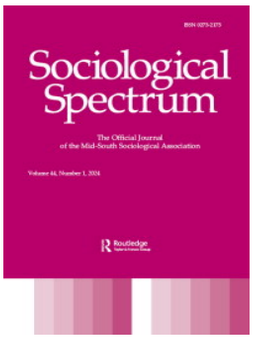

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ISSN: 0273-2173 (Print) 1521-0707 (Online) Journal homepage: www.tandfonline.com/journals/usls20

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To cite this article: Tiana Marrese, Itay Greenspan, Tally Katz-Gerro & Femida Handy (2024) Intergenerational transmission of pro-environmental behaviors: do grandparents' environmental behaviors influence grandchildren? , Sociological Spectrum, 44:1, 1-15, DOI: 10.1080/02732173.2023.2274021

To link to this article: https://doi.org/10.1080/02732173.2023.2274021

SOCIOLOGICAL SPECTRUM
2024, VOL. 44, NO. 1, 1–15
https://doi.org/10.1080/02732173.2023.2274021

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Intergenerational transmission of pro-environmental behaviors: do grandparents' environmental behaviors influence grandchildren?

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ABSTRACT

To understand the intergenerational transmission of pro-environmental behaviors within a family, we employ a nationally representative survey of young adults and their parents living within the United States. We analyze intergenerational transmission for three generations with information on children, parent, and grandparent behavior. Our findings suggest that strong relationships exist across three generations. Mediation analysis shows that parents significantly mediate the strong association between children and grandparents for most behaviors. These results imply that pro-environmental behaviors inculcated between generational dyads are robust and suggest educational efforts directed at quotidian household behaviors.

1. Introduction

Generational protest is an emerging characterization of the struggle against the climate crisis. This portrayal depicts the younger generation revolting against orders established by older generations (Bowman 2019). The question that arises from this picture is whether there exists resistance by youths to their parents' (and other older generations') behaviors (Bessant, Farthing, and Watts 2017). An alternative narrative argues that youth engage in similar or more extreme consumer behaviors as their parents through socialization processes, creating a demand for scarce resources and increasing waste (Adrangi, Dhanda, and Hill 2004). Given these two narratives, it is not clear which is the overriding force.

Socialization theories suggest that many consumer behaviors and practices are learned and practiced by children at home (Grønhøj and Thøgersen 2009). This influence is salient in multigenerational households where different but interacting generations face pressures and influences based on their socioeconomic, ecological, and political contexts (Bengtson 2001; Swartz 2009). In each generation, daily behaviors become intrinsic, persisting throughout life. In the environmental context, these behaviors include energy and water usage or waste recycling (Greenspan et al. 2022).

While the growing literature on intergenerational transmission (IGT) of environmental behaviors commonly investigates transmission between parents and children, it rarely includes the potential influence of grandparents. A robust look at the family unit should consider the grandparents and the IGT across three generations, thus our paper focuses on two research questions.

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First, we ask whether IGT exists across two generations regarding nine environmental behaviors, and second, whether IGT of these behaviors exists across three generations. We focus on the IGT of everyday behaviors that impact the environment, such as consuming electricity and water, recycling and reducing waste, using disposable items, participating in outdoor activities, and performing behaviors in the public sphere like donating, volunteering, or demonstrating for environmental causes.

Our research adds to previous studies on the IGT of environmental behaviors through two main contributions: (1) analysis of data on parent-child dyads of children who are young adults (approximately 18–28 years of age), and (2) analysis of IGT across *three* generations: grandparents, parents, and their children of the same family. These contributions add to the previous literature on younger children or cohort analysis. Since young adults are less likely to be under the control/guardianship of their parents, our findings examine if IGT remains salient as children become young adults.

2. Literature review

Intergenerational transmission (IGT) occurs when family members from different generations influence each other through routines, practices, and experiences. Research on familial IGT of environmental behaviors has shown the importance of parents (Gong et al. 2022; Grønhøj and Thøgersen 2009) and cultural context (Ando et al. 2015; Collado, Staats, and Sancho 2019) in shaping their children's behaviors. Scholars have examined this dyadic relation of parent-child similarities in attitudes and behaviors related to environmental practices (Casaló and Escario 2016; Grønhøj and Thøgersen 2009, 2012; Katz-Gerro et al. 2020; Leppänen et al. 2012; Matthies, Selge, and Klöckner 2012, Matthies and Wallis 2015; Volland 2013). For example, parents' and their children's recycling and purchasing behaviors were strongly correlated, but the correlation was less so in the case of energy-saving (Grønhøj and Thøgersen 2009, 2012). Similar correlations were found in a comparative study of South Korea, the USA, and Israel, where IGT of environmental behavior occurs for a sustainable lifestyle, energy consumption, and waste reduction (Katz-Gerro et al. 2020).

