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RESEARCH ARTICLE

Willingness of rural and urban citizens to undertake pollinator conservation actions across three contrasting European countries

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Abstract

1. Over the last two decades, ecological and conservation studies on pollinator insects have increased significantly. However, scientific evidence alone is not enough to translate knowledge into policy and into changes in behaviour. To reduce the gap between scientific knowledge on conservation actions and their actual uptake, one should understand the socio-psychological drivers of people's willingness to undertake these actions.
2. Here, we investigated the socio-psychological factors influencing individual behaviour in favour of conservation interventions for pollinators in rural versus urban environments across three European countries: Germany, Italy and the Netherlands. We administered an online questionnaire to 4541 respondents stratified by nationality, environment, age and gender.
3. Despite regional differences in socio-cultural and economic conditions, individuals from Germany, Italy and the Netherlands living in both rural or urban environments shared similar socio-psychological drivers to protect pollinators. People intended to take action to protect pollinators when they felt morally obliged to, when their social environment supported pollinator protection, when they believed their individual behaviour had an impact, and when they engaged frequently in outdoor activities.
4. Interestingly, specific values held towards pollinators, such as their right to exist, seemed much more important predictors of activating norms that promote conservation actions compared to increasing general environmental concern. In all countries, among the conservation actions, the most likely to be implemented was planting flowers, while one of the most unlikely was participating in monitoring activities.
5. *Synthesis and applications*. People from three contrasting European countries living in both rural and urban landscapes were mostly driven by the same socio-psychological factors to help pollinator insects. Therefore, our results offer

several practical recommendations to promote pollinator conservation across Europe. First, conservation practitioners interested in pollinator conservation should pay greater attention to values specific to pollinators, as they seemed more important behaviour predictors than general care for the environment. Second, engaging people in conservation efforts can be accomplished by increasing awareness about the vital roles that pollinators play within ecosystems. Lastly, promoting simple nature-based activities such as wildlife observation, and gardening can help foster a sense of connection to and appreciation for pollinators and pollination.

KEYWORDS

bees, biospheric values, flowers, garden, insect conservation, pollination, theory of planned behaviour, value-belief-norm theory

1 | INTRODUCTION

Pollinators enable the reproduction of the vast majority of flowering plants and are globally reported to decline (Dicks et al., 2021; Potts et al., 2016). Over the last few years, scientific studies on pollinator insects' ecology and conservation have increased significantly (Dicks et al., 2021). These studies indicate that individual actions such as planting wildflowers or installing bee hotels can contribute to pollinator conservation. However, scientific evidence alone is not enough to translate conservation knowledge into policy and into changes in behaviour (Hulme, 2014). To implement conservation actions, ecologists and policy makers need a deeper understanding of the psycho-social factors influencing people's intentions towards protecting biodiversity (Maas et al., 2019). However, psychology and behavioural science are rarely used in conservation research, particularly not for insects (Hall & Martins, 2020; but see Knapp et al., 2021).

Overall, a large range of personal and social factors influence human pro-environmental behaviours (Gifford & Nilsson, 2014). Concerning pollinators, previous studies mostly investigated people's knowledge and attitude towards them (Penn et al., 2020; Schonfelder & Bogner, 2017; van Vierssen Trip et al., 2020; Wilson et al., 2017), or focused on the leverages and barriers to the adoption of pro-pollinator gardening practices (Burr et al., 2018; Gusto et al., 2023; Silvert et al., 2023; Varga-Szilay & Pozsgai, 2023). Compared to vertebrates, who mostly are associated with positive values, attention and conservation efforts, insect pollinators are sometimes marginalized by the dislike for insects in general or by the focus on the honeybee (Hall & Martins, 2020; Hochkirch et al., 2023; Leandro & Jay-Robert, 2019; Sturm et al., 2021). In their pioneering study on the drivers of pro-pollinator behaviour, Knapp et al. (2021) showed that interactions with nature and perceived behavioural control (i.e. belief that the behaviour in question is under the person's control) were important predictors of pro-pollinator actions, while ecological knowledge was far less important. However, it is still not clear how the environmental context and cross-country socio-cultural differences can affect people's behaviour towards pollinators.

