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Dynamics and Heterogeneity of Environmental Attitude, Willingness and Behavior in Germany from 1993 to 2021

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Abstract: This paper analyzes environmental attitude, willingness, and behavior using a relatively broad range of survey items from the four Environment Modules of the International Social Survey Programme (ISSP) in Germany. The ISSP Environment Module is a repeated cross-sectional large-scale survey in Germany covering a period of nearly 30 years with four survey waves (1993, 2000, 2010, and 2020). We find that environmental attitude, willingness, and behavior are relatively stable between 1993 and 2010 in Germany. However, in the fourth wave, we find a significant upward trend in attitude and willingness compared to 2010—even though the COVID-19 pandemic was omnipresent at the time of the survey. This could indicate that climate change and environmental issues have gained such significance that they cannot easily be fully displaced by other major events, such as a pandemic. Moreover, we detect systematic heterogeneity in environmental attitude, willingness, and behavior predominantly with respect to respondents' education, residential region, and political orientation but also some heterogeneity regarding gender, age, and income. Finally, we reveal that the dynamic of environmental attitude, willingness, and behavior also depends on certain socio-demographic characteristics, such as residential region, or political orientation. Our findings are essential for a better understanding of the social feasibility of transformation pathways towards a sustainable energy system.

Keywords: environmental attitudes; pro-environmental behavior; willingness to pay; energy transition pathways; sustainable energy system; heterogeneity analysis

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1. Introduction

In order to reduce CO_2 emissions and attenuate global warming, governments worldwide are fostering the transformation of the current electricity, heat, and mobility sector (i.e., energy system). Researchers are designing alternative energy systems to meet CO_2 reduction targets and developing energy transformation paths with which the target energy system can be realized. All measures to transform the energy system affect citizens individually (e.g., through wind turbines in their neighborhood) and/or jointly (e.g., through the costs of energy). This makes private citizens a central actor when considering energy transformation paths. Hence, both to gain political support for, as well as to implement these measures, they have to be endorsed by citizens (e.g., [1–5]). In this transformation process towards a new energy system, the widespread use of renewable energy plays a crucial role (e.g., [5,6]).

In Germany, the transformation of the energy system is most advanced in the electricity sector. The introduction of the Renewable Energy Sources Act (EEG) in 2001 created an important legal regulatory framework that is driving the German energy transition in this sector and is a central pillar of the "Energiewende" [7]. Accordingly, citizens have to actively invest in renewable energy sources to cover their energy needs, e.g., in the form of PV systems, solar thermal installations, heat pumps, or electric cars. Moreover, they also have to accept changes to the infrastructure as required for an energy system

based on renewable energy. These changes include, for example, changes in the natural environment and the landscape due to an increasing number of wind turbines in a specific area (including one's own neighborhood) or the construction of high-voltage transmission lines to transport power from the place of production to the place of consumption. In both cases, civil protests have been delaying the development and construction of the necessary infrastructure [8,9]. The acceptance of carbon capture and storage is another and even more delicate example of an issue where public acceptance is necessary for this technique to be used to reduce CO_2 emissions in the near term (e.g., [10–12]). In this respect, environmental attitude, willingness, and behavior have shown to be related to the acceptance (e.g., [13–15]) and the (intended) adoption (e.g., [16–20]) of renewable energy technologies, even though environmental attitude cannot necessarily be taken as a perfect predictor of local acceptance, e.g., in the case of wind turbines (e.g., [21]). Citizens also have to change their usage behavior through, e.g., energy efficient heating and ventilation behavior or a reduction of car use. Energy efficient usage and consumption behavior play an important role in achieving energy efficiency targets that are anchored in the German "Klimaschutzgesetz (KSK)" [22] and are likely to be positively related to pro-environmental attitude, willingness, and stated behavior (English translation: Climate protection law).

In other words, researchers and practitioners can design the perfect energy system and develop the fastest and most economically efficient transformation path to this system, but if citizens do not adapt their usage and energy consumption behavior or engage in this transformation by adopting small-scale technologies and/or passively accepting renewable large-scale technologies together with the associated infrastructural changes as key elements of this path, the transformation process is less likely to be successful and the intended energy system will be more difficult to put into practice.

Against this background and in the context of the attitude–behavior gap, which has been shown to be empirically relevant (e.g., [23–25]), it is insightful to separately examine how environmental attitude, willingness, and behavior have evolved in Germany over time, sincePeoples' willingness to act in a certain way can be seen as a bridge between their attitude and behavior, as they can be seen as a behavioral intention [26]. By doing this, we can attain a better understanding of which transformation might be possible and under which conditions (e.g., [1–5]). In addition to examining how environmental attitude, willingness, and behavior have evolved over time, it is also important to know how they differ between different social groups and how these differences have evolved over time. Policy makers can then specifically target measures at different social groups, and incorporate possible changes in the environmental attitude, willingness, and behavior of these groups.

The present paper attends to these issues by (1) assessing the prevalence of environmental attitude, willingness, and behavior in the present as well as at different points in the recent past; (2) studying determinants of environmental attitude, willingness, and behavior; and (3) exploring how the heterogeneity of environmental attitude, willingness, and behavior between these social groups has evolved. Since we have to rely on the use of secondary data, the operationalization of these three core concepts is largely guided by data availability.

As a first step, we assess the dynamics of environmental attitude, willingness, and behavior in a repeated cross-sectional large-scale survey in Germany. At the latest since the United Nations Conference on Environment and Development in 1992 (Rio de Janeiro, Brazil), sustainability has played a central role in many societies, and it has even evolved into a leitmotif for various political, economic, and civil society (collective) actors (e.g., political institutions, decision makers in business, NGOs), guiding them in their actions [27] (p. 3). The guiding principle of sustainability can be understood as a contextual factor at the societal level that has led individuals to become more aware of the issues and importance of sustainable action over the course of their lives and to reconsider their attitude, willingness, and behavior towards the environment accordingly for two reasons. Firstly, sustainability is an intrinsically normative concept [28]. This normative understanding on the part of actors

who have internalized sustainability as a leitmotif is likely to be translated into normative expectations regarding the behavior of others. Against this background, sustainability can be understood as a normative norm [29] that can influence the thinking and actions of actors. Secondly, sustainability is likely to provide actors with increasing guidance in the sense of a descriptive norm [29] to the extent that the number of sustainably thinking and acting actors in a society increases over time. It is therefore to be expected that environmental attitude, willingness, and behavior became more positive in Germany in the past few decades. However, a recent study by the Umweltbundesamt [30] found that, despite an overall positive trend, the share of people who care about environmental problems is volatile over time. Furthermore, Hartmann and Preisendörfer [31] found both upwards and downwards trends of environmental worries in the last four decades. It is important to note that these studies only focus on attitudes. However, the concepts of willingness and stated behavior are likely to be more closely related to actual environmental behavior (e.g., [26,32]). Therefore, in this study, we examine whether and to what extent environmental attitude, willingness, and stated behavior (in the following referred to as behavior) changed between the years 1993, 2000, 2010, and 2021 by using a relatively broad range of available indicators of 10 survey items.

An advantage of this study is that it incorporates data from the latest ISSP Environment module, which has just been released with data stemming from interviews conducted in 2021. When we began this investigation in 2019, our hypothesis was that environmental attitude, willingness, and behavior would increase in future waves. This was based firstly on the enhanced presence of the debate on climate change and the environment in the media between 2014 and 2019 [33]—not least due to the Fridays for Future demonstrations—and secondly on the augmented probability of being affected by the adverse consequences of climate change, such as flooding or extreme heat. In fact, a study by Hartmann and Preisendörfer [31] also points in this direction, revealing that environmental worries in Germany increased considerably from 2018 to 2019. However, since the fourth wave of the Environment module was postponed from 2020 to 2021 and occurred in the midst of the COVID-19 pandemic, the formerly projected increase was less certain. There were uncertainties as to whether the pandemic would supersede the debate on climate change and the environment in the media and in people's everyday lives due to drastic personal consequences in the economic sphere, impacts on personal freedom, and the threat of adverse health consequences caused by the disease [34–36]. In this respect, analyzing the data from the fourth wave and comparing them to previous years is a crucial opportunity to examine whether the importance of climate change and environment issues—which, in the coming years, decades and centuries are expected to gain constantly more practical importance for the wellbeing of humanity—can potentially 'survive' temporarily overarching issues such as a pandemic.

