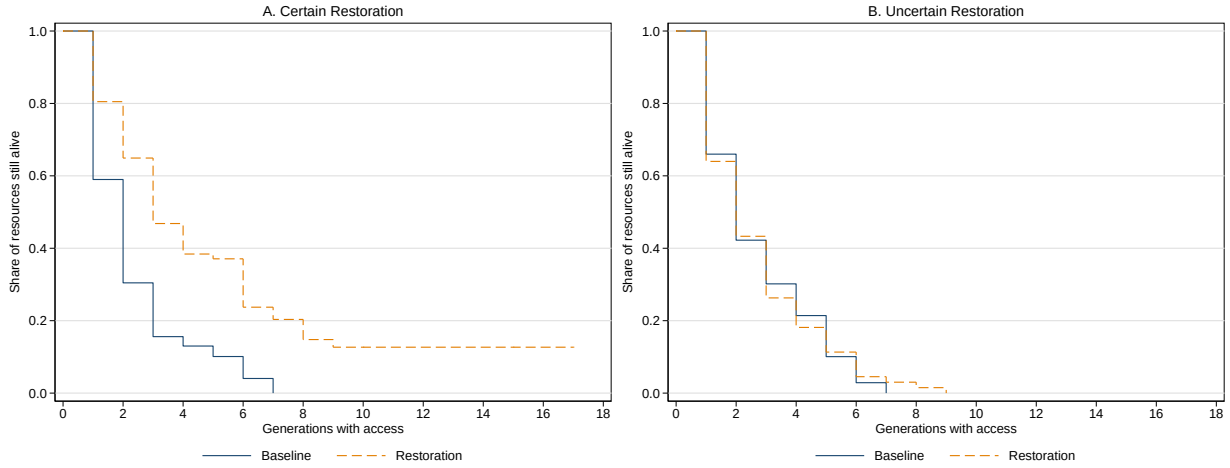
Figure 5: What Happens to the Resource under the Baseline and under Restoration



Notes. All groups that played the Baseline (368 Certain, 406 Uncertain) and all groups that played Restoration (555 and 416); the within-group comparison of Figure 3, Panel E, uses the groups that played both. Under the Baseline, the resource is conserved only if group extraction stays within 30. Under Restoration, it is also conserved if restoration succeeds: group extraction exceeds 30, committed group investment is at least 15, and restoration is available (always in Certain, with probability one half in Uncertain). Committed investment is not charged when restoration is unavailable.

unchanged under Uncertain Restoration (hazard ratios 0.41 and 1.03, Table C6).

Figure 6: Resource Survival under Baseline and Restoration



Notes. Kaplan-Meier estimates over 200 resources per condition. The event is depletion; resources that reach their pre-drawn potential length are censored. Table C6 gives the corresponding hazard models.

The two Baselines. The Baseline scenario is identical in the two conditions, but Baseline conservation is higher in the Uncertain condition. The gap is concentrated among resources for which participants played Baseline first: in the first generation of these resources, 54

of 100 Certain groups and 73 of 100 Uncertain groups pass on the resource ($p = 0.005$), whereas among the resources that played Restoration first the shares are 64 and 59 percent ($p = 0.470$; Table C8). We cannot attribute this gap to the design: the two conditions were run on the same platform, with the same recruitment criteria, instructions, stakes and protocol. Their participants were recruited at different times, however, since the conditions were fielded in sequence, the Certain condition first and the Uncertain condition second. Measured characteristics explain little of the gap: participants in the Uncertain condition are on average one year younger and report slightly lower patience, but in the first-generation Baseline-first groups no demographic characteristic recorded by the platform differs between conditions (joint $p = 0.841$; Tables C10 and C11), and controlling for the group means of all characteristics leaves a gap of 15.0 percentage points ($p = 0.027$; Table C12).

Whatever its source, two facts bound the role of this gap. First, it does not create the result: the Uncertain sample conserves more than the Certain sample without restoration and less with it, so that aligning the two Baselines would shrink the difference in the effect of the opportunity between conditions, from 23.5 to 16.0 percentage points with the common Baseline of Table C9, but not remove it. Second, the main conclusions survive a common Baseline. Table C9 pools the Baseline observations of both conditions into a single control group and compares each Restoration scenario with it, without unit fixed effects. Certain Restoration raises conservation by 18.9 percentage points ($p < 0.001$) and Uncertain Restoration by 2.9 points ($p = 0.288$); restricting to the first generation and to the scenario played first, so that the control group is the Baseline-first groups of both conditions and the treated groups the Restoration-first groups, the effects are 19.5 and 1.5 points. Over complete resource histories, Certain Restoration adds 0.84 generations of resource life and Uncertain Restoration 0.15 ($p = 0.160$). We therefore keep the pre-registered within-subject estimates as our main results, report the first generation and the common-Baseline comparison alongside them, and read the between-condition comparisons of levels under Restoration, which are not affected by the Baseline.

RESULT 2: *Certain Restoration raises the share of groups that pass on the resource by 23 percentage points and lengthens the life of the resource by about one generation. Uncertain Restoration does not detectably change either (conservation changes by -1 percentage point, with a 95 percent confidence interval from -7 to 5): participants' choices would conserve the resource as often as under Certain Restoration if the technology always worked, but it fails half of the time, and participants do not restrain enough to make up for it.*

5.3 Earnings and Their Dispersion

Whose earnings are counted matters for the welfare assessment of the restoration opportunity. The participants who face both scenarios earn less under Restoration: 2.24 points less in the Certain condition and 0.69 points less in the Uncertain condition (Figure 3, Panel G; Table C1). The extra extraction that the opportunity induces is smaller than the restoration cost that most of them end up paying to restore the depleted resource. These are, however, the earnings of the generations that had access to the resource under both scenarios. Counting every generation that a resource could have served, with zero earnings for the generations that lost access, reverses the sign under certainty. Earnings per potential participant slot (Panel H), the total earnings of a resource divided by three times its potential length, rise from 17.81 to 20.49 points under Certain Restoration, an increase of 2.68 points or 15 percent (standard error 0.61; signed-rank $p = 0.010$), and change from 18.60 to 18.16 points under Uncertain Restoration, a change of -0.45 points (standard error 0.48, $p = 0.356$). A reliable restoration opportunity makes the resource more valuable to the sequence of generations as a whole, at the expense of the generations that pay for restoring it; an unreliable one does not. Under Restoration, earnings per potential participant slot are 2.33 points lower in the Uncertain than in the Certain condition ($p = 0.018$; Mann-Whitney $p = 0.065$; Table C2).

Both restoration opportunities make earnings more unequal within a generation. The within-generation variance of earnings roughly doubles under Certain Restoration, from 22.9 to 43.7 points squared, and rises by almost half under Uncertain Restoration, from 22.1 to 32.2 (in standard deviations, from 4.0 to 5.6 points and from 3.8 to 4.7 points; Table C5). The dispersion comes from the extraction margin: within a group, some members move to repair and others keep restraining, and the former earn more. Across generations, the two conditions diverge. Certain Restoration lowers the variance of generation-mean earnings across the potential generations of a resource from 212.8 to 118.9, because fewer generations are left with nothing; Uncertain Restoration does not detectably change it (from 170.4 to 195.1, an estimate of 24.7 with a standard error of 12.9, $p = 0.057$; signed-rank $p = 0.337$; 3.6 against the pooled Baseline of Table C9). The difference between the two effects is 118.6 points squared (standard error 20.4).

RESULT 3: *Over all the generations that a resource could serve, earnings rise by 15 percent under Certain Restoration and do not change under Uncertain Restoration. The generations that face both scenarios earn less under Restoration. Both Certain and Uncertain Restoration make earnings more unequal within a generation; Certain Restoration makes them more equal across generations.*

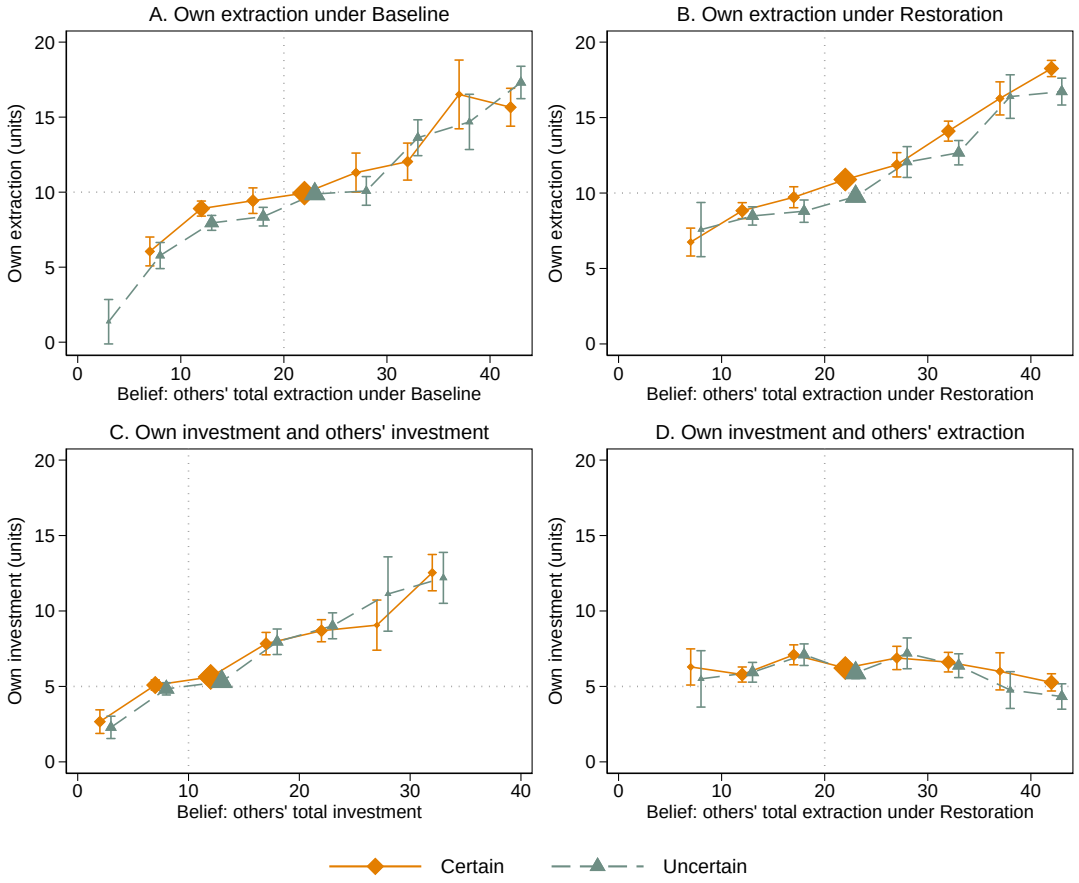
5.4 Beliefs about Groupmates

Table C18 reports the comparisons for beliefs about groupmates. Participants expect their groupmates to extract more when restoration is available: among Fully Active participants, the expected total extraction of the other two members rises from 20.35 to 23.59 units in the Certain condition and from 20.23 to 22.35 units in the Uncertain condition, increases of 3.24 units (standard error 0.31) and 2.12 units (standard error 0.26). Their difference, −1.11 units (standard error 0.41), has the same sign as the difference in the response of own extraction. Under Restoration, participants in the Uncertain condition expect their groupmates to extract 0.93 units less than participants in the Certain condition do (standard error 0.32), and to invest about the same (11.45 against 11.16 units). Expectations about others thus move with the opportunity in the same direction as behavior.

Own choices track these beliefs closely. Figure 7 plots own extraction and own investment against the belief about the total choice of the other two members of the group. Beliefs are concentrated on the fair shares: under Restoration, 553 of 1,665 Certain participants (33.2 percent) and 419 of 1,248 Uncertain participants (33.6 percent) expect the other two members to extract exactly 20 units in total, and 39.4 and 35.5 percent expect them to invest exactly 10. Under the Baseline, own extraction rises by 0.24 units in the Certain condition and 0.32 units in the Uncertain condition for each unit of expected extraction by the others; under Restoration, the slopes are 0.32 and 0.29. Participants who expect their groupmates to take their fair share of 20 units in total take their own fair share of 10; participants who expect them to take everything take substantially more. Own investment rises with the expected investment of the others, with slopes of 0.29 and 0.32 (Panel C): participants who expect their groupmates to commit 10 units in total, the fair share, commit 5; those who expect less commit less. Investment does not rise with the expected extraction of the others (Panel D); if anything, it falls slightly. The design leaves little room for it to rise: the commitment is deducted only if the group extracts more than 30 units, and restoring the resource then takes 15 units whatever the size of the excess. What the others are expected to extract changes how likely the commitment is to be called, not how much is needed when it is. Participants instead condition their investment on what they expect the others to invest: they treat restoration as a joint effort to be shared.

These associations are consistent with conditional cooperation (Fischbacher et al. 2001), with one caveat: beliefs about groupmates were elicited after all choices, so that beliefs may rationalize choices as much as guide them, and the shift in expectations between scenarios may reflect what participants know about their own response. Beliefs also predict own behavior far better than they predict what groupmates do: Figure C4 shows that the realized total choice of the other two members rises only mildly with the belief about it. On average,

Figure 7: Own Choices and Beliefs about Groupmates



Notes. All participants who played the scenario (Baseline: 1,104 Certain, 1,218 Uncertain; Restoration: 1,665 and 1,248). Mean own choice within bins of 5 units of the belief about the total choice of the other two members of the group, bins with at least 10 participants per condition; 95% confidence intervals. The area of a marker is proportional to the share of the condition's participants in the bin; the markers of the legend correspond to 10%. Dotted lines mark the fair shares: 10 units of extraction and 5 of investment for oneself, 20 and 10 for the other two members. The slope of the own choice on the belief (OLS, clustered at the resource) is 0.24 in Certain and 0.32 in Uncertain in Panel A, 0.32 and 0.29 in Panel B, 0.29 and 0.32 in Panel C, and −0.02 and −0.04 in Panel D. Beliefs about groupmates were elicited at the end of the study, after both scenarios, the preference and the price list. Figure C4 compares the same beliefs with the groupmates' realized choices.

beliefs are close to the truth: under Restoration, participants in the Certain condition expect their groupmates to extract 0.85 units less than they do, and participants in the Uncertain condition 0.80 units more; in both conditions they expect their groupmates to invest about one unit less than they do (1.00 and 0.81 units). The dispersion of beliefs thus reflects participants' own inclinations more than differences among their groupmates. Part of the response to the restoration opportunity therefore runs through expectations about others, or is rationalized through them: participants who take more when restoration is available also expect their groupmates to take more and, as Result 1 showed, almost always commit to restoring.

RESULT 4: *Participants expect their groupmates to extract more when restoration is available, and more so when it is certain. Participants extract more when they expect groupmates to extract more, and invest more in restoration when they expect groupmates to invest more. However, their restoration investment does not increase with the extraction they expect from groupmates. Beliefs about groupmates predict own behavior far better than they predict what groupmates do.*

5.5 Demand for Restoration and Beliefs about Its Consequences

Do the participants want the restoration opportunity after having experienced it? Table 4 reports the preference analyses. When asked which scenario should determine everyone's bonus at no cost, 80.5 percent of Fully Active participants in the Certain condition (821 of 1,020) and 73.3 percent in the Uncertain condition (734 of 1,002) choose Restoration; both shares differ from one half ($p < 0.001$), and the difference between conditions is -7.2 percentage points (standard error 2.0). Preferences are also intense. Those who prefer Restoration are willing to give up, on average, \$0.96 (Certain) and \$0.99 (Uncertain) of the \$4 decider bonus to have it implemented, and those who prefer the Baseline \$0.72 and \$0.71; more than eight in ten of the former and seven in ten of the latter give up a positive amount (Table C13). Signed willingness to pay, positive for Restoration and negative for the Baseline, averages \$0.63 in the Certain condition and \$0.53 in the Uncertain condition ($p = 0.059$; Mann-Whitney $p = 0.005$; \$0.73 and \$0.61 in an interval regression that accounts for the discreteness of the price list, Table C7). The unreliability of the technology thus lowers the share who want it, but not the intensity of the preference of those who do. The difference between conditions in the share is concentrated in the resources that played the Baseline first, -13.4 percentage points (standard error 2.8) against -0.8 points (standard error 2.5) in the resources that played Restoration first (Figure C2). It is robust to excluding the 61 participants who twice failed a comprehension check, as pre-registered: -7.6 percentage

points (standard error 2.1) in the share preferring Restoration, and a signed willingness to pay lower by \$0.11 (standard error 0.05).

Table 4: Preference between Scenarios and Willingness to Pay

	Certain	Uncertain	Difference	(SE)	p	Mann-Whitney p	N	Resources
A. Levels and differences between conditions								
Prefers Restoration (%)	80.5	73.3	−7.2	(2.0)	<0.001	<0.001	2,022	400
Signed WTP (\$; + Restoration, − Baseline)	0.63	0.53	−0.10	(0.05)	0.059	0.005	2,022	400
WTP for Restoration, among those who prefer it (\$)	0.96	0.99	0.03	(0.05)	0.581	0.932	1,555	396
WTP for Baseline, among those who prefer it (\$)	0.72	0.71	−0.01	(0.07)	0.925	0.890	467	258
Believed earnings advantage of Restoration (points)	6.23	3.68	−2.54	(0.77)	<0.001	0.001	2,022	400
Believed resource-life advantage of Restoration (generations)	3.78	2.41	−1.37	(0.22)	<0.001	<0.001	2,022	400

B. Tests of no preference within condition

	Certain		Uncertain	
	p	non-par. p	p	non-par. p
Share preferring Restoration = 50%	<0.001	<0.001	<0.001	<0.001
Mean signed WTP = 0	<0.001	<0.001	<0.001	<0.001

C. Association with beliefs about outcomes (OLS; order and generation 2+ controls)

	Prefers Restoration (pp)		Signed WTP (\$)	
	Certain	Uncertain	Certain	Uncertain
Believed earnings advantage of Restoration (per 10 points)	7.89 (0.80)	7.49 (0.79)	0.16 (0.02)	0.17 (0.02)
Believed resource-life advantage (per generation)	0.34 (0.31)	1.30 (0.31)	0.02 (0.01)	0.04 (0.01)
N	1,020	1,002	1,020	1,002

Notes. Fully Active participants. After playing both scenarios, participants choose which scenario should determine everyone's bonus and then complete a ten-row price list with fees from \$0.25 to \$4 attached to the preferred scenario. Recorded WTP is the highest fee accepted, a lower bound on willingness to pay; every participant switches at most once. Signed WTP is positive for Restoration and negative for Baseline. Experimental points convert to dollars at 50 points per dollar. Panel A reports OLS on the Uncertain indicator; its last two rows are the believed advantage of Restoration over Baseline in average earnings and in resource life. Panel B tests that the share equals 50% and that mean signed WTP equals zero; the non-parametric tests are the exact binomial and the signed-rank test. Panel C reports OLS of the preference indicator (in percentage points) and of signed WTP on both beliefs jointly, with controls for scenario order and generation 2 or later; beliefs were elicited after the preference and the price list. Standard errors clustered at the resource throughout.