A large body of literature claims that rural and urban citizens differ in their environmental and ecological perceptions, yet results are mixed (Bogner & Wiseman, 1997; Gifford & Nilsson, 2014; Hinds & Sparks, 2008; Huddart-Kennedy et al., 2009; Kalkbrenner & Roosen, 2016). This is highly relevant for pollinators, since the efficacy of conservation actions should change according to the landscape context (Scheper et al., 2013). Moreover, people's pro-pollinator behaviour might change across countries because of different cultural, environmental and economic contexts (Gifford & Nilsson, 2014; Gusto et al., 2023). For example, national cultural traits, population density or greenhouse gas emissions might affect pro-environmental behaviour (Iwińska et al., 2023; Minkov & Hofstede, 2014; Punzo et al., 2019; Vignoles et al., 2018). In the context of pollinator conservation, the European Union adopted the EU Pollinators Initiative (European Commision, 2018), a strategy based on scientific evidence from natural scientists, but which has limited appreciation of the complexity of social factors affecting implementation in different countries (Marselle et al., 2021). Testing differences between rural and urban environments and between countries can guide such policy instruments because it helps understanding how universal pro-pollinator actions are and whether tailored policy tools should be implemented regionally.

In several countries, many individual actions for pollinator insects are feasible and may require direct or indirect engagement, such as monitoring pollinators, planting flowers, building nests for bees, having conversations about pollinators' protection, and donating money to conserve them (Braman & Griffin, 2022). Investigating the preferences of people for such actions will help to establish conservation practices (Hargreaves, 2011). As a first step, it is crucial to understand why people intend or do not intend to protect pollinators, in particular in countries where conservation actions have not been widely implemented yet. The purpose of our research was to investigate the socio-psychological

drivers of the willingness to implement individual conservation interventions for pollinators across three European countries (Germany, Italy and the Netherlands) with contrasting socio-cultural and economic backgrounds. To increase the representativeness of our sample, we decided to measure the willingness to take actions through an online questionnaire, instead of directly observing behaviours of a few individuals (Nilsson et al., 2020). We drew on the combination of the two most commonly used theories in the environmental psychological domain: the value-belief-norm theory (Stern, 1999) and the theory of planned behaviour (Ajzen, 1991) (see Section 2 for more details). In particular, we administered a stratified online questionnaire and tested the following hypotheses: (1) the moral obligation to undertake pro-pollinator actions (i.e. the individual conviction that helping pollinators is right) will increase when feeling responsible and being aware of the consequences of pollinator decline and it will be influenced by deeply held personal values, such as environmental concern, specific values towards pollinators (utilitarian or intrinsic values of pollinators (Pascual et al., 2023)) and biospheric values (i.e. the importance people attach to caring for nature) (de Groot & Steg, 2010); (2) moral obligation, perceived behavioural control and social norm (i.e. informal rules defining acceptable behaviour in groups) will have a positive effect on the intention of pro-pollinator actions; and (3) the preference for pro-pollinator actions will differ across countries and will obtain more support in urban compared to rural environments due to the expected higher biospheric values and environmental concern of urban citizens.

2 | MATERIALS AND METHODS

2.1 | Survey design and study areas

Participants in our study were adults (age ≥16 years) living in Germany, Italy and the Netherlands. In order to minimize differences caused by the environment, we selected lowland and intensively managed areas, with a mean elevation lower than 300 m a.s.l. These are the areas in which conservation actions are most urgent due the presence of multiple environmental pressures on pollinators (Ganuza et al., 2022). In each country, we chose municipalities from either highly urbanized or rural environments (Table S1). We defined municipalities with a population density higher than 1500 inhabitants/km^2 and a minimum of overall 50,000 inhabitants as highly urbanized environments, while municipalities with less than 300 inhabitants/km^2 were classified as rural environments (WB, 2011). Finally, we used a stratified sampling design, with as strata country, environment (rural or urban) and standard sociodemographic characteristics, such as gender and age. All these variables were kept independent in our sample to avoid potential biases in our sample (Table S2; Figures S1–S3).