As a second step, we establish the determinants of environmental attitude, willingness, and behavior, i.e., whether they differ between different social groups. A review paper by Blankenberg and Alhusen [37] establishes a relation between the socio-demographic characteristics age, education, income, and gender and different environmental behaviors by reviewing economic and psychological literature. Moreover, Preisendörfer [38] finds differences in environmental awareness and behavior between East Germany and West Germany. More precisely, Preisendörfer [38] determines that the willingness to pay for environmental protection is lower in East Germany than in West Germany, while the importance attached to environmental protection is similar in both regions. The author further establishes a difference in environmental awareness in the field of waste and energy and in environmental behavior in the field of consumption, energy, and transport, which results in an overall more positive environmental behavior of people living in East Germany. In the present paper, we examined whether environmental attitude, willingness, and behavior depend on respondents' gender, age, personal income, or political orientation, as well as whether respondents have a university degree or live in the East of Germany. To do so, we used a series of OLS regression models with respondents' socio-demographic charac-

teristics as independent variables. By this, we assess whether findings from Blankenberg and Alhusen [37] that center around 2014 to 2017 also hold for recent measurements of environmental attitude, willingness, and behavior. This part of our research is largely explorative, aiming to contribute further recent insights into the determinants of pro-environmental attitude, willingness, and behavior. Moreover, it forms the basis for the next step of our investigation.

As a third step, we examine how differences between these socio-demographic groups have evolved over time. On the one hand, the broadening base hypothesis [39] predicts that socio-demographic differences will become less pronounced as environmental hazards increase. In the last few decades, this was arguably the case with, e.g., global and local temperatures as well as climate risks rising [40,41]. Hartmann and Preisendörfer [31] find support for this hypothesis using data on environmental worries in Germany between 1985 and 2015. On the other hand, the economic contingency hypothesis [39] postulates that differences between socio-demographic groups will only disappear if economic conditions are favorable. If economic conditions worsen, economically more vulnerable groups of society will prioritize economic over environmental concerns. These vulnerable groups in Germany do not just comprise people with lower incomes, but also women, East Germans, as well as less well-educated people. Between 1993 and 2021, the GDP in Germany constantly rose, but so too did the poverty risk, especially for the economically more vulnerable groups. The real GDP per person in Germany rose from 75 in 1993 to 85 in 2000 and again from 94 in 2010 to 104 in 2021 (prices of 2015 = 100) [42]. The at-risk-of-poverty rate in Germany rose from 14.7% in 2005 (earliest available data) and 14.0% in 2006 to 14.5% in 2010 and 16.6% in 2021 [43]. In 2020, the at-risk-of-poverty rate was 15.3% for men compared to 17.0% for women, 15.6% in West Germany compared to 18.4% in East Germany, and 6.5% for persons with a high level of education compared to 38.9% for persons with a low level of education [44]. In 2000, these differences were substantially smaller for level of education [45]. In 2010, they were somewhat smaller for gender [46], while they were substantially higher between East and West Germans [43]. Based on the broadening base and the economic contingency hypothesis, we thus expect to find an increase in differences in environmental attitude, willingness, and behavior for gender and level of education and a decrease for demographic region despite environmental and climate change issues being more urgent in 2021 and more prominent in the media [33]. Furthermore, McCright and Dunlap [47] showed that people oriented towards the political left are more likely to believe in global warming than people oriented towards the political right. The issue of global warming has become more polarized between the different political streams over the last three decades. We therefore expect to find an increase in differences in environmental attitude, willingness, and behavior between people oriented towards the political left and those oriented towards the political right over the last three decades.

This paper is, to the best of our knowledge, the first to systematically study the dynamics and determinants of environmental attitude, willingness, and behavior by analyzing a broad range of survey items posed in the exact same wording in each of the four survey waves resulting in large cross-sectional datasets, covering both a large time horizon up until the present and a broad range of attitudes, willingness, and behaviors. Franzen and Vogl [48] also use the ISSP survey to compare environmental concerns in the first three waves for 33 countries. Our selection of items is slightly different, since we, e.g., also incorporate behavior items. This is important, since stated behavior is likely to be more closely related to actual behavior than e.g., attitude items. Moreover, we focus on the German case, incorporate data from the fourth wave of the ISSP Environment module, and also investigate how differences in environmental attitude, willingness, and behavior evolved between socio-demographic groups over time. The latter can inform policy makers who can then specifically target measures to achieve a sustainable transformation of the energy system and direct them at different social groups, while taking into account possible changes in environmental attitude, willingness, and behavior of these groups. The general assessment of the status quo of environmental attitude, willingness, and behavior is an

important point of departure when planning the implementation of measures to enhance sustainable energy usage and consumption behaviors. This enhancement is also an integral part of German Federal Government's Energy Efficiency Roadmap up to 2045 [22]. Therefore, our findings are essential for a better understanding of the social feasibility of transformation pathways towards a sustainable energy system.

2. Material and Methods

2.1. Data

We use repeated cross-sectional data from four waves (1993, 2000, 2010, and 2020) of the Environment Module of the International Social Survey Programme (ISSP) for Germany [49–52]. The ISSP is a continuous cross-national program that began in 1984 and has focused on 11 different survey topics since its beginning (e.g., environment, citizenship, work orientations). Surveys are conducted annually in several countries around the world. There are currently 50 ISSP member states. Since survey topics are repeatedly asked over time, ISSP provides secondary researchers with international comparative datasets with a longitudinal dimension on the repeated survey topics. However, survey items used for a particular survey module (e.g., Environment Module) can change or even be replaced over time, which may reduce the number of items that can be used for intertemporal analysis.

In this study, we restrict our analysis to the four waves of the Environment Module that were conducted in Germany (n_{wave1} = 2106 (=1092 (East Germany) + 1014 (West Germany)), n_{wave2} = 1501, n_{wave3} = 1407, n_{wave4} = 1702). Not all of the four waves of the ISSP Environment module were conducted by the same survey institute. This means that we cannot necessarily rule out "house effects" (e.g., [53–55]) (Background information: Wave 1993 was conducted by GFM-GETAS, Hamburg ([56] p. 10), which was later acquired by IPSOS [57]. Wave 2000 was conducted by Infratest ([58] p. 15); wave 2010 was conducted by TNS Infratest [51]; and wave 2020 was conducted by Kantar [52]). In Germany, target persons of the ISSP Environment studies were sampled in each wave according to a multistage sampling procedure in combination with population registers. The survey itself was designed as a self-completion questionnaire. In waves 1993 and 2000, questionnaires were given to target persons by interviewers. In 2010, the survey was designed as CASI. However, respondents could also request that the interviewer conducts a personal interview, whereas 21% of respondents chose to be interviewed by the interviewer, as can be concluded from the variable MODE in the ISSP data set. In the fourth wave, questionnaires were mailed to study participants due to the COVID-19 pandemic. The former implies that respondents self-completed the survey while interviewers may have been present in the room, but interviewers did not interact with respondents (Background information: In the context of heterogeneity in administration modes, we tested for mode effects among our three core concepts. However, we found no significant mode effects. Furthermore, in 2010, respondents who chose to be interviewed instead of self-completing the questionnaire reported an insignificantly lower environmental attitude, willingness, and behavior. This counterintuitive result in contrast to expected interviewer effects (i.e., as a consequence of social desirability) may be explained by the free choice of administration mode for participation in the survey.). The four waves also differ with respect to the weighting procedures that, if at all, were applied. The German ISSP dataset of wave 1993 contains a weighting variable that is based on the "demographic statistics provided by the German Statistical Office" ([54], p. 9), whereas wave 2000 was released without any weighting factor for German respondents ([48], p. 44). Waves 2010 ([49], pp. 2–3) and 2020 ([50], pp. 9–10) contain weighting variables that adjust for deliberately over-sampling respondents from five eastern federal states.