In IGT, attitudes, concerns, and behaviors are passed between generations – upwards from children to parents (Liu, Chen, and Dang 2022) or more often downwards from parents to children – through socialization and reverse socialization processes using mechanisms such as observation, conversation, and imitation within the family (Meeusen 2014; Volland 2013). Studies have documented IGT between parents and children within the household in behaviors such as religiosity (Zhai and Stokes 2009), recycling in Germany (Matthies, Selge, and Klöckner 2012), energy consumption in Denmark (Hansen and Jacobsen 2020), and environmental literacy in South Korea and Macau, SAR (Liu, Chen, and Dang 2022), and gender ideology (Davis and Wills 2010). For example, Wallis and Klöckner (2020), found that adolescents' perceptions of their parents' behavior are decisive in adopting ecological behavior while Kong and Jia (2023) found that children's environmental knowledge was more influential on the parents' pro-environmental behaviors than the reverse. In a study of the influence of parents' environmental concerns on children's concerns in 16 countries, Casaló and Escario (2016) found a positive yet moderate association between parents' and children's levels of environmental concern, suggesting that parents are essential socialization agents. While the IGT literature has been validated in different samples in different countries, these studies, with a few exceptions (e.g., Casaló and Escario 2016), do not use nationally representative samples. Our study bolsters previous research by employing nationally representative data to validate the findings of IGT.

A key determinant of the IGT process is the family household as a domain of consumer socialization (Matthies and Wallis 2015; Sears 1983). Socialization refers to the ways in which individuals learn skills, knowledge, values, motives, and roles appropriate to their position in a

group or society (Bush and Simmons 2017). Like other social behaviors, environmentally consequential behaviors may be passed through either implicit observation and imitation or an explicit act, such as replicating your grandparents' favorite foods (Carolan 2015). Further, IGT can occur through appreciation (e.g., gardening with grandfather), shared experiences (visiting grandparents' farm), or observation (grandmother watching granddaughters) (Chawla 1999; Greenspan et al. 2022).

The IGT literature privileges the study of relations and socialization within the two-generation nuclear family of married couples with young children (Aghayeeabianeh and Talebi 2020). This tendency fails to consider extended family relationships, including grandparent-grandchild interactions that may also exhibit IGT of environmental behaviors. There are good reasons to consider grandparents' behavioral and attitudinal influences on their grandchildren (Griggs et al. 2009), especially where they co-reside (Ellis and Simmons 2014). When old and young generations live together – especially if grandchildren receive care from the grandparents – the young generation naturally socialize, and comes to learn daily skills, social norms, values, wisdom, and behaviors from the older members of the family (Shahrier, Kotani, and Saijo 2017). This socialization process is often referred to this as the "vertical transmission" of knowledge and behavior (Shahrier, Kotani, and Saijo 2017).

Indeed, three-generation transmission has also been examined by other social scientists like sociologists and psychologists in areas such as antisocial and aggressive behavior (Conger et al. 2003), mental health (Hancock et al. 2013), eating behavior (Jingxiong et al. 2007; Rhodes et al. 2016), and religious practices (Bengtson et al. 2009). Adding to this conversation, our research asks: Is there IGT concerning environmental practices and behaviors across three generations? It is reasonable to expect such transmission when children observe and hear narratives or share hands-on experiences with their grandparents.

To fully understand IGT between grandparents and children, we also seek to understand parental influence, which is likely to mediate this grandparent-grandchild relationship. Parental mediation is observed in studies involving grandchildren and grandparents in domains such as education (Luo et al. 2020), and substance abuse (Bailey et al. 2006). However, to our knowledge, very few studies examined three-generation IGT of environmental behaviors. One exception is Filimonau et al. (2023) recent study, which employed structural equation modeling to examine three consumer generations and their intentions to reduce food waste. This approach emphasizes the moderating effect of generations in determining an individual's behavior. Our study considers the mediating role of parents when investigating the shared environmental behaviors of grandparents and children beyond food waste reduction.

We conduct our research in the US, and thus a brief review of the role of grandparents is offered to provide the context for our three-generation IGT study. Growing evidence suggests the increased intensity of grandparent-grandchild interactions, with an estimated 7.1 million grandchildren under the age of 18 living with their grandparents, while nearly 40% are involved in the care for their grandchildren on a part-time or full-time basis (Dolbin-MacNab and Hayslip 2014; Ellis and Simmons 2014; Meyer and Kandic 2017). These data suggest that grandchildren and grandparents have multiple opportunities to interact and for IGT of environmental behaviors to occur. Thus, our focus on three-generation IGT is reasonable given the US context on multigenerational living arrangements and interactions.

Our study adds to the extant literature on IGT of environmental behavior in two ways. First, we investigate IGT on environmental behaviors across three generations, from grandparents to children. To do this, we first show that it is possible to use other-reported (perceived) data instead of self-reported data to infer the environmental behaviors of the grandparents. Second, we focus on the IGT of environmental behaviors using parent-child dyads where the child is a young adult (18-28 years) (Levinson 1986). By recruiting such a sample, we examine if IGT is

robust as children get older and more independent in their behavioral decisions (Haustein, Klöckner, and Blöbaum 2009; Sanson, Burke, and Van Hoorn 2018).