2.2 | Questionnaire and theoretical framework

To assess people's willingness to implement pollinator conservation actions in rural and urban environments, we proposed an integrated framework by establishing relationships among variables from the value-belief-norm and planned behaviour theories. The value-belief-norm theory integrates the norm-activation model with biospheric values, claiming that people intend to behave pro-environmentally because of general environmental beliefs and moral obligation (Schwartz, 1974; Stern, 1999). Individual moral obligation (i.e. personal norm) will become active once a person is aware of consequences and feels responsible for the environmental problem. By contrast, the theory of planned behaviour claims that the intention to perform a behaviour is determined by the attitude towards the behaviour, the subjective norms connected to the behaviour, and the perceived behavioural control (Ajzen, 1991). The combination of these two theories has been proposed and applied by several researchers of pro-environmental behaviour as a way to integrate self-interest (i.e. minimizing one's own risk) and pro-social motives (i.e. concern for and opinions of other people) (Bamberg & Möser, 2007; Klöckner, 2013). Our questionnaire consisted of 50 questions across five sections: (1) ecological and pollinator-oriented values; (2) value-belief-norm theory; (3) theory of planned behaviour; (4) socio-demographics (relationship with nature, age, gender, annual income, and education, that is tertiary vs primary and secondary education); and (5) intended behaviour, that is nine specific actions for conserving pollinators (see Table S3). As we assumed that most of our respondents would be unfamiliar with insect pollinator conservation, we harmonized the measurement context for all respondents, by briefly informing respondents about the function of pollinator insects, their decline status and conservation (Riepe et al., 2021) (see Table S3 and Supplementary methods for a detailed description of the administered questionnaire in the Appendix S1). The questionnaires were designed in English, and subsequently translated to the local language (Dutch, German and Italian) by the native speaking co-authors, so that the questions had the identical meaning in all countries. We pre-tested the questionnaire on 20 individuals to ensure comprehension of the questions and made minor refinements according to the received feedbacks.

2.3 | Data collection

The administration was performed by a market research company (Demetra Opinions.net Srl) by means of a web-based computer aided survey. Respondents were contacted by e-mails, non-response rate was approximately 10% and quality was checked with a trap question. This procedure guaranteed the desired stratification of the sample and, by using a stratified random sampling of the populations, we avoided selection biases towards people with a pre-existing interest in pollinators, which might occur when involving people through social media and networks of the authors. We carried out a pilot study on 120 individuals, analysed the data and made further minor refinements. After this pilot, we administered our questionnaire to a total of 4541 respondents. Informed consent to participate in the study was obtained from all participants and personal data was processed according to regulation (EU) 2016/679.

2.4 | Data analysis

2.4.1 | Structural equation modelling: Socio-psychological drivers of behaviour

First, we tested latent variables' validity by calculating the contribution of the measured items to the corresponding latent variable using confirmatory factor analysis (Whittaker & Schumacker, 2016). When necessary, we reversed the coded statements (items NEP 2 and PBC 3; Table S3), so that for each statement a high score indicated a high level of the associated trait. Cronbach's alpha coefficients were equal or higher than 0.60 for all latent variables, showing acceptable internal consistency. Second, we used structural equation modelling (SEMs) to test the relationships between the latent variables. We specified our models on the basis of the hypothesized relationships among the variables (see Supplementary methods for a detailed description of fitted linear regressions in the Appendix S1). We hypothesized that country (Germany, Italy, and the Netherlands) and environment (rural or urban) had an effect at the top of the sequential chain, that is on biospheric values. To define the subsequent relationships in the SEMs, we followed the value-belief-norm theory. Finally, we hypothesized that the willingness to implement pro-pollinator actions was influenced by personal norm, perceived behavioural control, social norm, frequency of time spent outdoor, gender, mean annual income, age and education. To evaluate the model fit, we used model fitting indices and considered the model good if standardized root mean square residual (SRMR) ≤0.05, root mean square error of approximation (RMSEA) ≤0.05, normed fit index (NFI) ≥0.95, and comparative fit index (CFI) ≥0.97 (Hu & Bentler, 1999). Mean annual income was not provided by all respondents. Since SEMs do not accept the inclusion of NAs, we opted to replace the missing values with median values derived from the responses of all respondents. This approach provides a more robust imputation method compared to using mean values. We also ran a sensitivity analysis excluding NAs and we obtained qualitatively similar results. In addition, to facilitate model convergence, we reduced the range of values by dividing annual mean income by 1000 and age by 10, and by log-transforming the frequency of time spent outdoor. Finally, we fitted three additional SEMs specifying the same relationship between variables for each country, separately. All model components were estimated by using the R package lavaan (Rosseel, 2012).

