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Climate action for (my) children

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Abstract

Sustaining large-scale public goods, such as the environment, requires individuals to take action; however, motivating voluntary climate action (VCA) is difficult because decision-makers today do not stand to benefit from their investments. Here, we propose that parents invest more in VCA if their link to future generations—through their offspring—is made salient. In a novel lab-in-the-field experiment, we vary whether parents are observed during a VCA decision (i.e., investing in planting real-world trees) by their own child. In addition to a no-observer control, we run additional control conditions with an unrelated adult or an unrelated child observing the parent decision-maker. As predicted, VCA varies across conditions, with larger treatment effects occurring when a parent's own child is the observer. In subgroup analyses, larger treatment effects occur among more educated parents. As a result of this study, VCA across conditions led to 14,000 trees being planted, offsetting approximately 8% of participants' annual CO_2 emissions for around four generations.

JEL-Classification: C99, Q51, Q54, H49, D19

Keywords: voluntary climate action, intergenerational cooperation, parents, children, observability, lab-in-the-field experiment

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1. Introduction

Individual actions—referred to as voluntary climate action (VCA; see, e.g., Goeschl et al. 2020)—are needed to reduce the harmful effects of climate change. VCA takes different forms on an individual level; however, one key unifying aspect of VCAs is that they necessitate incurring a cost to the individual to provide a benefit to the environment, a general public good that is largely consumed in the future (Fischer et al. 2004; Diederich and Goeschl 2014; Hauser et al. 2014). Examples of VCAs include investing in energy saving technology (e.g., solar panels), switching to CO2 friendly purchasing habits (e.g., buying less red meat), or even engaging in small, everyday behaviors, such as spending less time in the shower (Wynes and Nicholas 2017). In our study, we are interested in VCA that has a long-lasting positive effect on the environment: we focus on CO2 offsetting, using a foresting program which plants climate-efficient trees, as such programs have become increasingly widespread and available as means for individuals to help reduce their "carbon footprint" (Kollmuss et al. 2010).

While past research has examined contextual changes ("nudges") to motivate VCAs (Thaler and Sunstein 2008; Hauser et al. 2018)[1], we propose a novel perspective on how to solve VCA dilemmas by leveraging the intergenerational

[1]Bruns et al. (2018) implement a default option to nudge experimental subjects in the lab to contributions to carbon offsetting reductions. Similarly, Araña and León (2013) show that an opt-out condition for VCA programmes increases a VCA, compared to an opt-in condition. Results from field studies suggest that if supporting a VCA is a pre-set default option, this also increases average contributions of experts in the field of environmental economics (Löfgren et al. 2012). This effect is stable over longer time periods (Kesternich et al. 2019). Stimuli like matching and rebate subsidies also have positive effects on increasing a VCA (Kesternich et al. 2016). Energy saving initiatives (such as social norm nudges) have also been found to be effective in creating long-lasting effects on a VCA (Allcott and Rogers 2014; Jachimowicz et al. 2018). A recent study by Böhm et al. (2020) find that changing the default contribution level as well as providing individuals with the possibility to commit themselves to inter-generational solidarity leads to higher investments into long-term contributions for future generations. Also Carattini and Blasch (2020) point out that nudges like leveraging social norms can be effective to increase carbon offsetting behavior.

aspect of VCA. Extant research has focused on public goods within the same generation (see, e.g., Fehr and Gächter 2000; Milinski et al. 2006; Rand et al. 2009), or on cooperation between different generations (Charness and Villeval 2009), whereas little research exists on intergenerational goods where future generations cannot reciprocate the actions of the acting current generation and the incentives to cooperate with the future are low (Fischer et al. 2004; Sutter et al. 2013; Hauser et al. 2014; Kamijo et al. 2017; Ponte et al. 2017; Shahrier et al. 2017; Dengler et al. 2018). However, this does not imply that there exists no *link* to future generations: people—parents[2]—who have children are genetically related to the next generation, and have an incentive and responsibility to care for their offspring's wellbeing. We argue that this personal genetic link to the future makes parents particularly likely to engage in VCA—that sustains the intergenerational public good and benefit their child in the future—especially when their own child observes this action.

Through an innovative lab-in-the-field experiment with parents and their children, we propose to take advantage of parents' genetic link to the future in fostering more VCA today for the benefit of future generations. Thus, we exogenously vary to what extent future generations, including their own children, are salient to the parents when making their VCA decision. This is operationalized using a between-subjects experimental design with four treatments. We vary the salience of the genetic link to the future by using different types of observers: (I) in the baseline treatment *NoObserver*, a parent is not observed while making the

[2] Having children is an essential dimension to test our hypotheses involving the intergenerational link: we acknowledge the potential for self-selection into who chooses to become a parent, but we argue this makes them more—not less—important to study in this context. According to Eurostat, one-third of all 220 million EU households have children (Eurostat 2017). Therefore, considering parents is plausible and economically significant, as they form a major part of active participants in a society. As parents are in their adult life stage—working, producing and consuming—they can be considered one of the largest contributors to CO_2 emissions, compared to children or elderly persons (Zagheni 2011). Thus, getting parents to engage in any kind of VCA is likely to result in economically meaningful changes.

VCA decision; (II) in *StrangerAdult*, the parent is observed by another adult person, who is a stranger to the parent; (III) in *StrangerChild*, the parent is observed by a stranger child, to whom they are not related; and (IV) in *OwnChild*, the parent is observed by his/her own child.

We hypothesize that parents will be especially likely to engage in VCA when they are observed by their offspring, relative to other observers. While past work has shown the importance of observers to motivate costly cooperative behaviors (see, e.g., Yoeli et al. 2013; Hauser et al. 2016), a parents' offspring is critical here because it lets the parents recall their genetic link to the future. Therefore parents, who have their children's wellbeing at heart, are reminded of the benefits of investing into the future when their genetic beneficiaries are present (Smith 1977; Nowak 2006).

We find a remarkable willingness of parents to invest in VCA: over 80% of all parents invested in the VCA, which translates into almost 14,000 real trees being planted due to this research project. Across our entire sample, we observe some evidence for the hypothesis that parents give more when their children are watching their VCA decision. Importantly, as in Diedrich and Goeschl (2014), higher education increases the willingness to engage in VCA, and, furthermore, our treatment effects are substantially larger in the subsample of more educated parents. Our data shows consistent evidence that more educated parents are more likely to invest in VCA, especially when their own child is observing them.