Demand rests on optimistic beliefs about what the opportunity delivers. Participants believe that average earnings across the generations in their sequence were higher under Restoration by 6.23 points in the Certain condition and 3.68 points in the Uncertain condition, and that the resource survived longer by 3.78 and 2.41 generations (Table 4). Compared with what happened in their own resource, these beliefs overstate the advantage of Restoration in both conditions (Table C15): the realized earnings advantage per potential participant slot is 2.53 points in the Certain condition and −0.60 points in the Uncertain condition, and the realized resource-life advantage 0.99 and 0.06 generations. [15] Only 8.1 and 9.7 percent of participants state an earnings advantage within two points of the realized one, and 17.1 and 17.2 percent a resource-life advantage within one generation; nearly six in ten overstate the earnings advantage by more than the tolerance, and about two in three the resource-life advantage. Participants in the Uncertain condition do recognize that the

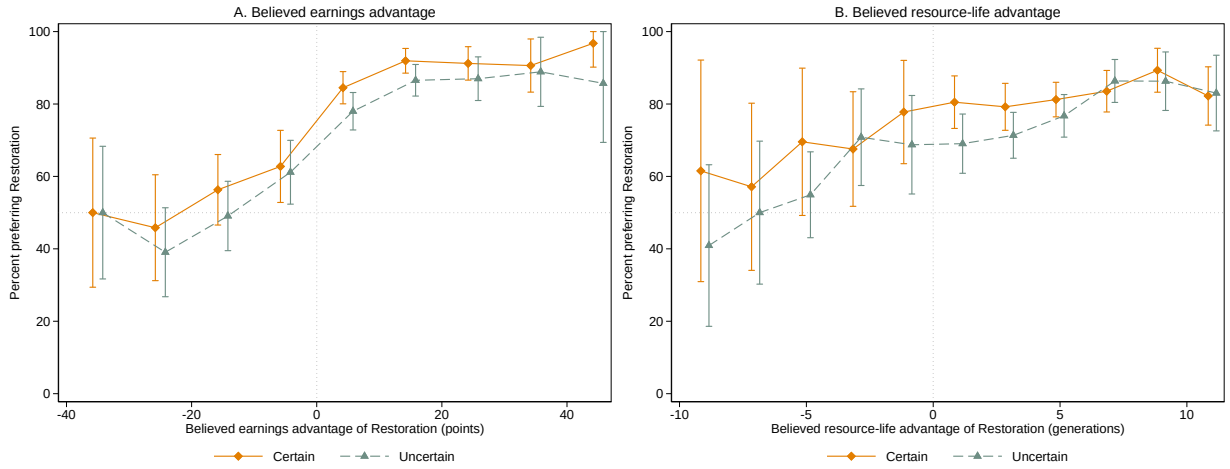
[15] If we compute average earnings for the groups that played each scenario, the realized earnings advantage is negative in both conditions (Tables C1 and C2), so that beliefs are optimistic under either benchmark.

opportunity is worth less, but they still believe it helps, whereas it does not.

Beliefs about consequences are the main correlate of demand. In the regressions of Table 4, Panel C, a believed earnings advantage higher by ten points is associated with a 7.9 percentage-point higher probability of preferring Restoration in the Certain condition and 7.5 points in the Uncertain condition, and with a signed willingness to pay higher by \$0.16 and \$0.17; a believed resource-life advantage higher by one generation adds 0.3 and 1.3 points to the probability and \$0.02 and \$0.04 to willingness to pay. Figure 8 shows the relation without functional form: the share who prefer Restoration is 56.1 and 51.7 percent among those who believe it lowered earnings, and 91.7 and 87.3 percent among those who believe it raised them by more than ten points, in the Certain and Uncertain condition respectively. In a comparison of correlates, beliefs about outcomes alone explain 12.7 and 13.6 percent of the variation in the binary preference and 8.8 and 11.3 percent of the variation in signed willingness to pay, more than own behavior in the game, beliefs about groupmates, or risk tolerance, patience and stated altruism, each of which explains less than 5 percent on its own (Table C14; the out-of-sample fit is almost as high). Own Baseline extraction enters negatively and own investment positively, so that participants who restrain and who commit to restoration are more likely to want the opportunity; the three preference measures do not predict the binary preference, but stated altruism predicts a higher willingness to pay for Restoration in the Uncertain condition (Figures C5 to C7). Expressed as belief errors, a one standard deviation larger overstatement of the earnings advantage is associated with a 15 and 14 percentage-point higher probability of preferring Restoration and with \$0.31 and \$0.33 higher signed willingness to pay (Table C17), while the absolute size of the error, whatever its sign, is related to demand only sporadically and with inconsistent signs (Table C16).

Three caveats apply. Beliefs about outcomes were elicited after the preference and the price list, so the associations describe how demand and beliefs go together rather than a causal effect of beliefs on demand. The realized outcomes of a participant's own resource are one possible benchmark for her beliefs: they embed the randomness of others' choices, of termination and of availability, so that belief errors measure the distance between beliefs and realized outcomes. Lastly, the price list elicits what a participant is willing to pay for everyone in her condition to be paid under her preferred scenario, so that willingness to pay reflects concern for others as well as expected own earnings, which is consistent with the role of stated altruism under uncertainty. What the evidence does establish is a joint pattern: a large majority of participants demand the restoration opportunity in both conditions, they overstate its benefits in both, and those who overstate them most demand it most, including in the condition where the opportunity leaves the resource and earnings unchanged.

Figure 8: Preference for Restoration and Beliefs about Its Advantage



Notes. Fully Active participants. Share preferring Restoration within bins of the believed advantage of Restoration over Baseline in average earnings (Panel A, bins of 10 points) and in resource life (Panel B, bins of 2 generations); bins with at least 10 participants per condition; 95% confidence intervals. Beliefs were elicited after the preference.

RESULT 5: *Large majorities prefer the Restoration scenario and are willing to pay for it in both conditions. Participants overstate its advantage in earnings and in resource life, and these beliefs, rather than own behavior, beliefs about groupmates, or preferences, are the main correlate of demand.*

5.6 What Participants Say

The analysis of the open-ended answers, coded with a large language model following a fixed scheme with a second model as independent coder (Appendix D), corroborates the mechanisms above in the participants' own words. Asked whether the presence of restoration technologies shaped their extraction choice, 23.2 percent of participants in the Certain condition and 17.6 percent in the Uncertain condition say that they took more, or accepted the risk of depletion, because the resource could be restored, and 30.5 and 26.3 percent describe restoration as a safety net or second chance for the resource without saying that their own extraction went up (Table D1). A majority in both conditions, 56.4 and 60.2 percent, describe restraint that does not depend on restoration: taking a fair share, playing safe, or leaving the resource to future groups. The cost of the investment, or the risk that restoration does not come about, is given as a reason by 5.8 percent in the Certain condition and 11.4 percent in the Uncertain condition (Table D1). The risk means different things in the two conditions. In the Certain condition, where the technology never fails, it is the risk that the group falls short of the restoration threshold: only 14 of these 102 answers refer to a

chance that restoration fails, and 41.2 percent also mention what the other members would do. In the Uncertain condition, 129 of 167 refer to the chance that the technology fails, and 15.8 percent of all participants who played Restoration mention it, against 2.3 percent in the Certain condition (Table D2).

Stated reasons track behavior (Table D3). The participants who say that restoration led them to take more extract 4.9 units more under Restoration than under the Baseline; those who say that restoration was not relevant to their choice do not change their extraction; and those who say that they took less, or invested, so that the resource would survive commit 6.5 units to restoration and do not change their extraction. Asked why they were willing to give up part of the decider bonus, about three quarters of the participants who prefer Restoration mention keeping the bonus, and 29.5 and 30.5 percent that restoration protects the resource for later groups; among those who prefer the Baseline, 16 percent say that the two scenarios are about the same and one in four voice doubts about others or about restoration (Table D4).

6 Conclusion

Restoration opportunities change the terms on which one generation can preserve a shared resource for the next. We asked how people respond to them, whether the response leaves the resource better or worse off, and whether people want them. Our answers come from a pre-registered experiment in which successive generations of participants, each deciding once, inherit a common-pool resource with or without the option to repair it after depletion.

The response is a shift from restraint to repair. When the opportunity is reliable, participants extract more, but they also commit the resources needed to undo the damage, and the resource is passed on more often, survives longer, and yields more to the sequence of generations as a whole. Mitigation deterrence is real, and, with a reliable and cheap restoration opportunity, it is not harmful: participants move toward the more efficient of the two ways of protecting the resource, as the model predicts for players who care enough about their successors. When it works half of the time, participants rely on it less, but not enough. They still extract more, they still commit to restoration, and because the repair fails half of the time, the resource is no better protected than without it, while earnings within a generation become more unequal. The share of groups that pass on the resource changes by one percentage point under uncertainty, in a design that detects a change of eight. Participants calibrate their reliance on restoration to its reliability only partially, and the shortfall is what an unreliable fail-safe costs.

The demand for the restoration opportunity does not follow its consequences. Large

majorities prefer the world with restoration in both conditions and pay for it, and they believe it raises earnings and lengthens the life of the resource by more than it does; under uncertainty, they believe it helps when it does not. The strongest predictor of demand is this belief; preferences and own behavior matter little. In a common-pool problem, the people who will rely on a restoration opportunity are the people whose restraint it affects. Our participants' beliefs about their groupmates' choices are accurate on average; what they misjudge is what the opportunity delivers once everyone responds to it. This is the counterpart, for resource users, of the demand for policies whose equilibrium effects voters underappreciate (Dal Bó et al. 2018), and it suggests that the popularity of restoration technologies, in surveys or in politics, is weak evidence of their value.

What generalizes from these findings is the structure of the behavioral response rather than any level: extraction rises with the availability of repair and with its reliability; restoration commitments center on the fair share and do not compensate for the expected free riding of others; conservation improves only when repair is reliable enough to deliver what the erosion of restraint costs; and demand tracks optimistic beliefs. Our design holds the cost of restoration fixed and low, so that repair is efficient when reliable; with a more expensive technology, the same erosion of restraint would be costly even under certainty, and the role of beliefs about cost would come to the fore. It also assumes complete reversibility and no stock dependency, which make restoration more attractive than it is likely to be for the atmosphere or for degraded ecosystems. Both extensions, and the manipulation of the information participants receive about the reliability and cost of restoration, are natural next steps.

For policy, the results have a simple reading. Restoration technologies can complement restraint, but only if they are reliable, and reliability is precisely what is uncertain about the technologies that are expected to remove carbon from the atmosphere at scale. Presenting them as a fail-safe invites the response we observe under uncertainty: less restraint, a commitment to repair, and a resource that is no better off. Whether they help therefore depends in part on how their reliability and cost are communicated to the people who decide whether to rely on them.

References

Abatayo, Anna Lou, Valentina Bosetti, Marco Casari, Riccardo Ghidoni, and Massimo Tavoni (2020), "Solar Geoengineering May Lead to Excessive Cooling and High Strategic

Uncertainty." *Proceedings of the National Academy of Sciences*, 117, 13393–13398.

Andersen, Steffen, Glenn W. Harrison, Morten I. Lau, and E. Elisabet Rutström (2006), "Elicitation Using Multiple Price List Formats." *Experimental Economics*, 9, 383–405.

Andre, Peter, Teodora Boneva, Felix Chopra, and Armin Falk (2024), "Misperceived social norms and willingness to act against climate change." *Review of Economics and Statistics*, 1–46.

Andreoni, Pietro, Johannes Emmerling, and Massimo Tavoni (2024), "Inequality repercussions of financing negative emissions." *Nature Climate Change*, 14, 48–54.

Barrett, Scott and Astrid Dannenberg (2012), "Climate Negotiations Under Scientific Uncertainty." *Proceedings of the National Academy of Sciences*, 109, 17372–17376.

Barro, Robert J. (1974), "Are Government Bonds Net Wealth?" *Journal of Political Economy*, 82, 1095–1117.

Battaglini, Marco, Salvatore Nunnari, and Thomas R Palfrey (2016), "The Dynamic Free Rider Problem: A Laboratory Study." *American Economic Journal: Microeconomics*, 8, 268–308.

Bernard, René, Panagiota Tzamourani, and Michael Weber (2023), "Climate change and individual behavior." *Chicago Booth Research Paper*, 2022–66.

Bosetti, Valentina (2021), "Integrated Assessment Models for Climate Change." *Oxford Research Encyclopedia of Economics and Finance*. Oxford University Press.

Brad, Alina and Etienne Schneider (2023), "Carbon Dioxide Removal and Mitigation Deterrence in EU Climate Policy: Towards a Research Approach." *Environmental Science & Policy*, 150, p. 103591.

Brandts, Jordi and Gary Charness (2011), "The Strategy Versus the Direct-Response Method: A First Survey of Experimental Comparisons." *Experimental Economics*, 14, 375–398.

Calzolari, Giacomo, Marco Casari, and Riccardo Ghidoni (2018), "Carbon Is Forever: A Climate Change Experiment on Cooperation." *Journal of Environmental Economics and Management*, 92, 169–184.

Cason, Timothy N. and Robertas Zubrickas (2019), "Donation-Based Crowdfunding with Refund Bonuses." *European Economic Review*, 119, 452–471.

Catlin, Jesse R. and Yitong Wang (2013), "Recycling Gone Bad: When the Option to Recycle Increases Resource Consumption." *Journal of Consumer Psychology*, 23, 122–127.

Cherry, Todd L., Stephan Kroll, David M. McEvoy, David Campoverde, and Juan Moreno-Cruz (2023), "Climate Cooperation in the Shadow of Solar Geoengineering: An Experimental Investigation of the Moral Hazard Conjecture." *Environmental Politics*, 32, 362–370.

Cherry, Todd L., David M. McEvoy, Stephan Kroll, and David Campoverde (2024), "Solar Geoengineering, Free-Driving and Conflict: An Experimental Investigation." *Environmental and Resource Economics*, 87, 1045–1060.

Dal Bó, Ernesto, Pedro Dal Bó, and Erik Eyster (2018), "The Demand for Bad Policy when Voters Underappreciate Equilibrium Effects." *Review of Economic Studies*, 85, 964–998.

Dechezleprêtre, Antoine, Adrien Fabre, Tobias Kruse, Bluebery Planterose, Ana Sanchez Chico, and Stefanie Stantcheva (2025), "Fighting climate change: International attitudes toward climate policies." *American Economic Review*, 115, 1258–1300.

Drouet, Laurent, Valentina Bosetti, Simone A. Padoan, Lara Aleluia Reis, Christoph Bertram, Francesco Dalla Longa, Jacques Després, Johannes Emmerling, Florian Fosse,

Kostas Fragkiadakis et al. (2021), "Net Zero-Emission Pathways Reduce the Physical and Economic Risks of Climate Change." *Nature Climate Change*, 11, 1070–1076.

Emmerling, Johannes, Laurent Drouet, Kaj-Ivar van der Wijst, Detlef Van Vuuren, Valentina Bosetti, and Massimo Tavoni (2019), "The Role of the Discount Rate for Emission Pathways and Negative Emissions." *Environmental Research Letters*, 14, p. 104008.

Fabre, Adrien, Thomas Douenne, and Linus Mattauch (2025), "Majority support for global redistributive and climate policies." *Nature Human Behaviour*, 9, 1583–1594.

Falk, Armin, Anke Becker, Thomas Dohmen, Benjamin Enke, David Huffman, and Uwe Sunde (2018), "Global Evidence on Economic Preferences." *Quarterly Journal of Economics*, 133, 1645–1692.

Falk, Armin, Anke Becker, Thomas Dohmen, David Huffman, and Uwe Sunde (2023), "The Preference Survey Module: A Validated Instrument for Measuring Risk, Time, and Social Preferences." *Management Science*, 69, 1935–1950.

Fischbacher, Urs, Simon Gächter, and Ernst Fehr (2001), "Are People Conditionally Cooperative? Evidence from a Public Goods Experiment." *Economics Letters*, 71, 397–404.

Fischbacher, Urs, Simon Gächter, and Simone Quercia (2012), "The Behavioral Validity of the Strategy Method in Public Good Experiments." *Journal of Economic Psychology*, 33, 897–913.

Fischer, Maria-Elisabeth, Bernd Irlenbusch, and Abdolkarim Sadrieh (2004), "An intergenerational common pool resource experiment." *Journal of environmental economics and management*, 48, 811–836.

Fréchette, Guillaume R. and Sevgi Yuksel (2017), "Infinitely Repeated Games in the Laboratory: Four Perspectives on Discounting and Random Termination." *Experimental Economics*, 20, 279–308.

Fuss, Sabine, William F Lamb, Max W Callaghan, Jérôme Hilaire, Felix Creutzig, Thorben Amann, Tim Beringer, Wagner de Oliveira Garcia, Jens Hartmann, Tarun Khanna et al. (2018), "Negative Emissions—Part 2: Costs, Potentials and Side Effects." *Environmental Research Letters*, 13, p. 063002.

Gächter, Simon, Felix Kölle, and Simone Quercia (2022), "Preferences and perceptions in Provision and Maintenance public goods." *Games and Economic Behavior*, 135, 338–355.

Gächter, Simon, Friederike Mengel, Elias Tsakas, and Alexander Vostroknutov (2017), "Growth and Inequality in Public Good Provision." *Journal of Public Economics*, 150, 1–13.

Giannousakis, Anastasis, Jérôme Hilaire, Gregory F Nemet, Gunnar Luderer, Robert C Pietzcker, Renato Rodrigues, Lavinia Baumstark, and Elmar Kriegler (2021), "How Uncertainty in Technology Costs and Carbon Dioxide Removal Availability Affect Climate Mitigation Pathways." *Energy*, 216, p. 119253.

Gilardi, Fabrizio, Meysam Alizadeh, and Maël Kubli (2023), "ChatGPT Outperforms Crowd Workers for Text-Annotation Tasks." *Proceedings of the National Academy of Sciences*, 120, p. e2305016120.

Grant, Neil, Adam Hawkes, Shivika Mittal, and Ajay Gambhir (2021), "Confronting Mitigation Deterrence in Low-Carbon Scenarios." *Environmental Research Letters*, 16, p. 064099.

Hauser, Oliver P, David G Rand, Alexander Peysakhovich, and Martin A Nowak (2014), "Cooperating with the Future." *Nature*, 511, 220–223.

Imbens, Guido W. and Donald B. Rubin (2015), *Causal Inference for Statistics, Social, and Biomedical Sciences: An Introduction*, New York. Cambridge University Press.

Kamijo, Yoshio, Asuka Komiya, Nobuhiro Mifune, and Tatsuyoshi Saijo (2017), "Negoti-

ating with the Future: Incorporating Imaginary Future Generations into Negotiations." *Sustainability Science*, 12, 409–420.

Lohse, Johannes and Israel Waichman (2020), "The Effects of Contemporaneous Peer Punishment on Cooperation with the Future." *Nature Communications*, 11, p. 1815.

Manara, Virginia Cecchini, Eleonora Ciscato, Pietro Guarnieri, and Lorenzo Spadoni (2025), "Back to the Future: An Experiment on Ecological Restoration." *Ecological Economics*, 227, p. 108386.

McLaren, Duncan (2020), "Quantifying the Potential Scale of Mitigation Deterrence from Greenhouse Gas Removal Techniques." *Climatic Change*, 162, 2411–2428.

McLaren, Duncan P, David P Tyfield, Rebecca Willis, Bronislaw Szerszynski, and Nils O Markusson (2019), "Beyond "Net-Zero": A Case for Separate Targets for Emissions Reduction and Negative Emissions." *Frontiers in Climate*, 1, p. 4.

Nockur, Laila, Laetitia Arndt, Johannes Keller, and Stefan Pfattheicher (2020), "Collective Choice Fosters Sustainable Resource Management in the Presence of Asymmetric Opportunities." *Scientific Reports*, 10, p. 10724.

Ostrom, Elinor (2008), "Institutions and the environment." *Economic affairs*, 28, 24–31.

Pace, Davide D, Taisuke Imai, Peter Schwardmann, and Joël J van der Weele (2025), "Uncertainty about carbon impact and the willingness to avoid CO2 emissions." *Ecological Economics*, 227, p. 108401.

Riahi, Keywan, Roberto Schaeffer, Jacobo Arango, Katherine Calvin, Céline Guivarch, Tomoko Hasegawa, Kejun Jiang, Elmar Kriegler, Robert Matthews, Glen P Peters et al. (2022), "Mitigation Pathways Compatible with Long-Term Goals." *Climate Change 2022 – Mitigation of Climate Change, Working Group III Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press.

Rodemeier, Matthias (2026), "Willingness to pay for carbon mitigation: Field evidence from the market for carbon offsets." *The Review of Financial Studies*, 39, 1–29.

Rogelj, Joeri, Drew Shindell, Kejun Jiang, Solomone Fifita, Piers Forster, Veronika Ginzburg, Collins Handa, Haroon Kheshgi, Shigeki Kobayashi, Elmar Kriegler et al. (2018), "Mitigation Pathways Compatible with 1.5 C in the Context of Sustainable Development." *Global Warming of 1.5 C*. Intergovernmental Panel on Climate Change, 93–174.

Schleussner, Carl-Friedrich, Gaurav Ganti, Quentin Lejeune, Biqing Zhu, Peter Pfleiderer, Ruben Prütz, Philippe Ciais, Thomas L Frölicher, Sabine Fuss, Thomas Gasser et al. (2024), "Overconfidence in Climate Overshoot." *Nature*, 634, 366–373.

