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# Values, Beliefs, Norms, and Conservation-Oriented Behaviors toward Native Fish Biodiversity in Rivers: Evidence from Four European Countries

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**ABSTRACT**

Riverine biodiversity in Europe is under threat from a range of anthropogenic factors. Key to effective biodiversity conservation is the public's willingness to support restoration efforts. Based on value-belief-norm (VBN) theory and using a longitudinal survey design with $n = 1{,}000$ respondents per each of four countries (France, Germany, Norway, Sweden) we measured individual conservation-oriented behaviors in natural settings over time (e.g., signing a petition, donating money) that benefit native river fish biodiversity. We also examined sociopsychological determinants of these behaviors. In addition to behavioral intentions and self-reported behaviors, we measured actual behavior (monetary donations). We found broad support for the VBN theory but also relevant cultural diversity. In France, Norway, and Sweden fish value orientations affected conservation-oriented behaviors, whereas in Germany general ecological worldviews had more explanatory power. Conservation-oriented outreach and information campaigns will be most effective when taking between-country differences in the relationship between beliefs and behaviors into account.

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Conservation psychology; human-nature relationship; longitudinal study; multinational survey; native river biodiversity; nonnative fishes; proenvironmental behavior; structural equation modeling; value-belief-norm model

## Introduction

Globally, human activities are exerting considerable influence on the biosphere (Williams et al. 2015), impacting ecosystems and biodiversity, and threatening human well-being (UN Environment 2019). Due to an ever-growing human freshwater footprint, the biodiversity of freshwater ecosystems is in a particularly critical state (Albert

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et al. 2021; Reid et al. 2019). Freshwater ecosystems host about one third of all vertebrate species and 43% of all fish species (Burkhead 2012; Reid et al. 2019). In Europe more than 40% of native freshwater fishes are threatened or already extinct, and numerous populations have strongly declined (Freyhof and Brooks 2011).

A range of anthropogenic pressures negatively affect freshwater biodiversity, including global warming, damming, habitat simplification and loss, pollution, overfishing and invasive species (Reid et al. 2019). Because human activity is a major determinant of the trajectory of natural ecosystems, effective conservation of native biodiversity requires managers pay careful attention to the socio-cultural context within which the general public perceives, and reacts to, biodiversity threats (Cooke et al. 2013; Walker-Springett et al. 2016). Ultimately, changes in individual human behaviors as well as in public policies and investments into ecosystem conservation and restoration are needed to support the achievement of conservation-oriented management goals (Clayton and Myers 2015; Selinske et al. 2018; Walker-Springett et al. 2016). European citizens are generally interested in biodiversity conservation (Burivalova, Butler, and Wilcove 2018; Eurobarometer 2013), but they appear to care little about specific threats to native freshwater biodiversity, such as those potentially coming along with introduced nonnative fishes (Cucherousset and Olden 2011), whose ecological effects, by their very nature, remain largely invisible to the general public (Closs et al. 2016; Cooke et al. 2013). Moreover, averting damage to native freshwater biodiversity is costly to society due to tradeoffs that must be made between the environment and other social concerns (Riepe et al. 2019; Szałkiewicz, Jusik, and Grygoruk 2018). Apart from influencing environmental policy making through voting, citizens are able to make individual choices in their daily routines that may collectively produce societal effects and thus may help conserve or recover biodiversity (e.g., signing a biodiversity-related petition or donating money to a conservation organization). One precondition for such actions to occur is public awareness of the state of freshwater ecosystems (Clayton and Myers 2015).

Our objective was to determine the sociopsychological determinants of individual conservation-oriented behaviors of European citizens (e.g., values, beliefs, norms) that may benefit native river fish species and populations (Clayton and Myers 2015; Steg and Nordlund 2019). We assumed that fishes were the most tangible component of freshwater biodiversity and therefore the public would be more likely to feel a connection to fishes than to smaller-bodied or entirely invisible components of freshwater ecosystems, such as microbes (Closs et al. 2016; Cooke et al. 2013). A secondary objective was to derive implications for outreach and intervention campaigns aimed at fostering freshwater conservation behavior (Schultz 2014; Steg and Vlek 2009) and to explore how these interventions may have to be adapted to different European cultures and specific societal conditions (Kochalski et al. 2019). To that end, we conducted longitudinal surveys among random samples of the general populations in two central European and two Scandinavian countries (Germany and France vs. Norway and Sweden, respectively). We measured relevant sociopsychological characteristics (Wave 1) and subsequently ascertained target behaviors performed in natural settings over a one-year period, for example, donating money to a conservation organization (Wave 2). To

