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ORIGINAL ARTICLE

Orientations toward 'people' and 'things' are associated with nature connectedness in a representative sample of the French adult population

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Abstract

Identifying the determinants of people's connection with nature is crucial for the future of nature conservation. The sense of connection with nature may be defined as how one relates to the natural world or sees oneself as part of it. A part of this connection is related to what is called "Environmental Identity", which begins to form early in life under the influence of experiences with nature. Differentiated traits of appreciation of one's "environments"—defined as the things, places, and people surrounding individuals throughout their lifetime—have been described in psychological studies on personality. Theorized as "General Orientations," these consist of specific forms of selectivity in individuals' attention, which differs from their values and encourages them to respond to certain stimuli in a specific way. The literature describes two general orientations, namely toward the social environment or "people" (PO) and toward the physical environment or "things" (TO). Despite the potential contributions of PO and TO for the study of nature connectedness, few attempts have been made to explore how these dimensions interrelate. Here, we analyzed survey responses from the ELIPSS panel, a representative sample of the French adult metropolitan population ($N = 1788$), to test the hypothesis that General Orientations, especially PO, as a personality-like trait are related to higher EID. We found that PO and TO were positively correlated with EID (strongly and moderately, respectively), and appeared to mediate the association between gender and EID. These findings raise the question as to whether General Orientations correspond to different ways of building connections with nature.

Keywords Connection with nature · General population · Environmental Identity · People Orientation · Thing Orientation · Scale revalidation

Introduction

Humans' connections with "nature" may be broadly defined as the different ways in which people bond and identify themselves with the non-human environment (Restall and Conrad 2015), which may include "all non-human living entities and their interaction with other living or non-living physical entities and processes" (IPBES 2019). Nature connectedness is considered to have declined or changed in Western-like societies in the last decades (Soga and Gaston 2016; Kesebir and Kesebir 2017).

Certain dimensions of connections with nature drive pro-environmental attitudes and behaviors (Kiesling and Manning 2010; Geng et al. 2015; Clayton et al. 2019; Baur et al. 2020; Whitburn et al. 2020; Martin et al. 2020), and their weakening is currently considered to be an intrinsic part of the environmental crisis (Zylstra et al. 2014; Riechers et al. 2020). Preserving or nurturing peoples' connections with

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nature, thus, appears to be critical for environmental conservation. To reach such a goal, it is necessary to characterize the diversity of individual approaches for connecting with nature and determine how people can be helped to anchor their attitudes and practices in them.

In addition to the critical role played by people's experience with the natural world and non-human beings (Colléony et al. 2019, 2020), other factors more directly related to the human collective, whether social (e.g., ethnicity, religion) or sociopsychological such as social identities (Brieger 2018), values, subjective norms, and social relational emotions (Petersen et al. 2019), have also been acknowledged to play a role in people's attention to nature (Gifford and Nilsson 2014). The same is true for various socialization processes such as community-based initiatives, which has also been widely recognized in nature bonding (Zylstra et al. 2014). Prévot et al. (2016) suggest that among adults, the effect of childhood environment is mediated by their current experiences, in particular the frequency of visiting natural environments as well as their pro-environmental social environment. Thus, in adequate conditions, with more opportunities for nature experiences, for example, it would be possible that an individual's inclination for the social environment, meaning how receptive one is to social human environment, contributes to the development of a certain connection with nature by fostering receptiveness to human influences about nature. Analogously, Branch et al. (2015) found that the orientation toward people had an indirect effect on students' interest in pursuing a career in engineering research through their positive perception of their educators' encouragement, and consequently, their intention to become involved in undergraduate research. These mediators could indeed satisfy students' People Orientation.

Positive associations between certain individual constructs that emphasize other human beings and nature connectedness have been recurrently theorized and empirically described in the literature, building on the body of psychological research on universal values, the self, and interpersonal relationships. These constructs include collective/self-transcendence values, attitudes, and traits such as agreeableness and prosocial personalities (Clayton 2003; Nisbet et al. 2009; Zhang et al. 2014; Olivos and Clayton 2017). Different processes may explain these associations. One process relates to nature exposure that individuals with high nature connectedness may seek. While nature exposure may lead to increased nature connectedness, reciprocally, nature connectedness may lead to increased exposure to nature that in turn may elicit higher prosocial perceptions, attitudes and behaviors. Studies suggest that the latter relationship may be mediated by emotions such as feelings of awe and the perception of beauty (Zhang et al. 2014; Goldy and Piff 2020). The former shift attention away from oneself (Piff et al. 2015; Goldy and Piff 2020), and the latter increases positivity, which are thought to ultimately increase prosociality (Zhang et al. 2014; Goldy and Piff 2020). In a review of the studies on the links between greenspaces and prosocial behaviors among children, Edi Putra et al. (2020) proposed complementary explanations based on theories on the relationships between urban greenspaces and health. Among them, stress reduction (Ulrich et al. 1991) and attention restoration (Kaplan 1995) provided by contact with nature could favor positive emotionality that in turn could foster prosocial development. Greenspaces could also nurture prosocial behavior development by favoring social interactions. Certain studies, however, suggest that the various types of nature do not have the same effects on prosocial behaviors (Joye and Bolderdijk 2015; Ng et al. 2019). Besides, the durability over time of the effect of exposure to nature on prosociality remains poorly known (Goldy and Piff 2020). Other processes that may explain the association between constructs that emphasize other human beings and nature connectedness relate more specifically to long-term dispositions such as values and empathy. For example, biospheric concern is negatively associated with self-enhancement and positively related to altruistic values (Schultz 2001; Schultz et al. 2005; de Groot and Steg 2008; Katz-Gerro et al. 2017). Environmental consciousness appears positively related to self-transcendence (Muralidharan and Sheehan 2017). Olsen and Tuu (2021) found that individuals' concern for long-term consequences of their food habits was related to self-transcendence. Environmental Identity (EID), a construct that depicts a stable connection with nature (Prévot et al. 2016), appeared negatively related to individualism (Clayton 2003) and social dominance (Clayton 2008). Recently, Clayton et al. (2019) found that EID was linked to empathy toward plants and nature in general on the one hand and people on the other. The authors explained that certain aspects of nature connectedness (in the form of biospheric concern or EID) are associated with the idea that one is part of a much larger interdependent system, which may be related to the ability to consider another's perspective more easily (Schultz 2000, 2001; Clayton 2012; Clayton et al. 2019), regardless of whether the being is human or non-human.