In total, the cumulative cross-sectional sample consists of 6716 individuals. Table 1 shows the (weighted) sample characteristics. In each wave of the survey, 52 to 53 percent of the sample are female, 7 to 41 percent have a university degree, and 17 to 52 percent live in the East of Germany. Furthermore, the average age in the four samples is between 45 and 53 years, while the average net personal income varies between €1162 and €3434 per month.

Table 1. Sample characteristics (weighted).

	Total		**1993**		**2000**		**2010**		**2020**	
Variable	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N
Age (years)	49.3 (25.2)	6716	45.3 (17.5)	2106	48.5 (17.2)	1501	51.0 (42.4)	1407	52.8 (18.8)	1702
Income (€) [a]	2160 (1945) [a]	4705	2358 (1412) [a]	791	3434 (2736) [a]	1162	1106 (947) [a]	1258	1938 (1444) [a]	1494
Variable	% of sample	N	% of sample	N	% of sample	N	% of sample	N	% of sample	N
Female	52.9	6708	53.0	2106	52.0	1501	53.4	1407	53.2	1694
Income (€) [a]										
0–1000	25.0		10.5		8.86		51.8		23.6	
1001–1900	30.4		34.0		19.5		34.5		33.3	
1901–3400	27.5		35.6		32.7		10.9		32.8	
>3400	17.0		19.9		38.9		2.8		10.3	
Univ. degree	17.4	6687	7.3	2105	8.1	1497	13.7	1405	41.4	1680
Region (East)	32.2	6716	51.9	2106	35.1	1501	18.2	1407	16.9	1702

Notes: N refers to the number of respondents who answered the respective item. [a] Net personal monthly income in € purchasing power of 2021 [59].

2.2. Survey Questions and Codings

Table 2 shows the selection of items that were used identically in all four waves of the ISSP Environment Module. They form the basis for the operationalization of the three core concepts in our study (i.e., environmental attitude, environmental willingness, and environmental behavior). The measurement of *environmental attitude* is based on respondents' (dis)agreement with statements in items 1 and 2; the measurement of *environmental willingness* is based on respondents' willingness to make personal (economic) sacrifices to protect the environment (items 3–5); and the measurement of *environmental behavior* is based on respondents' self-reported personal efforts for environmental protection (items 6–10).

For each of the three core concepts (attitude, willingness, behavior), we calculated an index as the mean of respondents' answers to the items in the respective group. Where a respondent did not answer all items that formed the basis of a concept, the index was calculated for the items the respondent did answer. If a respondent did not answer any of the items used to operationalize a particular concept, the given observation for this concept was dropped. The scales of items 3 to 9 were reversed compared to the original items for reasons of consistency with items 1 and 2. For item 10, respondents' answers were recoded as 'No' if they indicated 'Never' and as 'Yes' if they indicated 'Sometimes', 'Often', or 'Always', in order to subsume it in an index with questions 6–9. Overall, higher values of the scales for items 1 and 2 as well as the recoded scales for items 3 to 10 reflect a stronger pro-environmental orientation. Furthermore, the indices were normalized to have a scale between 0 and 1 to improve comparability across the different answer scales for the attitude, willingness, and behavior items. These normalized indices will be used in the analysis as dependent variables. For all three indices (i.e., environmental attitude, environmental willingness, and environmental behavior), higher index values reflect a stronger pro-environmental orientation.

Apart from the variables that form the basis for the operationalization of our dependent variables on environmental attitude, willingness, and behavior, we also consider respondents' gender, education, residential region, age, personal monthly net income, policy orientation, and a weighting factor in the analysis. Details on the underlying ISSP variables and any recoding that we undertook for the analyses can be found in Table A1 in the Appendix A.

Table 2. Operationalization of the three core concepts.

	Items	Scale	
	Environmental attitude	Original	Recoded
1.	We worry too much about the future of the environment and not enough about prices and jobs today.	1 Agree strongly 2 Agree 3 Neither agree nor disagree 4 Disagree 5 Disagree strongly	
2.	People worry too much about human progress harming the environment.		
	Environmental willingness		
3.	How willing would you be to pay much higher prices in order to protect the environment?	1 Very willing 2 Fairly willing 3 Neither willing nor unwilling 4 Fairly unwilling 5 Very unwilling	1 Very unwilling 2 Fairly unwilling 3 Neither willing nor unwilling 4 Fairly willing 5 Very willing
4.	How willing would you be to pay much higher taxes in order to protect the environment?		
5.	How willing would you be to accept cuts in your standard of living in order to protect the environment?		
	Environmental behavior		
6.	In the last five years, have you signed a petition about an environmental issue?	1 Yes 2 No	1 No 2 Yes
7.	In the last five years, have you given money to an environmental group?		
8.	In the last five years, have you taken part in a protest or demonstration about an environmental issue?		
9.	Are you a member of any group whose main aim is to preserve or protect the environment?		
10.	How often do you make a special effort to sort glass or tins or plastic or newspapers and so on for recycling?	1 Always 2 Often 3 Sometimes 4 Never	1 No (if Never) 2 Yes (if Often, Sometimes, or Always)

Notes: Available indicators in the ISSP Environment modules for identically measuring environmental attitude, willingness, and behavior in all four waves (1993, 2000, 2010, and 2020).

2.3. Methods

When analyzing complex survey data (i.e., data that were not gathered by simple random sampling to recruit survey participants), information on the sampling design (i.e., information on strata or clusters used in the sampling procedure) as well as any weighting factors (e.g., that account for sampling design features, non-response and/or undercoverage) must be considered in the analysis to reduce the risk of biased point estimates and/or incorrect variances [60]. However, as secondary researchers, we can only rely on information provided in the published datasets. Given the datasets used in this study, we can only consider the provided weighting factors and region as strata (cf. Table A1) using *svyset*. Svyset is a built-in procedure for the analysis of complex survey data in Stata (we used Stata 16.1 for our analysis), which we used for the estimation of descriptive as well as model parameters in the present study.

In the following, we will apply a complete case analysis which generally implies that descriptive analyses (cf. Sections 3.1 and 3.2) will be based on a higher number of observations than the regression analysis, since the latter disregards observations in the estimation procedure ("listwise deletion") if respondents have a missing value in at least

one of the model variables. Furthermore, we will use dummy coding for binary variables and weighted effect coding for categorical variables with more than two categories (income, age group, and political orientation in this study) in the heterogeneity analysis. Weighted effect coding has the advantage that estimation results do not depend on the choice of the reference category chosen for any non-substantial or arbitrary reason. Instead, weighted effect coded dummies capture the difference of a category's mean from the sample mean of the dependent variable, which allows us to examine whether or not certain categories perform significantly above or below average (cf. e.g., [61]).

3. Results

3.1. Environmental Attitude, Willingness, and Behavior over Time

Table 3 shows the share of respondents displaying a positive environmental attitude or behavior (i.e., disagree or disagree strongly for items 1 and 2, fairly willing or very willing for item 3–5, yes for item 6–9, and sometimes, often, or always for item 10) for each item and year. Looking at all years, it becomes clear that 48 to 57 percent of respondents think that people are currently not putting too much emphasis on environmental over economic issues (item 1 and 2), 32 to 48 percent of respondents are willing to make personal sacrifices in the form of paying higher prices, 18 to 27 percent in the form of higher taxes, and 37 to 59 percent in the form of cutting their standard of living. Only a minority reports to be a member of an environmental organization or having taken part in an environmental demonstration, while 23 to 32 percent of subjects report to have signed an environmental petition and 14 to 21 percent to have donated to an environmental group. Almost all respondents state to sometimes, often, or always make an effort to recycle. When looking at the weighted averages for each of the three core concepts, we can see that around half of the respondents displays a positive environmental attitude, about 29 to 39 percent of respondents indicate a willingness to act in an environmentally friendly manner, while approximately 30 to 35 percent of subjects report environmentally friendly behavior. Both for the weighted averages, as well as the single items, we find that environmental attitude, willingness, and behavior is highest in wave 2020 (with the exception of the items higher taxes and demonstration, which reaches a peak in 1993).