Our paper makes a number of contributions. First, we contribute to the literature on VCA, which has previously focused on nudges and contextual determinants. Here, we instead demonstrate the importance of genetically-related children on parents' VCA, especially among educated parents (Diederich and Goeschl 2014). Second, we contribute to the burgeoning literature on intergenerational public goods: public goods games have previously not taken into account the genetic component across generations (Fischer et al. 2004; Hauser et al. 2014), which we demonstrate is critical to encourage contributions to intergenerational public goods. Third, we contribute to the literature on child-parent interactions: Previous work has shown that children's decisions are influenced by the behaviors they observe in their parents (e.g., Ben-Ner et al. 2017; Fernández et al. 2004). Here we demonstrate that this causal link can also act in reverse: when their own children are present, parents act more generously. This may in part be driven by the realization that one's own children may benefit from a good act today, but also because parents may want to act as role models in front of their children.

The remainder of the paper is organized as follows. Section 2 formulates our hypotheses based on the existing literature. Section 0 describes our experimental method, and Section 0 summarizes details on the experimental sample. Section 5 presents the results, and Section 6 covers the discussion of our findings. We conclude in Section 7.

2. Related literature and hypotheses

Public goods and observability. Past work has shown that mechanisms such as direct and indirect punishment, direct rewarding, as well as reputation building, foster contributions to public goods in the laboratory (see, e.g., Rockenbach and Milinski 2006; Milinski and Rockenbach 2012) and in the field (see, e.g., Balafoutas, Nikiforakis and Rockenbach 2014). Observability in conjunction with punishment (Fehr and Gächter 2000), rewards (see, e.g., Hauser et al. 2016 and Rand et al. 2009), communication (Miller et al. 2002; Bracht and Feltovich 2009; Balliet 2010), and framing (Andreoni 1995; Rege and Telle 2004) also positively influence cooperative behavior in the laboratory. Interestingly, when participants can choose, they only make high contributions observable for others (Rockenbach and Milinski 2011). Furthermore, a burgeoning literature using field experiments has shown that being observed, even without the explicit mention or possibility for punishment or reward, also increases cooperative behavior (see, e.g., Bateson, Nettle, and Roberts 2006; Ekström 2012; Yoeli et al. 2013). The effect is typically stronger in the case of "overt observability", which means that actual identifying information (e.g., name and face), as well as behavior, are revealed to the observer at or after the point of decision (Bradley et al. 2018).

Types of observers. Most existing research has used adults (who are unrelated and strangers to the decision-makers, or DMs) as observers. However, for observability to have the largest effect in an intergenerational public good, we argue that a link between today's DM and the future generation needs to be established. Past research has found that increasing the salience of the beneficiaries of an altruistic decision (the "identifiable victim") can lead to more giving (Small et al. 2007). Thus, we propose that an observer who directly benefits from the public good, such as a representative of the future generation (e.g., a child today), will be more influential on the DM's decision than an observer from the current generation (e.g., an adult). In addition, adults who are observed by a child may also want to act as a role model by acting virtuously or in line with societal expectations (Adriani et al. 2018).

Genetic link to the future. The effect of an observer can be further increased by choosing a particularly relevant representative of the next generation – specifically, a parent's own child (e.g., Ben-Ner et al. 2017). We expect one's own offspring to be important, as parents have a vested genetic interest in their children (Hamilton 1964a, 1964b; Trivers 1972; Rand and Nowak 2013) who benefit from the VCA.[3] In fact, there is evidence that knowledge and attitudes with respect to

[3] This genetic connection can prompt other motivations in parents to act in positive ways in front of their children. For example, parents typically want to impart knowledge and good decision-making on their children (see, e.g., Ben-Ner et al. 2017) and be viewed as role models by their own children (see, e.g., Knafo and Schwartz 2001). Indeed, children are influenced by the behaviour of their parents when it comes to criminal behaviour (McCord and McCord 1958), educational choices (Dryler 1998), and career development (Keller and Whiston 2008).

climate change are exchanged between parents and children (Lawson et al. 2018). For example, Lawson et al. (2019) find that parents become more concerned about climate change when this issue is brought to them and discussed by their children. Parents are even more likely to engage in actions that benefit their offspring, compared to a situation where they themselves would benefit (Cassar et al. 2016). Observation by their child will therefore most likely trigger the parent's investment in VCA, relative to other observers, as the genetic link to the future is most salient in *OwnChild*. Our first hypothesis builds on this line of reasoning.

> ***HYPOTHESIS 1:*** *Participants' VCA behavior is highest when the observer is the participant's own child, is smaller when the decision is observed by a stranger child, and further decreases when the observer is an adult observer. VCA is lowest for the conditions without an observer.*

It is worth pointing out that *OwnChild* combines the individual components of all treatments relative to *NoObserver* – i.e., (i) have DMs be observed, (ii) by a representative of a future generation, (iii) to whom the DM has a genetic link to. Thus, testing Hypothesis 1 not only contributes to our understanding of the role of the genetic link in VCA but helps inform policy: if *OwnChild* has a significant effect over *NoObserver*, a social planner would benefit from a policy intervention that meets (i)–(iii). If, on the other hand, both *OwnChild* and *StrangerChild* are significant relative to *NoObserver*, only (i) and (ii) need to be fulfilled, and if all three conditions are significantly different from *NoObserver*, only (i) needs to be met.

By examining and comparing the treatment variations in detail, we can delineate further what drives the effect. In both *OwnChild* and *StrangerChild*, the observer is a representative of the future generation, but only in the *OwnChild* condition, the parent has a genetic link to the observer. Thus, the salience of the genetic link to the future should be higher in *OwnChild*.

HYPOTHESIS 2: *Participants' VCA behavior is higher when the decision is observed by their own child, relative to a stranger child.*

While traditional observability studies commonly use adults as observers (e.g., Hoffman et al. 1996), both the *OwnChild* and *StrangerChild* conditions use children who are representatives of future generations. In contrast, the *StrangerAdult* condition resembles the more traditional observability condition where an adult observes the decision. If being reminded of future beneficiaries through the presence of a child observer, or wanting to act as a role model in front of a child (regardless of whether or not there is a genetic link), plays an important role, we should expect the treatments where children are watching to yield larger effects than adult observers.

HYPOTHESIS 3: *Participants' VCA behavior is higher when the decision is observed by a child, relative to an adult observer.*

Across all observability treatments, an observer—child or adult—is present to watch the decision-maker relative to the *NoObserver* condition. Based on past literature (see Bradley et al. (2018) for a review article on observability), DMs would be expected to invest more in VCA if being observed, compared to not being observed. Therefore, we compare all conditions with an observer combined (*OwnChild*, *StrangerChild,* and *StrangerAdult*) to the *NoObserver* condition.