Semken, Christoph (2026), "The Marginal Impact of Emission Reductions: Estimates, Beliefs and Behavior." *Unpublished Manuscript*.

Sherstyuk, Katerina, Nori Tarui, Majah-Leah V. Ravago, and Tatsuyoshi Saijo (2016), "Intergenerational Games with Dynamic Externalities and Climate Change Experiments." *Journal of the Association of Environmental and Resource Economists*, 3, 247–281.

Tannenbaum, David, Alain Cohn, Christian Lukas Zünd, and Michel André Maréchal (2022), "What do cross-country surveys tell us about social capital?" *Review of Economics and Statistics*, 1–30.

Tasneem, Dina, Jim Engle-Warnick, and Hassan Benchekroun (2017), "An Experimental Study of a Common Property Renewable Resource Game in Continuous Time." *Journal of Economic Behavior & Organization*, 140, 91–119.

Vespa, Emanuel (2020), "An Experimental Investigation of Cooperation in the Dynamic Common Pool Game." *International Economic Review*, 61, 417–440.

Woerner, Andrej, Taisuke Imai, Davide D Pace, and Klaus M Schmidt (2024), "How to

increase public support for carbon pricing with revenue recycling." *Nature Sustainability*, 1–9.

Appendix

A Equilibrium Analysis

The following propositions characterize the conditions for existence of all symmetric and stationary SPNEs of the restorable common-pool resource game described in Section 2, where $\delta = \alpha p$ is the intergenerational discount factor and $W = nw$ the total endowment of a generation. In each equilibrium, the value of the game, V^{EQ}, is the objective in (1) of a player at the beginning of a period in which the resource is available. Assumption 1 is maintained throughout. Whether a single player can restore the resource on her own, that is, whether $T_R \leq w$, matters only for the two equilibria in which nobody restores.

Proposition 1 (Extract, Don't Restore) *Consider the profile where, in each period,* $e_i^\star = \frac{K}{n}$ *and* $r_i^\star = 0$. *If* $\rho = 0$ *or* $T_R > w$, *this profile is an equilibrium for any* $\delta \in [0,1]$. *If* $\rho > 0$ *and* $T_R \leq w$, *it is an equilibrium if and only if* $\delta \leq \frac{nT_R}{W+K}$. *In this equilibrium, the resource is exhausted in a single period, and the value of the game is* $V_1^{EQ} = \frac{W+K}{n}$.

Proposition 2 (Conserve, Don't Restore) *Consider the profile where, in each period,* $e_i^\star = \frac{T_E}{n}$ *and* $r_i^\star = 0$. *If* $\rho = 0$ *or* $T_R > w$, *this profile is an equilibrium if and only if* $\delta \geq \frac{K-T_E}{W+K}$. *If* $\rho > 0$ *and* $T_R \leq w$, *it is an equilibrium if and only if* $\frac{K-T_E}{W+K} \leq \delta \leq \frac{nT_R}{W+T_E+nT_R}$. *In this equilibrium, the resource is never exhausted, and the value of the game is* $V_2^{EQ} = \frac{W+T_E}{n(1-\delta)}$.

Proposition 3 (Extract, Restore) *Assume* $\rho > 0$. *An equilibrium of the game where, in each period,* $e_i^\star = \frac{K}{n}$ *and* $r_i^\star = \frac{T_R}{n}$ *exists if and only if* $\delta \geq \frac{T_R}{W+K}$. *In this equilibrium, the resource is exhausted when the game does not reach the Restoration Phase in a period. Thus, at the beginning of every period, the expected number of periods until the resource is exhausted, absent exogenous termination, equals* $1/(1-\rho)$. *The value of the game is* $V_3^{EQ} = \frac{W+K-\rho T_R}{(1-\delta\rho)n}$.

Proposition 4 (Conserve, Restore with Uncertain Restoration Technology) *Assume* $\rho \in (0,1)$. *An equilibrium of the game where, in each period,* $e_i^\star = \frac{T_E}{n}$ *and* $r_i^\star = \frac{T_R}{n}$ *exists if and only if* $\delta \geq \max\left\{\frac{K-\rho T_R-T_E}{W+K-\rho(W+T_E+T_R)}, \frac{T_R}{W+T_E+T_R}\right\}$. *In this equilibrium, the resource is never exhausted, and the value of the game is* $V_4^{EQ} = V_2^{EQ} = \frac{W+T_E}{n(1-\delta)}$.

Proposition 5 (Conserve, Restore with Certain Restoration Technology) *Assume* $\rho = 1$. *An equilibrium of the game where, in each period,* $e_i^\star = \frac{T_E}{n}$ *and* $r_i^\star = \frac{T_R}{n}$ *exists if and only if* $T_R \geq K - T_E$ *and* $\delta \geq \frac{T_R}{W+T_E+T_R}$. *In this equilibrium, the resource is never exhausted, and the value of the game is* $V_5^{EQ} = V_2^{EQ} = \frac{W+T_E}{n(1-\delta)}$.

With the experimental parameters ($n = 3$, $K = 60$, $w = 20$, $T_E = 30$, $T_R = 15$, so that $W = 60$ and $T_R < w$), the thresholds are $\frac{nT_R}{W+K} = \frac{3}{8}$, $\frac{K-T_E}{W+K} = \frac{1}{4}$, $\frac{nT_R}{W+T_E+nT_R} = \frac{1}{3}$, $\frac{T_R}{W+K} = \frac{1}{8}$, and, for $\rho = 1/2$, $\max\{\frac{K-\rho T_R-T_E}{W+K-\rho(W+T_E+T_R)}, \frac{T_R}{W+T_E+T_R}\} = \max\{\frac{1}{3}, \frac{1}{7}\} = \frac{1}{3}$; the condition $T_R \geq K - T_E$ of Proposition 5 fails. These are the conditions reported in Table 3.

B Proofs

Throughout, we use the one-shot deviation principle: a stationary profile is a subgame perfect equilibrium if and only if no player can gain by deviating in a single phase and conforming thereafter. Since players live for one period, a deviation affects a player's objective (1) through her own material payoff and through the value V^{EQ} inherited by her successor, discounted by $\delta = \alpha p$.

Proof of Proposition 1

In the Extraction Phase, there is no profitable deviation because, by Assumption 1, a player cannot unilaterally avoid the transition to the Restoration Phase (or to exhaustion, when $\rho = 0$) when everybody else extracts the largest feasible amount, and extracting less reduces her material payoff without changing the transition. When $\rho = 0$, there is no Restoration Phase and the proof is complete. When $\rho > 0$, the Restoration Phase is reached with probability ρ, and everybody else makes no restoration effort. If $T_R > w$, a player cannot unilaterally restore the resource, and any positive investment reduces her material payoff without changing the transition, so there is no profitable deviation. If $T_R \leq w$, a player can restore the resource on her own by investing T_R, which reduces her material payoff by T_R and gives her successor the value $V_1^{EQ} = \frac{W+K}{n}$; investing a positive amount smaller than T_R is never profitable. There is no profitable deviation if and only if

$$T_R \geq \delta \frac{W+K}{n} \quad \Longleftrightarrow \quad \delta \leq \frac{nT_R}{W+K}.$$

Proof of Proposition 2

In the Extraction Phase, there is no profitable deviation if and only if:

$$\begin{aligned} V^{EQ} = \frac{W+T_E}{n(1-\delta)} &\geq \frac{W+K}{n} \\ W + T_E &\geq (W+K)(1-\delta) \\ \delta &\geq \frac{K-T_E}{W+K} \end{aligned}$$

where the right-hand side of the first line is the payoff of a player who extracts the largest feasible amount, which triggers the transition to the Restoration Phase or to exhaustion, and whose successor inherits nothing because, in the Restoration Phase, nobody else invests and, under the condition derived next, she does not restore the resource on her own. In the Restoration Phase, which is reached (with probability ρ) only after a deviation in the

Extraction Phase, everybody else makes no restoration effort. If $\rho = 0$ or $T_R > w$, no player can restore the resource alone and there is no profitable deviation. If $\rho > 0$ and $T_R \leq w$, a player can restore the resource on her own by investing T_R, which gives her successor the value V_2^{EQ}; there is no profitable deviation if and only if

$$T_R \geq \delta \frac{W + T_E}{n(1-\delta)} \quad \Longleftrightarrow \quad nT_R(1-\delta) \geq \delta(W + T_E) \quad \Longleftrightarrow \quad \delta \leq \frac{nT_R}{W + T_E + nT_R}.$$

When this condition fails, a player who deviates in the Extraction Phase would restore the resource on her own, and the profile fails subgame perfection.

Proof of Proposition 3

In the Extraction Phase, there is no profitable deviation because, by Assumption 1, a player cannot unilaterally avoid the transition to the Restoration Phase when everybody else extracts the largest feasible amount. In the Restoration Phase, everybody else invests $\frac{T_R}{n}$, so that the resource is restored if and only if the player invests at least $\frac{T_R}{n}$, and investing more is never profitable. There is no profitable deviation if and only if:

$$-\frac{T_R}{n} + \delta V^{EQ} \geq 0.$$

Since the continuation value of the game under equilibrium strategies is equal to $V^{EQ} = \frac{(W+K)}{n} - \rho\frac{T_R}{n} + \rho\delta V^{EQ}$, we have $V^{EQ} = \frac{(W+K)-\rho T_R}{(1-\delta\rho)n}$ and the condition above becomes

$$\begin{aligned} \delta\frac{(W+K)-\rho T_R}{(1-\delta\rho)n} &\geq \frac{T_R}{n} \\ \delta(W + K - \rho T_R) &\geq T_R(1-\delta\rho) \\ \delta &\geq \frac{T_R}{(W+K)}. \end{aligned}$$

Proof of Propositions 4 and 5

In the Extraction Phase, there is no profitable deviation if and only if:

$$\begin{aligned} V^{EQ} &\geq \frac{W+K}{n} - \rho\frac{T_R}{n} + \rho\delta V^{EQ} \\ (1-\rho\delta)V^{EQ} &\geq \frac{W+K}{n} - \rho\frac{T_R}{n} \end{aligned}$$

where the right-hand side of the first line is the payoff of a player who extracts the largest feasible amount and then, conforming to the profile in the Restoration Phase, invests $\frac{T_R}{n}$

when the phase is reached. Since the continuation value of the game under equilibrium strategies is given by $V^{EQ} = \frac{W+T_E}{n(1-\delta)}$, the condition above becomes

$$(1-\delta\rho)\frac{W+T_E}{n(1-\delta)} \geq \frac{W+K}{n} - \rho\frac{T_R}{n}$$
$$\frac{1-\delta\rho}{1-\delta} \geq \frac{W+K-\rho T_R}{W+T_E}.$$

When $\rho = 1$, the condition above becomes $T_E \geq K - T_R$.

When $\rho \in (0,1)$, the condition above becomes:

$$\frac{(1-\delta\rho)(W+T_E) - (W+K-\rho T_R)(1-\delta)}{(1-\delta)(W+T_E)} \geq 0.$$

Since the denominator of the left-hand side is always positive, this condition reduces to checking whether the numerator is positive, that is,

$$\begin{aligned}(1-\delta\rho)(W+T_E) - (W+K-\rho T_R)(1-\delta) &\geq 0\\ \delta(W+K-\rho(W+T_E+T_R)) &\geq K-\rho T_R - T_E\\ \delta &\geq \frac{K-\rho T_R - T_E}{W+K-\rho(W+T_E+T_R)},\end{aligned}$$

where the last step assumes $W+K > \rho(W+T_E+T_R)$, which holds whenever $K \geq T_E+T_R$ and in particular for our parameters. Since the right-hand side is then strictly less than 1, there exists a value of $\delta \in [0,1]$ such that this holds.

In the Restoration Phase, everybody else invests $\frac{T_R}{n}$, so that the resource is restored if and only if the player invests at least $\frac{T_R}{n}$. There is no profitable deviation if and only if:

$$\begin{aligned}-\frac{T_R}{n} + \delta\frac{W+T_E}{n(1-\delta)} &\geq 0\\ \delta &\geq \frac{T_R}{W+T_E+T_R}.\end{aligned}$$

Since the right-hand side is strictly less than 1, there exists a value of $\delta \in [0,1]$ such that this holds.

C Supporting Tables and Figures

Table C1: Effect of the Restoration Opportunity within Each Condition, and the Difference between Conditions

	Baseline	Restoration	Effect	(SE)	p	Signed-rank p	N	Resources
A. Certain Restoration								
Individual extraction (units)	10.29	12.47	2.18	(0.17)	<0.001	<0.001	1,020	200
Group extraction (units)	30.87	37.41	6.54	(0.51)	<0.001	<0.001	340	200
Group extraction above threshold (%)	42.1	72.4	30.3	(3.3)	<0.001	<0.001	340	200
Resource conserved to next generation (%)	57.9	80.6	22.6	(2.9)	<0.001	<0.001	340	200
Resource life (generations)	1.84	2.78	0.94	(0.16)	<0.001	<0.001	200	200
Individual earnings (points)	30.29	28.05	−2.24	(0.17)	<0.001	<0.001	1,020	200
Earnings per potential participant slot	17.81	20.49	2.68	(0.61)	<0.001	0.010	200	200
Within-generation variance of earnings	22.92	43.68	20.76	(2.52)	<0.001	<0.001	340	200
Across-generation variance of earnings	212.8	118.9	−93.9	(15.8)	<0.001	<0.001	155	155
B. Uncertain Restoration								
Individual extraction (units)	10.01	10.93	0.92	(0.13)	<0.001	<0.001	1,002	200
Group extraction (units)	30.03	32.79	2.76	(0.38)	<0.001	<0.001	334	200
Group extraction above threshold (%)	34.4	53.0	18.6	(2.8)	<0.001	<0.001	334	200
Resource conserved to next generation (%)	65.6	64.7	−0.9	(2.9)	0.759	0.758	334	200
Resource life (generations)	2.03	2.08	0.05	(0.10)	0.634	0.943	200	200
Individual earnings (points)	30.01	29.32	−0.69	(0.19)	<0.001	0.002	1,002	200
Earnings per potential participant slot	18.60	18.16	−0.45	(0.48)	0.356	0.225	200	200
Within-generation variance of earnings	22.09	32.15	10.06	(1.85)	<0.001	<0.001	334	200
Across-generation variance of earnings	170.4	195.1	24.7	(12.9)	0.057	0.337	155	155

C. Difference in effects	Effect, Certain	Effect, Uncertain	Difference	(SE)	p	Mann-Whitney p	N	Resources
Individual extraction (units)	2.18	0.92	−1.26	(0.21)	<0.001	<0.001	2,022	400
Group extraction (units)	6.54	2.76	−3.78	(0.64)	<0.001	<0.001	674	400
Group extraction above threshold (%)	30.3	18.6	−11.7	(4.3)	0.007	0.004	674	400
Resource conserved to next generation (%)	22.6	−0.9	−23.5	(4.1)	<0.001	<0.001	674	400
Resource life (generations)	0.94	0.05	−0.89	(0.19)	<0.001	<0.001	400	400
Individual earnings (points)	−2.24	−0.69	1.55	(0.26)	<0.001	<0.001	2,022	400
Earnings per potential participant slot	2.68	−0.45	−3.13	(0.77)	<0.001	0.024	400	400
Within-generation variance of earnings	20.76	10.06	−10.70	(3.13)	<0.001	0.002	674	400
Across-generation variance of earnings	−93.9	24.7	118.6	(20.4)	<0.001	<0.001	310	310

Notes. Panels A and B report, for each condition, the mean under each scenario and the paired Restoration-minus-Baseline difference ("Effect"), which equals the estimate with individual, group or resource effects. Panel C reports the paired difference regressed on the Uncertain indicator (Uncertain minus Certain). Standard errors clustered at the resource; signed-rank and Mann-Whitney p-values are the non-parametric companions. Individual rows use Fully Active participants, group rows Fully Active groups and resource rows all resources; N counts participants, groups or resources. Variables as in Figure 3; across-generation variance is measured in points squared and computed over the potential sequence of generation-mean earnings, with zeros after access is lost, excluding the 45 resources per condition with a potential length of one.

Table C2: Certain versus Uncertain Restoration under the Restoration Scenario

	Certain	Uncertain	Difference	(SE)	p	Mann-Whitney p	N	Resources
A. All participants and groups that played Restoration (pre-registered sample)								
Individual extraction (units)	12.18	10.90	−1.29	(0.20)	<0.001	<0.001	2,913	400
Individual investment (units)	6.22	5.99	−0.24	(0.18)	0.177	0.080	2,913	400
Individual earnings (points)	27.95	29.37	1.42	(0.20)	<0.001	<0.001	2,913	400
Group extraction (units)	36.55	32.69	−3.86	(0.59)	<0.001	<0.001	971	400
Group extraction above threshold (%)	69.4	52.6	−16.7	(3.0)	<0.001	<0.001	971	400
Group investment at least 15 (%)	73.7	67.8	−5.9	(3.1)	0.060	0.045	971	400
Resource conserved to next generation (%)	80.2	63.9	−16.2	(2.9)	<0.001	<0.001	971	400
Group investment at least 15, given depletion (%)	71.4	66.2	−5.2	(4.1)	0.203	0.181	604	357
Restoration successful, given depletion (%)	71.4	31.5	−39.9	(4.0)	<0.001	<0.001	604	357
Conserved if restoration had been available (%)†	80.2	82.2	2.0	(2.6)	0.431	0.424	971	400
Within-generation variance of earnings	43.33	33.55	−9.78	(2.76)	<0.001	0.003	971	400
Resource life (generations)	2.78	2.08	−0.70	(0.20)	<0.001	0.003	400	400
Across-generation variance of earnings	118.9	195.1	76.2	(15.6)	<0.001	<0.001	310	310
Earnings per potential participant slot	20.49	18.16	−2.33	(0.98)	0.018	0.065	400	400
B. Generation 1 only								
Individual extraction (units)	12.59	11.07	−1.52	(0.31)	<0.001	<0.001	1,200	400
Individual investment (units)	6.20	5.97	−0.23	(0.25)	0.370	0.395	1,200	400
Individual earnings (points)	28.06	29.54	1.48	(0.32)	<0.001	<0.001	1,200	400
Group extraction (units)	37.77	33.20	−4.57	(0.93)	<0.001	<0.001	400	400
Group extraction above threshold (%)	74.0	53.5	−20.5	(4.7)	<0.001	<0.001	400	400
Group investment at least 15 (%)	76.0	67.5	−8.5	(4.5)	0.059	0.059	400	400
Resource conserved to next generation (%)	80.5	64.0	−16.5	(4.4)	<0.001	<0.001	400	400
Group investment at least 15, given depletion (%)	73.6	66.4	−7.3	(5.9)	0.214	0.208	255	255
Restoration successful, given depletion (%)	73.6	32.7	−40.9	(5.8)	<0.001	<0.001	255	255
Conserved if restoration had been available (%)†	80.5	82.0	1.5	(3.9)	0.702	0.701	400	400
Within-generation variance of earnings	43.41	31.63	−11.78	(4.19)	0.005	0.001	400	400

Notes. OLS on the Uncertain indicator; "Difference" is Uncertain minus Certain, standard errors clustered at the resource; Mann-Whitney p-values are the non-parametric companions. Panel A is the pre-registered sample: all Fully Active and Partially Active participants and groups that played Restoration. Panel B keeps generation 1, where all groups have access and no selection through earlier survival has occurred; it also removes an information difference, since the members of Restoration-only groups had been told that the Baseline resource was exhausted by earlier groups. The Baseline conservation differs between the two conditions (Section 5.2 and Table C8), so a difference between the two samples cannot be excluded; for extraction, the Baseline gap is small and the difference in effects in Panel C of Table C1 nets out each participant's own Baseline choice. The two rows conditional on depletion use groups whose extraction exceeded the threshold. The resource-level rows of Panel A compare the Restoration means of Table C1 between conditions. † Not pre-registered; "conserved if restoration had been available" holds observed choices fixed and sets availability to one.