Figure 1 depicts the mean of respondents' environmental attitude, willingness, and behavior per year. It can be seen that, for all years, respondents' attitudes are more positive than their willingness, which in turn was more positive than their behavior. Looking at the respective trends over time, it seems that attitude as well as willingness altered slightly in 2000, while, in 2010, they shift back to the status of 1993, and then reach their peak in wave 2020. A series of OLS regressions (cf. Table 4) suggest that, in fact, all three indices are relatively stable between 1993 and 2010, as we do not find significant differences between any year in any index. However, in wave 2020, we find a significant upward trend in attitude and willingness compared to 2010 ($\alpha = 0.05$).

Table 3. Pro-environmental attitude, willingness, and behavior.

	Item	Total		1993		2000		2010		2020	
	Attitude										
1.	Jobs and prices	50.8	(6461)	47.9	(2047)	48.4	(1448)	50.6	(1341)	56.6	(1625)
2.	Progress	53.0	(6338)	56.8	(2015)	48.4	(1399)	46.8	(1319)	57.4	(1605)
	Weighted Average	51.9		52.3		48.4		48.7		57.0	
	Willingness										
3.	Higher prices	39.3	(6436)	38.8	(1997)	31.7	(1438)	37.9	(1350)	47.5	(1651)
4.	Higher taxes	23.7	(6414)	26.8	(2020)	18.2	(1423)	23.2	(1326)	25.2	(1645)
5.	Living standard	47.4	(6433)	49.1	(2010)	37.3	(1428)	41.1	(1335)	59.1	(1660)

Table 3. *Cont.*

	Item	Total		1993		2000		2010		2020	
	Weighted Average	36.8		38.7		29.1		32.5		37.5	
	Behavior										
6.	Environmental group	5.8	(6646)	4.5	(2073)	4.4	(1491)	5.9	(1390)	8.7	(1692)
7.	Petition	28.2	(6616)	28.6	(2087)	31.7	(1475)	23.1	(1382)	28.6	(1672)
8.	Donation	17.1	(6535)	13.8	(2062)	17.9	(1468)	16.3	(1363)	21.4	(1642)
9.	Demonstration	6.5	(6519)	8.1	(2061)	5.6	(1458)	4.6	(1362)	6.7	(1638)
10.	Recycling	98.7	(6596)	97.9	(2034)	98.7	(1482)	98.9	(1391)	99.4	(1689)
	Weighted Average	31.3		30.4		31.7		35.3		33.2	

Notes: Share of respondents (%) displaying an environmentally friendly attitude, willingness, or behavior (i.e., indicating disagree or disagree strongly for item 1 and 2, fairly willing or very willing for item 3–5, yes for item 6–9, and sometimes, often, or always for item 10). Total number of observations for each item in parentheses. Weighted average refers to the average across the respective group (attitude, willingness, behavior) weighted by the number of respondents displaying a positive attitude, willingness, or behavior for each item.

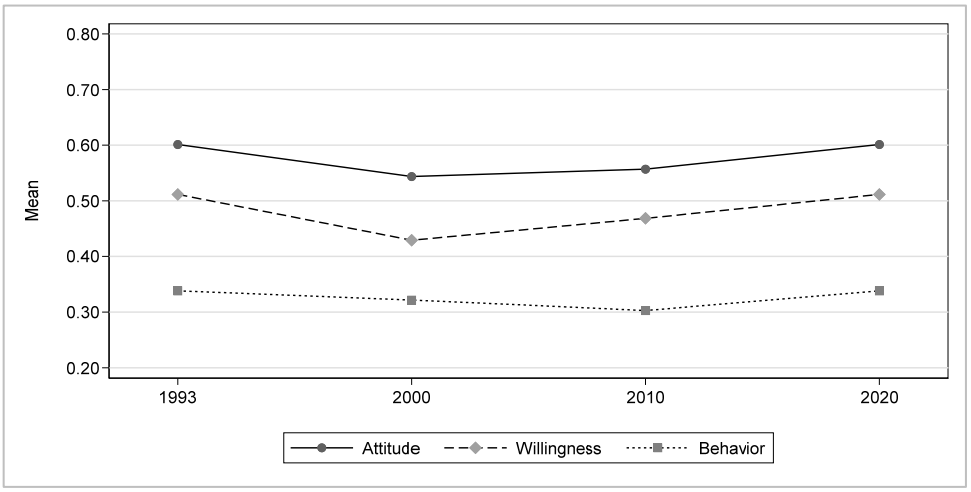

Figure 1. Environmental attitude, willingness, and behavior over time. Notes: Mean of attitude, willingness, and behavior indices in 1993, 2000, 2010, and 2020.

Table 4. Environmental attitude, willingness, and behavior over time; OLS regression estimates.

	Attitude			Willingness			Behavior		
	Base 1993	**Base 2000**	**Base 2010**	**Base 1993**	**Base 2000**	**Base 2010**	**Base 1993**	**Base 2000**	**Base 2010**
2000	−0.032			−0.048			0.012		
	(0.022)			(0.007)			(0.006)		
2010	−0.017	0.014		−0.007	0.040		−0.005	−0.017	
	(0.027)	(0.005)		(0.032)	(0.024)		(0.001)	(0.005)	
2020	0.027	0.059	0.044 **	0.036	0.084	0.043 *	0.027	0.015	0.032
	(0.027)	(0.005)	(0.001)	(0.030)	(0.022)	(0.002)	(0.003)	(0.009)	(0.004)
Constant	0.574 *	0.542 *	0.556 *	0.477	0.429	0.469 *	0.308 *	0.320 *	0.304 *
	(0.043)	(0.021)	(0.016)	(0.050)	(0.042)	(0.018)	(0.011)	(0.017)	(0.012)
Observations	6552	6552	6552	6613	6613	6613	6704	6704	6704
R^2	0.007	0.007	0.007	0.015	0.015	0.015	0.004	0.004	0.004

Notes: OLS regression estimates. Linearized standard errors in parentheses. Dummy coding used for the four waves. For the models with Base 2000 and 2010, the coefficients and standard errors of 1993 are omitted for reasons of clarity, since they are the negative equivalent of the respective coefficients and standard errors of 2000 and 2010, respectively, of the models with Base 1993. Similarly, for the models with Base 2010, the coefficients and standard errors of 2000 are also omitted. ** $p < 0.01$, * $p < 0.05$.

3.2. Heterogeneity in Environmental Attitude, Willingness, and Behavior over Time

In Figure 2, Panels a–f show the means of respondents' environmental attitude, willingness, and behavior indices per year broken down according to respondents' characteristics. On first sight, it is visually most salient that environmental attitude, willingness, and behavior indices are shifted downwards in the East compared to West Germany and upwards for respondents with a university degree compared to those without a university degree. The environmental attitude and willingness indices for the oldest groups of respondents are shifted slightly downwards compared to younger groups. Furthermore, for respondents in the two upper income groups (those with an income of more than €1900), there seems to be a steep increase in willingness from 2000 to 2010; for those with an income of €1001–€1900 a moderate increase, while, for those in the lowest income group (less than €1000), willingness slightly decreases. Moreover, for the highest income group of respondents (more than €3400), willingness is momentarily close to the environmental attitude index in 1993 and drops sharply in 2000. Finally, the difference between male and female respondents in environmental attitude and willingness seems to increase in wave 2020. The indices of the two lower income groups also seem to diverge from those of the two higher income groups in wave 2020. The indices of university degree seem to converge between the different groups in wave 2020, while for age, the indices generally seem to diverge in wave 2020. Regarding political orientation, we observe differences in the levels as well as in the development of the three core concepts across the three different political camps. Respondents from the left political camp score higher on all three indices compared to the other two camps. Furthermore, environmental attitude, willingness, and behavior develop positively over time for respondents oriented towards the political left. Among liberals, environmental attitude remains rather stable, whereas environmental willingness and behavior decrease over time. For respondents oriented towards the political right, environmental attitude, willingness, and behavior remain relatively stable on a low level.