HYPOTHESIS 4*: Participants' VCA behavior is higher when the decision to support VCA is observed by another person, relative to no observer.*

3. Methods

3.1 Voluntary climate action and study context

We carried out a novel lab-in-the-field experiment in Innsbruck, Austria. The experiment included an incentive-compatible survey programmed in oTree (Chen et al. 2016), and data were collected with tablets (see Online Appendix, OA). Participation took no longer than 20 minutes and our treatment conditions were randomly assigned to participants. Using a neutrally-framed recruitment stand in public spaces, we recruited parents who were accompanied by at least one of their own children aged between 7-14 years.[4] At all times during the experiment, only one parent (the DM) and one of the parent's own children (who is an observer in one condition and not involved in the experiment in the other conditions) were allowed to participate: in conditions where the child was not an observer, s/he was asked to wait outside the study booth and participate in various games and activities (supervised by research assistants).[5] In addition, for our conditions with observers who are not related to the participant, we employed confederate adults and confederate children who were introduced to the participant as "helpers from the community" to act as observers.[6]

The VCA on offer to participants in our study was carefully designed based on the extant literature. For example, the general public prefers investing in VCA with local mitigation goals (Torres et al. 2015). In our setting, the VCA to offset CO2 takes the form of a local foresting program, for which we collaborated with the forestry office Innsbruck ("Amt für Wald und Natur" of the city of Inns-

[4] We chose this age range as our pre-experimental focus groups have shown that these children are old enough to understand the experimental setup but young enough so that parents still serve as role models (which may be less plausible for older teenagers).

[5] Similarly, if a parent had more than one child with them, they were asked to wait outside and engage in the games and activities prepared for them.

[6] We ensured that no deception was used: confederates were not part of the research team, or involved in any part of the research. These members of the public were recruited through our informal networks with the requirement that they fit the age ranges of typical parent and child participants.

bruck”). We chose a foresting program for forest restoration, because such programs are among the best climate change solutions available today (Bastin et al. 2019). Participants were asked to choose between keeping money for themselves or spending that money on planting trees. All trees that participants decided to plant will be planted in 2020 and 2021 on the “Nordkette” and “Patscherkofel” mountain ranges in close proximity to Innsbruck, ensuring that the mitigation strategy is truly local. Moreover, this particular area has a high suitability for the VCA, as it has a high net plant productivity with the potential for forest restoration (Bastin et al. 2019).

Following the experimental design by Goeschl et al. (2020), subjects received a short and neutral description of the foresting program. In particular, they were informed that the foresting program has the following characteristics: (1) The trees would only be only planted if participants in our study actually chose to spend their money on planting a tree. This ensured that the decision the participants faced was incentive-compatible and truly contributed towards reducing CO2 in the environment. (2) The trees were selected in order to lead to a climate-friendly mixed forest, including climate-efficient species of different fir trees or deciduous trees. These tree types would usually not be planted as frequently due to their cost. (3) Each tree has an expected minimum age of 120 years (estimate provided by the forestry office Innsbruck). This means that each tree that was planted by our participants lasted at least the equivalent of four average (human) generations (following the Cambridge dictionary definition of a “generation”). (4) The trees would be monitored and controlled annually to ensure they are healthy, and they would be listed in the governmental forest database “Walddatenbank” to ensure a “paper trail” of the planting exists. (7) The trees would be planted in a forest that is certified with an internationally recognized “Program for the Endorsement of Forest Certification” (PEFC) certificate, ensuring environmental sustainability.[7] All these characteristics ensured the maximally possible credibility of our CO2 offsetting program.

Moreover, subjects were given information about greenhouse gas emissions and the role of trees for CO2 reductions before deciding on the VCA. Since the general population has relatively little prior knowledge about VCAs (Diederich and Goeschl 2014), we ensured that all participants first gained a basic understanding of the VCA in this study. Whereas MacKerron et al. (2009), Löschel, Sturm, and Vogt (2013), and Goeschl et al. (2020) provided information as text on the screen, participants in our study watched a short video.[8] The video informed participants about the public goods character of CO2 reductions by explaining how planting trees removes CO2 from the atmosphere and mitigates the effects of global climate change. In particular, the video highlighted that reducing CO2 has an impact not only on current generations, but also on future ones.

3.2 Experimental conditions

The experimental treatments are summarized in Table 1. We implemented four conditions in a between-subjects design, varying observability, and the type of observer. In all conditions, a parent received a windfall endowment of €69 and was asked to decide how much of that money to keep for themselves and how much to invest into the VCA (i.e., planting trees). Using their endowment, participants could purchase between 0 and 46 trees, with each tree costing €1.50 (the average cost of planting a tree in the foresting program).[9] Any money not invested

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[7] Another type of certification exists in the form of a CO2 certification. However, Tyrolean forests are not yet CO2 certified, which is a process that takes years to qualify for and is currently underway (but not yet complete) by the local authorities. In the meantime, the current certification programme fulfils all our required characteristics (such as longevity and investment into the future) to qualify as VCA in our study.

[8] We used a publicly available video by "youknow", a leading provider of e-learning in the German-speaking world. The video is accessible here: https://www.youtube.com/watch?v=ZGXVq9obUms

[9] In 2018, the average Austrian citizen emitted 9.2 tonnes of CO2 equivalent per capita (Eurostat 2018). According to the Tyrolian authorities, 46 trees from diverse climate-friendly species are needed to reduce approximately 10% of the annual CO2 emissions of

in planting trees was paid to participants in cash at the end of the experiment. We also collected data on basic demographics (e.g., gender, age, education, etc.) and included a short survey at the end of the experiment (see OA).

Table 1. Experimental conditions, varying who observes the participant.

Condition	Observer	Intergenerational link?	Genetic link?
NoObserver	No observer	No	No
StrangerAdult	Adult (not related to DM)	No	No
StrangerChild	Child (not related to DM)	**Yes**	No
OwnChild	DM's own child	**Yes**	**Yes**

In our baseline *NoObserver* condition, the DM made the decision in private without being observed by anyone. In the *StrangerAdult* condition, the DM was observed by another adult who is a hired actor (confederate) to act as the observer and who is unrelated to the DM (see detailed information about the observability procedure in the OA). This condition is similar to the standard procedure used in observability experiments in the lab, where a DM is observed by another adult, which helps establish a "general observability" effect. In the *StrangerChild* condition, the observer was an actor who is a child between 7 and 14 years old and unrelated to the DM, which helps identify whether the VCA can be encouraged by having an observer from the future (beneficiary) generation. Finally, in the *OwnChild* condition, the observer was the child of the DM, in order to understand whether the DM's own child has an effect on the DM's VCA behavior. Detailed information on the experimental design can be found in the OA.

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an average Austrian citizen. This is in line with estimations by the Environment Agency European (2012).