The data on grandparent behavior thus enables analysis of IGT within grandparent-parent and grandparent-child dyads. We further parse out how much of the IGT between children and grandparents' behaviors is mediated by parents' behaviors. Finally, it is also important to note that our study adds to the understanding of IGT of environmental behaviors a robust empirical analysis that relies on survey data administered to a nationally representative sample of American family dyads (parent and child respondents).

3. Research questions, analytic model, and hypotheses

Our primary research questions are: (1) Is there IGT of environmental behaviors across two generations (parents and children in addition to grandparents and parents) within a family? (2) Is there IGT of environmental behaviors across three generations (grandparents and children) within a family? (3) Is there IGT of environmental behaviors across three generations (grandparents and children) within a family when mediated by parents' behaviors?

Figure 1 provides an analytic framework for these research questions and displays the relevant hypotheses. For ease of representation, the grandparents are marked hereinafter as **G1**, parents as **G2** and children as **G3**. Table 1 provides the hypotheses referenced in the analytic figure (Figure 1).

Parents and children (G2 and G3) are direct participants in the survey. Their responses to survey questions are self-reported (**G2R** and **G3R,** where R stands for **reported**). The eldest generation, grandparents (G1), are not direct participants in the survey. Direct responses from G1 were not collected for this research. In designing the survey instrument, we conducted a qualitative study with 6 intergenerational families. All three generations were present. We assess

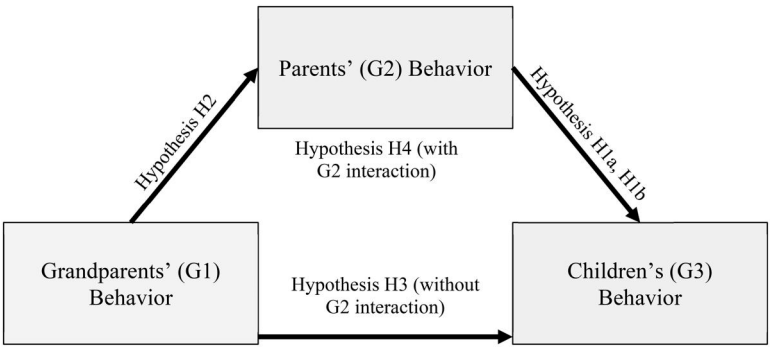

Figure 1. Analytical Framework.

Table 1. Summary of Hypotheses.

Interaction/Link	Hypothesis
IGT between Parents (G2) and Children (G3)	**H1a** Parents' self-reported behaviors (G2R) are significantly and positively correlated with children's self-reported behaviors (G3R)
	H1b Parents' perceived behaviors (G2**P**) are significantly and positively correlated with children's self-reported behaviors (G3R)
IGT between Grandparents (G1) and Parents (G2)	**H2** Grandparents' perceived behaviors (G1**P**) are significantly and positively correlated with the parents' self-reported behaviors (G2R)
IGT between Grandparents (G1) and Children (G3)	**H3**: Grandparents' perceived behaviors (G1**P**) are significantly and positively correlated with children's self-reported behaviors (G3R)
IGT between Grandparents (G1) and Children (G3) mediated by parents	**H4**: Grandparents' perceived behaviors (G1**P**) are significantly and positively correlated with children's self-reported behaviors (G3R) when mediated by parents' self-reported behaviors (G2R)

the frequency of their behaviors as **perceived** and reported by G2 (G1's children). We denote G2's responses to G1's perceived behavior as **G1P** (where P denotes **perceived** behavior).

To assess the validity of our method of using *perceived* behaviors in lieu of *reported* behavior, we turn to data on parents (G2) whose behaviors are both self-reported (G2R) and reported as perceived by their children (G2**P**). We find strong relations between perceived (G2**P**) and reported (G2R) behaviors of G2, suggesting that we may rely on perceived behaviors when self-reported behaviors are unavailable. However, in those analyses where either G2P or G2R may be used, we choose G2R as the more robust measure. Utilizing reported and perceived behavior drawn from the survey enables a three-generation analysis of IGT of nine measured environmental behaviors.

4. Methodology

4.1. Research design

An online, cross-sectional, and nationally representative survey of parent-child dyads was conducted in the United States in 2018.

4.2. Respondents and data collection

A US-based survey firm deployed an anonymous questionnaire to their online panel. Participants were selected according to age criteria. Respondents met eligibility if parents were between 42 and 61 years of age at the time of the survey and their children were between 18 and 28. This age delineation ensured that parents were coming of age at the beginning of the global environmental movement, and their children grew up following the onset of environmental issues being incorporated into public discourse. In addition, the children's age group ensured that a child's family influence and personal independence were both present in their behavioral decisions.