2.4.2 | Preference in pro-pollinator action intentions across countries and environments

First, we used Pearson's χ^2 tests for detecting differences between preferences in pollinator conservation actions across European countries and in rural and urban environments. Second, we investigated preferences in conservation actions in rural and urban environments by re-coding respondents' answer on a 5-point Likert scale to likely (>3) or unlikely (≤3) (Franceschinis et al., 2022). Then, we fitted binomial generalized linear mixed models for each country separately. We fitted as fixed factors type of pro-pollinator action, environment (rural or urban) and their interactions, and respondent ID as random factor. Models using the normal, Poisson or negative binomial distributions with the full Likert scale as response variable did not meet assumptions. We visually assessed model residuals using the R package DHARMa (Hartig, 2019). Data analyses and representations were carried out using R 3.6.2 (R Core Team, 2020).

3 | RESULTS

3.1 | General results of structural equation modelling

A total of 4541 respondents took part in our survey, 1520 from Germany, 1507 from Italy and 1514 from the Netherlands. For each country, half of the respondents lived in urban areas while the other half lived in rural areas, half of the respondents were female and half male and mean age was 42 years in Germany, 47 in Italy and 39 in the Netherlands (see Table S1). The items measuring latent variables were reliable given Cronbach α coefficients ranging from 0.60 to 0.91. Fit indices from the confirmatory factor analysis (CFA) showed that the model fit the data reasonably well ($\chi^2 = 7184.62$; df = 459; RMSEA = 0.056; CFI = 0.91, SRMR = 0.05).

3.2 | Drivers of moral obligation to protect pollinators (Hypothesis 1)

Respondents in Germany and in Italy had higher biospheric values than respondents from the Netherlands (Figure 1). Living in rural environments had a weak positive effect on biospheric values as well. People holding a biospheric value orientation tended to be concerned for the environment and to show positive values for pollinators. Environmental concern and pollinator associated value had a positive effect on awareness of the consequences of pollinator decline, with a stronger effect of pollinator values. Awareness of consequences positively affected ascription of responsibility, which in turn positively affected personal norm, that is people aware of pollinators' crucial role in ecosystems felt responsible for their conservation and, as a consequence, believed that helping them was right. Besides the effect of ascription of responsibility, personal norm was positively affected by environmental concern and pollinator associated value.

3.3 | Drivers of the intention of pro-pollinator actions (Hypothesis 2)

The willingness to implement pro-pollinator actions was positively affected by personal norm, perceived behavioural control, and social norm. Moreover, time spent outdoors and mean annual income positively affected the willingness to help pollinators. Age, gender and education did not have a significant effect (Figure 1). Separate