4. Experimental sample

We ran the experiment with a total of 368 parents, 92 in each of the four treatment conditions.[10] Data were collected starting at the end of 2019 until early 2020, in three different locations in the city of Innsbruck. In Table B-1 in the OA, we provide background details on our participants based on the post-experimental questionnaire. In Table B-2, descriptive statistics are further broken down by treatment, showing that randomization worked: the randomly assigned participants are comparable across a number of relevant characteristics. Across all treatments, 67% of our participants are female (248 out of 368) and the average age is 42 years. Participants have, on average, 2.06 children, and the vast majority (96%) are currently employed. With respect to education, 86% received a high school diploma (by completing an exam called "Matura"), which provides general access to higher education and labor market qualifications.[11] Out of those with a high school diploma, half (50%) have a university degree. The majority is married or in a registered relationship (66%), and there is approximately an equal split between those living in the city (49%) versus those living in the countryside. Our recruited sample is largely representative of the general population of Innsbruck (Austria), where our trial took place.

Following Goeschl et al. (2020), we included a survey question asking participants how risk-seeking they viewed themselves (based on Falk et al. 2018). The mean reported value was 5.35 on a scale from 0 (not risk-seeking at all) to 10 (fully risk-seeking), and did not differ between treatments (Kruskal-Wallis test

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[10] We conducted a power analysis to estimate the minimum sample size in advance of the experiment based on the existing literature. Both the minimum sample size and main analyses were pre-registered (see "Saving the planet – one tree at a time" (#27772)). Unless otherwise noted, we follow the main analyses from the pre-registered analyses plan. Details can be found in the OA.

[11] The exam is called „Matura" or "Reifeprüfung" in Austria. One is qualified to take the exam after a minimum of 12 years of schooling. It is comparable with a US high-school diploma or A-levels in the UK.

(kwallis), $p = 0.255$).[12] Additionally, we asked participants how patient they believe they are, as a proxy of their time preferences. The average reported score was 5.92, measured on a scale from 0 (not at all patient) to 10 (fully patient). We did not find any treatment differences for the patience measure (kwallis, $p = 0.397$).

In three out of four treatments, the participant was observed. We therefore also provide summary statistics of the different observer characteristics. Stranger adult observers (who were hired by the experimenters as confederates) in the *StrangerAdult* condition were on average 39.89 years old and observing children 11.33 years (*StrangerChild:* 12.23 years; *OwnChild*: 10.43 years; Wilcoxon-Mann-Whitney test (WMW), $p < 0.001$).[13] The majority (55%) of observers was female, and the number of female observers did not differ across treatments (Fisher's exact $p = 0.231$). In Table B-6 in the OA, we provide a summary of the gender matches of participants and observers for the treatments with observers. Because both the participant sample as well as the observers were made up of more women (F) than men (M), we have 99 FF matches, 88 FM, 54 MF, and 35 MM matches. Gender matches were balanced across treatment conditions (χ^2, $p = 0.497$).

5. Results

5.1 Total number of trees planted

Our first result is purely descriptive but nonetheless remarkable: across all conditions, the 368 participants chose to plant a total amount of 13,988 trees (our

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[12] All *p*-values in the paper and in the OA are based on two-sided tests.

[13] We had to select the children observers in the *StrangerChild* treatment ahead of the experiment: we chose confederates of ages 7 to 14 for the reasons described earlier. Although the average age of children in the *OwnChild* treatment was less than 1.5 years lower (and statistically significantly so) than in the *StrangerChild* treatment, we do not believe that this small difference between the two treatments is sufficient to affect our results in a meaningful way.

outcome measure, labeled *VCA*; out of a maximum possible 16,928 trees). On average, participants invested 82.63% of their €69 endowment into the VCA, with 66.58% of participants choosing to invest their *entire* endowment into planting all possible 46 trees. The average *VCA* does not differ by the participant's gender (female participants: 37.79 trees vs. male: 38.47 trees; WMW, $p = 0.724$).

5.2 Covariates that predict VCA

We begin by examining which variables are predictive of *VCA* across conditions (see Table 2). Age is a significant predictor of *VCA* (coeff = 2.23, p = 0.037), whereas gender (coeff = 0.50, p = 0.748) and the participant's number of kids are not significant (coeff = 0.91, p = 0.209). These results are all consistent with past findings (see, e.g., Löschel, Sturm and Vogt 2013 and Diederich and Goeschl 2014).

Higher education ("*High School Dipl.*") is associated with higher *VCA* (coeff = 10.77, $p < 0.001$), in line with Diederich and Goeschl (2014). Employment is also positively associated (coeff = 11.37, p = 0.001), as one might expect that being employed implies greater disposable income (see also Löschel, Sturm and Vogt 2013). Meanwhile, neither risk nor patience is significantly associated with *VCA* (*Risk*: coeff = 0.15, p = 0.598; *Patience*: coeff = -0.23, p = 0.355). Lastly, we find some variation by study location.[14]

[14] We discuss this variation by study (recruitment) location in more detail in the OA.

Table 2. Regression results for the entire sample without treatments.

	(1) *VCA*	(2) *VCA*	(3) *VCA*	(4) *VCA*
Age	0.23^{**}	0.20^{*}	0.51	0.43
	(0.11)	(0.11)	(0.34)	(0.33)
Female	0.50	0.65	2.70	3.30
	(1.56)	(1.55)	(4.78)	(4.72)
Nr. kids	0.91	1.12	2.63	3.20
	(0.73)	(0.73)	(2.21)	(2.19)
Risk	0.15	0.21	1.16	1.33
	(0.29)	(0.29)	(0.88)	(0.87)
Patience	-0.23	-0.17	-1.01	-0.80
	(0.25)	(0.25)	(0.77)	(0.76)
High School Dipl.	10.77^{***}	9.69^{***}	24.65^{***}	21.69^{***}
	(2.03)	(2.05)	(5.67)	(5.64)
Employed	11.37^{***}	11.36^{***}	24.37^{***}	24.44^{***}
	(3.43)	(3.41)	(9.28)	(9.18)
Constant	6.64	9.07	-13.69	-7.80
	(6.24)	(6.24)	(18.67)	(18.46)
var(e.vca)			1063.18^{***}	1024.69^{***}
			(168.38)	(161.91)
N	362	362	362	362
Location Fixed Effects	No	Yes	No	Yes

Notes: Ordinary least squares ((1)-(2)) and tobit regressions ((3)-(4)); upper limit 46 and lower limit 0). Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Age in years. Female equals 1 for female participants. The number of kids controls for the respective variable for each participant. Risk measures self-assessed risk attitudes with higher values indicating higher risk-seeking. Patience measures self-assessed time preferences with higher values indicating higher patience. High School Diploma. is equal to 1 for participants who completed secondary education and 0 otherwise. Employed is equal to 1 if a participant is employed and 0 otherwise. Location Fixed Effects include dummies for study locations Rathausgalerien, Herbstmesse, and Sillpark.