Table C3: Effect of the Restoration Opportunity across Specifications

Outcome	Condition	(1) Main	(2) Unit cluster	(3) + Partially Active	(4) Generation 1	(5) Excl. compr. failures	(6) First-played only
Individual extraction	Certain	2.18 (0.17)	2.18 (0.16)	1.84 (0.15)	2.44 (0.21)	2.19 (0.17)	1.58 (0.34)
	Uncertain	0.92 (0.13)	0.92 (0.14)	0.86 (0.14)	1.08 (0.17)	0.89 (0.13)	0.88 (0.29)
	Difference	−1.26 (0.21)	−1.26 (0.21)	−0.97 (0.21)	−1.36 (0.27)	−1.30 (0.22)	−0.69 (0.45)
Individual earnings	Certain	−2.24 (0.17)	−2.24 (0.18)	−2.40 (0.17)	−2.09 (0.24)	−2.25 (0.18)	−2.40 (0.32)
	Uncertain	−0.69 (0.19)	−0.69 (0.16)	−0.66 (0.17)	−0.44 (0.22)	−0.65 (0.19)	−0.42 (0.32)
	Difference	1.55 (0.26)	1.55 (0.24)	1.73 (0.24)	1.65 (0.33)	1.59 (0.26)	1.97 (0.45)
Group extraction	Certain	6.54 (0.51)	6.54 (0.48)	5.51 (0.50)	7.32 (0.63)	–	4.73 (1.03)
	Uncertain	2.76 (0.38)	2.76 (0.41)	2.59 (0.40)	3.25 (0.52)	–	2.65 (0.87)
	Difference	−3.78 (0.64)	−3.78 (0.63)	−2.91 (0.64)	−4.07 (0.82)	–	−2.07 (1.35)
Above threshold (pp)	Certain	30.3 (3.3)	30.3 (3.0)	26.7 (3.1)	33.0 (4.1)	–	20.4 (5.4)
	Uncertain	18.6 (2.8)	18.6 (2.9)	17.4 (2.5)	19.5 (3.5)	–	15.4 (5.1)
	Difference	−11.7 (4.3)	−11.7 (4.2)	−9.3 (4.0)	−13.5 (5.4)	–	−4.9 (7.4)
Resource conserved (pp)	Certain	22.6 (2.9)	22.6 (2.9)	22.8 (2.7)	21.5 (3.8)	–	28.2 (5.0)
	Uncertain	−0.9 (2.9)	−0.9 (2.9)	−0.8 (2.5)	−2.0 (3.7)	–	−2.2 (4.9)
	Difference	−23.5 (4.1)	−23.5 (4.1)	−23.7 (3.7)	−23.5 (5.3)	–	−30.4 (7.0)
Within-generation variance	Certain	20.76 (2.52)	20.76 (2.51)	20.24 (2.06)	20.37 (3.00)	–	18.60 (3.95)
	Uncertain	10.06 (1.85)	10.06 (1.90)	9.92 (1.93)	11.74 (2.45)	–	8.12 (3.14)
	Difference	−10.70 (3.13)	−10.70 (3.15)	−10.33 (2.82)	−8.64 (3.87)	–	−10.48 (5.04)

Notes. Coefficients with standard errors in parentheses. (1) Main specification: Fully Active, paired, clustered at the resource. (2) Same, clustered at the individual or group (equal to a paired t-test). (3) Pre-registered robustness (i) and (ii): adds Partially Active participants and groups in an unpaired comparison of everyone who played each scenario; clustered at the individual for individual outcomes, as registered, and at the resource for group outcomes. (4) Pre-registered robustness (iii): generation 1. (5) Excludes participants who twice failed a comprehension check on the second scenario or the preference task (pre-registered; individual outcomes only). (6) Not pre-registered: only the scenario each Fully Active participant or group played first, a comparison between resources by order. "Difference" is Uncertain minus Certain.

Table C4: Certain versus Uncertain Restoration across Specifications

Outcome	(1) Main	(2) + Controls	(3) Fully Active	(4) Excl. compr. failures	(5) Restoration first	(6) Baseline first
Individual extraction	−1.29 (0.20)	−1.33 (0.19)	−1.54 (0.24)	−1.34 (0.20)	−1.05 (0.27)	−1.47 (0.28)
Individual investment	−0.24 (0.18)	−0.22 (0.17)	−0.17 (0.20)	−0.33 (0.18)	−0.19 (0.23)	−0.25 (0.25)
Individual earnings	1.42 (0.20)	1.39 (0.20)	1.27 (0.26)	1.43 (0.20)	1.56 (0.28)	1.29 (0.29)
Group extraction	−3.86 (0.59)	−3.98 (0.59)	−4.62 (0.73)	–	−3.15 (0.82)	−4.40 (0.83)
Above threshold (pp)	−16.7 (3.0)	−17.0 (2.9)	−19.4 (3.6)	–	−17.5 (4.2)	−15.5 (4.2)
Group investment at least 15 (pp)	−5.9 (3.1)	−6.0 (3.1)	−7.3 (3.6)	–	−5.6 (4.4)	−6.1 (4.4)
Resource conserved (pp)	−16.2 (2.9)	−16.3 (2.8)	−15.9 (3.4)	–	−15.0 (3.7)	−17.4 (4.3)
Within-generation variance	−9.78 (2.76)	−9.57 (2.81)	−11.53 (3.15)	–	−12.49 (4.10)	−7.19 (3.73)

Notes. Coefficient on the Uncertain indicator, standard errors clustered at the resource in parentheses. (1) Main: all who played Restoration. (2) Adds controls for scenario order and generation 2 or later. (3) Fully Active only. (4) Excludes comprehension failures (individual outcomes only). (5) and (6) Resources that played Restoration first and Baseline first. Columns (2), (3), (5) and (6) are not pre-registered. Generation 1 is in Panel B of Table C2.

Table C5: Dispersion of Earnings in Standard-Deviation Units

	Baseline	Restoration	Effect	(SE)	p	Signed-rank p	N	Resources
A. Certain Restoration								
Within-generation SD of earnings (points)	4.00	5.56	1.57	(0.20)	<0.001	<0.001	340	200
Across-generation SD of earnings (points)	12.97	8.86	−4.11	(0.67)	<0.001	<0.001	155	155
B. Uncertain Restoration								
Within-generation SD of earnings (points)	3.77	4.74	0.97	(0.17)	<0.001	<0.001	334	200
Across-generation SD of earnings (points)	11.32	12.43	1.11	(0.58)	0.058	0.239	155	155

Notes. As Table C1, with standard deviations in place of the pre-registered variances.

Table C6: Depletion by Generation: Discrete-Time Hazard Models

	Certain	Uncertain	Pooled
A. Linear probability model (percentage points)			
Restoration	−22.2 (2.7)	0.8 (2.6)	−22.2 (2.7)
Restoration × Uncertain			23.0 (3.8)
B. Complementary log-log hazard model (hazard ratios)			
Restoration	0.41 [0.33, 0.51]	1.03 [0.86, 1.23]	0.41 [0.33, 0.51]
Restoration × Uncertain			2.51 [1.90, 3.32]
Group-scenario observations	923	822	1,745
Resources	200	200	400

Notes. Not pre-registered. One observation per group and scenario played; the outcome is depletion of the resource in that generation. All models include indicators for generation (1, 2, 3, 4 or later), interacted with condition in the pooled column. Panel A reports coefficients in percentage points with standard errors in parentheses, and Panel B hazard ratios with 95% confidence intervals. Standard errors clustered at the resource.

Table C7: Willingness to Pay: Recorded Value and Interval Regression

	OLS, recorded value	Interval regression
Mean signed WTP, Certain ($)	0.63 (0.04)	0.73 (0.04)
Uncertain − Certain	−0.10 (0.05)	−0.12 (0.06)
Believed earnings advantage (per 10 points)	0.17 (0.02)	0.20 (0.02)
Believed resource-life advantage (per generation)	0.03 (0.01)	0.04 (0.01)
Participants	2,022	2,022

Notes. Not pre-registered. Fully Active participants. The price list records the highest fee accepted, so willingness to pay lies between that fee and the next one on the grid, and above $4 for those who accept every fee. The interval regression uses these bounds for signed WTP. The belief coefficients come from models that also include the Uncertain indicator, scenario order and generation 2 or later. Standard errors clustered at the resource.

Table C8: Baseline Conservation across Conditions

	Certain	Uncertain	Difference	(SE)	p	Mann-Whitney p	N	Resources
Groups conserving the resource under Baseline (%)								
Baseline first, generation 1	54.0	73.0	19.0	(6.7)	0.005	0.005	200	200
Baseline first, all generations	54.7	67.1	12.5	(4.9)	0.011	0.012	391	200
Restoration first, generation 1	64.0	59.0	−5.0	(6.9)	0.470	0.469	200	200
Restoration first, all generations	59.7	62.0	2.3	(4.8)	0.629	0.640	383	200
Both orders, generation 1	59.0	66.0	7.0	(4.8)	0.149	0.149	400	400
Both orders, generation 2 or later	55.4	63.6	8.2	(5.0)	0.103	0.106	374	193

Notes. Not pre-registered. Groups that played Baseline. The Baseline scenario is identical in the two conditions, so these differences are a diagnostic, not a treatment effect. OLS on the Uncertain indicator; standard errors clustered at the resource. In Baseline-first resources, generation 1 plays Baseline before any exposure to Restoration.

Table C9: Both Restoration Conditions against a Common Baseline

	Pooled	Certain Restoration		Uncertain Restoration			
	Baseline	Effect (SE)	p	Effect (SE)	p	Obs.	Resources
A. Fully Active participants and groups, both scenarios							
Individual extraction (units)	10.15	2.32 (0.18)	<0.001	0.78 (0.14)	<0.001	4,044	400
Individual earnings (points)	30.15	−2.10 (0.17)	<0.001	−0.83 (0.19)	<0.001	4,044	400
Group extraction (units)	30.45	6.95 (0.54)	<0.001	2.34 (0.42)	<0.001	1,348	400
Group extraction above threshold (%)	38.3	34.1 (2.9)	<0.001	14.7 (2.8)	<0.001	1,348	400
Resource conserved to next generation (%)	61.7	18.9 (2.5)	<0.001	2.9 (2.8)	0.288	1,348	400
Within-generation variance of earnings	22.51	21.17 (2.51)	<0.001	9.64 (1.89)	<0.001	1,348	400
B. Generation 1, first-played scenario only							
Individual extraction (units)	10.00	1.88 (0.39)	<0.001	0.81 (0.32)	0.012	1,200	400
Individual earnings (points)	30.00	−2.22 (0.36)	<0.001	−0.34 (0.33)	0.307	1,200	400
Group extraction (units)	30.01	5.65 (1.16)	<0.001	2.44 (0.97)	0.012	400	400
Group extraction above threshold (%)	36.5	31.5 (5.8)	<0.001	11.5 (6.1)	0.059	400	400
Resource conserved to next generation (%)	63.5	19.5 (5.1)	<0.001	1.5 (5.9)	0.799	400	400
Within-generation variance of earnings	20.52	24.62 (5.61)	<0.001	8.07 (3.84)	0.036	400	400
C. All resources, complete histories							
Resource life (generations)	1.94	0.84 (0.17)	<0.001	0.15 (0.10)	0.160	800	400
Across-generation variance of earnings	191.6	−72.7 (12.6)	<0.001	3.6 (13.2)	0.788	620	310
Earnings per potential participant slot	18.20	2.28 (0.64)	<0.001	−0.05 (0.61)	0.937	800	400

Notes. Not pre-registered; prompted by Table C8. Stacked scenario outcomes regressed on a constant and separate indicators for Certain Restoration and Uncertain Restoration, so that Baseline observations from both conditions form one control group and each enters once. No unit fixed effects. Standard errors clustered at the resource. Panel B keeps generation 1 and the scenario played first: the control is the Baseline-first groups of both conditions and the restoration observations come from Restoration-first groups. Panel C compares complete Baseline and Restoration histories of all resources.

Table C10: Balance of Participant Characteristics across Conditions

	Certain	Uncertain	Difference	(SE)	p	Norm. diff.	N
A. All participants							
Age (years)	39.72	38.44	−1.28	(0.46)	0.006	−0.10	3,210
Female (%)	53.7	54.8	1.0	(1.6)	0.532	0.02	3,173
White (%)	70.7	68.9	−1.7	(1.7)	0.309	−0.04	3,154
Black (%)	14.5	15.2	0.7	(1.3)	0.608	0.02	3,154
Born in the United States (%)	92.5	94.1	1.6	(0.9)	0.059	0.06	3,210
Risk tolerance (0–10)	5.24	5.29	0.05	(0.08)	0.583	0.02	3,213
Patience (0–10)	7.23	7.10	−0.13	(0.07)	0.057	−0.07	3,213
Altruism (0–10)	7.21	7.32	0.11	(0.08)	0.147	0.05	3,213
Joint test: Prolific characteristics					0.021		3,132
Joint test: preference measures					0.039		3,213
Joint test: all characteristics					0.009		3,132
B. Fully Active participants							
Age (years)	39.91	38.66	−1.25	(0.56)	0.026	−0.10	2,019
Female (%)	54.4	54.8	0.3	(2.0)	0.862	0.01	1,996
White (%)	69.2	67.8	−1.4	(2.1)	0.491	−0.03	1,980
Black (%)	16.9	17.1	0.2	(1.7)	0.887	0.01	1,980
Born in the United States (%)	92.4	93.1	0.7	(1.1)	0.556	0.03	2,019
Risk tolerance (0–10)	5.24	5.25	0.01	(0.11)	0.895	0.01	2,022
Patience (0–10)	7.19	6.99	−0.20	(0.09)	0.026	−0.10	2,022
Altruism (0–10)	7.26	7.34	0.08	(0.09)	0.366	0.04	2,022
Joint test: Prolific characteristics					0.402		1,968
Joint test: preference measures					0.053		2,022
Joint test: all characteristics					0.100		1,968

Notes. Not pre-registered. Age, sex, ethnicity and country of birth come from the Prolific demographic exports matched on the Prolific identifier; all 3,213 participants match. Residence in the United States and English as first language were recruiting criteria. Withdrawn, expired and "prefer not to say" answers are missing. Risk tolerance, patience and altruism come from the end-of-study survey, after both scenarios were played. Each row regresses the characteristic on the Uncertain indicator, standard errors clustered at the resource. The normalized difference divides the difference in means by the square root of the average of the two within-condition variances (Imbens and Rubin 2015). Joint tests regress the Uncertain indicator on the listed characteristics and report the p-value of the F-test that all coefficients are zero. For comparison, the median age of our participants is 37 years, against about 48 years for the adult population in the 2020 United States Census, in which 51.5 percent of adults are female, and 61.6 percent of the population is White alone and 12.4 percent Black alone.

Table C11: Balance of Participant Characteristics: Generation 1 by Scenario Order

	Certain	Uncertain	Difference	(SE)	p	Norm. diff.	N
A. Generation 1, Baseline first							
Age (years)	40.33	39.28	−1.05	(0.99)	0.289	−0.09	598
Female (%)	54.7	58.0	3.3	(4.0)	0.408	0.07	591
White (%)	66.2	68.2	1.9	(3.8)	0.615	0.04	588
Black (%)	18.9	18.5	−0.4	(3.4)	0.901	−0.01	588
Born in the United States (%)	92.0	91.6	−0.3	(2.3)	0.884	−0.01	598
Risk tolerance (0–10)	5.58	5.45	−0.13	(0.19)	0.515	−0.05	600
Patience (0–10)	7.23	6.91	−0.32	(0.17)	0.060	−0.16	600
Altruism (0–10)	7.15	7.38	0.23	(0.18)	0.215	0.10	600
Joint test: Prolific characteristics					0.841		584
Joint test: preference measures					0.044		600
Joint test: all characteristics					0.250		584
B. Generation 1, Restoration first							
Age (years)	40.08	38.01	−2.07	(0.96)	0.033	−0.17	599
Female (%)	54.7	56.8	2.1	(4.1)	0.619	0.04	594
White (%)	74.2	68.4	−5.8	(3.6)	0.111	−0.13	589
Black (%)	16.4	15.1	−1.3	(2.9)	0.652	−0.04	589
Born in the United States (%)	92.7	92.6	−0.0	(2.0)	0.990	−0.00	599
Risk tolerance (0–10)	5.03	5.17	0.13	(0.21)	0.520	0.06	600
Patience (0–10)	7.34	7.08	−0.26	(0.15)	0.085	−0.14	600
Altruism (0–10)	7.45	7.42	−0.02	(0.17)	0.890	−0.01	600
Joint test: Prolific characteristics					0.078		586
Joint test: preference measures					0.217		600
Joint test: all characteristics					0.092		586

Notes. As Table C10. Each panel has 100 resources and 300 participants per condition. Panel A is the sample in which Baseline conservation differs between conditions (Table C8).

Table C12: Baseline Conservation Gap in Generation-1 Baseline-First Groups, with Controls

	(1)	(2)	(3)
Uncertain (percentage points)	19.0 (6.7)	18.5 (6.7)	15.0 (6.7)
p	0.005	0.006	0.027
Group means of age, sex, ethnicity, country of birth	No	Yes	Yes
Group means of risk tolerance, patience, altruism	No	No	Yes
Groups (one per resource)	200	200	200

Notes. Not pre-registered. Linear probability model of Baseline conservation on the Uncertain indicator; one group per resource; robust standard errors in parentheses. Controls are group means over members who answered; missing group means are set to zero with an indicator.

Table C13: Distribution of Willingness to Pay for the Preferred Scenario

	Prefer Restoration		Prefer Baseline	
	Certain	Uncertain	Certain	Uncertain
Participants	821	734	199	268
Mean WTP ($)	0.96	0.99	0.72	0.71
Median WTP ($)	0.75	0.75	0.50	0.50
WTP above zero (%)	82.2	83.0	70.9	74.3
WTP of at least $1 (%)	49.7	47.0	37.2	35.8
WTP at the top of the list, $4 (%)	3.4	5.0	2.5	1.1
Mean WTP if above zero ($)	1.17	1.19	1.01	0.96
Mann-Whitney p, Uncertain vs Certain	0.932		0.890	

Notes. Fully Active participants, by the scenario preferred in the no-cost choice. Recorded WTP is the highest fee accepted on the price list (grid from $0.25 to $4), a lower bound on willingness to pay; zero means that the preferred scenario was given up at the lowest fee.

Table C14: In-Sample and Out-of-Sample Fit of Four Sets of Correlates of Preference and Signed Willingness to Pay

	Prefers Restoration				Signed WTP			
	Certain		Uncertain		Certain		Uncertain	
Variables included	In	Out	In	Out	In	Out	In	Out
Own extraction (both scenarios) and investment	4.4	3.8	4.4	3.9	4.3	3.8	4.8	4.4
Beliefs about groupmates' extraction and investment	2.3	1.7	1.2	0.4	1.9	1.2	1.4	0.7
Beliefs about Restoration's earnings and resource-life advantage	12.7	12.4	13.6	13.4	8.8	8.3	11.3	10.8
Risk tolerance, patience and altruism	0.3	−0.4	0.2	−0.4	1.0	0.3	2.0	1.5
All of the above, scenario order and generation 2 or later	16.7	14.1	18.5	15.8	12.9	10.0	16.2	13.9

Notes. Not pre-registered beyond the role of beliefs about outcomes. Entries are R^2 in percent from OLS regressions on Fully Active participants, by condition (1,020 Certain, 1,002 Uncertain); the binary preference is a linear probability model. Each of the first four rows fits one set of variables alone, without controls; the last row includes all eleven variables, scenario order and an indicator for generation 2 or later. The rows are separate fits: they are not incremental or partial R^2. "In" is the in-sample R^2. "Out" is the out-of-sample R^2 from ten-fold cross-validation with folds assigned to resources, so that a resource is never split between estimation and prediction: one minus the ratio of the squared prediction error to the squared error of the estimation-sample mean. It is negative when the variables predict worse than that mean. Beliefs were elicited after the preference and the price list. Figure C5 reports the coefficients of the full model. A LASSO on the full model, with the penalty chosen by ten-fold cross-validation and the two controls always included, leaves the picture unchanged: over 20 random fold assignments, own Baseline extraction, own investment, the belief about groupmates' investment and the two beliefs about outcomes are retained every time in all four models, in the preference models the only variables ever dropped are the traits, and the penalized coefficients of the retained variables stay close to OLS.