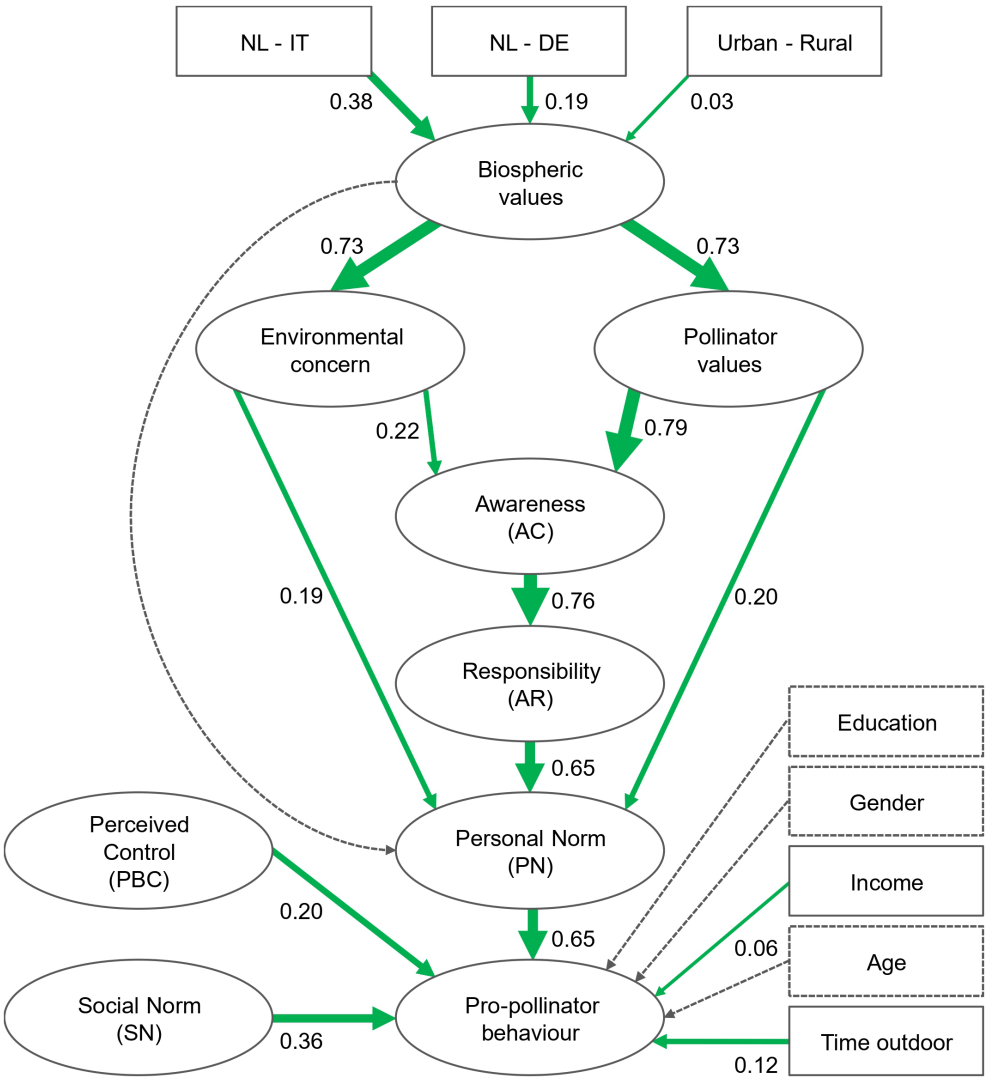

FIGURE 1 Results from the structural equation model with paths representing standardized path coefficients. Arrows' size is directly proportional to the standardized coefficient. Latent variables are represented by circles, while manifest variables by rectangles. *p*-value <0.05 for all coefficients, except where indicated by grey dotted lines (*p*-value >0.05). DE, Germany; IT, Italy; NL, Netherlands. AC, awareness of consequences; AR, ascription of responsibility; PBC, perceived behavioural control; PN, personal norm; SN, social norm. Effects of the country on biospheric values were calculated as contrasts using the Netherlands as baseline.

structural equation models for each country yielded similar results (Tables S4–S6). However, in Germany, citizens from rural areas showed higher biospheric values. In addition, annual income had a significant positive effect on intended behaviour in Germany and Italy, and no effect in the Netherlands, while female gender had a positive effect only in Germany. Finally, in Italy, having a tertiary education negatively affected intended behaviour compared to primary and secondary education.