A complementary but rarely investigated approach is to consider more globally why individuals relate to natural elements in different ways. From this perspective, the concept of "General Orientations"—i.e., how people generally apprehend the world—may be used as an interpretation (Hills 1989). General Orientations have been theorized by psychologists focusing on personality and career choices. They pertain to person–environment-fit approaches, which analyze how people differ in the way they respond to different aspects of their environment. Some authors have pointed to the existence of fundamental orientations toward specific parts of the environment and proposed classifying

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them under two basic units: the social environment comprised of "people" and the physical environment of "objects" (Drechsler et al. 1979). This approach was formalized in the specialization theory of Little (1976), which designated people and objects as "primary objects," thus promoting the study of the articulation between personality and the environment using a simple typology inspired by the philosopher Peter Frederic Strawson's proposal in which these elements were "ontologically primitive" bricks of the environment (Hills 1989).

General Orientations have been described as interests (McIntyre and Graziano 2016; McIntyre et al. 2021) driven by a dispositional–motivational complex (Graziano et al., 2011) that influences how individuals respond behaviorally, cognitively, and affectively to specific aspects of their environment. This response style is reinforced in a "specialization" loop (Little 1976) across experiences with behavioral, cognitive, and affective processes that are mutually strengthened (Little 1976; McIntyre and Graziano 2016). General Orientations probably stem from exposure to particular environments (McIntyre and Graziano 2019). The "Thing" Orientation (TO) implies greater attention to the physical environment (i.e., things/objects) (Ngambeki et al. 2012; McIntyre and Graziano 2016) and greater interest in manipulating and interacting with things, whereas the "People" Orientation (PO) suggests a tendency to look for and succeed in social interactions (Ngambeki and Magana 2020). Persons with a high TO seem to better understand the fundamentals of the existence of objects and their behavior in space, while persons with a high PO tend to have a better ability to respond to people's emotions (Ngambeki and Magana 2020). Recent work suggests that these orientations operate at the response stage more than at the perceptual stage (McIntyre and Graziano 2016). Previous studies suggested that PO and TO are independent constructs as opposed to poles of a single dimension or correlates as previously supposed (Graziano et al. 2012; Woodcock et al. 2013). They are, thus, non-exclusive constructs. PO and TO usually correlate with the social and realistic subscales (Woodcock et al. 2013) of the Holland model, a widely used typology in counseling psychology that describes personality profiles. However, Little's constructs are thought to be more global responses to the environment (Graziano et al. 2011; Woodcock et al. 2013), even if PO and TO have been chiefly explored in relation to vocational interest (e.g., Woodcock et al. 2013; Branch et al. 2015; Yang and Barth 2015; Kemper and Brinkmeier 2019; Bairaktarova and Pilotte 2020; McIntyre et al. 2021). They seem to relate to activities beyond the professional framework and shape one's everyday environment (McIntyre and Graziano 2019).

Because General Orientations are stable dispositions that encourage selective attention and drive individuals to give priority to some stimuli over others (McIntyre and Graziano 2016; Lee 2019), thus possibly influencing learning (Ngambeki and Magana 2020), General Orientations may be a promising means to enhance nature education interventions. Indeed, ensuring that the nature experiences offered by a given program include both types of stimuli related to General Orientations could contribute to make sure that all their participants are provided with the stimuli they need.

On the one hand, "person-specialists" are described as individuals inclined toward affiliative, empathic, and nurturant activities (Little 1976), interpreting both people and things using subjective and psychological constructs. "Thing specialists," on the other hand, tend to interpret people and things using "objective" criteria such as color, shape, or chemical composition. Moreover, these basic characteristics of personality (Woodcock et al. 2013) are proposed to shape the nature, intensity, and persistence of thoughts, feelings, and behaviors (Graziano et al. 2012) toward primary as well as "secondary" objects such as art, combinations of people and things, and animals (Hills 1989), and more generally to influence cognition and learning (McIntyre et al. 2021). General Orientations also seem particularly relevant given that they characterize individuals early in life and in the long term (Graziano et al. 2011). They could shape nature experience in childhood and ultimately connection with nature. Finally, orientations are presented as a specific construct that is theoretically distinct from values (Lee 2019), which have been particularly studied in environmental psychology. Orientations may, thus, possibly bring new understanding of how people connect with nature.

Unfortunately, few studies have explored how PO–TO and nature connectedness are interrelated, although the possibility of relations between "trait-like" constructs (i.e., relatively stable characteristics) such as personality aspects and nature connectedness has been suggested (Nisbet et al. 2009). Lee (2019) propose that both TO and PO may predict socially and ecologically conscious consumer behaviors. In 1989, Hills hypothesized that perceiving animals as a thing or a person depended on an individual's levels of PO and TO, which could highlight the adoption of humanistic and moralistic versus utilitarian and negativistic values toward the animal. Separating PO and TO profiles into a four-group typology, she found that women and individuals with high levels of both TO and PO compared to non-specialists were more likely to be oriented toward animals and view them as persons. However, Hills' results may suffer from a loss of power due to a small sample ($n = 101$) divided for the analyses into four groups of person and/or thing specialists. She called for more research to understand these findings and the intertwined role of gender and PO–TO, especially because the cute and "macho" animals selected for the study may have exacerbated the role of gender in the perception of the animal concept. McIntyre and Graziano (2019) studied the relationship between people's General Orientations and their

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everyday environment with a focus on people and artifacts; with the exception of animals, they did not categorize natural elements (i.e., plants, natural landscapes). The authors did not find a relation between PO and "gravitating toward" animals or people, though their study was based on a small homogenous sample of students.