A series of OLS regressions (cf. Table 5), which was run on the subsample of respondents with valid observations for each of the model variables, confirm and add to the descriptive results in that they show to what extent, if at all, the influence of explaining factors changed over time. We find that environmental attitude is significantly more pronounced among women than men in the waves 2000, 2010, and 2020 (($\alpha = 0.001$) and ($\alpha = 0.05$), respectively). The effect sizes vary negligibly between 0.044 and 0.048, indicating that gender differences in environmental attitude remain relatively stable from wave 2000 to wave 2020. In contrast, we find that women exhibit more environmental willingness only in wave 2020 ($\alpha = 0.001$) compared to men. We find no significant gender differences in environmental behavior in any of the years. Thus, it generally appears that female respondents are more environmentally friendly when it comes to environmental attitude, but not necessarily when it comes to willingness or behavior.

With regard to the influence of university degree, we find a slightly more consistent pattern across the three environmental indices, suggesting that university degree is a robust factor in environmental attitude, willingness, and behavior. In three of the four waves, respondents with a university degree display a significantly more environmentally friendly attitude in wave 1993 ($\alpha = 0.05$), wave 2010 ($\alpha = 0.001$), and wave 2020 ($\alpha = 0.001$) than those without a university degree. Those with a university degree also had a more pronounced environmental willingness as well as behavior in wave 2000 to wave 2020 ($\alpha = 0.05$) (to be precisely: this significant level refers to the lowest common significant level across all indices and years). At the same time, we observe that the differences between respondents with and without a university degree vary across the years with respect to environmental attitude [0.058, 0.109] and environmental willingness [0.071, 0.115], whereas they remain relatively stable with respect to environmental behavior [0.052, 0.061]. Differences in environmental attitude constantly decrease, while differences in environmental willingness increase from wave 2000 to wave 2010 and then decrease sharply below the wave 2000 value in wave 2020.

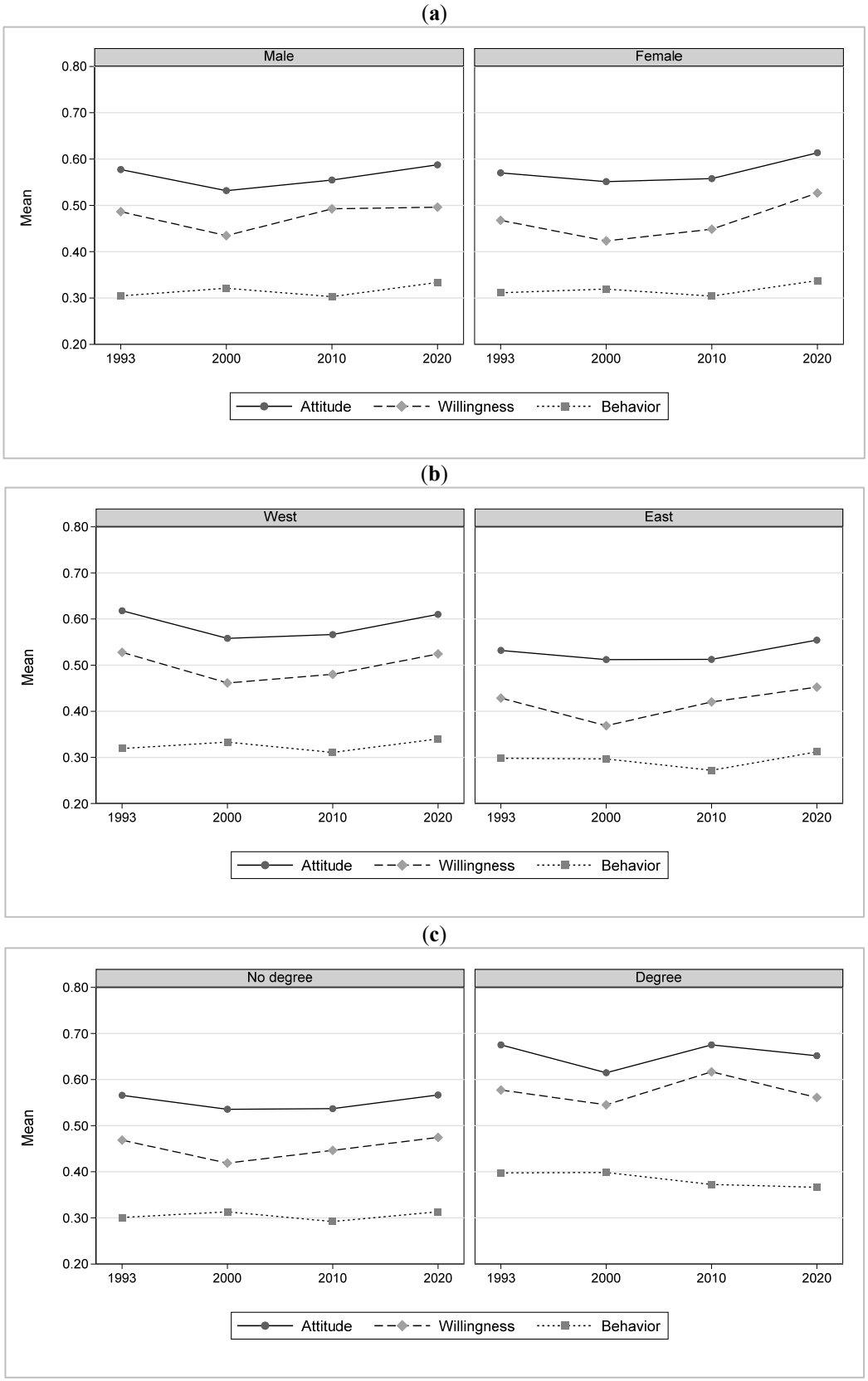

Figure 2. *Cont*.