Table C15: Accuracy of Beliefs about the Advantage of Restoration

	All Fully Active		Generation 1	
	Certain	Uncertain	Certain	Uncertain
A. Earnings advantage of Restoration (points)				
Mean belief	6.23	3.68	6.75	4.56
Mean realised difference in own resource	2.53	−0.60	2.68	−0.45
Mean signed error (belief minus realised)	3.70	4.28	4.06	5.00
SD of signed error	19.07	18.59	19.23	18.74
Mean absolute error	15.76	15.59	16.02	15.72
Median absolute error	13.67	14.43	13.88	14.26
Root mean squared error	19.42	19.07	19.64	19.38
Within tolerance (%)	8.1	9.7	7.0	10.3
Above tolerance (%)	57.8	57.4	59.7	58.5
Below tolerance (%)	34.0	32.9	33.3	31.2
Correct sign: positive, zero or negative (%)	43.6	41.5	42.0	41.3
B. Resource-life advantage of Restoration (generations)				
Mean belief	3.78	2.41	3.75	2.40
Mean realised difference in own resource	0.99	0.06	0.94	0.05
Mean signed error (belief minus realised)	2.79	2.35	2.82	2.35
SD of signed error	4.89	4.87	4.70	4.88
Mean absolute error	4.72	4.55	4.54	4.52
Median absolute error	4.00	4.00	4.00	4.00
Root mean squared error	5.63	5.40	5.48	5.42
Within tolerance (%)	17.1	17.2	18.2	18.2
Above tolerance (%)	66.5	63.1	66.8	62.5
Below tolerance (%)	16.5	19.8	15.0	19.3
Correct sign: positive, zero or negative (%)	36.4	25.3	36.5	26.0
Participants	1,020	1,002	600	600

Notes. Not pre-registered. Fully Active participants state by how much average earnings (points, from −40 to 40) and resource life (generations, from −10 to 10) are higher under Restoration than under Baseline. Each belief is compared with the realized Restoration-minus-Baseline difference in the respondent's own resource: earnings per potential participant slot, which count zero for generations that lost access, and generations with access. Tolerance is ±2 points and ±1 generation, boundaries included. All respondents have equal weight, so the mean realized difference is weighted by the number of Fully Active respondents per resource and differs from the equal-resource means of Table C1; in generation 1 each resource has three respondents. The realized difference in one's own resource is one possible benchmark; it includes the randomness of others' choices, of termination and of restoration availability, and the questionnaire does not define the benchmark beyond average earnings and resource life. The errors therefore describe the distance between beliefs and realized outcomes.

Table C16: Absolute Belief Errors and Demand for Restoration

	Prefers Restoration (pp)	Signed WTP ($)	WTP, prefer Restoration ($)	WTP, prefer Baseline ($)
All Fully Active, Certain				
Earnings-belief error (per SD)	−3.4 (1.5)	−0.054 (0.042)	0.025 (0.039)	0.103 (0.052)
Resource-life-belief error (per SD)	0.4 (1.3)	0.011 (0.037)	0.022 (0.034)	0.056 (0.059)
Participants	1,020	1,020	821	199
Resources	200	200	198	118
R^2	0.012	0.004	0.007	0.058
All Fully Active, Uncertain				
Earnings-belief error (per SD)	−1.0 (1.8)	−0.009 (0.045)	0.064 (0.039)	0.123 (0.056)
Resource-life-belief error (per SD)	2.4 (1.7)	0.110 (0.042)	0.082 (0.041)	−0.021 (0.042)
Participants	1,002	1,002	734	268
Resources	200	200	198	140
R^2	0.035	0.014	0.024	0.053
Generation 1, Certain				
Earnings-belief error (per SD)	−3.2 (1.8)	−0.039 (0.055)	0.059 (0.055)	0.138 (0.074)
Resource-life-belief error (per SD)	−0.2 (1.7)	−0.025 (0.044)	−0.039 (0.044)	−0.010 (0.093)
Participants	600	600	488	112
Resources	200	200	198	92
R^2	0.007	0.014	0.020	0.069
Generation 1, Uncertain				
Earnings-belief error (per SD)	0.3 (2.2)	0.015 (0.058)	0.057 (0.049)	0.114 (0.082)
Resource-life-belief error (per SD)	2.3 (2.1)	0.106 (0.054)	0.073 (0.051)	−0.006 (0.062)
Participants	600	600	451	149
Resources	200	200	196	117
R^2	0.018	0.017	0.016	0.042

Notes. Not pre-registered. OLS by condition; the first column is a linear probability model in percentage points. Absolute errors are those of Table C15, both entered jointly and standardized over the pooled Fully Active sample, so coefficients are per standard deviation and comparable across panels. Controls: both realized differences, scenario order and, in the first two panels, an indicator for generation 2 or later. Standard errors clustered at the resource in parentheses. The last two columns condition on the preferred scenario. Beliefs were elicited after the preference and the price list.

Table C17: Signed Belief Errors and Demand for Restoration

	Prefers Restoration (pp)	Signed WTP ($)	WTP, prefer Restoration ($)	WTP, prefer Baseline ($)
All Fully Active, Certain				
Earnings-belief error (per SD)	14.9 (1.5)	0.311 (0.042)	0.073 (0.042)	−0.070 (0.074)
Resource-life-belief error (per SD)	1.6 (1.5)	0.112 (0.039)	0.104 (0.038)	−0.032 (0.058)
Participants	1,020	1,020	821	199
Resources	200	200	198	118
R^2	0.132	0.091	0.023	0.038
All Fully Active, Uncertain				
Earnings-belief error (per SD)	14.1 (1.5)	0.328 (0.041)	0.138 (0.047)	−0.005 (0.056)
Resource-life-belief error (per SD)	6.4 (1.5)	0.198 (0.034)	0.123 (0.037)	−0.031 (0.047)
Participants	1,002	1,002	734	268
Resources	200	200	198	140
R^2	0.154	0.116	0.043	0.031
Generation 1, Certain				
Earnings-belief error (per SD)	13.5 (2.1)	0.270 (0.064)	0.029 (0.066)	−0.156 (0.089)
Resource-life-belief error (per SD)	2.3 (2.1)	0.145 (0.058)	0.111 (0.053)	−0.105 (0.103)
Participants	600	600	488	112
Resources	200	200	198	92
R^2	0.109	0.086	0.028	0.088
Generation 1, Uncertain				
Earnings-belief error (per SD)	14.8 (2.1)	0.321 (0.056)	0.125 (0.057)	0.050 (0.089)
Resource-life-belief error (per SD)	3.7 (1.9)	0.147 (0.046)	0.079 (0.045)	−0.093 (0.065)
Participants	600	600	451	149
Resources	200	200	196	117
R^2	0.135	0.101	0.027	0.036

Notes. As Table C16, with signed errors (belief minus realized difference); positive values overstate the advantage of Restoration. Conditional on the realized differences, these models re-express the regressions of demand on beliefs in Table 4; they are not independent evidence.

Table C18: Beliefs about Groupmates: Pre-Registered Comparisons

	Certain			Uncertain			Difference
	Baseline	Restoration	Effect	Baseline	Restoration	Effect	in effects
A. Fully Active participants: paired difference							
Belief: groupmates' total extraction (units)	20.35	23.59	3.24	20.23	22.35	2.12	−1.11
			(0.31)			(0.26)	(0.41)
Participants		1,020			1,002		
B. All participants who played Restoration: Uncertain minus Certain							
	Certain		Uncertain		Difference	(SE)	
Belief: groupmates' total extraction (units)	23.52		22.59		−0.93	(0.32)	
Belief: groupmates' total investment (units)	11.45		11.16		−0.29	(0.29)	
Participants	1,665		1,248				

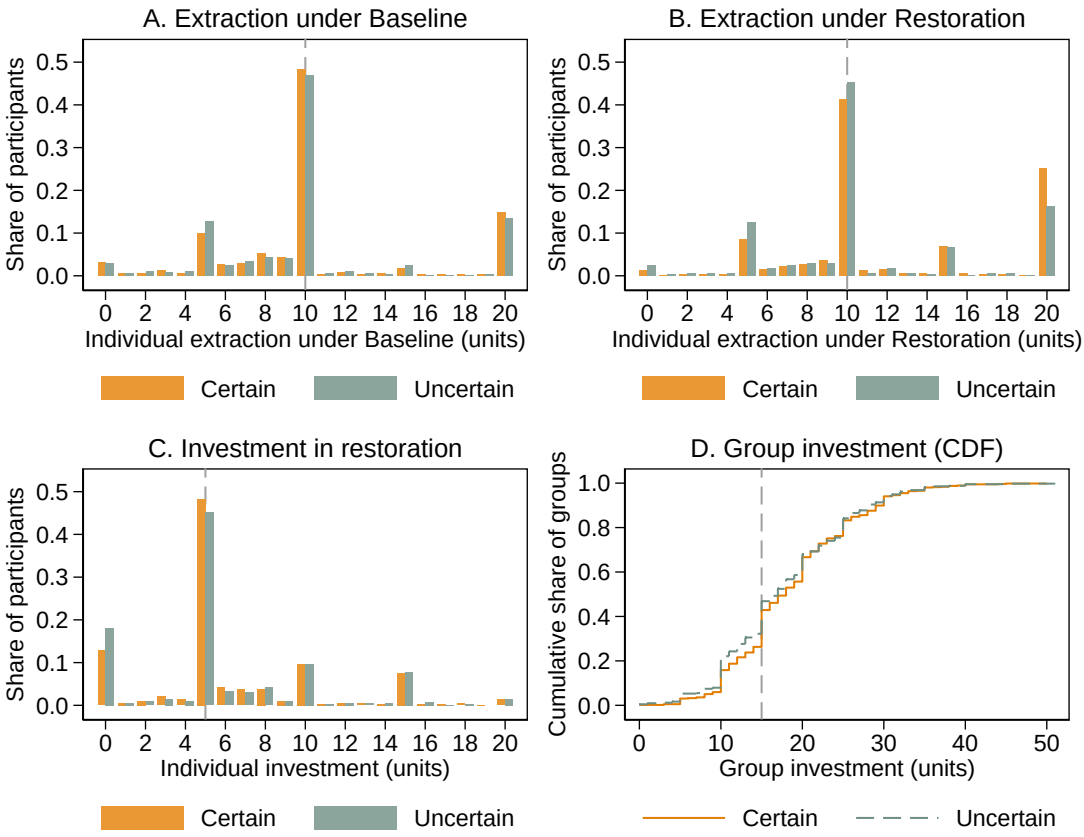
Notes. Beliefs about the total choice of the other two members of the group, on a scale from 0 to 40, elicited at the end of the study. Panel A: the mean belief about groupmates' extraction under each scenario among Fully Active participants and the paired Restoration-minus-Baseline difference ("Effect"), with the Uncertain-minus-Certain difference in effects in the last column. Panel B: beliefs about groupmates' extraction and investment under the Restoration scenario among all participants who played it, and the Uncertain-minus-Certain difference. Standard errors clustered at the resource in parentheses.

Table C19: Effect of the Restoration Opportunity by Scenario Order

	Certain			Uncertain		
	Baseline first	Restoration first	p	Baseline first	Restoration first	p
Individual extraction (units)	2.73	1.69	0.002	1.40	0.43	<0.001
	(0.24)	(0.24)		(0.18)	(0.17)	
Resource conserved to next generation (pp)	24.53	20.99	0.539	−5.36	3.61	0.130
	(4.26)	(3.87)		(4.31)	(4.03)	
Participants	477	543		504	498	
Groups	159	181		168	166	

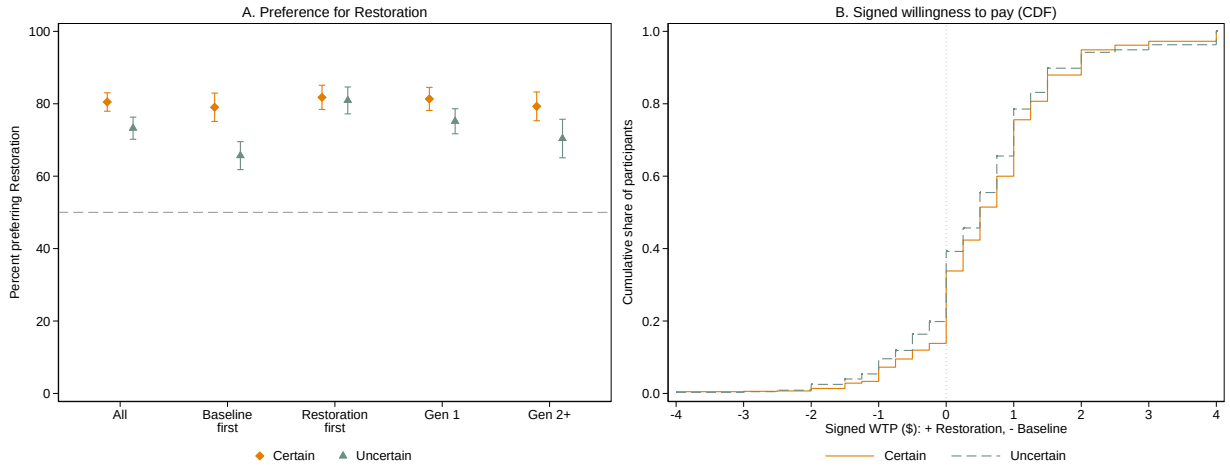
Notes. Not pre-registered. Paired Restoration-minus-Baseline differences among Fully Active participants (extraction) and Fully Active groups (conservation), separately for the resources that played the Baseline scenario first and those that played the Restoration scenario first, with standard errors clustered at the resource in parentheses; p is the p-value of the difference between the two orders within a condition.

Figure C1: Distribution of the Choices, by Condition



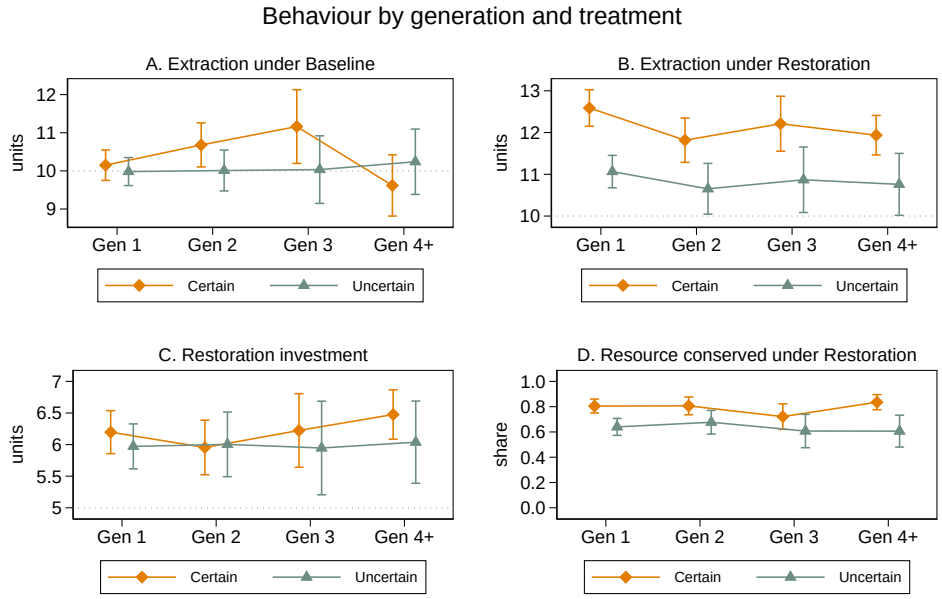
Notes. All participants who played the scenario (Panel A: Baseline; Panels B and C: Restoration) and all groups that played Restoration (Panel D). Dashed lines: extraction of 10, investment of 5, and the group investment threshold of 15. Investment is exactly 5 for 48.3% of Certain and 45.1% of Uncertain participants, and 0 for 12.9% and 18.1%.

Figure C2: Preference for Restoration by Subgroup, and Signed Willingness to Pay



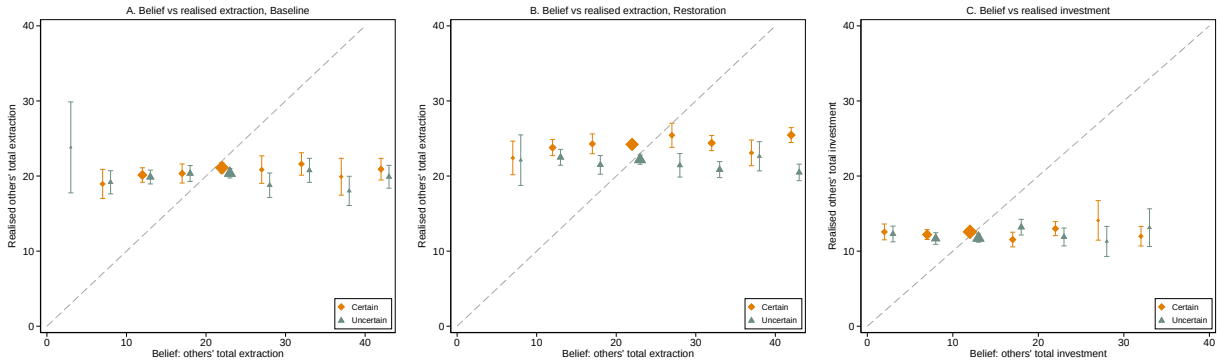
Notes. Fully Active participants. Panel A shows means with 95% confidence intervals, standard errors clustered at the resource; comparisons by scenario order are not pre-registered. Panel B shows the cumulative distribution of signed WTP.

Figure C3: Behavior by Generation and Condition (Pre-Registered as Exploratory)



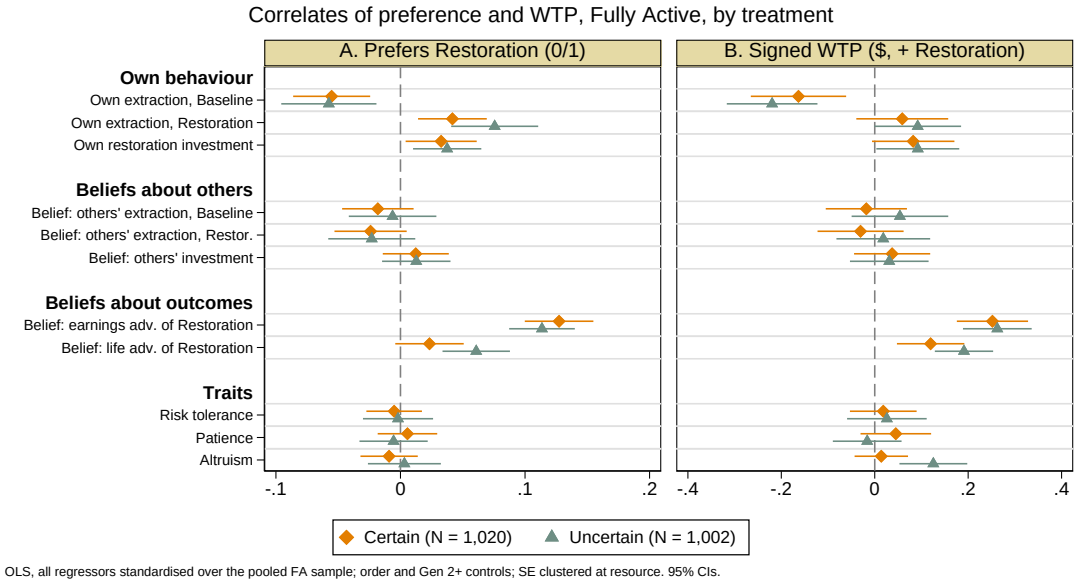
Notes. All participants and groups that played the scenario; means with 95% confidence intervals; generation bins with at least 10 observations. Later generations exist only where earlier generations conserved, so differences across generations are descriptive.