Even though different parts of the environment, not only animals (Hills 1989), may be considered "thing-like" or "person-like" depending on the person or cultural context, to our knowledge, no study has investigated a possible relation between PO and an inclination toward the natural world as a more general unit. The latter may be found in the concept of Environmental Identity (EID), which may be defined as how one integrates the natural world as an inner part of oneself and promotes attention to this world (Clayton et al. 2019). EID is conceptually close to other widely used concepts of connection with nature and correlated with their scales (Tam 2013; Balundė et al. 2019) such as Nature Relatedness (NR) (Nisbet et al. 2009) and Connectedness to Nature (CNS, Mayer et Frantz 2004). Their scales have been found to be mainly markers of one higher-order common construct (Tam 2013). Many connectedness to nature scales were identified as unidimensional in scope, meaning that they were conceptualized to mainly capture a specific aspect of the human-nature connection. For example, the CNS was initially designed to capture an affective aspect (Mayer and Frantz 2004; Perrin and Benassi 2009; Clayton 2012), while the INS scale or the Implicit association test were meant to capture a cognitive aspect (Schultz 2002; Schultz et al. 2004; Schultz and Tabanico 2007; Tam 2013; Restall and Conrad 2015). On the contrary, the EID scale, along the Nature Relatedness scale, was explicitly defined with different dimensions of nature connectedness, namely cognitive and non-cognitive aspects such as emotional attachment (Tam 2013; Restall and Conrad 2015). It is, however, more focused on identity, and less focused on emotions compared to the Nature Relatedness scale (Nisbet et al. 2009), which is also presented as including a dimension of an "internalized identification with nature" (Nisbet et al. 2009). Tam (2013) found that both scales had the highest external validity among a set of commonly used connectedness to nature scales.

The specificity of the EID concept is that it was built on previous studies on social identity based on the idea that identity is constructed with social context and experience, leading people to acquire a representation of how they "fit into a particular place and time" including ties and resemblance with others (Clayton 2012). EID is also an interesting construct for building long-term environmentally friendly societies, as it implies a stable connection with nature (Prévot et al. 2016) and may predict both pro-environmental behaviors and human well-being (Clayton et al. 2019). EID relates explicitly to both living organisms from a strict biological definition (e.g., species, trees) and spaces or elements that may be considered living, non-living, or both (i.e., ecosystem, mountain, land, geographical location, outdoors, sunset, storms) depending on a person's point of view. Some people with strong EID may, thus, prefer plants, animals, or "inanimate" nature (Clayton et al., 2019). In any case, EID suggests an intimate relationship with these elements. We, thus, hypothesized that a general orientation toward people (PO), which suggests an appetence for interpersonal interactions (Ngambeki et al. 2011), could predict EID.

TO has been previously associated with animal orientation (Hills 1989), and for this reason, it could also be expected to predict EID. TO is described as a tendency to interpret elements of one's environment (people and things) primarily in a physical way by focusing on shape, color, and so on. It could, therefore, facilitate the development of EID by focusing one's attention on the natural world with a more material connection with nature (Ives et al. 2018). However, we expected TO to be a weaker predictor of EID than PO, as the latter is related to the process of viewing animals as persons, while EID is closely related to the process of taking into consideration others' point of view. Moreover, TO has been related to "gravitating toward" artifacts (buildings, electronics) (McIntyre and Graziano 2019), which may contribute to a more limited experience of nature, as previously mentioned.

The articulation between the PO–TO framework and the psychology of natural environment research requires further consideration. In this paper, we aim to investigate whether General Orientations for the human social environment (for people) and the physical environment (for things/objects) (Graziano et al. 2011) are good predictors of a stable connection with nature. Indeed, General Orientations may motivate different patterns of behaviors, both individual life decisions and more localized behaviors (McIntyre and Graziano 2019), and could possibly contribute to improving our understanding of individuals' relationships with the natural elements of their environments.

We, thus, hypothesized that:

(H1) People Orientation (PO) relates to Environmental Identity (EID), thus supporting the idea that PO is associated with a stronger orientation toward the natural world;

(H2) Thing Orientation (TO) may also predict EID, thus supporting the idea that EID also involves an inclination toward the physical dimension of the environment in addition to the perception of the environment in terms of the self or other beings;

(H3) PO is a stronger predictor of EID than TO.

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We also expected that the EID scale would, in a sample of the French adult population, be dependent on people's experience with nature during childhood and their potentially pro-environmental social environment. We, thus, adjusted for these factors in the multivariate analyses in addition to sociodemographic characteristics. The most common sociodemographic characteristics are uncertain predictors of nature connectedness (Raudsepp 2001). Sociodemographic variables are all interconnected in their relations to individual connection with nature (Ignatow 2006; Gifford and Nilsson 2014), and it is difficult to explore them individually. Indeed, to date, associations with age, gender, and education seem to vary according to the constructs studied (Raudsepp 2001; Gifford and Nilsson 2014). EID score was variously found to be no different between genders (Clayton 2003) or higher among women (Clayton and Kilinç 2014; Prévot et al. 2016). In parallel, gender has been identified as a strong predictor of General Orientations, with women presenting a stronger PO and men presenting a stronger TO (Graziano et al. 2012; Woodcock et al. 2013). Because General Orientations are related to both gender and certain pro-environmental attitudes and behaviors, we expected that they could indirectly link gender and EID.