Parents within the selected panel who had children in the appropriate age group received an email to an anonymous online survey. Parents were prompted to invite their children to participate by providing their children's email address. In some cases, the recruitment method worked in the opposite direction, in which young adults fitting the age criteria were surveyed first and then asked to invite their parents. All participants consented using the online system, in line with university ethics guidelines. The online survey took 15 minutes to complete.

4.3. Sample

The final sample consisted of 541 parent-child dyads and was generated from a non-probability sample; however, it represented the general population in the USA in terms of geographic distribution and ethnic background. The mean age of parents was 52.6 (SD = 5.03), the mean age of children was 23.9 (SD = 3.18), and the gender distribution was almost equal, with 55% identifying as women. The recorded socio-demographic characteristics are detailed in the measurement section.

4.4. Instrument and variable measurement

The authors designed the survey instrument for a larger project on the IGT of environmental behaviors within the family. Participants were asked to report *their* frequency of nine environmental behaviors at the time of the survey, and how they perceived the frequency of *their parents'* engagement in this same set of nine environmental behaviors when the participant was in high school. The time of high school was chosen because this period of adolescence reflects a stage of

life in which individuals still live in the house. Furthermore, their adulthood memories are strong enough to remember what their parents did during their childhood. Research instruments asking respondents retrospective questions about their parents have been used in various fields (e.g., Hancock et al. 2013; Yaish and Katz-Gerro 2012).

The self-reported question read: "How often do **you** perform the following activity?" while the other-reported question read, "To the best of your recollection, how often did **your parents** perform the following activities in your youth around the time you were in high school?"

The nine behaviors were: reducing electricity consumption, reducing water consumption, recycling waste, buying organic food, avoiding disposable dishes, repairing or donating unused clothes, keeping a vegetarian or vegan diet, performing environmental advocacy activities such as donating, volunteering, petitioning, demonstrating and participating in outdoor activities with the family. Responses utilized a 5-point Likert scale ranging from 1 = Never to 5 = Always. Descriptive statistics on frequency of behavior by gender and generation are presented in Table A1 (appendix). A copy of the questionnaire is available upon request.

The main variables of interest for the nine environmental behaviors are:

1. **G3R:** self-reported frequency of the children's (G3) behavior.
2. **G2R:** self-reported frequency of the parents' (G2) behavior.
3. **G2P:** the perceived behavior of the parents (G2), as reported by their children (G3).
4. **G1P:** the perceived behavior of the grandparents (G1), as reported by the parent respondent (G2).

Socio-demographic control variables include: **gender** (Binary: Female = 1); **education** (a 3-point scale of "high school or less"=1, "some college"=2, "college degree or more"=3); **race/ethnicity** ("White Non-Hispanic"=1, "Black Non-Hispanic"=2, "Hispanic"=3, "Other Non-Hispanic"=4); employment status ("Full time"=1, "Part time"=2, "Not employed"=3;, **household size** (ranges from 1 to 14); **region** ("Northeast"=1, "South"=2, "Midwest"=3, "West"=4), **household income** (5 categories ranging from "Under $30,000" to "$100,000 and over"); **religiosity** (5-point scale from "not religious at all"=1 to "very religious"=5); **economic views** (5-point scale from "very liberal"=1 to "very conservative"=5); and **political views** (5-point scale from "very liberal"=1 to "very conservative"=5).

To avoid multicollinearity, we only control for the characteristics of the *younger respondent* within the dyad of each model. For example, in analyzing the relationship between the environmental behaviors of the children (G3) and grandparents (G1), only G3's controls are included. Similarly, when examining the relationship between grandparents (G1) and parents (G2), only G2's controls are included. Table A2 (appendix) showcases a summary for the demographic variables and the last column presents the correlations of these variables between generations. While some of these (such as gender and employment status) are weakly related, a strong relationship exists for variables like Race/Ethnicity and Region.

4.5. Analytic procedure

We sequentially test our hypotheses: **First step:** we test if parents' self-reported behaviors (G2R) are significantly and positively correlated with the children's self-reported behaviors (G3R) to examine **H1a**. We run nine linear models, one for each behavior, where the dependent variable is G3R, and the main independent variable is G2R. We include sociodemographic controls of G3. Behaviors that have statistically significant coefficients in the linear model imply IGT. Additionally**, H1b** tests IGT between parents and children when parent behavior is other-reported by G3 (rather than self-reported). This tests whether the parents' perceived behaviors (G2P) significantly and positively correlate with the children's self-reported behaviors (G3R). The same

analytical step was run for all behaviors. Additional methodological analyses, detailed in Section 4.6, are run to validate the similarity between self-reported and other-reported behaviors before testing **H2**.

Second step: Having shown significant associations between reported and perceived behaviors in the methodological test, we examine **H2** and **H3**, the IGT between grandparents (G1P) and *their* children (G2R), as well as the relationship of grandparents (G1P) with *their grand*children (G3R). Like the first step, linear regression models are utilized to test for IGT between three generations.

Third step: H4 tests the relationship between grandparents' (G1P) and children's (G3R) environmental behavior when mediated by parents' behaviors (G2R). Mediation analysis with bootstrapping is employed. The analytic structure of this section follows Vandewater et al. (2014) while the final estimates rely on algorithms described by Imai, Keele, and Tingley (2010).