Figure C4: Accuracy of Beliefs about Groupmates



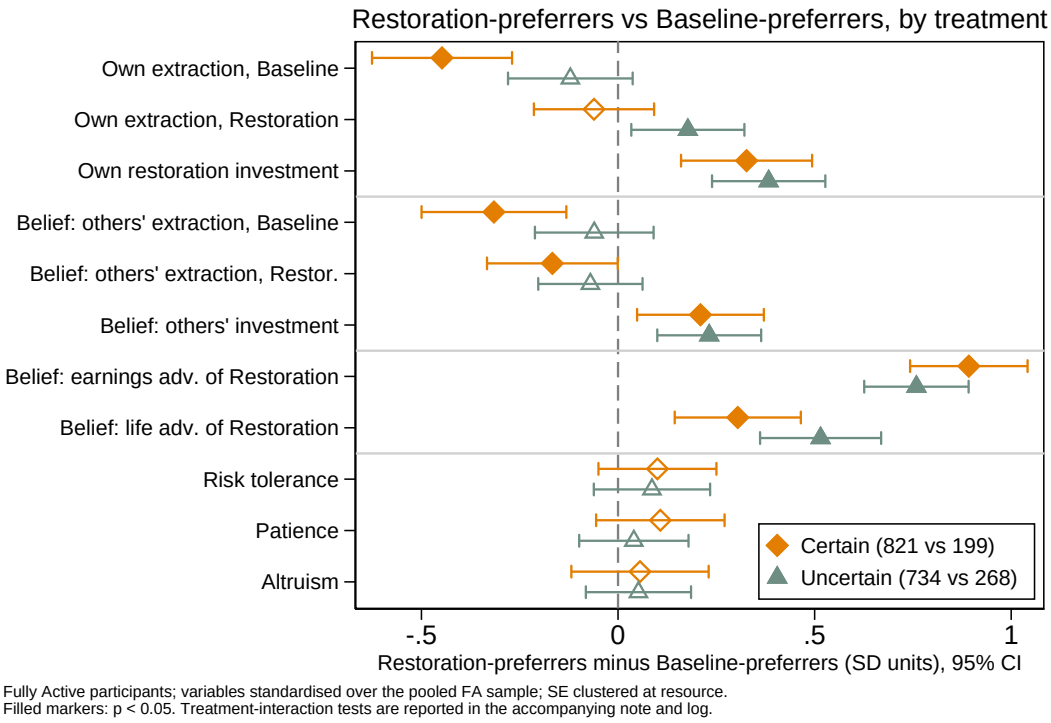
Notes. Not pre-registered. All participants who played the scenario. The realized total choice of the other two members within bins of 5 units of the belief about it, bins with at least 10 participants per condition; means with 95% confidence intervals. The area of a marker is proportional to the share of the condition's participants in the bin; the markers of the legend correspond to 10%. The dashed line marks perfect accuracy. Own choices against the same beliefs are in Figure 7.

Figure C5: Correlates of the Preference for Restoration and of Signed Willingness to Pay



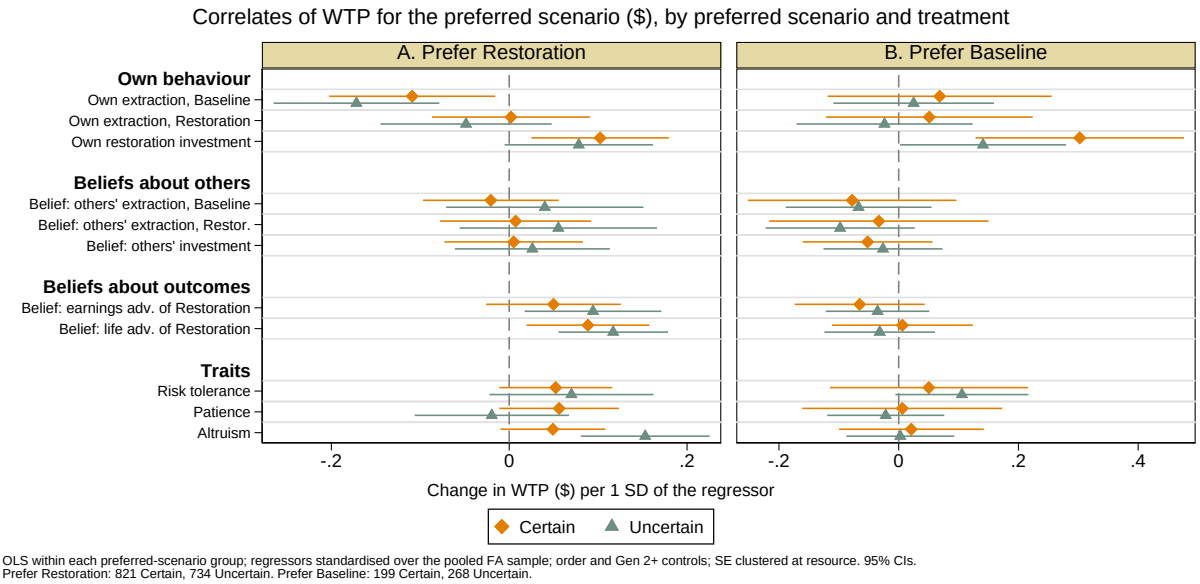
Notes. Not pre-registered beyond the role of beliefs. OLS by condition; regressors standardized over the pooled Fully Active sample; controls for scenario order and generation 2 or later; standard errors clustered at the resource; 95% confidence intervals.

Figure C6: Who Prefers Restoration: Standardized Differences between Those Who Prefer Restoration and Those Who Prefer Baseline



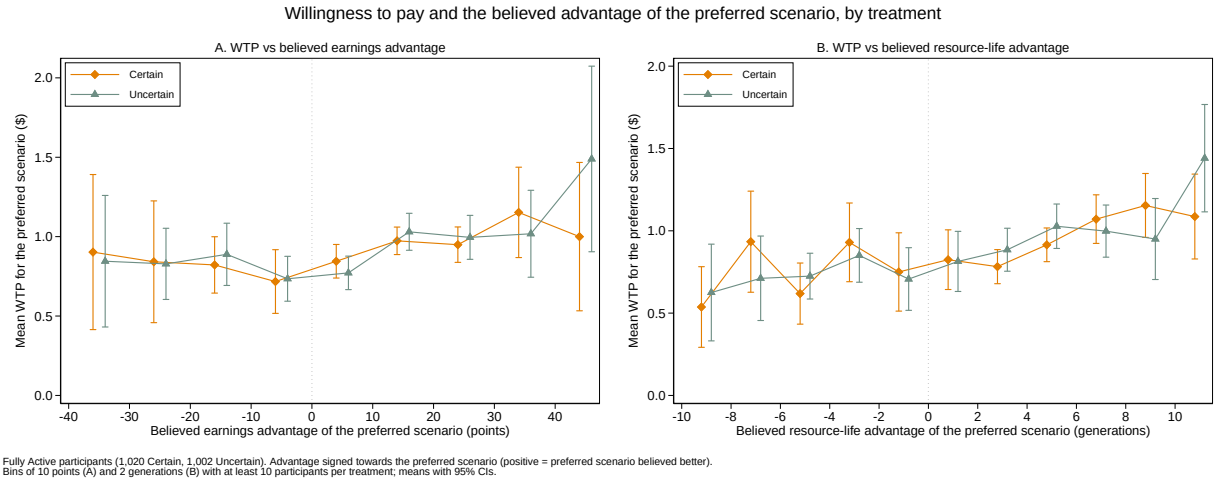
Notes. Not pre-registered. Fully Active participants. Differences in means, in pooled standard-deviation units, by condition; standard errors clustered at the resource; filled markers indicate $p < 0.05$.

Figure C7: Correlates of Willingness to Pay within Each Preferred Scenario



Notes. Not pre-registered. OLS of WTP for the preferred scenario on the eleven standardized correlates, scenario order and generation 2 or later, separately for participants who prefer Restoration and who prefer Baseline, by condition; standard errors clustered at the resource; 95% confidence intervals. These regressions condition on the observed preference.

Figure C8: Willingness to Pay and the Believed Advantage of the Preferred Scenario



Notes. Not pre-registered. Fully Active participants. The believed advantage is signed towards the preferred scenario. Bins of 10 points (Panel A) and 2 generations (Panel B) with at least 10 participants per condition; means with 95% confidence intervals.

D The Open-Ended Answers

Questions and coding

The survey has two open-ended questions. The *strategy question*, asked to every participant at the end of the study: "Think about how many points you decided to take from the common resource. Was the presence of restoration technologies relevant in shaping your choice (when available) and if so, how? What other factors were important to you?" (3,213 answers: 1,749 Certain, 1,464 Uncertain). The *WTP question*, asked to Fully Active participants right after the price list: "Can you explain the main reason behind the choice you just made, that is, the most you were (or weren't) willing to give up from your bonus to have your preferred Part implemented?" (2,022 answers: 1,020 Certain, 1,002 Uncertain).

This is the pre-registered exploratory analysis of the open-ended answers. Every answer was coded with a large language model (Claude Opus 5, one call per answer, blind to the participant's choices, earnings and willingness to pay) following a fixed coding scheme. The coder sees the question, the rules of the game, the participant's session layout (which scenario was Part 1, which scenarios the participant played, and for the WTP question the scenario preferred at no cost) and the answer. The same scheme was applied to both questions. Large language models have been shown to match or exceed the reliability of crowd workers in text annotation tasks of this kind (Gilardi et al. 2023).

Codes. An answer can receive several of twelve codes, one of which is marked as primary. The first six were defined before reading the answers; the last six were added after reading a random sample of answers because they are frequent and fit none of the first six.

1. *Fairness*: a fair or equal share, not being greedy, doing one's part.
2. *Restoration led to taking more* (mitigation deterrence): took more, or accepted the risk of exhaustion, because a depleted resource could be repaired.
3. *Restoration as safety net*: valued as a backup or second chance for the resource to survive, without saying own extraction went up.
4. *Maximizing own returns*: own earnings, own bonus, taking the maximum, keeping the money.
5. *Balancing own and future groups' interests*: an explicit trade-off.
6. *Play safe, do not rely on restoration*: staying at or below the threshold regardless of restoration.
7. *Concern for future groups*: leaving the resource alive as a motive in itself, without a trade-off or backup language.

8. *Expectations about other members*: what the other two would do, buffers, trust or distrust.
9. *Restoration costly or unreliable*: the cost of the investment, or the risk that restoration does not come about, because the technology fails or because the group does not invest enough, given as a reason.
10. *Indifference* between the two scenarios.
11. *Confusion* about the rules or the question.
12. *Other*: none of the above, "no", "N/A", a bare restatement of the choice.

Answers carry two codes on average on the strategy question and 1.6 on the WTP question, and the codes cluster: fairness, play safe and concern for future groups often co-occur, and balance often appears with safety net or future groups. The main exhibits therefore group the twelve codes. For the strategy question, seven groups: *took more because of restoration* (code 2); *restoration as safety net* (3 and 5); *restraint regardless of restoration* (6, 7 and 1); *maximizing own returns* (4); *expectations about other members* (8); *restoration costly or unreliable* (9); *residual* (10 to 12). For the WTP question, six: *keeping the bonus* (4); *restoration protects the resource* (3, 7 and 5); *fairness* (1); *doubts about others or restoration* (8, 9 and 6); *indifference* (10); *residual* (2, 11 and 12). Tables D5 to D7 report the twelve codes.

For the strategy question the coder also records whether restoration was *relevant* to the choice (yes, no, not addressed), and if yes in which direction (took more or accepted the risk; took less or invested so that the resource survives; direction not stated); whether the answer mentions that restoration is uncertain; and the quality of the answer (substantive, minimal, nonsense). Every answer is also screened for identifying content: 13 answers were flagged for possible identifying content; none contains a name, contact or location.

Reliability. A second model (Claude Sonnet 5, same prompt) coded every answer independently. On the strategy question the two coders agree on the primary group for 82.5% of answers (Cohen's $\kappa = 0.78$), on the primary code for 77.7% ($\kappa = 0.75$) and on whether restoration was relevant for 92.9% ($\kappa = 0.88$); averaged over the twelve codes, they agree on whether a code applies for 92.8% of answers ($\kappa = 0.65$). On the WTP question the corresponding figures are 83.1% ($\kappa = 0.74$) for the primary group, 78.7% ($\kappa = 0.69$) for the primary code and 94.9% ($\kappa = 0.64$) for the codes. Among the codes applied to more than one percent of answers, agreement is weakest on "restoration costly or unreliable" ($\kappa = 0.36$ on the strategy question): the second coder applies it to almost any mention of the investment, the first only when the cost or the unreliability is given as a reason, which is the intended reading. The tables use the first coder.

Main exhibits

Table D1: Strategy Question: What Participants Say Drove Their Extraction Choice

	Certain	Uncertain	Difference	(SE)	p
A. Share of answers mentioning the category (%)					
Took more because of restoration	23.2	17.6	−5.6	(1.6)	<0.001
Restoration as safety net	30.5	26.3	−4.2	(1.7)	0.016
Restraint regardless of restoration	56.4	60.2	3.8	(1.8)	0.039
Maximizing own returns	20.8	18.1	−2.7	(1.4)	0.047
Expectations about other members	32.5	30.5	−2.0	(1.6)	0.208
Restoration costly or unreliable	5.8	11.4	5.6	(1.0)	<0.001
Residual	8.2	10.0	1.7	(1.0)	0.069
B. Primary category (%, columns sum to 100)					
Took more because of restoration	20.6	14.3	−6.3	(1.5)	<0.001
Restoration as safety net	16.2	15.7	−0.5	(1.3)	0.713
Restraint regardless of restoration	34.0	37.7	3.7	(1.8)	0.042
Maximizing own returns	10.2	9.6	−0.7	(1.1)	0.527
Expectations about other members	11.0	10.5	−0.5	(1.2)	0.691
Restoration costly or unreliable	1.1	4.0	2.8	(0.6)	<0.001
Residual	6.9	8.3	1.3	(0.9)	0.123
N	1,749	1,464			

Notes. All participants (1,749 Certain, 1,464 Uncertain). Groups of codes: "took more because of restoration" is code 2; "restoration as safety net" codes 3 and 5; "restraint regardless of restoration" codes 6, 7 and 1 (play safe, concern for future groups, fairness); "residual" codes 10 to 12. Panel A: share of answers that mention a code of the group; an answer can mention several groups, so the shares do not sum to 100. Panel B: the group of the primary code. Difference is Uncertain minus Certain in percentage points, standard errors clustered at the resource, p from the t-test. Table D5 reports the twelve codes.

Table D2: Strategy Question: The Stated Role of Restoration

	Certain	Uncertain	Difference	(SE)	p
A. Participants who played Restoration (% of answers)					
Restoration relevant to the choice	62.6	55.7	−7.0	(1.9)	<0.001
took more, or accepted the risk, because of restoration	22.2	17.5	−4.8	(1.6)	0.003
took less, or invested, so that the resource survives	17.6	15.1	−2.5	(1.4)	0.083
relevant, direction not stated	22.8	23.1	0.3	(1.5)	0.861
Restoration not relevant	22.1	31.7	9.6	(1.7)	<0.001
Not addressed	15.3	12.6	−2.7	(1.3)	0.034
Mentions that restoration is uncertain	2.3	15.8	13.4	(1.1)	<0.001
Answer gives a reason (substantive)	72.9	69.8	−3.1	(1.7)	0.075
Answer is minimal	27.1	30.0	2.9	(1.7)	0.091
Answer is nonsense or off-topic	0.0	0.2	0.2	(0.1)	0.158
N	1,665	1,248			
B. Participants who played only Baseline (% of answers)					
Restoration relevant to the choice	0.0	0.5	0.5	(0.5)	0.329
Not addressed	100.0	99.5	−0.5	(0.5)	0.329
Answer gives a reason (substantive)	50.0	56.5	6.5	(5.4)	0.233
N	84	216			

Notes. Panel A: participants who played the Restoration scenario (2,913 answers). "Relevant" rows are exhaustive: the three indented rows sum to the first. Panel B: participants who played only Baseline because Restoration had already been exhausted in their generation (300 answers). Shares in percent, standard errors clustered at the resource.

Table D3: Strategy Question: Stated Role of Restoration and Actual Behavior, Fully Active Participants

Stated role of restoration	N	Extr. Base.	Extr. Rest.	Difference	(SE)	Investment	Prefers Rest. (%)	Signed WTP ($)
Took more because of restoration	457	9.1	14.0	4.9	(0.3)	6.6	82.3	0.72
More careful, or invested, because of restoration	248	9.9	9.8	−0.1	(0.3)	6.5	75.0	0.49
Relevant, direction not stated	481	9.8	11.2	1.4	(0.2)	7.3	86.9	0.77
Not relevant	570	11.6	11.6	−0.1	(0.1)	4.2	63.3	0.29
Not addressed	266	9.7	10.7	1.0	(0.3)	6.9	80.5	0.72
All Fully Active	2,022	10.2	11.7	1.6	(0.1)	6.1	76.9	0.58

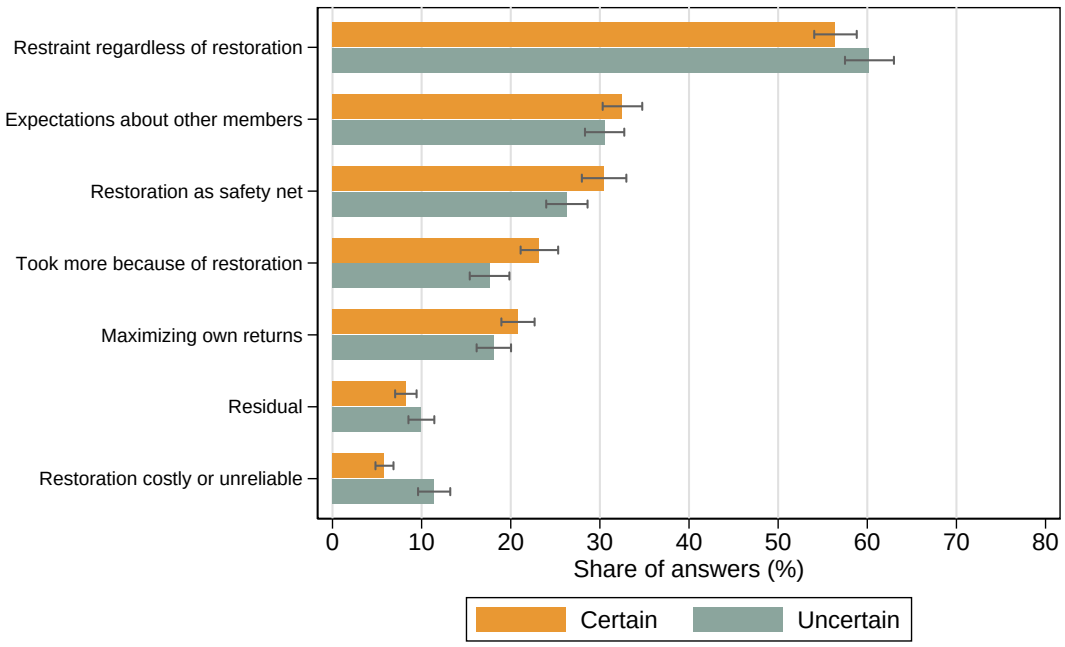
Notes. Fully Active participants (2,022), both conditions pooled. Rows group participants by what they said about restoration (Table D2). Extraction in points (0 to 20) in each scenario; Difference is the mean within-participant Restoration-minus-Baseline gap with its standard error clustered at the resource; Investment is the committed restoration investment; Prefers Rest. is the share preferring Restoration at no cost; Signed WTP is positive for Restoration and negative for Baseline. The gap of those who say restoration made them take more differs from the gap of those who say it was not relevant with $p = <0.001$ (6.0 points in Certain, 3.5 in Uncertain); the gap of those who say it made them more careful differs from the same reference with $p = 0.974$. This is a check that the coding tracks behavior, not a causal estimate: participants describe choices they have already made.