5.3 Treatment effects on the VCA

Turning to our conditions, we first descriptively summarize the raw *VCA* values (see Figure 1). We observe the lowest *VCA* in *NoObserver* (mean = 37.12, 25^{th} percentile = 35.00 and 75^{th} percentile = 46.00) and *StrangerAdult* (mean = 37.09, 25^{th} percentile = 32.00, 75^{th} percentile = 46.00). *VCA* is slightly higher in *StrangerChild* (mean = 38.24, 25^{th} percentile = 34.00, 75^{th} percentile = 46.00) and it is highest in *OwnChild* (mean = 39.60, 25^{th} percentile = 43.00, 75^{th} percentile = 46.00).

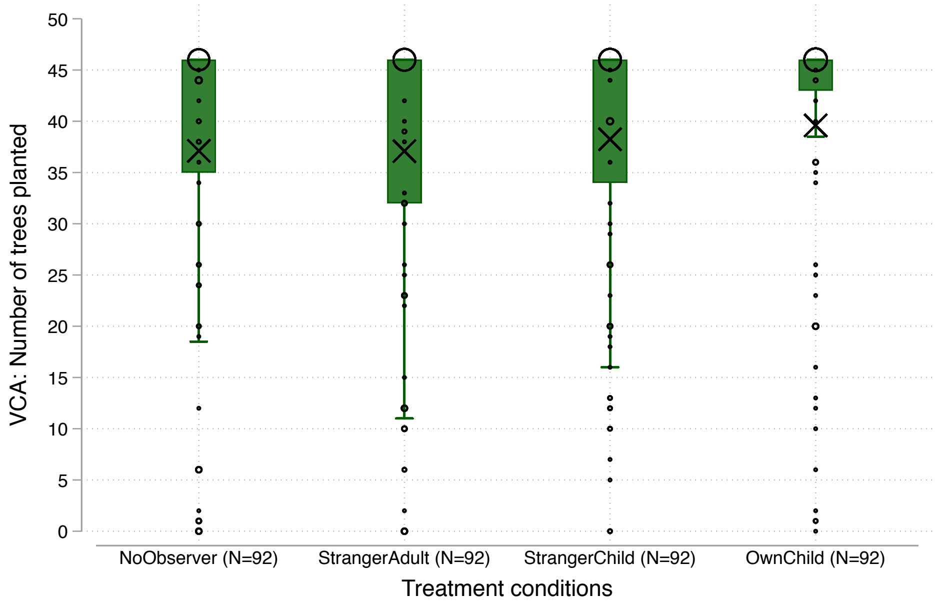

Figure 1. VCA: Number of trees planted by treatment condition (*N* = 368 subjects). Each box plot shows the average VCA of participants in each treatment. Box plots show the mean (indicated by black X signs), the 25th and 75th percentiles, Tukey whiskers (median ± 1.5 times the interquartile range), and individual data points. Larger dots indicate a higher number of participants who invested the corresponding number of trees.

Econometric specifications. We examine the effect of our treatments econometrically (see Table 3). Our analytical strategy is twofold: First, we estimate the treatment effects on *VCA* using ordinary least squares (OLS) regressions (in columns (1) and (2)). Second, we employ Tobit regressions (columns (3) and (4)) to estimate treatment effects, taking into account that the dependent variable is the number of trees planted (i.e., *VCA*), which is bounded by 0 trees on the lower end (if the participant keeps the entire endowment for him/herself) and by 46 trees on the upper end (if the participant invests the entire endowment into the VCA). For both models, we use the following specifications for columns (1) and (3), which shows the main effects of the independent variables (treatment dummies) without any control variables:

$$VCA_i = \beta_0 + \beta_1 StrangerAdult_i + \beta_2 StrangerChild_i + \beta_3 OwnChild_i + \varepsilon_i \quad (1)$$

where $i = 1, \ldots, n$ indicates participant i, *VCA* is a continuous variable (ranging from 0 to 46) measuring the number of trees a participant decided to plant, and the *StrangerAdult*, *StrangerChild,* and *OwnChild* dummies are 1 in the respective treatments and 0 otherwise, ε_i measures unobserved scalar random variables (errors).

In addition, we also report in columns (2) and (4) the same specification with a number of control variables (see Section 5.2 above for a discussion on covariates):

$$VCA_i = \beta_0 + \beta_1 StrangerAdult_i + \beta_2 StrangerChild_i + \beta_3 OwnChild_i + \beta_4 Rathausgalerien_i + \beta_5 Sillpark_i + \beta_6 Herbstmesse_i + \beta_7 Age_i + \beta_8 Female_i + \beta_9 NrKids_i + \beta_{10} Risk_i + \beta_{11} Patience_i + \beta_{12} Educ_i + \beta_{13} Employed_i + \varepsilon_i \quad (2)$$

where *Rathausgalerien*, *Sillpark,* and *Herbstmesse* are dummy variables for each of the three study locations and 0 otherwise, *Age* is a continuous variable and *Female* a dummy variable for the participant's age and gender, *NrKids* is a continuous variable capturing the participant's number of kids, *Risk* and *Patience* are self-reported scale measures (scale range from 0 to 10), *High School Dipl.* is a dummy variable which is 1 if the participant completed secondary education ("Matura") and *Employed* is a dummy variable which is 1 if the participant is currently employed; all other variables are as defined in Eq. (1).

Table 3. Regression results for the entire sample.

	(1)	(2)	(3)	(4)
	VCA	***VCA***	***VCA***	***VCA***
OwnChild	2.48	3.68*	9.44	11.79*
	(2.09)	(1.98)	(6.52)	(6.02)
StrangerChild	1.12	2.06	4.16	5.60
	(2.09)	(1.96)	(6.37)	(5.79)
StrangerAdult	-0.03	2.54	2.02	9.49
	(2.09)	(2.00)	(6.35)	(5.99)
Age		0.20*		0.45
		(0.11)		(0.33)
Female		0.69		3.64
		(1.55)		(4.70)
Nr. kids		1.11		3.14
		(0.73)		(2.20)
Risk		0.19		1.25
		(0.29)		(0.87)
Patience		-0.18		-0.82
		(0.25)		(0.76)
High School Dipl.		10.02***		22.77***
		(2.06)		(5.66)
Employed		11.78***		25.75***
		(3.42)		(9.20)
Constant	37.12***	6.27	57.12***	-16.60
	(1.47)	(6.42)	(4.81)	(18.86)
var(e.VCA)			1315.15***	1007.66***
			(209.16)	(159.05)
N	368	365	368	365
Location Fixed Effects	No	Yes	No	Yes