Finally, our study also had a methodological goal to validate a French version of the Environmental Identity scale among a large representative sample of the French adult metropolitan population.

Materials and methods

Sample

In 2019, a 10-min questionnaire (Baudry and ELIPSS Team 2019; Supplementary S1) was submitted to the ELIPSS panel, a representative sample of individuals living in ordinary households that was randomly chosen from the French adult metropolitan population (except Corsica; 18–79 years at inclusion). After inclusion, participants in the ELIPSS panel (coordinated by the *Centre de Données Socio-Politiques*, CDSP; www.elipss.fr) were given a tablet computer connected to mobile 3G Internet, enabling them to participate in a questionnaire proposed each month. A total of 2405 panelists were invited to respond to the Natinterest questionnaire. Sociodemographic data were obtained from an ELIPSS annual survey and the annual census survey. Specific questions (i.e., being a member of an environmental organization or having an environment-related job) and the French version of the New Ecological Paradigm Scale (Schleyer-Lindenmann et al. 2014) were taken from previous surveys submitted to the ELIPSS panel (Boulbry et al. 2016; Petev et al. 2017). As for each monthly survey, individual weightings of respondents were calculated in three steps to adjust for nonresponses: using the homogeneous response group method, adjusting the weighting for five criteria from the 2014 annual census (gender, age, nationality, education level, and Research and National Development Zones or ZEAT, corresponding to the previous administrative regions[1]), and performing a final readjustment to correct for nonresponses in a given set of questions. Panel members receive reminders to respond to their monthly questionnaire. Elipss panel was constituted in two phases, and attrition was 22% in four years for the pilot part of the panel, and 16% after two years for the complementary panel.

Questionnaire

Environmental Identity

Environmental Identity (EID) is mainly observed as unidimensional but sometimes shows the multiple dimensions of nature connectedness (Olivos and Aragonés 2011): Environmental Identity (feeling of belonging to nature), appreciation of nature (values attributed to nature), pleasure associated with nature (especially, engaging in outdoor activities), and motivation to protect nature. A total of 13 out of 24 items of the long version of the EID scale were retained due to the space limitation of the questionnaire. The selected items related to the first three dimensions identified by Olivos and Aragonés (2011) and suggested by Clayton (2003) throughout the development process of the scale: Environmental Identity, enjoyment of nature, and appreciation of nature. A final dimension identified by Olivos and Aragonés (2011) but explaining less variance, environmentalism, called ideology by Clayton, was not retained, as we wanted to privilege items relating to connection with nature as opposed to ideas regarding its preservation.

Our adapted version of the EID scale (13 items) was still longer than the short EID scale (11 items), with several overlapping items.

Orientation toward people and orientation toward things

Graziano et al. (2011) and earlier Little (1972, 1976) proposed scales to measure PO and TO based on items that describe situations and activities with responses toward the object of interest (people or things). In this study, PO and TO were measured using the scale of Graziano et al. (2011), which is a shorter operational tool based on Little's scale.

From the 13 items, two items from the Thing orientation subscale were excluded because respondents had difficulty answering during pre-testing and one new item was introduced in the same subscale. All the other items were similar

[1] https://www.insee.fr/en/metadonnees/definition/c1910.

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or only slightly adapted from the original English version. The English translation of the French version is shown in supplementary S1. Items were formulated as a statement of appreciation of activities. TO was measured with four items on observing or repairing human-made objects commonly considered to be highly artifactual/transformed objects such as computers, while PO was measured with eight items mostly relating to observing, listening, or interacting with human strangers.

For each scale, processes of translation and test–retest were conducted to ensure the quality of the translation. These were carried out by EB and ACP, with the help of a group of PhD students.

Sociodemographic variables

Income was recorded as an ordered variable corresponding to the monthly income per household unit of consumption. Education was measured with a five-level item recording the highest diploma (ordered responses being No diploma or junior high school certificate, vocational diploma, high school diploma, 2-year university degree, and bachelor's degree or higher). Age was recorded in 5-year intervals ranging from the first category "less than 24 years" to the last category "70 years and older". Sex (binary response woman/man) was used as a proxy for gender.

Experience of nature

Two items recording place of residence from 0 to 11 years and from 12 to 17 years were used as proxies for levels of experience of nature during these critical early periods of life. Item responses used a five-point response: large city or metropolis (> 50,000 inhabitants), medium city (between 20,000 and 50,000 inhabitants), small city (between 2000 and 20,000 inhabitants), village or hamlet (< 2000 inhabitants), and other (recoded as missing values). This classification was based on the common use of "city" and "village" in French. We acknowledge that such a measure is an unrefined proxy for experience of nature during childhood, which was used because of survey length constraints. Nevertheless, we considered rurality of living place during childhood to be a relevant control variable, as in a sample of French students, a positive correlation was found between current EID and rurality of childhood habitat (Prévot et al. 2016).

Statistics

Statistical analyses were performed in three steps: descriptive statistics were calculated on the items as well as the total scores of the scales after their revalidation. Revalidation of the scales consisted in classical psychometrics verifications (distribution of the items, dimensionality, internal consistency, construct validity). Finally, a structural equation model (SEM) was calculated to test our hypotheses.

Descriptive statistics

Descriptive statistics were calculated primarily in the weighted sample, so they were more representative of the French adult metropolitan population, although non-weighted estimations were generally similar. Only six respondents had missing data for the TO and PO items and eleven for the EID items. We used pairwise complete observations for parallel analysis and bivariate statistics and deleted these individuals for factor analysis. For bivariate statistics, we compared the correlation coefficients of PO/EID and TO/EID with the test proposed by Steiger (1980) for comparing dependent (i.e. here, from the same group) overlapping (i.e., sharing one predictor) correlations.