4.6. Validating the data for G1

In addition to **H1a** and **H1b**, we take a closer look at the similarities between parents' reported behaviors (G2R) and their perceived behaviors (G2P) as reported by their children (G3). Comparing these variables validates our use of grandparents' perceived behaviors (G1P).

We validate our findings in two ways. First, we run Pearson's correlations between G2R and G2P for each of the nine environmental behaviors. A positive and significant correlation implies that G2P and G2R have a linear relationship. Then we undertake a bootstrapping approach to observe the distribution of the average difference between G2R and G2P for each behavior given 10,000 samples with replacement. The null hypothesis purports no difference in the population mean between all pairs. If the resulting confidence intervals contain zero or show values of a small deviation from zero, there is strong evidence for no significant difference between reported and perceived behaviors.

We use bootstrapping because, unlike *t*-tests or McNemar's test, it does not require assumptions about the underlying distribution of the data. Additionally, it provides multiple statistics around the point of interest. The metric of mean paired difference also removes the dependence caused by family pairings. Unweighted data is used since it is only necessary to show that G2R is internally consistent with G2P.

4.6.1. Results of validation

Table 2 presents the results of the methodological comparison of G2R and G2P. The second column reports the Pearson correlations between G2P and G2R. All the self-reported (G2R) and the other-report (G2P) variables are significantly and positively correlated, ranging from 0.348 to 0.644.

In addition to ensuring a positive, significant correlation, we examine the mean difference between G2P and G2R using paired bootstrapping indicating the extent and direction of variation between the two variables. Column 3 presents the parameter of interest the population mean of the average difference for the nine behaviors. The fourth column of Table 2 shows the confidence intervals for this statistic. In four of the nine behaviors, the confidence interval for the difference in means between populations contains zero, suggesting no significant difference exists. In the five other behaviors, the magnitude of intervals ranges between 0.671 and 0.850, Indicating that the largest deviation from 0 has an average difference of less than 1 on a scale of 1–5. This finding implies that a child's perception of their parent's behavior is closely aligned with the actual reported behavior of their parent. Considering this validation analysis, we conclude that using G1 behaviors as perceived by G2 (who are their children), is a reasonable proxy in undertaking a three-generation analysis.

5. Findings

We report our findings in the order of our four hypotheses.

Hypothesis H1a: The left side of Table 3 (Model 1) reports the linear regression coefficients and adjusted R-squared for the nine reported behaviors between parents (G2R) and children (G3R). This model corresponds to hypothesis H1a. Findings suggest that the explanatory power of the parent's reported environmental behavior in the presence of sociodemographic controls is positive and statistically significant at the 0.001 level for all environmental behaviors except for reducing water consumption which is statistically significant at the 0.01 level (regression coefficients ranging from 0.218 to 0.533). This implies that IGT of reported behaviors between parents and their young-adult children exists in the US, confirming **H1a**.

Hypothesis H1b: The right side of Table 3 (Model 2) reports the same metrics for each of the nine reported behaviors between parents' perceived behavior (G2P) and children's reported behaviors (G3R). The explanatory power of the parent's perceived environmental behavior in the linear regression is positive and statistically significant at the 0.001 level for all environmental behaviors (coefficients range from 0.362 to 0.670). The right side of Table 3 confirms **H1b,** showing that IGT exists in the US for the perceived behaviors of parents and reported behavior of their young-adult children.

Hypothesis H2: Table 4 presents the relationship between G1P and G2R is shown in. Coefficients from the regression models (ranging from 0.245 to 0.487) are statistically significant at the 0.001 level for all 9 behaviors. These results confirm **H2**.

Hypothesis H3: Table 5 presents the relationship between grandparents' perceived behavior (G1P) and children's reported behavior (G3R). All coefficients are positive and significant,

Table 2. Pearson's correlations, bootstrap means, and bootstrap confidence intervals of paired differences between G2R and G2P.

Behavior	Correlation	Mean of Bootstrap Distribution	Bootstrap 95% Confidence Interval
Reduce electricity consumption	0.421***	0.301	(0.205, 0.396)
Reduce water consumption	0.396***	0.165	(0.057, 0.270)
Recycle waste	0.549***	0.069	(−0.035, 0.175)
Buy organic food	0.621***	−0.202	(−0.285, −0.119
Avoid using disposable dishes	0.449***	−0.011	(−0.124, 0.102)
Repair or donate clothes	0.348***	0.018	(−0.079, 0.113)
Participate in environmental advocacy	0.502***	0.119	(0.028, 0.209)
Keep a vegetarian diet	0.644***	0.034	(−0.041, 0.110)
Participate in outdoor activities	0.536***	0.760	(0.671, 0.850)

Significance levels for correlations: *$p \leq .05$, **$p \leq .01$, ***$p \leq .001$.