3.4 | Preference in pro-pollinator action intentions across countries and environments (Hypothesis 3)

The intention to carry out pro-pollinator actions differed between countries ($\chi^2 = 768.66$, df = 2, *p*-value <0.001, Figure 2) and between people living in rural and urban environments ($\chi^2 = 10.937$, df = 1, *p*-value <0.001). In particular, people living in a rural environment in Germany had a higher willingness to install a bee hotel and a trend for a higher willingness to plant flowering plants for pollinator insects, and to support and/or accept national, regional or municipal legislation aimed at protecting pollinator insects (Figure 2; Table S7). By contrast, in Italy, supporting legislation aimed at protecting pollinators, that was the most likely action, was more likely in urban than rural environments (Figure 2; Table S8). All other intended behaviours showed to be equally likely in Italian rural and urban environments. Similar to Germany, planting flowering plants and installing a bee hotel were the most likely actions in the Netherlands, and they were found to be more likely in rural than in urban environments (Figure 2; Table S9).

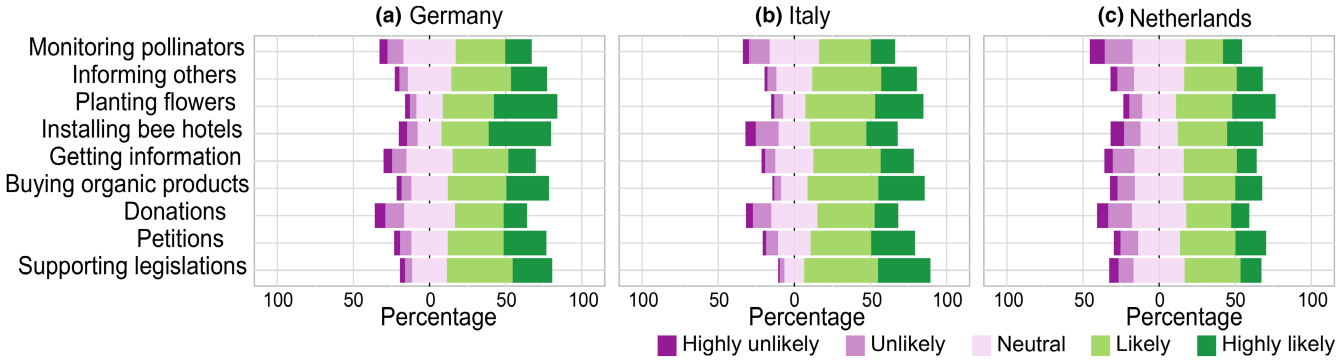

FIGURE 2 Survey respondents' willingness to undertake pollinator conservation actions ($n = 4541$) (a) in Germany, (b) in Italy and (c) in the Netherlands.

4 | DISCUSSION

Our results show that people intended to take action to conserve pollinators when they felt morally obliged to, received support from their social environment, believed their individual behaviour had an impact and frequently engaged in outdoor activities. In addition, individuals who held positive values towards pollinators were typically more conscious of their vital role. On the other hand, having a greater concern for the environment may not be a sufficient condition for raising awareness about the importance of pollinators. Observed patterns were mostly consistent across countries and environment contexts (i.e. rural vs. urban), suggesting that similar policy recommendations might be effective across Europe. However, we found some regional differences in the preference for adopting specific pro-pollinator actions.

People with intrinsic values for pollinators, such as their right to exist, or that acknowledged the utilitarian value of pollinators had a deeper understanding of the consequences of pollinator decline. As recognized by value-oriented approaches, values, such as caring for and about pollinator insects, can be the most important drivers of the consequent willingness to undertake conservation. The crucial importance of specific values held towards pollinators is not surprising considering that insects are usually marginalized by the dislike for them (Schonfelder & Bogner, 2017) and that their decline has been less visible compared to that of large vertebrates such as birds or mammals (Hall & Martins, 2020). Besides holding positive values for pollinators, feeling co-responsible for their decline and being concerned for the environment led to a sense of moral obligation to protect pollinators, as predicted in the first hypothesis.