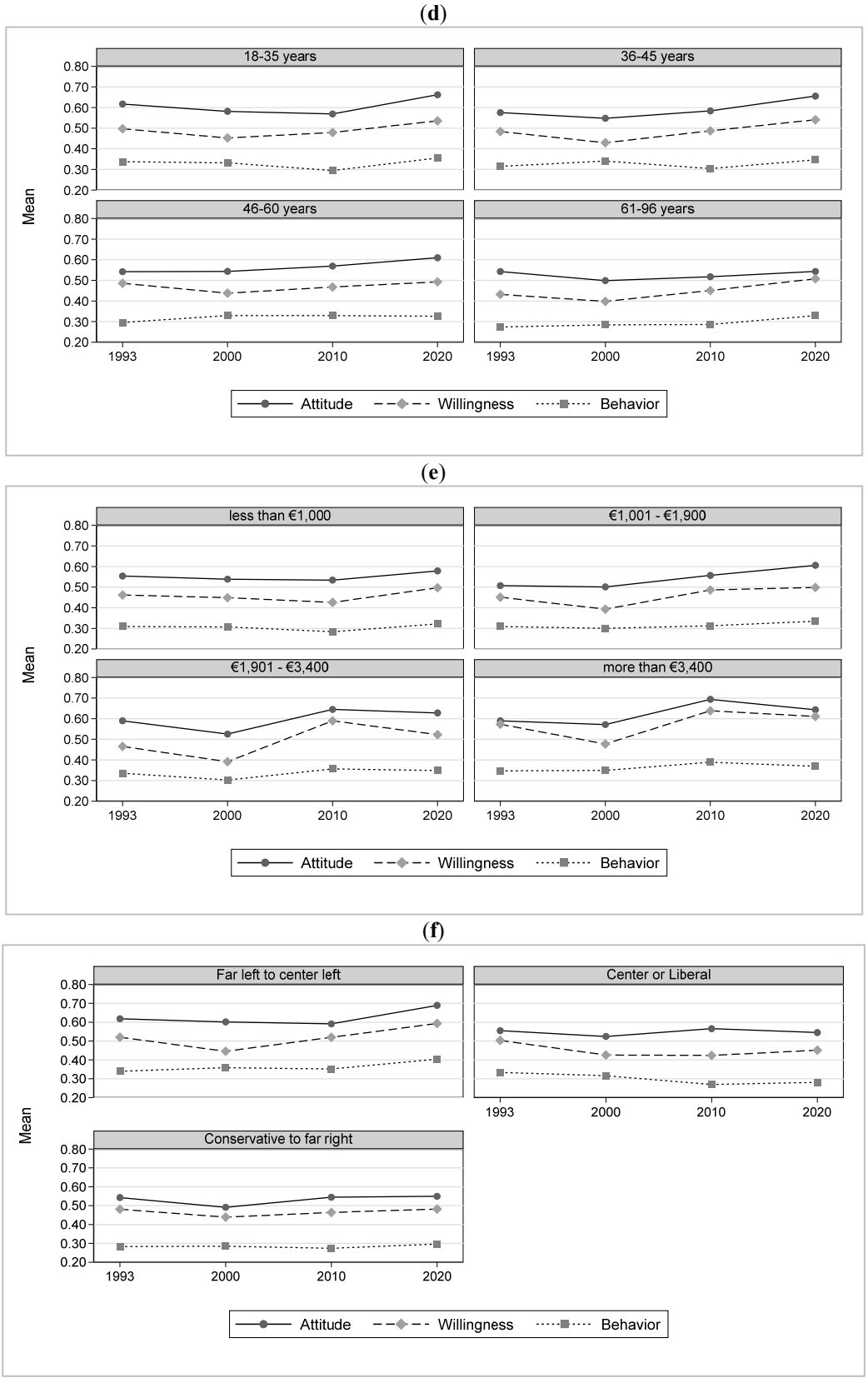

Figure 2. Heterogeneity in environmental attitude, willingness, and behavior. Notes: Environmental attitude, willingness, and behavior by year and characteristic (gender, region, university degree, age group, income group, political orientation). (**a**) gender; (**b**) region; (**c**) university degree; (**d**) age; (**e**) income; (**f**) political orientation.

Table 5. Heterogeneity of environmental attitude, willingness, and behavior over time.

	Attitude				Willingness				Behavior			
	1993	**2000**	**2010**	**2020**	**1993**	**2000**	**2010**	**2020**	**1993**	**2000**	**2010**	**2020**
Female (=1)	0.013	0.044 **	0.042 *	0.048 **	0.034	−0.001	0.026	0.061 ***	0.022	0.022	0.028	0.012
	(0.033)	(0.016)	(0.019)	(0.017)	(0.029)	(0.015)	(0.017)	(0.016)	(0.025)	(0.012)	(0.015)	(0.015)
Male (=0)	Reference				Reference				Reference			
University degree (=1)	0.109 *	0.047	0.092 ***	0.058 ***	0.037	0.101 ***	0.115 ***	0.071 ***	0.091	0.058 **	0.052 *	0.061 ***
	(0.047)	(0.025)	(0.022)	(0.017)	(0.050)	(0.023)	(0.021)	(0.016)	(0.066)	(0.020)	(0.025)	(0.015)
No university degree (=0)	Reference				Reference				Reference			
East Germany (=1)	−0.019	−0.048 **	−0.051 **	−0.068 ***	−0.062 *	−0.089 ***	−0.042 *	−0.072 ***	0.003	−0.038 **	−0.033 *	−0.035 *
	(0.033)	(0.017)	(0.019)	(0.016)	(0.029)	(0.015)	(0.017)	(0.016)	(0.031)	(0.012)	(0.014)	(0.014)
West Germany (=0)	Reference				Reference				Reference			
Age: 18–35 years	0.030	0.041 **	0.035 *	0.064 ***	0.022	0.016	0.029 *	0.019	0.023	0.011	−0.001	−0.008
	(0.022)	(0.013)	(0.016)	(0.016)	(0.018)	(0.012)	(0.013)	(0.017)	(0.018)	(0.010)	(0.013)	(0.015)
Age: 36–45 years	0.020	0.000	0.005	0.037	−0.024	0.011	0.004	0.020	0.011	0.005	0.002	0.034
	(0.029)	(0.015)	(0.019)	(0.021)	(0.027)	(0.013)	(0.017)	(0.021)	(0.020)	(0.011)	(0.016)	(0.022)
Age: 46–60 years	−0.016	−0.007	0.013	0.011	−0.028	−0.011	−0.006	−0.017	−0.010	0.010	0.014	−0.005
	(0.023)	(0.013)	(0.014)	(0.012)	(0.019)	(0.012)	(0.012)	(0.012)	(0.017)	(0.010)	(0.012)	(0.011)
Age: 61–96 years	−0.040	−0.032 *	−0.044 **	−0.051 ***	0.020	−0.014	−0.020	−0.003	−0.029	−0.024 **	−0.014	−0.003
	(0.032)	(0.013)	(0.013)	(0.010)	(0.026)	(0.012)	(0.012)	(0.009)	(0.018)	(0.009)	(0.010)	(0.009)
Income: €1000 or less	−0.019	−0.023	−0.022 *	−0.033	0.005	0.011	−0.034 ***	−0.018	−0.032	−0.026	−0.020 **	−0.007
	(0.041)	(0.025)	(0.009)	(0.018)	(0.038)	(0.024)	(0.008)	(0.015)	(0.033)	(0.017)	(0.007)	(0.014)
Income: €1001–€1900	−0.037	−0.036 *	0.000	0.011	−0.009	−0.015	0.011	−0.006	−0.001	−0.012	0.012	0.004
	(0.022)	(0.016)	(0.012)	(0.011)	(0.019)	(0.015)	(0.011)	(0.011)	(0.014)	(0.011)	(0.010)	(0.011)
Income: €1901–€3400	0.030	−0.004	0.095 ***	0.005	−0.035 *	−0.019	0.110 ***	−0.005	−0.002	−0.011	0.053 *	−0.002
	(0.020)	(0.011)	(0.022)	(0.012)	(0.017)	(0.011)	(0.020)	(0.011)	(0.016)	(0.008)	(0.024)	(0.011)
Income: €3400 or more	0.021	0.027 *	0.083 *	0.020	0.070 *	0.021 *	0.115 **	0.083 ***	0.021	0.021 **	0.056	0.008
	(0.035)	(0.011)	(0.040)	(0.020)	(0.028)	(0.010)	(0.037)	(0.019)	(0.027)	(0.008)	(0.037)	(0.021)
Far left to center left	0.045 **	0.068 ***	0.012	0.060 ***	0.013	0.020 *	0.021 ***	0.051 ***	0.029 **	0.033 ***	0.029 ***	0.053 ***
	(0.014)	(0.010)	(0.007)	(0.008)	(0.012)	(0.009)	(0.006)	(0.007)	(0.011)	(0.008)	(0.005)	(0.007)

Table 5. *Cont.*

	Attitude				Willingness				Behavior			
	1993	**2000**	**2010**	**2020**	**1993**	**2000**	**2010**	**2020**	**1993**	**2000**	**2010**	**2020**
Center & liberal	−0.033	−0.025 **	−0.018	−0.072 *	−0.034	−0.006	−0.071 **	−0.075 **	−0.024	−0.008	−0.053 ***	−0.072 ***
	(0.040)	(0.008)	(0.031)	(0.028)	(0.037)	(0.007)	(0.023)	(0.026)	(0.036)	(0.006)	(0.014)	(0.017)
Conservative to far right	−0.050 **	−0.061 ***	−0.018	−0.065 ***	−0.010	−0.023	−0.024 *	−0.053 ***	−0.031 **	−0.041 ***	−0.043 ***	−0.055 ***
	(0.018)	(0.016)	(0.013)	(0.010)	(0.015)	(0.015)	(0.011)	(0.009)	(0.012)	(0.011)	(0.009)	(0.008)
Constant	0.552 ***	0.533 ***	0.543 ***	0.589 ***	0.524 ***	0.458 ***	0.465 ***	0.481 ***	0.313 ***	0.321 ***	0.301 ***	0.321 ***
	(0.030)	(0.012)	(0.016)	(0.016)	(0.022)	(0.012)	(0.014)	(0.015)	(0.021)	(0.009)	(0.011)	(0.013)
Observations	556	1056	872	907	555	1055	887	921	562	1064	891	924
R^2	0.068	0.078	0.082	0.160	0.064	0.079	0.131	0.142	0.056	0.064	0.081	0.104

Notes: OLS regression estimates accounting for complex survey data. Linearized standard errors in parentheses. Conventional dummy coding used for gender, university degree and region. Weighted effect coding used for age, income, and political orientation. Models were estimated twice with changing base categories to report coefficients for all weighted effect coded dummies. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

With the exception of environmental attitude and behavior in wave 1993, respondents living in the East of Germany display a significantly less environmentally friendly attitude, willingness, and behavior ($\alpha = 0.05$)[8]. The regional differences in environmental attitude increase constantly from wave 2000 to wave 2010 to wave 2020, for willingness they increase in wave 2000, then attenuate in wave 2010, and increase again up to wave 2020, while for behavior the effect sizes vary negligibly between -0.033 and -0.038. Our results thus indicate a persistent regional divide in environmentalism in Germany.