Table D4: WTP Question: What Participants Say Drove Their Willingness to Pay

	Prefers Restoration		Prefers Baseline		WTP ($) by mention		
	Certain	Uncertain	Certain	Uncertain	Mentioned	Not mentioned	p
A. Share of answers mentioning the category (%)							
Keeping the bonus	73.3	74.4	78.4	73.1	0.78	1.30	<0.001
Restoration protects the resource	29.5	30.5	5.0	10.4	1.33	0.77	<0.001
Fairness	13.5	10.6	7.5	13.8	1.23	0.87	<0.001
Doubts about others or restoration	12.8	17.0	24.1	25.0	0.83	0.93	0.034
Indifference between scenarios	6.1	6.1	16.1	16.0	0.37	0.96	<0.001
Residual	13.4	11.7	15.1	16.4	1.08	0.89	0.002
B. Primary category (%, columns sum to 100)							
Keeping the bonus	55.5	54.6	66.3	56.3			
Restoration protects the resource	21.1	21.0	3.0	5.6			
Fairness	6.6	5.6	2.0	9.3			
Doubts about others or restoration	4.6	6.0	11.1	10.4			
Indifference between scenarios	2.9	3.8	7.5	7.8			
Residual	9.3	9.0	10.1	10.4			
N	821	734	199	268			

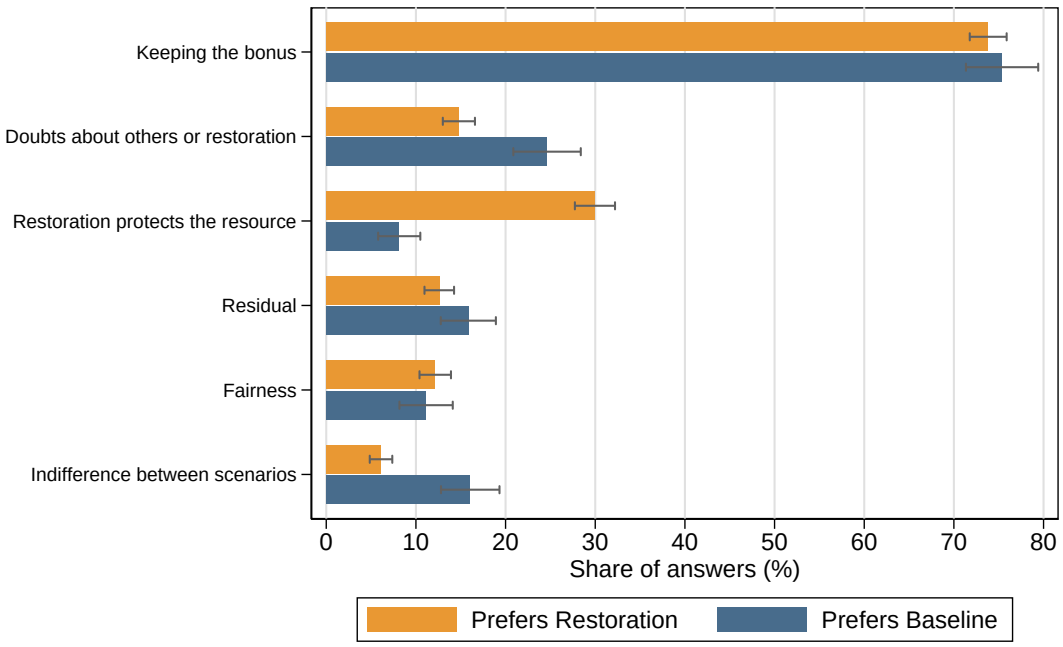
Notes. Fully Active participants (2,022 answers), by the scenario preferred at no cost and by condition. Groups of codes: "keeping the bonus" is code 4; "restoration protects the resource" codes 3, 7 and 5; "doubts about others or restoration" codes 8, 9 and 6; "residual" codes 2, 11 and 12. Panel A: share of answers mentioning a code of the group; the last three columns give the mean amount participants were willing to give up (dollars, 0 to 4) among answers that mention the group and among those that do not, both preferences and conditions pooled, with the p-value of the difference (standard errors clustered at the resource). Panel B: group of the primary code. Table D7 reports the twelve codes.

Figure D1: Strategy Question: Groups Mentioned, by Condition



Notes. Share of answers mentioning a code of each group, all participants (1,749 Certain, 1,464 Uncertain), with 95% confidence intervals clustered at the resource. Groups ordered by the pooled share. Same numbers as Panel A of Table D1.

Figure D2: WTP Question: Groups Mentioned, by Preferred Scenario



Notes. Share of answers mentioning a code of each group among Fully Active participants who preferred Restoration and among those who preferred Baseline at no cost (2,022 answers, both conditions pooled), with 95% confidence intervals clustered at the resource. Groups ordered by the pooled share.

The twelve codes

Table D5: Strategy Question: The Twelve Codes, by Condition

	Certain	Uncertain	Difference	(SE)	p
A. Share of answers mentioning the category (%)					
Fairness, equal share	26.0	23.4	−2.6	(1.6)	0.099
Restoration led to taking more	23.2	17.6	−5.6	(1.6)	<0.001
Restoration as safety net	26.4	21.9	−4.5	(1.7)	0.009
Maximizing own returns	20.8	18.1	−2.7	(1.4)	0.047
Balancing own and future interests	8.1	6.4	−1.8	(0.9)	0.052
Play safe, do not rely on restoration	29.0	35.2	6.3	(1.7)	<0.001
Concern for future groups	23.8	27.3	3.5	(1.6)	0.030
Expectations about other members	32.5	30.5	−2.0	(1.6)	0.208
Restoration costly or unreliable	5.8	11.4	5.6	(1.0)	<0.001
Indifference between scenarios	0.2	0.1	0.0	(0.1)	0.800
Confusion	1.5	2.3	0.8	(0.5)	0.071
Other, uninformative	6.6	7.7	1.1	(0.9)	0.189
B. Primary category (%, columns sum to 100)					
Fairness, equal share	14.4	12.4	−1.9	(1.2)	0.114
Restoration led to taking more	20.6	14.3	−6.3	(1.5)	<0.001
Restoration as safety net	12.2	11.7	−0.4	(1.2)	0.713
Maximizing own returns	10.2	9.6	−0.7	(1.1)	0.527
Balancing own and future interests	4.0	4.0	0.0	(0.7)	0.954
Play safe, do not rely on restoration	12.1	16.4	4.3	(1.3)	0.001
Concern for future groups	7.5	8.9	1.4	(1.0)	0.165
Expectations about other members	11.0	10.5	−0.5	(1.2)	0.691
Restoration costly or unreliable	1.1	4.0	2.8	(0.6)	<0.001
Indifference between scenarios	0.2	0.1	−0.1	(0.1)	0.389
Confusion	0.7	1.2	0.5	(0.3)	0.145
Other, uninformative	6.0	7.0	1.0	(0.8)	0.241
N	1,749	1,464			

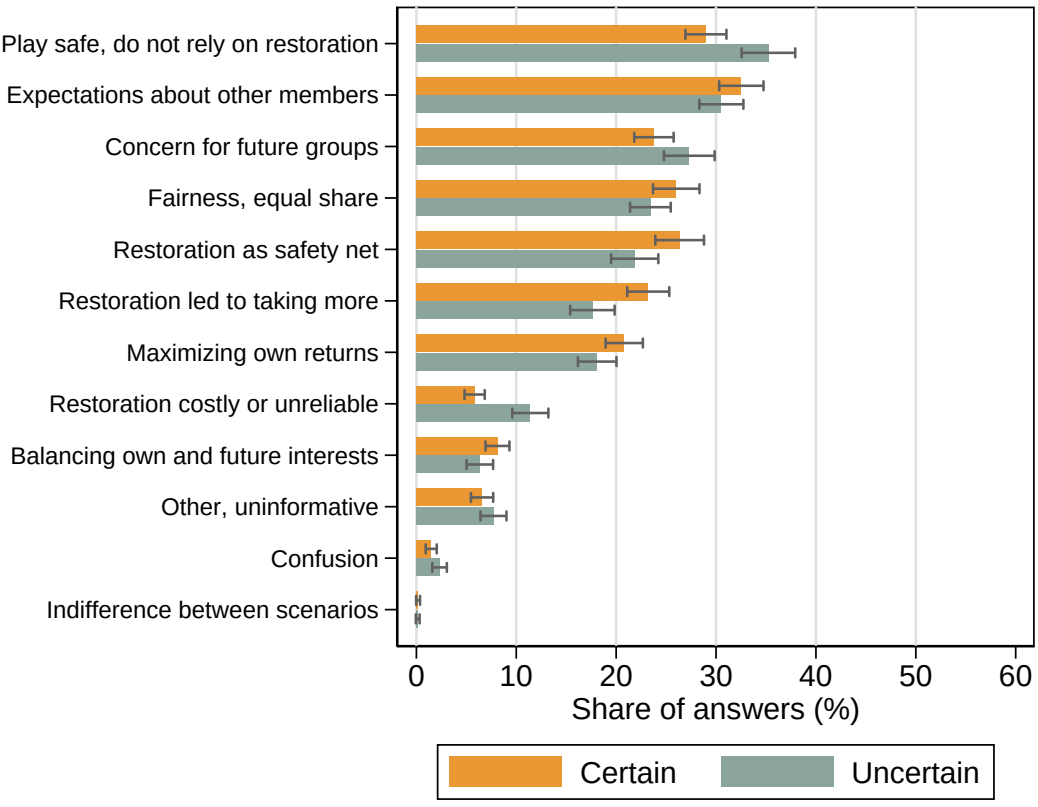
Notes. All participants (1,749 Certain, 1,464 Uncertain). Panel A: share of answers that mention each code; an answer can carry several, so the shares do not sum to 100. Panel B: the primary code of each answer. Difference is Uncertain minus Certain in percentage points, standard errors clustered at the resource, p from the t-test.

Table D6: Strategy Question: Codes Mentioned and Behavior, Fully Active Participants

Answers mentioning	N	Extr. Base.	Extr. Rest.	Difference	(SE)	Investment	Prefers Rest. (%)	Signed WTP ($)
Fairness, equal share	456	9.4	10.7	1.2	(0.2)	5.5	75.4	0.62
Restoration led to taking more	512	9.1	13.7	4.6	(0.2)	6.6	79.3	0.66
Restoration as safety net	523	10.0	10.9	1.0	(0.2)	7.0	88.0	0.81
Maximizing own returns	365	14.5	16.0	1.5	(0.3)	4.7	73.4	0.37
Balancing own and future interests	129	10.2	12.0	1.8	(0.4)	6.1	93.0	1.06
Play safe, do not rely on restoration	617	9.1	9.6	0.4	(0.1)	5.2	72.0	0.51
Concern for future groups	446	8.9	10.5	1.6	(0.2)	6.7	82.1	0.75
Expectations about other members	588	9.8	11.3	1.6	(0.2)	5.7	75.3	0.57
Restoration costly or unreliable	187	10.3	10.7	0.3	(0.3)	4.4	56.7	0.23
Indifference between scenarios	5	10.6	9.4	−1.2	(0.6)	4.4	80.0	0.40
Confusion	39	10.1	9.8	−0.3	(0.8)	6.5	69.2	0.50
Other, uninformative	169	11.2	12.2	1.1	(0.4)	7.8	75.7	0.52
All Fully Active	2,022	10.2	11.7	1.6	(0.1)	6.1	76.9	0.58

Notes. Fully Active participants (2,022), both conditions pooled; each row is the subsample of answers that mention the code, so rows overlap. Columns as in Table D3. The three codes grouped as "restraint" in Table D1 differ in behavior: answers that mention playing safe show almost no extraction gap between scenarios, answers that mention fairness or future groups show the average gap.

Figure D3: Strategy Question: Codes Mentioned, by Condition



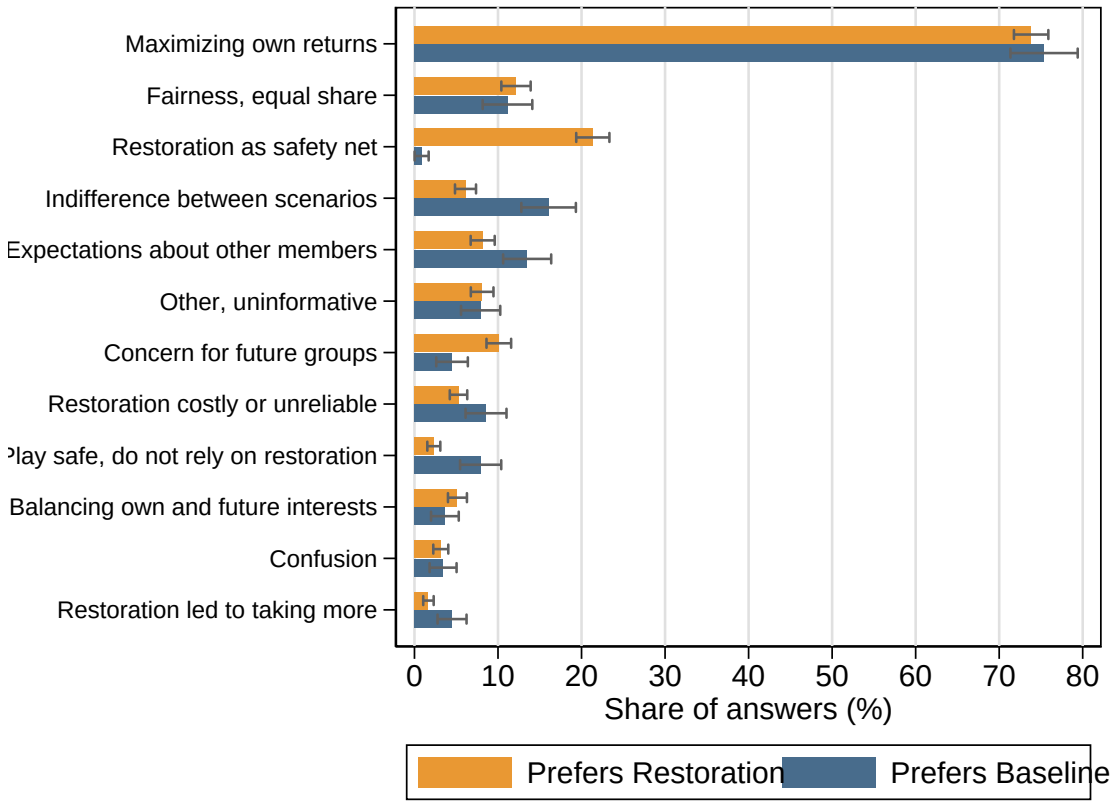
Notes. Share of answers mentioning each code, all participants (1,749 Certain, 1,464 Uncertain), with 95% confidence intervals clustered at the resource. Codes ordered by the pooled share. Same numbers as Panel A of Table D5.

Table D7: WTP Question: The Twelve Codes, by Preferred Scenario and Condition

	Prefers Restoration		Prefers Baseline		WTP ($) by mention		
	Certain	Uncertain	Certain	Uncertain	Mentioned	Not mentioned	p
A. Share of answers mentioning the category (%)							
Fairness, equal share	13.5	10.6	7.5	13.8	1.23	0.87	<0.001
Restoration led to taking more	2.2	1.1	2.5	6.0	0.96	0.91	0.653
Restoration as safety net	20.2	22.6	1.0	0.7	1.41	0.81	<0.001
Maximizing own returns	73.3	74.4	78.4	73.1	0.78	1.30	<0.001
Balancing own and future interests	5.6	4.6	3.0	4.1	1.22	0.90	<0.001
Play safe, do not rely on restoration	2.3	2.3	6.0	9.3	0.75	0.92	0.020
Concern for future groups	10.2	9.9	1.5	6.7	1.44	0.86	<0.001
Expectations about other members	7.9	8.4	13.6	13.4	0.86	0.92	0.314
Restoration costly or unreliable	3.3	7.5	9.0	8.2	0.83	0.92	0.237
Indifference between scenarios	6.1	6.1	16.1	16.0	0.37	0.96	<0.001
Confusion	3.2	3.1	4.0	3.0	0.92	0.91	0.982
Other, uninformative	8.4	7.8	8.5	7.5	1.18	0.89	<0.001
B. Primary category (%, columns sum to 100)							
Fairness, equal share	6.6	5.6	2.0	9.3			
Restoration led to taking more	1.0	0.5	0.5	3.4			
Restoration as safety net	15.0	15.0	0.5	0.7			
Maximizing own returns	55.5	54.6	66.3	56.3			
Balancing own and future interests	3.4	2.9	2.0	2.2			
Play safe, do not rely on restoration	0.5	1.0	3.0	2.2			
Concern for future groups	2.7	3.1	0.5	2.6			
Expectations about other members	3.0	2.7	4.5	4.5			
Restoration costly or unreliable	1.1	2.3	3.5	3.7			
Indifference between scenarios	2.9	3.8	7.5	7.8			
Confusion	1.3	1.9	2.0	1.5			
Other, uninformative	6.9	6.5	7.5	5.6			
N	821	734	199	268			

Notes. Fully Active participants (2,022 answers), by the scenario preferred at no cost and by condition. Panel A: share of answers mentioning each code; the last three columns give the mean amount participants were willing to give up (dollars, 0 to 4) among answers that mention the code and among those that do not, both preferences and conditions pooled, with the p-value of the difference (standard errors clustered at the resource). Panel B: primary code.

Figure D4: WTP Question: Codes Mentioned, by Preferred Scenario



Notes. Share of answers mentioning each code among Fully Active participants who preferred Restoration and among those who preferred Baseline at no cost (2,022 answers, both conditions pooled), with 95% confidence intervals clustered at the resource. Codes ordered by the pooled share.

E Survey Instrument

This appendix reproduces the text of the survey instrument, rendered from the Qualtrics questionnaires. Section E.1 follows the main path of the survey for a participant of the Certain condition, in the first generation of a resource that plays the Baseline scenario first ("Part 1") and the Restoration scenario second ("Part 2"). Section E.2 reports the screens that differ in the Uncertain condition, and Section E.3 the screens that differ for participants in the second or a later generation. Emphasis follows the original screens. Comprehension questions were followed by feedback screens ("You answered all questions correctly! You can now proceed." or the correct answers, as described in Section 3), omitted here. Participants who preferred Part 2 at no cost saw the price-list screens with the roles of the two parts exchanged.

E.1 The main path of the survey (Certain Restoration, Baseline first, generation 1)

Introduction.

Welcome

Thanks for participating in this study.

You will earn $2 for completing it.

In addition, you will earn a **bonus payment** that depends on your choices and the choices of other participants. In particular, your choices will earn you points, which will be later converted to dollars at the rate of 50 points = $1.

The study has three parts.

- In each part, you will engage in a different task.
- Your bonus will be based on your earnings in either Part 1 or 2.
- You will not know in advance which part will be selected. Therefore, you should make each decision as if it could determine your final bonus.
- Your choices will also affect other participants' bonuses.

You will now read the instructions for Part 1. Please read carefully. There will be a comprehension quiz and you will be able to participate **only if you answer all the questions correctly**.

Baseline Instructions.

PART 1 - Instructions

Groups

You will be randomly matched with two other participants, forming a **group of three**.

Groups act one after the other, in a sequence. Like yours, all groups consist of real participants in this study.

Task

There is a common resource that is passed from one group to the next.

At the start of your group's turn, the resource contains 60 points. Each group member receives:

- a private endowment of 20 points, and
- the possibility to take up to 20 additional points from the resource.

Your earnings = 20 + points you take from the resource.

Each member decides simultaneously and independently how many points to take (0-20).

What happens after your group's decision

- If your group takes **30 points or less**, the resource **regenerates** to 60 points for the next group.
- If your group takes **more than 30 points**, the resource **is exhausted.** Your group keeps its earnings but members of all later groups earn 0.

Continuation of the study After each group, the computer rolls a 10-sided die:

- if the die lands on 1 or 2, the study ends;
- if it lands on 3 through 10, the study continues by recruiting another group.

Why your choice matters

Your take-out decision determines both your earnings and the earnings of all future groups in the sequence.

PART 1 - Comprehension Quiz

Before we start, we ask you a few comprehension questions to verify your understanding of the instructions.

You can use the "Back" button at the bottom of this page to go back and read the instructions again before submitting your answers!

You must answer all questions correctly to proceed and be eligible for payment.

Members of a group receive their endowment of 20 points and take out these amounts from the resource: 19, 8, 17. Together, this adds up to 44 points (19+8+17). Will the resource regenerate?

- Yes, the common resource will regenerate.
- No, the common resource will be exhausted.

What is the largest total amount that a group can extract while still allowing the resource to regenerate and subsequent groups to earn benefits?

- 60
- 50
- 40
- 30
- 20

What is the chance that another group of participants will be recruited to play this game after you?

- 6 out of 10
- 8 out of 10
- 10 out of 10

Baseline Choice.

PART 1

You are in Group 1 , placed at the beginning of the sequence.