Among the direct effects on pro-pollinator behaviour intention, personal norm had the most prominent influence. This reinforces the notion that, once activated, the reflection of the personal value system in a given situation becomes a direct, relevant determinant of the behaviour (Schwartz, 1974; Stern, 1999). Besides personal norm, also social norm, perceived behavioural control, time spent outdoor and annual income positively affected the intention to undertake pro-pollinator actions. Family, friends or social networks supporting the intention of undertaking pollinator actions had a positive effect on the intention to undertake conservation, verifying the importance of social approval (Gusto et al., 2023; Knapp et al., 2021). In addition, our results point at the positive effect of spending time outdoors, supporting the findings of previous research on environmental behaviour in general and on pollinators in particular (Chawla, 2020; Gifford & Nilsson, 2014; Knapp et al., 2021; Richardson et al., 2020; Schultz, 2002; Sumner et al., 2018). Time spent outdoor is a simple metric compared to the diverse values held towards nature, but people who spend more time in nature, are usually more highly connected to it (Lin et al., 2014; Mayer & Frantz, 2004). Interactions with nature can also be described as relational values, which encompass all forms of connections to biodiversity overcoming its intrinsic versus instrumental view (Chan et al., 2016). Strengthening these relational values involves engaging relationships with pollinator insects, with people through pollinator insects, and vice versa (Chan et al., 2016). Finally, we found a weak positive effect of annual income, indicating that wealthier individuals might show greater willingness to conserve pollinators. Our finding might be linked to the willingness to sacrifice personally to protect the environment that has been sometimes found to be higher for wealthier persons (Leong et al., 2018; Marquart-Pyatt, 2012). However, previous studies on environmental concern and income showed mixed results (Gifford & Nilsson, 2014).

In contrast to our expectations of a higher development of pro-environmental behaviour in cities compared to rural areas (Gifford & Nilsson, 2014), we found no effect in Italy and the Netherlands, while we observed increased environmental concern in rural environments in Germany. This result might be due to a stronger contrast between rural and urban areas in Germany than in the selected areas in Northern Italy and the Netherlands. Over the last decades, Germany has experienced a re-densification of cities (Wolff et al., 2018), while, the Netherlands and Northern Italy show high levels of urban sprawl; that is expansion of low-density residential housing (European Environment Agency and Federal Office for the Environment, 2016). The positive effect of rural environments was reported by others (Huddart-Kennedy et al., 2009) and might be due to a more frequent experience of

natural environments, a known important factor promoting positive environmental attitudes (Chawla, 2020). Future studies could further explore the comparison of extremely different environments, for example by looking at the willingness of pro-pollinator actions in near-natural environments.

Even if different countries showed consistent predictions, we observed some geographical differences. Differences in environmental values across European countries have been already reported and linked to personal and social norms, political views, gender or age (Sargisson et al., 2020). For example, the fact that Dutch respondents showed the lowest scores of biospheric values might be linked to their younger mean age (Sargisson et al., 2020). By contrast, in Germany, women were slightly more likely to undertake pollinator conservation, confirming results from previous studies where women tended to show stronger altruistic and biospheric values (Marquart-Pyatt, 2012; Sargisson et al., 2020).

4.1 | Preference in pro-pollinator action intentions across countries and environments

Across the three European countries, we found a strong support for intending to plant and grow flowers for pollinators. The action of planting flowers also found a high support in the study of Knapp et al., 2021 probably because it is related to the beloved practice of gardening. Barriers to the adoption of pro-pollinator gardening have been deeply investigated, highlighting the need of knowledge on how to best increase floral availability and decrease pesticide use (Burr et al., 2018; Gusto et al., 2023; Silvert et al., 2023; Varga-Szilay & Pozsgai, 2023). The social practice theory highlights that adopting new behaviours should be encouraged through the establishment of practices and not focusing on the characteristics of the individuals who would adopt them (Hargreaves, 2011). Social practices consist in materials, meanings and competencies for different actions. For example, planting flowers for pollinators depends on the same material as gardening, but requires new competencies (such as knowledge on which flowers are rich in pollen and nectar (Gusto et al., 2023; Silvert et al., 2023)) and meanings (such as positive values for pollinators). In addition, German and Dutch citizens from rural environments expressed a higher likelihood to plant flowers and install bee hotels compared to urban citizens, most likely because urban inhabitants have little green space around to do so (de Vries et al., 2020). By contrast, in Italy, all intended behaviours, except for supporting legislation aimed at protecting pollinators, were equally likely in rural and urban environments. In contrast to Germany and to the Netherlands, where installing bee hotels was selected as the second most preferred practice, it was quite disliked by Italians, possibly due to their lesser exposure to the expanding marketing of bee hotels. However, respondents in the study from all three countries agreed that participating in monitoring activities was one of the least likely options to adopt. According to the social practice theory, this action is particularly demanding in terms of new materials and skills that should be gained.