Notes: Ordinary least squares ((1)-(2)) and tobit regressions ((3)-(4)); upper limit 46 and lower limit 0). * p < 0.10, ** p < 0.05, *** p < 0.01. StrangerAdult, StrangerChild, OwnChild equals 1 for the respective treatment, and 0 otherwise (baseline is the NoObserver treatment). Age is measured in years. Female equals 1 for female participants. The number of kids controls for the respective variable for each participant. Risk measures self-assessed risk attitudes with higher values indicating higher risk-seeking. Patience measures self-assessed time preferences with higher values indicating higher patience. High School Dipl. is equal to 1 for participants who completed secondary education and 0 otherwise. Employed is equal to 1 if a participant is employed and 0 otherwise. Location Fixed Effects include dummies for study locations Rathausgalerien, Herbstmesse, and Sillpark.

Main results. As Table 3 shows, the largest coefficient relative to the baseline *NoObserver* is the *OwnChild* treatment. Without control variables, the *OwnChild* coefficient is positive but not significant (OLS: coeff = 2.48, p = 0.236; Tobit: coeff = 9.44, p = 0.149), whereas with control variables, the *OwnChild* treatment leads to significantly larger *VCA* (OLS: coeff = 3.68, p = 0.064; Tobit: coeff = 11.79, p = 0.051). Neither the coefficient on *StrangerAdult* nor *StrangerChild* is significant with or without control variables. Thus, in line with our descriptive and graphical results (Figure 1), some of our econometric results suggest that *OwnChild* leads to the highest VCA, relative to the *NoObserver* baseline condition. These results are partly in line with hypothesis 1, specifically in that *OwnChild* has the largest coefficient relative to *NoObserver*.

Potential mechanisms. These results suggest directionally (but not always significantly) that parents may be affected by the presence of their own children when making the VCA decision, but not with other observers present. To isolate the potential mechanisms at work, we explore three explanations using non-parametric tests.[15] First, we investigate to what extent the genetic link in particular matters (hypothesis 2), holding constant the "observer's generation". While *VCA* is higher, as predicted, in *OwnChild* (39.60 trees planted) than in *StrangerChild* (38.24 trees planted), this difference is not significant (WMW, $p = 0.419$).

Second, we examine hypothesis 3 to test whether a representative of the future generation as an observer has a larger impact on VCA than an adult observer (hypothesis 3). We pool *VCA* across the two treatments, in which a child is the observer (*StrangerChild* and *OwnChild*), and compare it with *VCA* in *StrangerAdult*. Again, as expected, the average VCA is higher (38.92 trees planted) when being observed by a child, but not significantly different from the average VCA (37.09 trees planted) when being observed by an adult (WMW, $p = 0.471$).

Finally, we investigate a general "observability effect" (hypothesis 4), comparing *VCA* in *NoObserver* with the average *VCA* from across the three treatments with observers (*StrangerAdult*, *StrangerChild,* and *OwnChild*). Even though *VCA* is higher, the difference between the pooled observer conditions (38.31 trees planted) and the *NoObserver* condition (37.12 trees planted) is also not significant (WMW, $p = 0.328$).

[15] We pre-registered the use of non-parametric tests for this analysis. However, an alternative specification testing the joint coefficients from Table 2 yields similar results.

5.4 Treatment effects by education[16]

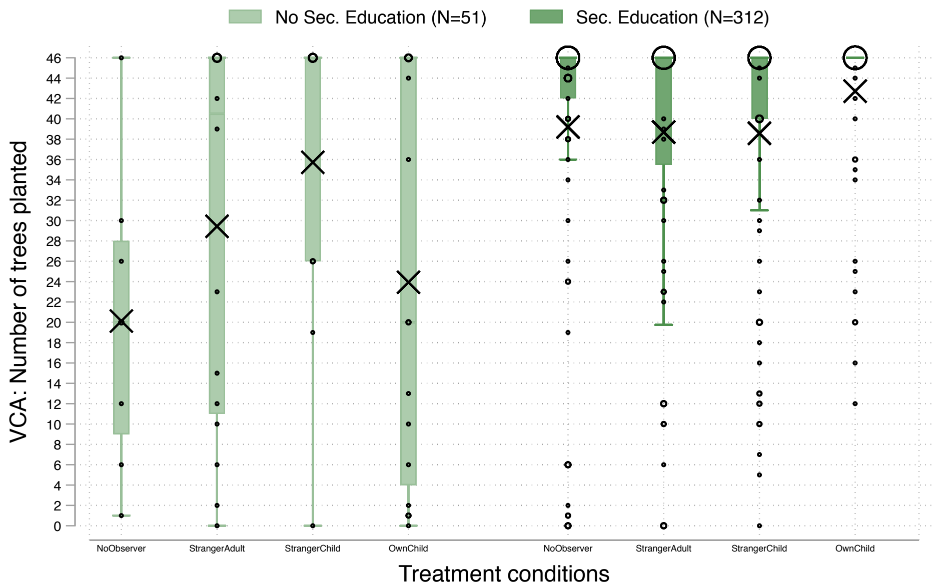

Figure 2. VCA: Number of trees planted by condition and education (N = 363 subjects). Each set of four box plots shows the average VCA of participants for each education level. Respective condition order for each education level: *NoObserver*, *StrangerAdult*, *StrangerChild*, and *OwnChild*. Box plots show the mean (indicated by black X signs), the 25th and 75th percentiles, Tukey whiskers (median ± 1.5 times the interquartile range), and individual data points. Larger dots indicate a higher number of participants with the corresponding number of trees.

Since education has been found to be a key determinant of the willingness to invest in VCA (Diederich and Goeschl 2014), we examine our treatment effects in two sub-analyses (pooling across locations).[17] Specifically, we look at participants with versus without *High School Diploma.* Average *VCA* by treatment and *High School Diploma* groups are graphically summarized in Figure 2. First, we observe a substantial main effect of having a high school diploma, pooled across treatments, consistent with prior research (Diederich and Goeschl 2014): whereas participants with secondary education invested in planting 39.37 trees on average (25^{th} percentile = 40.00, 75^{th} percentile = 46.00), participants without secondary

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[16] The sub-group analysis by education level was not pre-registered. In Table B-4 in the OA, background information on participants by education can be found.
[17] Separately, we also analyze treatment effects by another subgroup—study location—in the OA.

education invested at a significantly lower rate of 27.61 trees (25^{th} percentile = 10.00, 75^{th} percentile = 46.00; WMW, $p < 0.001$).