Table 3. Linear regression models for nine behaviors between G2 and G3.

	Model 1, G2R and G3R		Model 2, G2P and G3R	
Behavior	Regression Coefficient (SE)	Adjusted R-Square	Regression Coefficient (SE)	Adjusted R-Square
Reduce electricity consumption	0.327*** (0.083)	0.124	0.424*** (0.066)	0.167
Reduce water consumption	0.218** (0.076)	0.072	0.386*** (0.066)	0.154
Recycle waste	0.475*** (0.060)	0.286	0.538*** (0.051)	0.344
Buy organic food	0.482*** (0.047)	0.307	0.434*** (0.053)	0.305
Avoid using disposable dishes	0.302*** (0.069)	0.161	0.489*** (0.051)	0.319
Repair or donate clothes	0.392*** (0.070)	0.163	0.526*** (0.060)	0.264
Participate in environmental advocacy	0.360*** (0.063)	0.224	0.362*** (0.051)	0.245
Keep a vegetarian diet	0.431*** (0.070)	0.253	0.400*** (0.073)	0.242
Participate in outdoor activities	0.533*** (0.058)	0.290	0.670*** (0.040)	0.455

Significance levels for coefficients: *$p \leq .05$, **$p \leq .01$, ***$p \leq .001$.
Controls used are gender, education, race/ethnicity, employment status, household size, region, household income, religiosity, economic views, and political views.

although the strength of this significance is diminished – as reflected in both the value of the coefficient and the magnitude of the adjusted R-square. The coefficients for these models range from 0.125 to 0.361, confirming **H3** that a relationship exists between grandparents' and their grandchildren's behaviors.

Hypothesis H4: Lastly, given possible parental mediation, we examine the transmission of environmental behaviors from grandparents to children. Table 6 presents the results of the mediation analysis with bootstrapping. The total effect is the relationship between G1 and G3 without considering G2. The indirect effect is the influence mediated by the parents. The direct effect shows the direct association of G1 and G3 after accounting for G2. Seven out of nine behaviors are significantly mediated by the parents, leaving no direct effect between grandparents and children. The other two behaviors - reducing electricity consumption and participating in environmental advocacy – are instances where grandparents significant impact their grandchild's behavior, even when accounting for parent, which suggests that H4 is partially confirmed. Table A3 presents further sensitivity analysis using G2P rather than G2R, there are no significant changes to conclusions.

Table 4. Linear regression models for nine behaviors between G1P and G2R.

Behavior	Coefficient (SE)	Adjusted R-Square
Reduce electricity consumption	0.290*** (0.054)	0.141
Reduce water consumption	0.308*** (0.051)	0.184
Recycle waste	0.245*** (0.047)	0.132
Buy organic food	0.442*** (0.044)	0.336
Avoid using disposable dishes	0.336*** (0.056)	0.189
Repair or donate clothes	0.258*** (0.053)	0.184
Participate in environmental advocacy	0.446*** (0.063)	0.391
Keep a vegetarian diet	0.487*** (0.072)	0.332
Participate in outdoor activities	0.372*** (0.056)	0.249

Significance levels for coefficients: $^{*}p \leq .05$, $^{**}p \leq .01$, $^{***}p \leq .001$.
Controls are same as previous models.

Table 5. Linear regression models for nine behaviors between G1P and G3R.

Behavior	Coefficient (SE)	Adjusted R-Square
Reduce electricity consumption	0.236*** (0.054)	0.103
Reduce water consumption	0.159** (0.056)	0.061
Recycle waste	0.125* (0.054)	0.122
Buy organic food	0.287*** (0.055)	0.205
Avoid using disposable dishes	0.163** (0.060)	0.098
Repair or donate clothes	0.173** (0.062)	0.109
Participate in environmental advocacy	0.361*** (0.058)	0.253
Keep a vegetarian diet	0.360*** (0.072)	0.210
Participate in outdoor activities	0.298*** (0.060)	0.147

Significance levels for coefficients: $^{*}p \leq .05$, $^{**}p \leq .01$, $^{***}p \leq .001$.
Controls are same as previous models.

Table 6. Total, Indirect, and Direct Effects for nine behaviors between G1P, G2R, and G3R.

Behavior	Total Effect (on G3)	Indirect Effect (of G2)	Direct Effect (of G1)
Reduce electricity consumption	0.222***	0.073**	0.149*
Reduce water consumption	0.169**	0.048*	0.121
Recycle waste	0.135**	0.119***	0.016
Buy organic food	0.202***	0.161***	0.041
Avoid using disposable dishes	0.118*	0.090***	0.027
Repair or donate clothes	0.168***	0.099***	0.069
Participate in environmental advocacy	0.270***	0.097***	0.173***
Keep a vegetarian diet	0.246***	0.149***	0.097
Participate in outdoor activities	0.283***	0.173***	0.111

Significance levels for coefficients: $^{*}p \leq .05$, $^{**}p \leq .01$, $^{***}p \leq .001$.
Controls are same as previous models.