Revalidation of EID, PO, and TO scales

As our EID, PO, and TO scales were newly translated French versions, we first performed a revalidation of these scales. We graphically searched for floor or ceiling effects and calculated their mean and standard deviation. We performed first principal component analyses and parallel analyses on non-weighted data (as conventionally performed) to examine the dimensionality of each of the translated scales (EID and PO–TO questionnaire). The unidimensional structure was determined using screeplot. We then performed exploratory factor analysis (EFA) to determine the weightings of the items in each scale after Barlett's test of sphericity and the Kaiser–Meyer–Olkin measure of sampling adequacy to verify the factorability of the data and the adequacy of sampling.

EFA based on the polychoric correlation, a technique used to estimate the correlation between ordinal measures from variables assumed to be normally distributed, was calculated (Baglin 2014). EFAs were performed using the minimum residual method and oblimin rotation. Because estimations were adjusted for zero values using the correction for continuity due to the low value of some cells (17 for EID), we explored the robustness of our results by analyzing the scale with a full-information item factor analysis with a nominal response model.

Internal consistency (i.e., consistency in the measurement of the same construct using different items of the same scale or subscale) was then evaluated with the alpha Cronbach for each of the dimensions identified.

For the descriptive statistics, EID, PO, and TO scores were computed as additive indexes (same weighting for all items).

Construct validity is an important step for validating whether a questionnaire "measures what it is intended to

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measure" (Tsang et al. 2017), conventionally assessed by verifying that its scale is associated (or not) with the way that it should be with other measures from close concepts. We analyzed the external convergence validity of the EID scale by calculating its correlation with the following measures: a five-level version of the Inclusion of Nature in Self scale (INS, Schultz 2002), with items comprised of two circles with a different overlap to represent the various levels of inclusion of nature (the initial seven-level version was not used due to the width constraint imposed by the use of tablets for the questionnaire); and the New Paradigm scale (NEP) (Schleyer-Lindenmann et al. 2014), which measures five facets including anti-anthropocentric beliefs (assessing the intrinsic value of nature), rejection of human exemptionalism, and balance of nature. NEP scores were measured in a previous study involving the ELIPSS panel (Petev et al. 2017), and these scores were linked to the data collected in the questionnaire submitted for the present study.

Convergent and divergent validities of PO and TO scales were tested with a French translated version of the "Short Big Five" (Soto and John 2017), incorporating 30 items, with pairs of items measuring 15 personality facets across five subscales. Because the last dimensions of the factor analysis did not correspond to a clear factor, only four of the five subscales were retained (neuroticism, conscientiousness, agreeableness, openness, but not extraversion; data not shown).

Structural equation modeling

We used the structural equation modeling (SEM) framework to test the hypothesized predictors of EID. This framework allows us to model in path analysis different latent variables such as the psychometric dimension measured by multiple items, thus revealing the relationships between latent variables (Hoyle 1995). A particular advantage of this approach, which uses both a measurement and a structure model, is that it allows for the control of measurement errors. EID, PO, TO, and childhood rurality were introduced as latent variables in our model. The correlation between all predictors (except items from latent variables) was calculated to detect any multicollinearity as well as the variance inflation factors (VIF) using a threshold of three (Zuur et al. 2009).

Because some outcome measures were not normally distributed, we used SEM with a maximum likelihood estimation method with robust standard errors and a robust test statistic adapted to ordinal data with more than four categories that diverge from normal distribution (Rhemtulla et al. 2012; Gana and Broc 2019). Suggestions of residual covariance from modification indices were considered, and added to the model only if they were theoretically meaningful (see Supplementary S4) (Grace 2006). Our model was based on the weighted sample. We assessed the fit of the model with commonly used indices for SEM: the standardized root mean square residual (SRMR), with an absolute fit index under 0.08; the comparative fit index (CFI) of the specified model against the null model, with an incremental fit index considered (very) good at 0.90 (0.95) or over (Gana and Broc 2019); and the root mean square error of approximation (RMSEA), a parsimonious fit index that assesses the discrepancy between a hypothesized and observed model that should tend toward 0 (Hu and Bentler 1999; Gana and Broc 2019). We verified that the local fit indices did not contain inadmissible parameter estimates (negative variance). All structural equation modeling was performed with the *sem* function of the Lavaan package (Rosseel 2012).

Variables and paths included in structural equation modeling

We assessed the effect of PO, TO and gender on EID, with age, education, income, childhood rurality (as a proxy for experience of nature during childhood), membership in an environmental group and environment-related job (as proxies for social environment) as controlling variables. We assessed the effect of gender on PO and TO and adjusted for age (previously found to play a role in General Orientation, with older individuals expressing more PO on average). Correlation between the residual errors for PO and TO was added.

Regarding gender, we assessed (1) the total effect, i.e., the sum of the direct and indirect effects of gender (mediated by PO or TO) on EID; (2) the direct effect (i.e., the effect of gender that was not mediated by PO or TO); and (3) the indirect effects (i.e., the effect of gender mediated by PO or TO). The indirect effects were estimated as the product of the coefficient procedure.

For all the statistical tests, the level of significance was set at 0.05. The ratio of participants to free parameters (23:1) was considered good (Gana and Broc 2019).