Parents with more educational attainment. We repeat our empirical strategy (see Eqs. (1) and (2)) for each subgroup analysis. Participants with high school diploma form the majority of our sample (312 of 368 participants, or 86%). Focusing on these participants first, we observe consistent and sizeable effects of the OwnChild treatment: across all specifications, parents who are observed by their own child are significantly more likely to invest in VCA (see OwnChild coefficient all columns in). We do not find any evidence that being observed by a stranger adult or stranger child leads to higher VCA. Consistent with our results across the entire sample, these findings suggest that the OwnChild condition leads to the highest VCA for more educated parents.

The genetic link uniquely matters for more educated parents. Furthermore, we also find evidence that parents invest significantly more when being observed by their own child, compared to being observed by a stranger child (WMW, $p = 0.031$). This result supports hypothesis 2, demonstrating that, for more educated parents, the genetic link between a parent and their own child uniquely matters for VCA, even when holding constant that the observer is a representative of a future generation.

Table 4. Regression results for parents with a high school diploma.

	(1)	(2)	(3)	(4)
	VCA	***VCA***	***VCA***	***VCA***
OwnChild	3.52*	5.03**	13.73*	18.11**
	(2.01)	(1.97)	(7.25)	(7.07)
StrangerChild	-0.62	0.70	-0.83	3.54
	(1.95)	(1.92)	(6.50)	(6.32)
StrangerAdult	-0.51	2.14	1.01	11.33
	(1.98)	(2.00)	(6.70)	(6.94)
Age		0.05		0.12
		(0.11)		(0.36)
Female		0.56		2.96
		(1.52)		(5.21)
Nr. kids		1.52**		4.53*
		(0.74)		(2.59)
Risk		0.18		1.31
		(0.29)		(0.99)
Patience		-0.20		-1.14
		(0.24)		(0.85)
Employed		15.87***		38.32***
		(3.81)		(11.67)
Constant	39.20***	18.73***	61.59***	7.98
	(1.37)	(6.54)	(5.15)	(21.60)
var(e.VCA)			1180.56***	1030.96***
			(217.36)	(189.84)
N	312	311	312	311
Location Fixed Effects	No	Yes	No	Yes

Notes: Ordinary least squares ((1)-(2)) and tobit regressions ((3)-(4)); upper limit 46 and lower limit 0). errors in parentheses. p < 0.10, ** p < 0.05, *** p < 0.01. StrangerAdult, StrangerChild, OwnChild equals 1 for the respective treatment, and 0 otherwise (baseline is the NoObserver treatment). Age is measured in years. Female equals 1 for female participants. The number of kids controls for the respective variable for each participant. Risk measures self-assessed risk attitudes with higher values indicating higher risk-seeking. Patience measures self-assessed time preferences with higher values indicating higher patience. Employed is equal to 1 if a participant is employed and 0 otherwise. Location Fixed Effects include dummies for study locations Rathausgalerien, Herbstmesse, and Sillpark.

Parents with lower educational attainment. Turning to participants without a high school diploma ($N = 51$), we find that the treatment effects look qualitatively different. Specifically, average *VCA* is low in the *NoObserver* condition (20.13) and, remarkably, also in the *OwnChild* condition (23.94). The highest mean *VCA* is observed in the *StrangerChild* condition (35.73), which is significantly different from the *NoObserver* condition without covariates (see columns 1 and 3 in Table 5) but not significant with covariates (columns 2 and 4). The *StrangerAdult* condition (29.44) falls in the middle.

Table 5. Regression results for parents without a high school diploma.

	(1)	(2)	(3)	(4)
	VCA	***VCA***	***VCA***	***VCA***
OwnChild	3.81	-1.44	6.30	-2.48
	(7.72)	(8.05)	(12.58)	(11.83)
StrangerChild	15.60*	11.95	27.94*	18.95
	(8.28)	(8.08)	(14.37)	(12.52)
StrangerAdult	9.31	2.78	15.12	2.79
	(7.72)	(7.70)	(12.74)	(11.33)
Age		1.26***		2.18***
		(0.40)		(0.68)
Female		4.28		9.47
		(6.08)		(9.71)
Nr. kids		-0.33		-1.40
		(2.38)		(3.59)
Risk		1.19		2.19
		(1.01)		(1.65)
Patience		-1.67		-2.57
		(1.10)		(1.70)
Employed		1.81		3.78
		(8.75)		(12.79)
Constant	20.13***	-28.70	22.10**	-65.04*
	(6.30)	(20.17)	(10.15)	(32.32)
var(e.VCA)			800.58***	550.50***
			(241.69)	(164.17)
N	51	51	51	51
Location Fixed Effects	No	Yes	No	Yes

Notes: Ordinary least squares ((1)-(2)) and tobit regressions ((3)-(4)); upper limit 46 and lower limit 0). Standard errors in parentheses. p < 0.10, ** p < 0.05, *** p < 0.01. StrangerAdult, StrangerChild, OwnChild equals 1 for the respective treatments, and 0 for the baseline NoObserver treatment. Age is measured in years. Female equals 1 for female participants. The number of kids controls for the respective variable for each participant. Risk measures self-assessed risk attitudes with higher values indicating higher risk-seeking. Patience measures self-assessed time preferences with higher values indicating higher patience. Location Fixed Effects include dummies for study locations Rathausgalerien, Herbstmesse, and Sillpark.

6. Discussion

In an intergenerational public good (for example, planting trees that offset CO2 emissions), the beneficiaries (future generations) are not the same as the decision-makers (current generation). We conjectured that parents, who have a genetic link to the future through their children, would be particularly likely to invest in planting trees, a measure of VCA. In our novel lab-in-the-field study, we found a remarkable willingness of parents to invest in the VCA: over 80% of all parents invested in the VCA, with two-thirds of all participants investing their *entire* endowment into planting trees. This is far more than the usual VCA contributions found in the literature: Bruns et al. (2018) report that participants spent 35% of a default amount of money on VCA, while Diederich and Goeschl (2014) find that only 16% of subjects chose the emission reduction instead of a cash amount.

We proposed that VCA would be heightened when a parent is being observed by their own offspring. The parent's own child would serve multiple purposes, most importantly as a reminder of the fact that a (genetic) link connects the parent (decision-maker) to their own child (future beneficiary). Across our entire sample, we find some evidence for the hypothesis that parents give more when their children are watching their VCA decision. Importantly, education plays a key role: as Diedrich and Goeschl (2014) note, higher education increases the willingness to engage in VCA and, furthermore, in our setting, our treatment effects are substantially larger in the subsample of participants with a high school diploma. We find consistent evidence that parents with a high school diploma are more likely to invest in VCA when their own child is observing them, both relative to when no observer is present as well as when another child (to whom they are not related) observes them. This latter finding rules out the explanation that these parents engage in the VCA when a non-genetically linked future beneficiary is present, consistent with the argument that intergenerational transmission of benefits is driven by parents' realization that VCA today helps their own children in the future.