6. Discussion and conclusion

We tested in this paper IGT of nine environmentally consequential behaviors among three generations of American families. We used original data from a cross-sectional survey on environmental behaviors by parents and children who also reported on the perceived behaviors of grandparents and parents (reported by parents and children, respectively). We estimated models for the relationship between the environmental behaviors of three generations within families.

Parent (G2R) and child (G3R) behaviors are significantly associated, confirming H1a (Table 3), similar to results in previous research (for example, Gong et al. 2022; Grønhøj and Thøgersen 2009). The effects of this association are around 0.4, with recycling waste, buying organic food, and participating in outdoor activities holding the largest magnitudes. Parents' perceived behaviors (G2P) are also significantly and positively correlated with children's self-reported behaviors (G3R) (confirmation of H1b in Table 3), and the implementation of perceived behavior increases the magnitudes of the correlation between parents' and children's behaviors in most cases. Along with additional analyses, this finding supports the use of the perceived behavior of a parent as a proxy for self-reported behavior.

Grandparents' perceived behaviors (G1P) are significantly and positively correlated with the parents' self-reported behaviors (G2R) – confirming H2 (Table 4). The effect sizes between G1 and G2 average around 0.35, with the largest associations occurring for following a vegetarian diet, participating in environmental activities, and buying organic foods. The differing magnitudes for behaviors between G2 and G3 (Table 3) versus G1 and G2 (Table 4) suggest the likelihood of generational differences in practices. Additionally, grandparents' perceived behaviors (G1P) are significantly and positively correlated with the child's self-reported behavior (G3R) (confirmation of H3 in Table 5), although with smaller magnitudes. These models suggest that intergenerational transmission exists across the three generations. However, the effects for specific activities are generation-dependent and may decrease given an additional generation as a mediating force.

IGT across three generations mirrors similar findings, for example, about religious practices (Bengtson et al. 2009) or smoking (Vandewater et al. 2014), raising the question of whether IGT occurs in other behaviors as well. Finally, we established that in more than half of the cases, the associations between the environmental behaviors of grandparents and grandchildren are mediated by the parent's behavior, suggesting only partial confirmation of H4.

We note that the link between G1 and G3 (mediated by G2) is significant for all behaviors. A more nuanced interpretation is needed since the association between G1 and G3 is mediated by the parent's behavior in more than half of the measured behaviors. One possible interpretation is that certain measured behaviors – such as those related to organic food and disposable dishes – were not as available to the G1 generation as compared to G2 and G3. In contrast activities such as participating in outdoor activities were common for both G2 and G1 generations. This explanation emphasizes the prevalence of behaviors in different generations and their influence on potential IGT.

From another possible perspective, the behaviors with both direct and indirect G1–G3 effects are those undertaken jointly across all three generations. In behaviors like participating in environmental activism, there is a sense of interaction that facilitates the success of such behaviors. Additionally, conservation activities like reducing electricity consumption is a practice that occurs regardless of age or socio-economic status. These behaviors require active socialization, similar to findings in Katz-Gerro et al. (2020), where active socialization was most influential in transmitting environmental behaviors across generations.

Our data focus on children who are young adults (18–28), demonstrating that IGT is consistent as the child becomes an adult. In addition, our methodological contribution shows that perceived or other-reported behaviors within families may be used as a proxy of self-reported behavior and can be helpful in future research on IGT when certain generations cannot be surveyed.

Our findings suggest several ways in which to promote environmentally friendly behaviors. Since the IGT of environmental practices is robust in young adulthood, incentivizing household behaviors may be a productive strategy. Through IGT, the practices of each generation are passed down. For example, although reducing the use of electricity may be the normative behavior due to scarcity of resources, this behavior passes down through generations despite the changes in the family's socioeconomic status. Practices learned at home in saving and recycling resources may counterbalance the promotion of consumerism.

Our research has limitations typical to survey research. We rely on self-reported behaviors, and in these times of increasing pressure of climate change, respondents may be inclined to exaggerate the pro-environmental behaviors they have undertaken. As all survey researchers, we rely on the honesty of respondents, and by using anonymized internet surveys we reduce social desirability bias. Another limitation, detailed in the method section, is the use of perceived behavior in the absence of self-reported behaviors by grandparents. Although we validated the use of perceived behaviors (by matching perceived and self-reported behaviors for parents), there is concern that using perceived behaviors in lieu of self-reported behaviors may bias the findings. Lastly, our research uncovers correlation rather than causation in pro-environmental behaviors between generations; we cannot determine why and how such transmission occurs. While our analytical framework focused on transmission from grandparents to parents to children, we do not suggest that an opposite direction of influence, from the younger generation to the older, does not exist. The inability to isolate directionality does not significantly detract from our findings; instead, it suggests the need for future research.