Overall, 14 respondents had missing data for at least one item of the response variables (i.e., EID or PO–TO scales). As for the explanatory variables, missing data amounted to less than 7% of each variable (age and education: 5.72%; social environment variables: 4.99% and 5.38%; place of residence variables: less than 2%; unweighted values), except for income for which 14.76% of values were missing. For SEM analysis, we removed missing individuals from the predicted variables. New weighting was done on the final sample of 1788 individuals. We performed a multivariate imputation by chained equations (MICE) with polytomous regression (for categorical variables) with 20 imputations (White et al. 2011) to replace missing data from other variables using predictors of the model (except for General Orientations, which were also predicted variables), as well as other relevant variables from the census (including perceived

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Table 1 Descriptive statistics for the predicted scales: Environmental Identity (EID); People orientation (PO) and Thing Orientation (TO). Interscale correlation coefficients were computed with bootstrapping (1000 repetitions). For the correlation coefficients, all p values were < 0.001. *SD* standard deviation. Source: "L'intérêt pour la nature dans un contexte d'urbanisation" (NatInterest), 2019, ELIPSS/CDSP

Scale	Items	Mean score (SD) (without/with weighting)	Range	Bootstrapped correlation coefficient/α *Cronbach*[a] without/with weighting		
				EID	PO	TO
EID	13	3.72 (0.65)/3.66 (0.71)	1–5	*0.90/0.91*		
PO	4	3.49 (0.65)/3.44 (0.71)	1–5	0.34/0.40	*0.70/0.73*	
TO	4	2.83 (1.03)/2.82 (1.04)	1–5	0.28/0.36	0.10/0.20	*0.82/0.81*

[a]Diagonal values

financial situation, housing occupation status, marital status, partner's education level, and professional category of the respondent and his/her partner). The dataset was completed with the median of 20 values obtained for each of the missing values. MICE was performed using the mice package (van Buuren 2015). All statistical analyses were conducted using R software, version 4.0.2 (R Core Team 2013).

Results

Descriptive statistics

Sociodemographic characteristics

A total of 1802 individuals answered the *NatInterest* questionnaire (74.9% of the panelists invited to answer). Descriptive statistics for sociodemographic characteristics are detailed in Supplementary S2 (Table S2-A).

People Orientation, Thing Orientation, and Environmental Identity scales

Results of the revalidation of the scale are shown in Supplementary S3. Similarly to the findings of previous studies (Clayton 2012), EID presented mainly one dimension and a strong reliability, which allowed us to sum the item scores. In contrast to the results from other populations, three dimensions were identified in the PO–TO scale, with the subdivision of PO into two dimensions: one relative to active PO (five items on social interactions) and one relative to passive PO (observation or listening, mainly two items). Only the strongest PO subscale was retained (active PO), and items cross-loading between any two of the three dimensions were excluded. The final main PO scale consisted of four out of eight PO items (S3). All four TO items were retained. Reliability was acceptable for the final dimensions of PO and TO (Table 1), although it was slightly weaker than in previous studies (Graziano et al. 2011; Woodcock et al. 2013).

Places of residence

The majority of respondents lived in a village or hamlet or a small city during early (0–11 years) and later childhood (12–17 years); (Table S2-B). Place of residence at 0–11 and at 12–17 years were highly correlated ($r = 0.81/0.79$ for the unweighted and weighted samples, respectively) and, thus, summed into a new single indicator of place of residence from 0 to 17 years for the descriptive statistics.

Bivariate analyses

Bivariate analyses between EID and the retained predictor variables are presented in Table 2. EID was positively related to PO and TO. Before adjustment, there was no significant difference in the strength of the correlations between PO/EID and TO/EID ($z = -1.50$, $p = 0.13$). Regarding the sociodemographic characteristics, it was negatively but weakly related to education level and women, with a small difference of EID mean scores between genders (men: 3.74 (SD = 0.69), women: 3.59 (SD = 0.72); difference: 0.142,

Table 2 Correlation coefficients among EID and predictive independent variables

	r	SD	t value	p value
Gender[a]	−0.10	0.02	−4.32	< 0.001
Age	0.17	0.03	6.68	< 0.001
Income	−0.01	0.03	−0.27	0.800
Education	−0.08	0.03	−2.93	0.006
Experience of nature during childhood	0.14	0.02	5.60	< 0.001
Environment-related job[b]	0.12	0.02	5.95	< 0.001
Environmental group membership[b]	0.06	0.02	2.96	0.004

Correlation coefficients were computed with bootstrapping (1000 repetitions) and weightings. *SD* standard deviation. Source: "L'intérêt pour la nature dans un contexte d'urbanisation" (NatInterest), 2019, ELIPSS/CDSP

[a]Coded 1 for women and 0 for men

[b]Coded 1 for "Yes" and 0 for "No"

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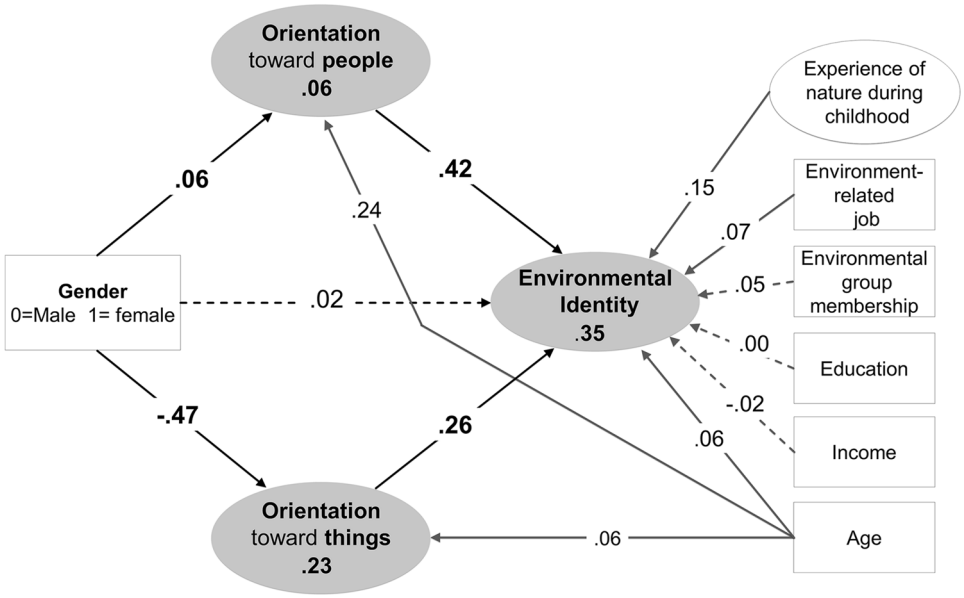