4.2 | Implications for pollinator conservation

Several recommendations to promote people's uptake of pro-pollinator actions emerged from this study. First, positive values held towards pollinators proved to be predictive of the intention to conserve them, showing that caring for and about pollinator insects is deeply rooted in individual personalities. Conservationists should acknowledge that values attached to pollinator insects seemed more important for pollinator protection than general care for nature, and might start a deeper investigation of the social values connected to insects and entangled in collective cultures and traditions (Hall & Martins, 2020; Manfredo et al., 2017). Second, as indicated by other studies, to activate pro-pollinator actions, it is crucial to raise awareness on pollinator's ecosystem role (Knapp et al., 2021; Stern, 1999). Knowing the role that pollinators play in ecosystems and the impact of human pressures on their activity can be an effective strategy to engage citizens in pro-pollinator actions. However, knowledge is just one of many external and internal factors affecting human behaviour, and increasing knowledge does not necessarily lead to action (Hornsey & Fielding, 2017; Hulme, 2014; Kollmuss & Agyeman, 2002). For example, in our study, time spent outdoor also increased the willingness to protect pollinators. Therefore, a third recommendation would be to promote simple nature-related outdoor activities, that, according to recent studies, should involve at least one physical sense such as observing wildlife, listening to bee buzzes or gardening (Richardson et al., 2020). Building relations around nature and experiencing nature (Chan et al., 2016), mostly during childhood (Chawla, 2020), should be prioritized in education, as merely knowledge has a limited capacity to change behaviour compared to transforming people's perceptions and beliefs (Schultz, 2011). Therefore, programs aimed at engaging people with citizen science, gardening and urban beekeeping seem all promising strategies (Sturm et al., 2021) and are, luckily, becoming more popular. Finally, our results indicate that the same general approach to promote pollinator conservation can be applied across different countries with contrasting socio-economic and cultural background.

AUTHOR CONTRIBUTIONS

Costanza Geppert and Lorenzo Marini conceived the study; Costanza Geppert and Cristiano Franceschinis analysed the data; Costanza Geppert and Lorenzo Marini wrote the manuscript, David Kleijn, Ingolf Steffan-Dewenter and Lorenzo Marini received funding for the study, all authors contributed to designing and formulating the questionnaire, interpreting the results and drafting the manuscript.

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CONFLICT OF INTEREST STATEMENT

All authors declare that they have no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings are available in the Zenodo database https://doi.org/10.5281/zenodo.10960349.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

Figure S1: Age distribution of survey respondents by country and by environment (rural and urban) according to gender.

Figure S2: Mean annual income (€) distribution by country and by environment (rural and urban).

Figure S3: (a) correlation between age and the frequency of time outdoor per year (Pearson's $r = 0.02$, p-value $= 0.221$); (b) correlation between mean annual income and the frequency of time outdoor per year (Pearson's $r = 0.04$, p-value $= 0.004$).

Table S1: List of all municipalities involved in the study.

Table S2: Percentages of respondents belonging to rural and urban environments per country.

Table S3: 5-point Likert items of the questionnaire.

Table S4: Results of the SEM for Germany, β = standardized path coefficient.

Table S5: Results of the SEM for Italy, β = standardized path coefficient.

Table S6: Results of the SEM for the Netherlands, β = standardized path coefficient.

Table S7: Effects of type of intended behaviour and country on the likelihood of performing or not performing pro-pollinator actions for Germany.

Table S8: Effects of type of intended behaviour, country and their interaction on the likelihood of performing or not performing pro-pollinator actions for Italy.

Table S9: Effects of type of intended behaviour, country and their interaction on the likelihood of performing or not performing pro-pollinator actions for the Netherlands.

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