Regarding the association between age and environmentalism, we find a consistent pattern in age-related differences across the three indices and four waves. The effect sizes of the weighted effect coded age groups capture the deviation of each age group from the average index score across all age groups at a specific year while controlling for the other model variables. The findings suggest that younger people generally show an above-average environmental attitude, willingness, and behavior, while older age groups exhibit below-average environmental attitude, willingness, and behavior. However, these differences between the youngest and oldest age group are only significant for environmental attitude from wave 2000 to wave 2020 ($\alpha = 0.05$)[8]. This suggests that an age gap only occurs with respect to environmental attitude, but not with respect to environmental willingness or behavior.

Results regarding the association between respondents' personal net income and environmentalism are not robust over time. To be precise, we do not find that lower (or higher) personal net income is constantly significantly negatively (or positively) associated with environmentalism in any of the indices. For instance, for environmental attitude, the highest income groups' deviations are occasionally significantly larger than the average index score. Only with regard to environmental willingness do we see that the highest income group (€3400 or more) exhibits a significant above-average environmental willingness across all years ($\alpha = 0.05$)[8]. Moreover, we find that, in wave 2010, the lowest income group (€1000 or less) was significantly below the average for all three indices.

Finally, respondents oriented towards the political left (far left to center left) positively deviate from the intercept in all indices for all years except for environmental attitude in wave 2010 and willingness in wave 1993 ($\alpha = 0.05$) (to be precisely: this significant level refers to the lowest common significant level across all indices and years). Conversely, respondents oriented towards the political right (conservative to far right) exhibit below-average environmental scores in all three indices and years except for environmental attitude in wave 2010 and willingness in wave 1993 and wave 2000 ($\alpha = 0.05$)[8]. Those in the center also deviate negatively from the average with respect to environmental attitude in wave 2000 and wave 2020 and with respect to environmental willingness and behavior in wave 2010 and wave 2020 ($\alpha = 0.05$)[8]. Interestingly, the results also show polarization tendencies in environmentalism. The political ideological gap in environmental attitude, willingness, and behavior widens from wave 1993 to wave 2020, as reflected in the increasing difference between the respective coefficients of "far left to center left" and "conservative to far right". Even more importantly, these differences were insignificant in the earlier waves but became significant in the later waves (cf. Table A2). However, our descriptive results suggest that this increasing divergence in environmental willingness and behavior over time seems to be driven less by a polarization effect in the conservative to right camp than by an opposing development in the left compared to the liberal camp (cf. Figure 2, Panel f).

4. Conclusions

In this study, we used repeated cross-sectional data on environmental attitude, willingness, and behavior as well as socio-demographic variables from four waves of the ISSP Environment module reaching as far back as 1993 up until the most recent round in 2021.

Regarding the general trend in environmental attitude, willingness, and behavior, we reveal that respondents' environmental attitude, willingness, and behavior is stable between 1993 and 2010. This contrasts with our expectation that sustainability influenced

Germany's population during the observation period via the normative and increasingly also via the descriptive norm mechanism. Our results do not reveal strictly increasing linear trends in the development of pro-environmental attitudes, willingness, or behaviors in the population. Moreover, we do not see a significant difference in attitude, willingness, or behavior between wave 1993 and wave 2020. This is rather sobering since pro-environmental attitude, willingness, and behavior do not appear to have changed from the first wave to the most recent wave.

However, in wave 2020, environmental attitude and willingness increase significantly compared to the previous wave in 2010. It would therefore appear that the increased presence of the climate change and environment debate and the increased urgency of the issue in the general media over the past few years is also reflected in people's environmentally friendly attitude, willingness, and behavior. This finding holds despite the fact that, at the time of the survey, the COVID-19 pandemic was the primary topic in the public discourse and was directly affecting people's lives (on an economic, health, and personal freedom level)—arguably for most people more immediate at that time than climate change or adverse environmental consequences. We can thus say that these findings support the notion that climate change and environmental issues are finally considered so significant by the general public that they cannot easily be fully displaced by other major events, such as a pandemic. This would also imply that, if there had been no overlap between the pandemic and the 2020 wave, we may possibly have observed a much more pro-environmental attitude, willingness, and behavior. This, however, is a question to be addressed in future research.

Furthermore, in line with the attitude–behavior gap, we find that the respondents' environmental attitudes are generally more positive than their willingness, which in turn is more positive than their behavior in all four waves. Thus, even though the items in the different groups do not perfectly correspond, these findings point towards a persistent attitude–behavior gap with respondents' willingness bridging this gap. At the same time, we observe that attitude and willingness correspond more closely with each other over time than any of these two concepts with behavior. In other words, the gap between attitude and behavior does not appear to be equidistant over time, emphasizing the instability of the relationship between both concepts, at least when measured as they were in this study. We revealed systematic heterogeneity in environmental attitude, willingness, and behavior. In the following, we will attempt to explain these differences. Respondents with a university degree have a more environmentally friendly attitude, willingness, and behavior than respondents without a university degree. Attending a university or similar institution might have increased respondents' awareness of environmental issues, as many curricula at least partly cover these issues [62]. In Germany, organizations, such as the student organization oikos International, are further fostering this trend by offering, for example, complementary lectures and panel discussions on topics related to sustainability. Our findings are also partially in line with insights from Blankenberg and Alhusen [37], who demonstrate that higher educated people are more environmentally friendly in terms of some of the elicited environmental behaviors.

Respondents living in West Germany also display a more environmentally friendly attitude, willingness, and behavior than those living in East Germany. In the federal states of the former GDR, environmental protection issues only entered the broad public discourse after reunification in 1989, while in the West of Germany this process already began in the late 1960s [38]. This delayed public discourse on environmental protection in East Germany could explain the differences between respondents living in East and West Germany. On this basis and also on the basis of the broadening base and the economic contingency hypothesis, we would have expected these differences to slowly fade over time. However, for attitude and willingness, and also to a lesser extent for behavior, we do see an increase in regional differences from wave 2010 to wave 2020. This suggests that there could be other factors driving this divergence, which we, due to data availability issues, could not

control for. One of these factors could be value orientation, which might take a long time to change, or different beliefs.

In the three recent waves, the youngest group holds a significant above-average environmental attitude, while for the oldest income group, the opposite is true. In each wave, the youngest respondents in our sample have high prospects of experiencing the consequences of climate change and global warming predicted, for instance, for 2050 or 2100 [63]. They are thus more likely to worry about climate change and environmental issues. In contrast, for respondents aged 61 to 96 years old, this is more unlikely for 2050 and impossible for 2100. Although the adverse environmental consequences of climate change are already unfolding, their negative effects are expected to be much more pronounced in the future. Thus, even if we assume a desire on the part of older respondents to protect their children and grandchildren from these more severe adverse effects, the fact that they themselves are unlikely to experience them could cause them to be less environmentally concerned than young respondents. Furthermore, younger age groups are likely to be more receptive to internalizing the leitmotif of sustainability in their earlier socialization phase, which could also be a reflection of the origin of the Fridays for Future protests in 2018 with which younger respondents are more likely to identify. Interestingly, this difference in attitude did, however, not translate into an increasing age-related difference in environmental willingness or behavior over time. This might be because our indices capture a variety of different behaviors with environmental protests being only one factor. Moreover, the survey does not capture people below the age of 18, which is a large group among the Fridays for Future movement (52.8 percent of the activists are between 14 and 19 years old [64]).