Fig. 1 Sociodemographic, People Orientation, and Thing Orientation effects on Environmental Identity in the French adult metropolitan population estimated by structural equation modeling. Observed variables are displayed in rectangular shapes and latent variables in oval shapes. The single-headed black solid arrows indicate significant paths ($p < .05$). Dashed arrows represent non-significant paths. Coefficients on the arrows represent standardized β estimates. R^2 values for dependent latent variables are presented in oval shapes. Age, income, education, proxy for experience of nature during childhood, environmental group membership, and environment-related job (proxy for social influence) were included as controlling variables

se = 0.03, p < 0.001, bootstrap n = 1000). Conversely, EID was positively related to age. EID was not related to income. Regarding the social environment variables, EID was positively correlated with environment-related job and environmental group membership.

Finally, PO and TO were moderately and positively related (Table 1).

Structural equation modeling of Environmental Identity

The model provided a good fit to the data ($\chi^2 = 2037.1$, $df = 345$, robust CFI 0.90, robust RMSEA 0.05, SRMR 0.05). Figure 1 shows the estimated standardized coefficients, while Table 3 provides the confidence intervals (see also Supplementary S4 for all parameters of the model). PO and TO were good positive predictors of EID. Rural place of residence during childhood and environment-related job were also positive predictors of EID, as expected (Fig. 1). Gender, income, education and environmental group membership were not direct predictors of EID.

Gender predicted both PO and TO, with the latter association being particularly strong. Being a woman was associated with a lower TO score and a higher PO score. Gender had an indirect effect on EID through TO (−0.13, $p < 0.001$), a weak indirect effect through PO (0.02, $p = 0.03$), and a weak total effect (−0.08, $p < 0.001$).

Discussion

Estimating individual levels of nature connectedness at the population scale and identifying their predictors may be an important step in nurturing such ties with nature.

From a methodological point of view, this study is the first to revalidate a short French version of the Environmental Identity scale in a representative sample of the French adult metropolitan population. EID has explicitly been defined in a multidimensional way (Tam 2013). Even though studies tend to consider it more frequently to be unidimensional, Clayton et al. (2019) suggested that it was possible for a multidimensional structure of the EID scale to emerge in a diverse sample. This was not the case in our sample, which essentially advocates for a single dominant dimension in the French general population.

In parallel to psychological studies and tools centered on natural environments, how individuals are selectively orientated toward certain elements of their environment in general has been theorized by psychologists working on personality and professional choices. Surprisingly, however, little is known about the relation between traits that

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Table 3 Confidence intervals for standardized coefficients of predictors of structural equation model ($N = 1788$)

Predicted/predictor variables	CI (95%)
Environmental Identity	
Direct effect	
Experience of nature during childhood	**[0.10; 0.19]**
Age	**[0.01; 0.10]**
Gender	[−0.03; 0.07]
Income	[−0.06; 0.02]
Education	[−0.04; 0.05]
Environmental group membership	[0.00; 0.10]
Environment-related job	**[0.03; 0.11]**
TO	***[0.20; 0.32]***
PO	***[0.36; 0.48]***
Indirect effect	
Gender → TO → EID	***[−0.16; −0.09]***
Gender → PO → EID	***[0.00; 0.04]***
Total effect	
Gender → EID	***[−0.12; −0.03]***
Thing orientation	
Gender	**[−0.51; −0.43]**
Age	**[0.02; 0.09]**
People orientation	
Gender	**[0.01; 0.11]**
Age	**[0.20; 0.29]**

Parameter estimates in which intervals do not include zero (prior to rounding) are shown in boldface. Core effects studied are shown in italics. Source: "L'intérêt pour la nature dans un contexte d'urbanisation" (NatInterest), 2019, ELIPSS/CDSP

EID Environmental Identity, *PO* people orientation, *TO* thing orientation, *CI* confidence interval

characterize the orientation types of individuals and their connection with nature. Yet theoretical arguments exist for a relationship between General Orientations, in particular PO, and nature connectedness. Here, we tested the relations of General Orientations with EID in a large representative sample of the French adult metropolitan population while adjusting for sociodemographic and social environment factors. The indirect relationships between gender and EID, through these General Orientations, were also investigated. PO, and to a lesser extent, TO both predicted EID among a representative sample of the French adult metropolitan population. Our results support the hypothesis that besides being associated with an orientation toward animals (Hills 1989), General Orientations are related to a strong relationship with the natural world in general.

As a possible explanation, we suggest that the relationship between PO–TO and EID is mediated by experiences with nature. Experiences with nature may be physical, social, vicarious or symbolic, and entail cognitive, affective and evaluative processes (Kellert 2002). They may involve sensations and emotions (Truong et al. 2020). Similarly, connections with nature have been described as multiform: material, experiential, cognitive, emotional, or philosophical (Abson et al. 2017). Under the PO–TO theory, it would be possible that receptivity to nature stimuli differ according to PO–TO. TO emphasizes material experiences (e.g., color, shape), with Ngambeki et al. (2011) suggesting that TO is less an orientation toward an entity than a process orientation that focuses on how an entity "was made [and] works". It would, thus, be interesting to investigate, for example, whether individuals with high levels of TO are more focused on certain aspects of their experiences with nature (e.g., view, cognitive patterns) compared to those with lower levels of TO.