Despite these limitations, our findings suggest the need for further research and some actions. For example, how to design educational strategies for the younger generation that can result in robust and sustainable behaviors that become integrated into household behaviors that are passed on through generations? Where are the behaviors best learned? While we have looked at IGT from older to younger generations, research is needed to establish if IGT is unidirectional: do youth learning new pro-environmental behaviors influence the behaviors of their parents (and grandparents)? Finally, does the context make a difference? Is IGT more prevalent in certain cultures? Can findings on IGT generalize to non-western countries? And, while we investigated nine different behaviors, there are other behaviors that still need to be explored.

Acknowledgements

This work was supported by the US-Israel Binational Science Foundation [grant number 2014080]. We thank the reviewers and editors for extensive and constructive comments.

Disclosure statement

We confirm that there are no relevant financial or non-financial competing interests to report.

Funding

This work was supported by the United States – Israel Binational Science Foundation [BSF Grant 2014080].

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Appendix

Table A1. Descriptive statistics of environmental behaviors by gender and generation.

	G3		G2		G1	
Behavior	Female Average (SE)	Male Average (SE)	Female Average (SE)	Male Average (SE)	Female Average (SE)	Male Average (SE)
Reduce electricity consumption	3.09 (0.07)	3.16 (0.08)	3.73 (0.05)	3.73 (0.11)	3.69 (0.06)	3.69 (0.13)
Reduce water consumption	2.99 (0.08)	3.01 (0.08)	3.64 (0.05)	3.65 (0.12)	3.44 (0.07)	3.45 (0.14)
Recycle waste	3.27 (0.08)	3.31 (0.09)	3.61 (0.06)	3.92 (0.12)	2.75 (0.08)	2.91 (0.16)
Buy organic food	2.48 (0.07)	2.01 (0.0697)	2.52 (0.05)	2.44 (0.11)	1.89 (0.07)	2.05 (0.14)
Avoid using disposable dishes	2.86 (0.07)	2.74 (0.09)	3.13 (0.06)	2.97 (0.13)	3.09 (0.07)	2.85 (0.13)
Repair or donate clothes	3.69 (0.07)	3.16 (0.09)	4.22 (0.04)	3.79 (0.11)	3.96 (0.06)	3.66 (0.13)
Participate in environmental advocacy	1.84 (0.06)	1.67 (0.06)	1.88 (0.05)	1.89 (0.11)	1.87 (0.06)	1.85 (0.13)
Keep a vegetarian diet	1.81 (0.07)	1.43 (0.06)	1.63 (0.05)	1.35 (0.08)	1.51 (0.05)	1.55 (0.11)
Participate in outdoor activities	2.80 (0.07)	2.83 (0.08)	2.69 (0.05)	2.80 (0.11)	3.34 (0.06)	3.30 (0.12)

Table A2. Descriptive statistics of sample and correlation between generations.

Behavior	G2	G3	Correlation Between Generations
Gender			
Female	45.7%	81.5%	0.21
Education			
High school or less	32.2%	22.7%	0.49
Some college	41.6%	44.2%	
College degree or more	26.2%	33.1%	
Race/Ethnicity			
White non-Hispanic	78.2%	84.5%	0.79
Black non-Hispanic	7.9%	8.3%	
Hispanic	7.6%	4.4%	
Other non-Hispanic	6.3%	2.8%	
Employment Status			
Full time	47.0%	50.8%	0.12
Part time	25.0%	16.1%	
Not employed	28.1%	33.1%	
Region			
Northeast	19.6%	19.8%	0.96
South	35.1%	34.2%	
Midwest	29.6%	29.9%	
West	15.7%	16.1%	
Household Income			
Under $30,000	31.2%	16.5%	0.59
$30,000–$49,999	25.1%	20.9%	
$50,000–$74,999	17.6%	24.4%	
$75,000–$99,999	13.5%	15.9%	
$100,000 +	12.6%	22.4%	
Household Size	3.24	3.19	0.47
Religiosity ('not religious at all' = 1 to 'very religious' = 5)	2.43	3.04	0.50
Economic views ('very liberal' = 1 to 'very conservative' = 5	2.85	3.17	0.44
Economic views ('very liberal' = 1 to 'very conservative' = 5	2.85	3.12	0.45

Table A3. Sensitivity Analysis of Total, Indirect, and Direct Effects for nine behaviors using G1P, G2P, and G3R.

Behavior	Total Effect (on G3)	Indirect Effect (of G2)	Direct Effect (of G1)
Reduce electricity consumption	0.222***	0.079***	0.142*
Reduce water consumption	0.169**	0.078***	0.090
Recycle waste	0.135***	0.080***	0.055
Buy organic food	0.202***	0.181***	0.021
Avoid using disposable dishes	0.118*	0.109***	0.008
Repair or donate clothes	0.168**	0.113***	0.055
Participate in environmental advocacy	0.270***	0.092***	0.178***
Keep a vegetarian diet	0.246***	0.155***	0.092
Participate in outdoor activities	0.284***	0.215***	0.116

Significance levels for coefficients: $^{*}p \leq .05$, $^{**}p \leq .01$, $^{***}p \leq .001$.
Controls are same as previous models.