- The common resource counts 60 points.
- You received an endowment of 20 points.
- You can take **between 0 and 20** points from the resource.
- The other two members of your group can do the same.
- If your group takes out **30 or less**, the resource **regenerates** for later groups**.**
- If your group takes out **more than 30**, the resource is **exhausted** and members of all later groups earn 0 points.

How many points do you want to take out ?

[Slider from 0 to 20]

Baseline End Page.

Part 1 is over!

You will now move to Part 2.

Please read the instructions carefully! After the instructions, we will ask you questions to ensure you understand them.

Restoration Instructions.

PART 2 - Instructions

Same as in Part 1:

- We will form groups of three, which will play one after another.
- The common resource starts with 60.
- Each group member receives an endowment of 20 and may take additional points (up to 20) from the resource.
- **Your earnings = endowment (20) + points you take from the resource.**
- Each member decides simultaneously and independently how many points (if any) to take.
- If your **group takes 30 or less** in total, the resource **regenerates** to 60 for the next group.
- After each group, the computer rolls a 10-sided die: if the die lands on 1 or 2, the study ends while if it lands on 3 through 10, the study continues by recruiting another group.

New in Part 2:

- If your group takes **more than 30 points**, the resource **can still be restored** as you and your groupmates can invest part of your endowment in restoration technologies:
- If your group **invests less than 15 in restoration** , the resource is **exhausted** for sure. Your group keeps its earnings but members of all later groups earn 0.
- If your group **invests at least 15 in restoration** , the resource **regenerates** to 60 for the next group**.**
- Each member decides simultaneously and independently how many points (if any) to invest.
- Points you commit to restoration are deducted from your endowment only if restoration is needed (i.e., when the group takes out more than 30).

PART 2 - Comprehension Quiz

Before we start, we ask you a few comprehension questions to verify your understanding of the instructions.

You can use the "Back" button at the bottom of this page to go back and read the instructions again before submitting your answers!

Assume your group collectively takes out more than 30 points from the common resource. What happens to the resource?

- The resource is exhausted for sure.
- It depends on restoration efforts: if the group invests enough in restoration, resource exhaustion is avoided for sure.
- It depends on both restoration efforts and luck: resource exhaustion is avoided if the group invests enough and restoration is effective (which occurs 1 out of 2 times).

If your group takes out too much, what's the minimum amount your group must invest in restoration to avoid exhaustion?

- 75
- 60
- 45
- 30
- 15

Restoration Choice.

PART 2

You are in Group 1 , placed at the beginning of the sequence.

- The common resource counts 60 points.
- You received an endowment of 20 points.
- You can take **between 0 and 20** points from the resource.
- The other two members of your group can do the same.
- If your group takes out **30 or less**, the resource fully **regenerates** for later groups.
- If your group takes out **more than 30**, you and your groupmates can choose to give up part of your **private endowment** to **invest in restoration technologies.** Otherwise, the resource is **exhausted** and members of all later groups earn 0.

How many points do you want to take out ?

[Slider from 0 to 20]

PART 2

If your group has taken out more than 30 points:

- You and your groupmates can give up part of your private endowment to **invest in restoration technologies**.
- Restoration efforts can fully regenerate the resource **only if your group invests 15 points or more in total.**

How many points do you want to invest in restoration technologies?

[Slider from 0 to 20]

Restoration End Page.

Part 2 is over!

You will now move to the final part of the study, where we will ask you some questions regarding the tasks you already engaged with.

Baseline vs Restoration - Comprehension Check.

PART 3

Recap:

In Parts 1 and 2, you completed similar tasks.

- In both parts, you were assigned to a group of three and made choices about a common resource.
- The resource gave each member a **20-point endowment + the chance to take out extra points**.
- Groups played one after another, and the resource was shared across the sequence.

Key difference:

- **Part 1:** If your group took out too much, the resource was exhausted and this could not be reversed.
- **Part 2**: If your group took out too much, exhaustion could be reversed if the group invested enough in restoration technologies. With sufficient investment, the resource was fully regenerated and passed to the next group.

What is the key difference between Part 1 and Part 2?

- The endowment was higher in Part 1
- The endowment was higher in Part 2
- Groups were larger in Part 2
- Groups were larger in Part 1
- Resource exhaustion was reversible in Part 1 but not in Part 2
- Resource exhaustion was reversible in Part 2 but not in Part 1
- The two games were identical

Baseline vs Restoration Choice.

PART 3 - Bonus Payment

Your bonus will depend on **either Part 1** (irreversible resource exhaustion) or **Part 2** (reversible resource exhaustion with restoration technologies) – not both.

The computer will randomly select **one participant - the decider** - whose answers will determine which part is used to compute everyone's payments.

Every participant who completed both Parts is equally likely to be selected.

If you are the decider, you will also receive an additional decider bonus of $4.

In a moment, you will first be asked which Part you would prefer if both options were at no cost.

You will then be presented with 10 additional choices in which one option carries a cost (deducted from the decider bonus) and the other is at no cost.

After everyone has answered, the computer will:

- Randomly select one participant as the decider
- Flip a fair coin:
- If Heads: the decider's answer to the first (no-cost) question determines which Part is used for everyone's bonus. The decider keeps the full 4$.
- If Tails: the computer randomly draws one of the 10 additional choices, and the decider's preference there determines which Part is used and how much (if any) is deducted from the decider bonus.

Because both the first question and any of the additional choices could be the one that counts, it is in your interest to treat each as if it were the one that matters.

Comprehension check:

If the virtual coin lands on Tails, how much will be deducted from the decider's $4 bonus?

- 0$
- 2$
- It depends on the decider's answer to the first question.
- It depends on the decider's preference in one of the 10 additional choices.

Recap: How Is the Bonus Determined?

- If the coin lands on Heads : no cost is deducted. The decider's answer to the first question (where both options are at no cost) determines which Part is used to compute everyone's bonus.
- If the coin lands on Tails : the deduction depends on the decider's preference in one of the 10 additional choices, drawn at random. The Part the decider prefers in that choice is used to compute everyone's bonus, and the cost of such preferred option is deducted from the $4 bonus.
- Because both the first question and any of the additional choices could be the one that counts, it is in your interest to treat each as if it were the one that matters.

Your Preference (at no cost)

Imagine you are randomly selected by the computer as the decider, and you have the chance to decide what determines everyone's bonus, at no cost .

This means both options below are at no cost and you will keep the whole 4$ decider bonus.

Which Part would you like to determine everyone's bonus?

- Part 1 (irreversible resource exhaustion)
- Part 2 (reversible resource exhaustion with restoration)

Baseline vs Restoration WTP (Part 1 preferred).

How to Answer the Next Question

Please read carefully.

On the next screen you will see a list of choices, and in each row you will choose between:

- Left: **Part 2 (reversible resource exhaustion with restoration)** is implemented for everyone, and nothing is deducted.
- Right: **Part 1 (irreversible resource exhaustion)** is implemented for everyone, and a fee is deducted from your $4 decider bonus.

The option on the left is the same in every row.

The option on the right entails a larger fee as you go down the list, so the right option becomes more expensive the further down you go down.

You must make a choice in every row, but for simplicity you only need to click once , on the row where you switch from Part 1 (with the fee deducted) to Part 2 (at no cost) — that is, the first fee that is more than you are willing to give up to have Part 1 implemented.

Here is an example so you can try the interface.

Intuitively: think about the most you would be willing to give up from your $4 bonus to have Part 1 implemented instead of Part 2. Switch to the left as soon as the fee is larger than that amount.

- All paid for **Part 2**, **no cost** vs. All paid for **Part 1** & **$0.25 deducted**
- All paid for **Part 2**, **no cost** vs. All paid for **Part 1** & **$0.50 deducted**
- All paid for **Part 2**, **no cost** vs. All paid for **Part 1** & **$0.75 deducted**
- All paid for **Part 2**, **no cost** vs. All paid for **Part 1** & **$1.00 deducted**

Your Preference (at a cost)

Imagine you are randomly selected by the computer as the decider, and you have the chance to decide what determines everyone's bonus, at different costs .

Click once on the row where you switch from Part 1 (with the fee deducted) to Part 2 (at no cost) — that is, the first fee that is more than you are willing to give up to have Part 1 implemented.

- All paid for **Part 2**, **no cost** vs. All paid for **Part 1** & **$0.25 deducted**
- All paid for **Part 2**, **no cost** vs. All paid for **Part 1** & **$0.50 deducted**
- All paid for **Part 2**, **no cost** vs. All paid for **Part 1** & **$0.75 deducted**

- All paid for **Part 2**, **no cost** vs. All paid for **Part 1** & **$1.00 deducted**
- All paid for **Part 2**, **no cost** vs. All paid for **Part 1** & **$1.25 deducted**
- All paid for **Part 2**, **no cost** vs. All paid for **Part 1** & **$1.50 deducted**
- All paid for **Part 2**, **no cost** vs. All paid for **Part 1** & **$2.00 deducted**
- All paid for **Part 2**, **no cost** vs. All paid for **Part 1** & **$2.50 deducted**
- All paid for **Part 2**, **no cost** vs. All paid for **Part 1** & **$3.00 deducted**
- All paid for **Part 2**, **no cost** vs. All paid for **Part 1** & **$4.00 deducted**

Can you explain the main reason behind the choice you just made — that is, the most you were (or weren't) willing to give up from your bonus to have your preferred Part implemented?

Your answer won't affect your payment, but it is very important for the scientific goals of this study as it helps us understand how people decide in situations like this one.

A sentence or two is plenty.

[Open text box]

Baseline vs Restoration Beliefs.

A few times, we will now ask you to **guess a number** — for example, what the other members of your group did, or how things turned out across the study.

You can earn an **extra bonus for these guesses**: at the end, one of your guesses will be picked at random, and if it is close enough to what actually happened, you will earn a bonus of 20 points (50 points = $1).

You never need to do any calculations.

Your best chance of the bonus is simply to give your most accurate guess.

Consider all groups in the sequence.

In which part do you think participants earned more ?

- **Left** implies earnings were **higher without** restoration.
- **Middle** implies earnings were **the same**.
- **Right** implies earnings were **higher with** restoration.

Drag the slider below to enter your best guess.

Reminder: you will receive the bonus if your guess is within 2 points of the actual difference in participants' earnings between the two conditions.

Consider all groups in the sequence.

In which part do you think the resource survived longer ?

- **Left** implies the resource survived **longer without** restoration.

- **Middle** implies resource life was **the same**.
- **Right** implies the resource survived **longer with** restoration.

Drag the slider below to enter your best guess.

Reminder: you will receive the bonus if your guess is within 1 point of the actual difference in resources' life between the two conditions.

Now think about the part in which you played **without the possibility to restore:**

- You were part of a group of three
- Each group member had a 20-point endowment + the chance to take out extra points (up to 20)
- If the group took out more than 30 in total, the resource was irreversibly exhausted

How many points do you think the other two members of your group took out in total?

Reminder: you will receive the bonus if your answer is within 2 points of what the other two members of your group actually did.

[Slider from 0 to 40]

Now think about the part in which you played **with the possibility to restore:**

- You were part of a group of three
- Each group member had a 20-point endowment + the chance to take out extra points (up to 20)
- If the group took out more than 30 in total, a group restoration effort of 15 units could save the resource from exhaustion

(1) How many points do you think the other two members of your group took out in total?

[Slider from 0 to 40]

(2) How many points do you think the other two members of your group invested in restoration technologies, in total?

This guess refers to the restoration investment they committed in advance, regardless of whether the resource was actually depleted.

[Slider from 0 to 40]

Each field counts as a separate guess for the bonus draw.

Reminder: you will receive the bonus if your answer is within 2 points of what the other two members of your group actually did.

End.

Thank you!

Before the study is over, we ask you to answer a few final questions.

Think about how many points you decided to take from the common resource. Was the presence of restoration technologies relevant in shaping your choice (when available) and if so, how? What other factors were important to you?

[Open text box]

Please tell us, in general, **how willing or unwilling you are to take risks**.

Please indicate your answer on a scale from 0 to 10, where 0 means you are "completely unwilling to take risks" and 10 means you are "very willing to take risks."

[Answer scale: Completely unwilling to take risks (0) to Very willing to take risks (10)]

We now ask you for your willingness to act in a certain way. Please indicate your answer on a scale from 0 to 10. A 0 means "completely unwilling to do so," and a 10 means "very willing to do so."

How willing are you to give up something that is beneficial for you today in order to benefit more from that in the future?

[Answer scale: Completely unwilling to do so (0) to Very willing to do so (10)]

How willing are you to give to good causes without expecting anything in return?

[Answer scale: Completely unwilling to do so (0) to Very willing to do so (10)]

The study is over.

Once all participants have made their choices and expressed their preferences, your bonus payment will be determined and paid out.

Thank you very much for your participation!

Please click the button below to be redirected back to Prolific and register your submission.

E.2 Screens that differ in the Uncertain Restoration condition

Restoration Instructions (Uncertain).

PART 2 - Instructions

Same as in Part 1:

- We will form groups of three, which will play one after another.
- The common resource starts with 60.
- Each group member receives an endowment of 20 and may take additional points (up to 20) from the resource.
- **Your earnings = endowment (20) + points you take from the resource.**
- Each member decides simultaneously and independently how many points (if any) to take.
- If your **group takes 30 or less** in total, the resource **regenerates** to 60 for the next group.
- After each group, the computer rolls a 10-sided die: if the die lands on 1 or 2, the study ends while if it lands on 3 through 10, the study continues by recruiting another group.

New in Part 2:

- If your group takes **more than 30 points**, the resource **can still be restored** as you and your groupmates can invest part of your endowment in restoration technologies.
- IMPORTANT: these technologies may allow your group to reverse exhaustion, but they are **still in their trial phase and are effective only some of the time .** Whenever your group takes out more than 30, the computer rolls one virtual coin: if it lands on **heads**, the restoration technologies are effective; if it lands on **tails**, they are not. Each happens 1 out of 2 times.
- If the coin lands on **heads**, the points you commit to restoration are deducted from your endowment and, if your group **invests at least 15 in restoration** in total, the resource **regenerates** to 60 for the next group; if your group **invests less than 15**, the resource is **exhausted**. Thus, conditional on reaching the investment needed, **restoration works 1 out of 2 times.**
- If the coin lands on **tails**, the resource is **exhausted** whatever your group invests, and the points you committed are not deducted. Your group keeps its earnings but members of all later groups earn 0.
- Each member decides simultaneously and independently how many points (if any) to invest.
- Points you commit to restoration are deducted from your endowment only if restoration is needed (i.e., when the group takes out more than 30) **and the coin lands on heads**. If

the coin lands on tails, you keep the points you committed.

PART 2 - Comprehension Quiz

Before we start, we ask you a few comprehension questions to verify your understanding of the instructions.

You can use the "Back" button at the bottom of this page to go back and read the instructions again before submitting your answers!

Assume your group collectively takes out more than 30 points from the common resource. What happens to the resource?

- The resource is exhausted for sure.
- It depends on restoration efforts: if the group invests enough in restoration, resource exhaustion is avoided for sure.
- It depends on both restoration efforts and luck: resource exhaustion is avoided if the group invests enough and restoration is effective (which occurs 1 out of 2 times).

If your group takes out too much, what's the minimum amount your group must invest in restoration to avoid exhaustion?

- 75
- 60
- 45
- 30
- 15

Restoration Choice (Uncertain).

PART 2

You are in Group 1 , placed at the beginning of the sequence.

- The common resource counts 60 points.
- You received an endowment of 20 points.
- You can take **between 0 and 20** points from the resource.
- The other two members of your group can do the same.
- If your group takes out **30 or less**, the resource fully **regenerates** for later groups.
- If your group takes out **more than 30**, you and your groupmates can choose to give up part of your **private endowment** to **invest in restoration technologies.** Otherwise, the resource is **exhausted** and members of all later groups earn 0.
- Restoration efforts can fully regenerate the resource only if your group **invests at least 15 in total and restoration is effective, which happens 1 out of 2 times**. Otherwise, the resource is exhausted and members of all later groups earn 0.

How many points do you want to take out ?

[Slider from 0 to 20]

PART 2

If your group has taken out more than 30 points:

- You and your groupmates can give up part of your private endowment to **invest in restoration technologies**.
- Restoration efforts can fully regenerate the resource **only if your group invests 15 points or more in total, and restoration technologies are effective (they work 1 out of 2 times).**

How many points do you want to invest in restoration technologies?

[Slider from 0 to 20]

Baseline vs Restoration Beliefs (Uncertain).

A few times, we will now ask you to **guess a number** — for example, what the other members of your group did, or how things turned out across the study.

You can earn an **extra bonus for these guesses**: at the end, one of your guesses will be picked at random, and if it is close enough to what actually happened, you will earn a bonus of 20 points (50 points = $1).

You never need to do any calculations.

Your best chance of the bonus is simply to give your most accurate guess.

Consider all groups in the sequence.

In which part do you think participants earned more ?

- **Left** implies earnings were **higher without** potential restoration.
- **Middle** implies earnings were **the same**.
- **Right** implies earnings were **higher with** potential restoration.

Drag the slider below to enter your best guess.

Reminder: you will receive the bonus if your guess is within 2 points of the actual difference in participants' earnings between the two conditions.

Consider all groups in the sequence.

In which part do you think the resource survived longer ?

- **Left** implies the resource survived **longer without** potential restoration.
- **Middle** implies resource life was **the same**.
- **Right** implies the resource survived **longer with** potential restoration.

Drag the slider below to enter your best guess.

Reminder: you will receive the bonus if your guess is within 1 point of the actual difference in resources' life between the two conditions.

Now think about the part in which you played **without the possibility to restore:**

- You were part of a group of three
- Each group member had a 20-point endowment + the chance to take out extra points (up to 20)
- If the group took out more than 30 in total, the resource was irreversibly exhausted

How many points do you think the other two members of your group took out in total?

Reminder: you will receive the bonus if your answer is within 2 points of what the other two members of your group actually did.

[Slider from 0 to 40]

Now think about the part in which you played **with the possibility to restore:**

- You were part of a group of three
- Each group member had a 20-point endowment + the chance to take out extra points (up to 20)
- If the group took out more than 30 in total, a group restoration effort of 15 units could save the resource from exhaustion 1 out of 2 times

(1) How many points do you think the other two members of your group took out in total?

[Slider from 0 to 40]

(2) How many points do you think the other two members of your group invested in restoration technologies, in total?

This guess refers to the restoration investment they committed in advance, regardless of whether the resource was actually depleted.

[Slider from 0 to 40]

Each field counts as a separate guess for the bonus draw.

Reminder: you will receive the bonus if your answer is within 2 points of what the other two members of your group actually did.

E.3 Screens that differ for generations 2 and later

Restoration Choice (generation 2 or later, Restoration first).

PART 1

Earlier group(s) made decisions before your group.

Their choices allowed the common resource to regenerate and become **available to your group**.

Your group can now make its decision and earn a bonus payment.

- The common resource counts 60 points.
- You received an endowment of 20 points.
- You can take **between 0 and 20** points from the resource.
- The other two members of your group can do the same.
- If your group takes out **30 or less**, the resource fully **regenerates** for later groups.
- If your group takes out **more than 30**, you and your groupmates can choose to give up part of your **private endowment** to **invest in restoration technologies.** Otherwise, the resource is **exhausted** and members of all later groups earn 0.

How many points do you want to take out ?

[Slider from 0 to 20]

PART 1

If your group has taken out more than 30 points:

- You and your groupmates can give up part of your private endowment to **invest in restoration technologies**.
- Restoration efforts can fully regenerate the resource **only if your group invests 15 points or more in total.**

How many points do you want to invest in restoration technologies?

[Slider from 0 to 20]

Baseline Choice (generation 2 or later, Restoration first).

PART 2

Earlier group(s) made decisions before your group.

Their choices allowed the common resource to regenerate and become **available to your group**.

Your group can now make its decision and earn a bonus payment.

- The common resource counts 60 points.
- You received an endowment of 20 points.

- You can take **between 0 and 20** points from the resource.
- The other two members of your group can do the same.
- If your group takes out **30 or less**, the resource **regenerates** for later groups**.**
- If your group takes out **more than 30**, the resource is **exhausted** and members of all later groups earn 0 points.

How many points do you want to take out ?

[Slider from 0 to 20]