The relationship between PO and EID may have further explanations. One perspective relates to the biophilia hypothesis, which postulates that people have an inner need to relate to living things (Kellert and Wilson 1993). There may be individual differences in the level of biophilia, and PO could be part of a broader orientation toward life that characterizes highly biophilic individuals. Another perspective is the tendency of individuals with high EID to see interconnections in the environment or view themselves as a part of and dependent on a larger collective. This view may encourage the cultivation of these connections, whether with humans or nonhumans. Both perspectives suggest a certain proximity in the relationships between humans and nonhumans on the one hand and between humans only on the other. One approach to the correlation between nature connectedness and people-centered constructs is to interpret them from the perspective of ontologically similar relationships between beings. The idea of a separation between humans and nature is far from universal (Descola 2015). Though less acknowledged in Western cultures, the social relationships of humans indeed occur with both other humans and non-human beings (Kalof 2003). Different conceptualizations in environmental psychology illustrate this proximity. Schultz (2002) proposed his model of inclusion with nature to theorize the way in which individuals situate themselves in nature, operationalized by one of the most commonly used nature connectedness scales, based on previous research on intimate relationships between humans (Aron et al. 1992). A central proposal of Aron et al. (1992) was that a meaningful aspect of closeness was the general "sense of being interconnected with another." A similar theoretical transfer focused on between-people bonding was recently made by Green et al. (2016), who expanded Erikson's stages of development to include environmental bond development. Clayton et al. (2019), who suggested that EID could help humans to develop the ability to empathize with other humans, underlined the proximity of feelings that emerge among humans and with other elements of nature. Analogous observations have been made in certain studies

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on values, which identified biospheric and altruistic values—in simple terms, the importance given, respectively, to the biosphere and other humans—as pertaining to a single construct (Stern and Dietz 1994).

Lastly, the concept of relational values could also possibly contribute to explaining the relationship between PO and EID. Recently considered in order to overcome the narrow dualistic classification of intrinsic/instrumental values, relational values articulate social relations among humans as well as between humans and elements of nature. According to this concept, all relations among people and nature, including relationships between people involving nature, may be the subject of values in themselves, influenced by norms or individual preferences (Chan et al. 2016). Through this approach, nature is not considered separately but is rather a part of oneself through connections with other human beings, places, and parts of the environment (Klain et al. 2017). To summarize, PO could be related to EID, because it draws on a tendency to connect with other beings and more easily allows the adoption of values attributed to other natural elements through human relations.

The observed relationship between TO and EID may also be explained by the construction of connection with nature. TO could, by favoring the nature and magnitude of certain thoughts, feelings, and behaviors in relation with material experiences of nature, also facilitate the development of EID through a different path than PO. Regarding the lower predictive value of TO, a hypothetical explanation could relate to people's attraction to highly transformed objects such as electronics and buildings (McIntyre and Graziano 2019). It is possible that this orientation decreases opportunities to experience nature by increasing people's attention to artifacts, which ultimately shapes their environment through repetitive personal choices (in other words, TO people are more likely to select more artificial environments).

We also showed that PO and TO slightly link gender and EID in an opposing manner, which results in a very small total correlation (direct plus indirect paths) between these two factors. Our results suggest that while female gender is weakly related to an increase in EID through the General Orientations, so is male gender, but through a different path, resulting in indirect correlations that slightly compensate for each other. Previous studies showed that women tend to express more concern about the environment than men do, which was suggested to result from their higher care and altruistic orientation (Gifford and Nilsson 2014; Brieger 2018) and their socialization (Zelezny et al. 2000). In our study, women presented a slightly lower EID, which contrasts with previous studies on this concept. One possible explanation relates to the exclusion of environmentalism from our scale, which includes items relating to people's sense of moral duty toward the elements of nature. This would mean that the small gender difference in EID, as previously observed, was driven by the ideology aspects of the scale.

Implications of results for sustainability science and practice

Although the connections with nature developed by individuals result from various complex processes operating during childhood and later in life, it would be of interest to explore whether PO and TO relate to the diverse ways of experiencing the natural elements of ones' environment. If so, they could have an interesting application, for example, by helping in nature education programs through the proposal of activities that respond better to the different personality traits of individuals. More specifically, programs' designers may want to be sure to include activities relevant for both general orientations; or alternatively, may want to decline in different versions their content, increasing for example the proportion of activities specifically meaningful and attractive for people with a high level of one or both of the General Orientations (towards people or things); or even, to alternate both type of activities to better keep the attention of their participants throughout a specific session.

Conclusion

Our study demonstrates that General Orientations—both toward people and toward things—positively relate to connection with nature. Further research will be needed to clarify the articulation between these two different approaches in terms of how individuals integrate their environment. This study more specifically raises the question of a typology of connections that could reveal PO–TO concepts. It is important to better understand how these concepts may be articulated regarding the various aspects of nature connectedness, such as people's sensory experiences as well as their cognitive and emotional relations with the natural environment.

More specifically, it is necessary to address how values and General Orientations may be articulated, especially if they are different concepts as previously suggested. Many authors have theorized about the role of values in environmental concerns (e.g., Stern and Dietz 1994; Stern 2000), considering that they develop in childhood as young individuals experience socialization and afterwards become relatively stable. It has been suggested that General Orientations may influence "who and what people value" (McIntyre and Graziano 2019). It is, therefore, possible that the relation between PO and EID is mediated by values that could largely develop in individuals who are more people oriented.

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Declarations

Conflict of interest The authors have no relevant financial or non-financial interests to disclose.

Ethical standards The ELIPSS panel was declared to the National Commission for Data Protection and Privacy (CNIL). It is registered with the National Center for Scientific Research (CNRS) under the number 2-12030. The Natinterest project was evaluated by the Scientific and Technical Committee of the Elipss project and the Data Protection correspondent of the CNRS.

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