The group with the highest income (i.e., respondents with a personal income of €3400 a month or more in purchasing power of 2021) exhibits an above-average environmental willingness in all four waves, whereas in neither wave they systematically differ with respect to environmental attitude or behavior. This finding is not that surprising given that the willingness items target financial aspects and respondents with higher personal incomes have better monetary resources to cope with any of the issues asked. In other words, they are more likely to be able to afford paying higher prices for environmentally friendly products, higher taxes, or cut back on their relatively high standard of living. However, this group is not necessarily different to other income groups in terms of environmental attitudes and behavior, particularly when behavior requires high behavioral (non-monetary) costs.

Furthermore, in wave 2010, the lowest income group is significantly below the average in all three indices. This might be due to the financial crisis of 2008 hitting the economically most vulnerable group hardest, thereby reducing their scope for paying higher prices, taxes, cutting back their standard of living, and worrying about the environment in general, let alone engaging in time- or money-consuming environmental behaviors.

In this paper, we also revealed how the differences between these socio-demographic groups evolved over time. In particular, gender differences are slightly larger in 2020 than in the previous waves with a slight kink in wave 2010, while they first emerge in wave 2020 for environmental willingness. Our data for environmental attitude and willingness thus confirm the broadening base hypothesis in combination with the economic contingency hypothesis for gender. Educational differences (university degree) constantly decrease (except for the year 2000) for environmental attitude and are lower in wave 2020 than in waves 2000 and 2010, respectively, for environmental willingness. The broadening base in combination with the economic contingency hypothesis could therefore not be confirmed for educational differences in environmental attitude and willingness. The combined hypotheses did appear to hold for environmental behavior, however, where a slight increase was observed in educational differences in wave 2020 compared to the previous waves. Regional differences constantly increased in environmental attitude, again contradicting the broadening base hypothesis in combination with the economic contingency hypothesis. For environmental willingness and behavior, the picture is less clear. Regional differences first increased in wave 2000, decreased in wave 2010, and then

increased again (but to a value lower than in wave 2000) in wave 2020. In summary, the broadening base hypothesis in combination with the economic contingency hypothesis was only partly confirmed by our data, and partly our data pointed in the opposite direction.

We demonstrated selective polarization tendencies in pro-environmentalism depending on political orientation, with the political ideological gap in willingness and behavior widening steadily from wave 1993 to wave 2020. Our hypothesis based on findings from McCright and Dunlap [47] was thus confirmed for environmental willingness and behavior.

Studying environmental attitude over an extensive time span is associated with several difficulties. As secondary researchers, we depend on the availability of data. Therefore, the first limitation of our study is that we could only use items that were asked identically in all waves when operationalizing environmental attitude, willingness, and behavior. This in turn means that the indicators we used may not be differentiated enough to allow for a nuanced measurement of each concept. For example, despite the fact that behavior was measured on the basis of five indicators, four of five indicators (i.e., environmental group, petition, donation, demonstration) focused on peoples' engagement in political actions to protect the environment. This is a very special form of pro-environmental behavior that requires a substantial amount of commitment to environmental protection and also substantial behavioral costs (e.g., demonstration). At the same time, recycling efforts, if operationalized dichotomous as in this study, have been high in Germany since 1993, resulting in little room for improvement. However, even when looking at the distribution of recycling efforts given the original coding scheme, we can see that recycling efforts remained quite stable at a high level since the second wave. This indicator, which measures pro-environmental behavior at relatively low behavioral costs comes with a ceiling effect. It would have been desirable for the Environment Module of the ISSP to include in all waves more behavioral indicators covering daily routines with relatively low behavioral costs, such as bicycles or public transport usage or reduced car usage. The latter was included in the waves of 1993, 2000, and 2010, but unfortunately dropped in the recent wave of 2020. As an aside, reduced car usage did not exhibit a clear linear trend over the three waves, as might have been expected. As a second limitation, the problem of data availability also inhibited the selection of explanatory variables with which to test the theoretical model. As a result, in this study, we primarily investigated the influence of socio-demographic variables on environmental attitude, willingness, and behavior.

In summary, this study showed that environmental attitude, willingness, and behavior should neither be understood as static nor universal, but rather as a snapshot. They are dynamic over time and can vary between persons. Furthermore, this study revealed that socio-demographic differences are also dynamic. These findings are crucial for a better understanding of which transformation pathways towards a sustainable energy system are socially feasible and under which conditions. Policy makers can specifically target measures at different social groups and account for possible changes, e.g., in the environmental attitude, willingness, and behavior of these groups. With the knowledge that environmental attitude, willingness, and behavior generally rose in wave 2020—again, despite the COVID-19 pandemic—policy makers have good prospects for enhancing and incentivizing more sustainable energy usage and consumption behaviors, as well as for incentivizing decisions to adopt renewable energy technologies, stressing—alongside financial aspects –the sustainability of these technologies or products.

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Data Availability Statement: The data used in this study is available from GESIS as documented in [49–52].

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Coding Schemes of Remaining Model Variables

Table A1. Explaining variables and coding schemes.

	ISSP Variable Names (Wave Specific)	Codings for Analysis Based on ISSP Variables	
University degree*	1993 v205 2000 v205 2010 DE-DEGR 2020 EDULEVEL	Measurement of educational level varies across the five waves which requires wave-specific coding schemes	
		Dummy coding for 1993: 0: No university degree (=1 to 8) 1: University degree (=9)	Dummy coding for 2000: 0: No university degree (=1 to 6) 1: University degree (=7)
		Dummy coding for 2010: 0: No university degree (=1 to 7 or =9) 1: University degree (=8)	Dummy coding for 2020: 0: No university degree (=0 to 4) 1: University degree (=6 to 8)
Region	1993 country 2000 country 2010 c_sample 2020 c_sample	Available information was dummy coded: 0: West 1: East	
Income	1993 v231 2000 v240 2010 DE_RINC 2020 DE_RINC	In 1993, 2000 and 2010, open answer formats were used. In 2020, 27 answer categories (for substantial answers) were used for personal income. In 2000, 2010, and 2020, income was documented to be personal net income. Due to lacking documentation in 1993, income concept (net or gross) is not unequivocally net. Income was categorized in four income groups after adjusting for purchasing power (as of 2021, using the time series "Purchasing Power Equivalents of Historical Amounts in German Currencies" provided by Deutsche Bundesbank): 1: €1000 or less (PP 2021) 2: €1001 to €1900 (PP 2021) 3: €1901 to €3400 (PP 2021) 4: €3400 or more (PP 2021)	
Gender	1993 v200 2000 v200 2010 SEX 2020 SEX	Available information was dummy coded: 0: Male 1: Female	
Age	1993 v201 2000 v201 2010 AGE 2020 AGE	Answers to open answer format were collapsed into four age groups. Generated for each wave separately, weighted effect coded dummies: 1: 18–35 years 2: 36–45 years 3: 46–60 years 4: 61–96 years	

Table A1. *Cont.*

	ISSP Variable Names (Wave Specific)	Codings for Analysis Based on ISSP Variables
Party affiliation	1993 v306 2000 v246 2010 PARTY_LR 2020 PARTY_LR	Original five-point scale with substantial answers (1 = far left, 2 = left, center left, 3 = center, liberal, 4 = right, conservative and 5 = far right) was collapsed into three categories with 1 = far left to center left (=1 & 2), 2 = center, liberal (=3), 3= conservative to far right (=3 & 4). Furthermore, we separately generated weighted effect coded dummies for each wave.
Weighting factor	1993 v419 2000 v327 2010 WEIGHT 2020 WEIGHT	Available information was adopted without any changes.

Table A2. F-Test on regression coefficients across both political camps ("far left to center left" vs. "conservative to far right") for each of the three core concepts.

	Attitude	Willingness	Behavior
1993	F (1,1) = 5.21 p = 0.26	F (1,1) = 5.21 p = 0.26	F (1,1) = 0.36 p = 0.66
2000	F (1,1) = 13.94 p = 0.17	F (1,1) = 13.94 p = 0.17	F (1,1) = 478.41 p = 0.03
2010	F (1,1) = 354.09 p = 0.03	F (1,1) = 20.62 p = 0.14	F (1,1) = 0.41 p = 0.64
2020	F (1,1) = 512.27 p = 0.03	F (1,1) = 143.68 p = 0.05	F (1,1) = 870.58 p = 0.02

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