Our study makes several contributions to the literature. First, we contribute to the literature on VCA. Previous studies have studied both the personal characteristics that determined engagement with VCA (Diederich and Goeschl 2014) and contextual cues—often in the form of nudges—that can lead to more VCA (see, e.g., Araña and León 2013; Böhm et al. 2020; Carattini and Blasch 2020). In this paper, we focus instead on a novel context that we use as an intervention – the role of the genetic link across the generations. Since VCAs are intergenerational by nature, we argue that VCA interventions can benefit from taking into account the intergenerational structure of families. We show that parents are indeed more willing to invest in future public goods when they are observed by their children, not just other adults or children – an effect that is particularly strong among more educated parents.[18] The presence of their child might have triggered several responses in parents, through which the treatment may have worked, including making salient to the parent that their child is a direct future beneficiary of their actions today, that they serve as a role model to their child on environmental issues, or even that their child might hold them accountable for selfish behavior.

Second, we contribute to the burgeoning literature on intergenerational public goods. Previous research has studied resource replenishment rates (Fischer et al. 2004), institutions (Hauser et al. 2014), and peer punishment (Lohse and Waichman 2020). However, a previously neglected aspect of intergenerational public goods is relatedness (Nowak 2006): decision-makers may not be present to reap the benefits of their actions in the future, but their own descendants could benefit. As a result, genetic offspring should be considered in other interventions to increase contributions to intergenerational public goods.

Furthermore, our study also speaks to standard public goods game: although observability is a widely studied intervention in economics (e.g., Hoffman et al. 1996; Yoeli et al. 2013), our study suggests that the "qualitative" type of observers matters: while adults are typically recruited for studies using observability, we show that variation in observers can yield differing results. In our setting, adult observers did not affect VCA, neither in the main nor subgroup analyses. Our findings document the importance of choosing an observer that manipulates the theoretical construct in question.

Finally, we contribute to the long-standing literature on child-parent interactions. Most of this literature has only investigated one direction of this causal

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[18] The importance of the role of education on VCA has previously been noted (see Diederich and Goeschl 2014).

relationship—how parents influence their children—such as, for example, the extent to which parents' sharing behavior in the dictator game influences their child's subsequent dictator game behavior (Ben-Ner et al. 2017). Similarly, prior fieldwork has found that preferences are shaped by their parents' behavior in childhood and persist into adulthood (Fernández et al. 2004). Here, we reverse the causal direction of this relationship, finding that parents' behavior is shaped by their children. Our intervention is relatively minimal and only involves observation by children, leaving open the possibility that children's actual influence on their parents is much larger in reality.

Our findings offer practical implications for policy-makers and research questions for scholars across a variety of domains. We focused on VCA, specifically planting trees. However, parents make many important decisions in daily life that have consequences, if not always for future generations, at least for years and decades to come that also shape the lives of the next generation. Consider, for instance, voting: in many countries (including Austria), adults are not allowed to take their children into the voting booth. Would parties that emphasize long-term investments in education and environmental protection receive a greater voting share if parents had to choose under the watchful eyes of their own children? While this is an open empirical question, one could imagine that voting systems may take such considerations into account (e.g., Kamijo et al. 2017). Even in more mundane activities, such as shopping for groceries (e.g., buying meat or vegetarian alternatives), or choosing whether to take the bike to work or on the school run, a parent's behavior may be affected if their own children are present during the decision-making process.

Of course, our study is not without limitations. Our results only speak to a certain segment of society: adults with at least one child. We did not investigate how parents are different in their VCA behavior from adults who are not parents.

We chose not to compare parents and non-parents for several reasons. First, potential selection issues would complicate the interpretation of any results: do non-parents choose not to have children for reasons that are related to intergenerational considerations (e.g., environmental burden, overpopulation), or did they initially want to have children but were not able to have them for one reason or another? Second, there is no obvious "kin" equivalent for non-parents who could act as the relevant observer: children are a parent's obvious connection to the future, whereas for non-parents other relatives (e.g., their own parents or siblings) may not benefit from the intergenerational public good in the future. Other proxies (e.g., nephews or nieces) may not be as close to the non-parent as a parent's own child.

7. Concluding remarks

In conclusion, we demonstrated that different observers may differentially affect parents' costly investment into VCAs. Because of the intergenerational aspect of VCAs, we argued that the parent's own child is a particularly effective observer to encourage parental VCA behavior, as children are a genetic link for parents to the future. As climate change continues to accelerate, more research will be needed to understand how researchers and policy-makers can encourage VCA – one pathway may be through the leverage and watchful eyes of children who stand to gain from encouraging today's investments into the future.

Other information

Ethical Approval: The ethics committee of the University of Innsbruck has approved this research (Certificate of good standing, 43/2019; July 29 2019).

Pre-Registration: The project has been pre-registered before data collection (see “Saving the planet – one tree at a time” (#27772) on aspredicted.org). The pre-analysis plan is available on request.

Author Contributions: Both authors contributed equally to all aspects of the project, including, but not limited to, experimental design, project planning, implementation, manuscript writing, and data analysis.

Competing Interests: The authors declare no competing interests.

Availability statements

Data: The datasets generated and analyzed will be made available through the Open Science Framework after publication:
https://osf.io/2kdgz/?view_only=ae4b96704c8f41d8b66eebd1e5ce7bbf

Code: Custom code that supports the findings of the study will be made available through the Open Science Framework after publication:
https://osf.io/2kdgz/?view_only=ae4b96704c8f41d8b66eebd1e5ce7bbf

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Climate action for (my) children

Abstract
Sustaining large-scale public goods, such as the environment, requires individuals to take action; however, motivating voluntary climate action (VCA) is difficult because decision-makers today do not stand to benefit from their investments. Here, we propose that parents invest more in VCA if their link to future generations-through their offspring-is made salient. In a novel lab-in-the-field experiment, we vary whether parents are observed during a VCA decision (i.e., investing in planting real-world trees) by their own child. In addition to a no-observer control, we run additional control conditions with an unrelated adult or an unrelated child observing the parent decision-maker. As predicted, VCA varies across conditions, with larger treatment effects occurring when a parent's own child is the observer. In subgroup analyses, larger treatment effects occur among more educated parents. As a result of this study, VCA across conditions led to 14,000 trees being planted, offsetting approximately 8 % of participants' annual CO2 emissions for around four generations.

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