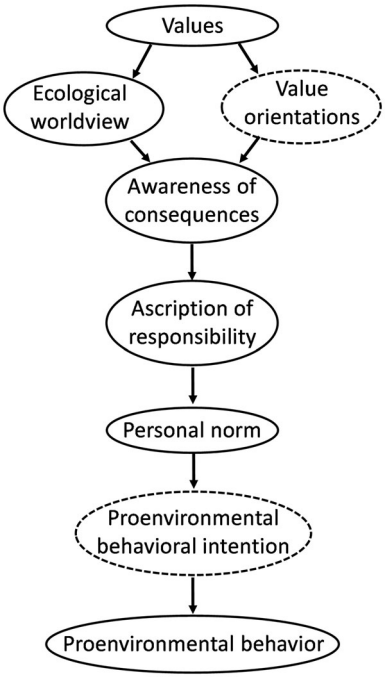


**Figure 1.** Constructs of the value-belief-norm theory to predict proenvironmental behaviors. Arrows indicate assumed direction of causal effects between model components. Dotted lines indicate our hypothesized extensions.

estimate the validity of these retrospectively reported behaviors, we elicited and measured real donation behavior in Wave 2.

To predict the target behaviors, we drew upon the value-belief-norm (VBN) theory (Stern 2000), a framework which has proved successful for the explanation of intentionally performed proenvironmental behaviors in different contexts (Clayton and Myers 2015), notably when behavioral costs are low (Steg and Nordlund 2019). The theory assumes a hierarchy of sociopsychological constructs that causally influence one another in a cascade-like fashion and ultimately determine individual behavior (Figure 1).

According to the VBN model, proenvironmental behaviors occur in response to a feeling of moral obligation to take proenvironmental action (personal norm). Personal norms are activated if people feel responsible for an environmental problem (ascription of responsibility), a feeling that presupposes awareness of the problem (awareness of consequences). Awareness of consequences is stronger when people endorse an ecological worldview (Dunlap 2008; Dunlap et al. 2000), which is shaped by biospheric-altruistic values (Steg and Nordlund 2019; Stern 2000; Stern et al. 1995). Values are transsituational goals that serve as guiding principles in life (Schwartz 1994). We extended this model (i) with behavioral intentions (i.e., an individual's readiness to perform the behavior in question; Fishbein and Ajzen 2010) to mediate the influence of personal norm on actual behavior (Bamberg and Möser 2007; Klöckner 2013) and (ii) by complementing the general ecological worldview construct with more specific wildlife value orientations (Jacobs et al. 2019) focused on fishes (Bruskotter and Fulton 2007,

2008; Figure 1). Our specific objective motivated the exploratory inclusion of this model extension.

Located in different biogeographical regions (Tockner, Robinson, and Uehlinger 2009), the four study countries vary in their natural fish species inventory (Freyhof and Brooks 2011), and in the number and ecological status of their water bodies (European Environment Agency 2018). Moreover, they differ in a multitude of economic and socio-cultural aspects related to the aquatic environment such as, for instance, participation rates in freshwater-related recreational activities like fishing and boating (Arlinghaus, Tillner, and Bork 2015; Kochalski et al. 2019) and the economic significance of the fisheries and aquaculture industry (European Union 2018). We assumed that cognitive decision-making processes were comparable between western Europeans and thus expected the VBN model to be adequate for predicting conservation-oriented behaviors in all study countries (Fornara et al. 2020; Steg and Nordlund 2019). However, we also expected between-country differences in the societal importance of fishes and the aquatic environment to modify the modeled processes (Kochalski et al. 2019).

## Materials and Methods

### *Variants of the VBN Model*

Because there are different ways of integrating sociopsychological constructs into the VBN theory (e.g., Klöckner 2013), we considered six variants of the VBN model per country to incorporate fish-related beliefs (Figure 2).

The arrows in the models indicate the direction of hypothesized causal relationships between the constructs, all of which were expected to yield positive coefficients (Bamberg and Möser 2007; Klöckner 2013; Stern 2000). We assumed that people had sufficient control over certain proenvironmental behaviors (e.g., signing a petition, donating money) to form temporally stable behavioral intentions that mediate the effect of personal norms on these behaviors (Fishbein and Ajzen 2010). We thus added behavioral intentions to all model variants (Figure 2). In numerous applications of the VBN model the ecological worldview construct (Dunlap 2008) was operationalized by means of the New Ecological Paradigm scale (NEP), a measure of proenvironmental orientation (Dunlap et al. 2000). However, the NEP reflects very general beliefs about global ecological challenges. To adapt the VBN model to our specific objective, we explored wildlife value orientations related to fishes (Bruskotter and Fulton 2008) as a supplement to, or a substitute for, NEP (Figures 1, 2). Wildlife value orientations are beliefs pertaining to wildlife organized around fundamental values and giving them meaning (Jacobs et al. 2019). Hence, fish value orientation (FVO) reflects a perspective similar to the NEP, but with a focused conceptual bandwidth. It was introduced as a mediating construct at the same hierarchical level as the NEP. Consequentially, we considered three types of models encompassing only NEP (Models A), both NEP and FVO (Models B), and only FVO (Models C; Figure 2).

Whereas the VBN model is conceived of as a mediator model, where each construct is assumed to directly influence the next in line (Chen 2015; Steg and Nordlund 2019), it is also open to being tested for direct effects of one construct on another that is

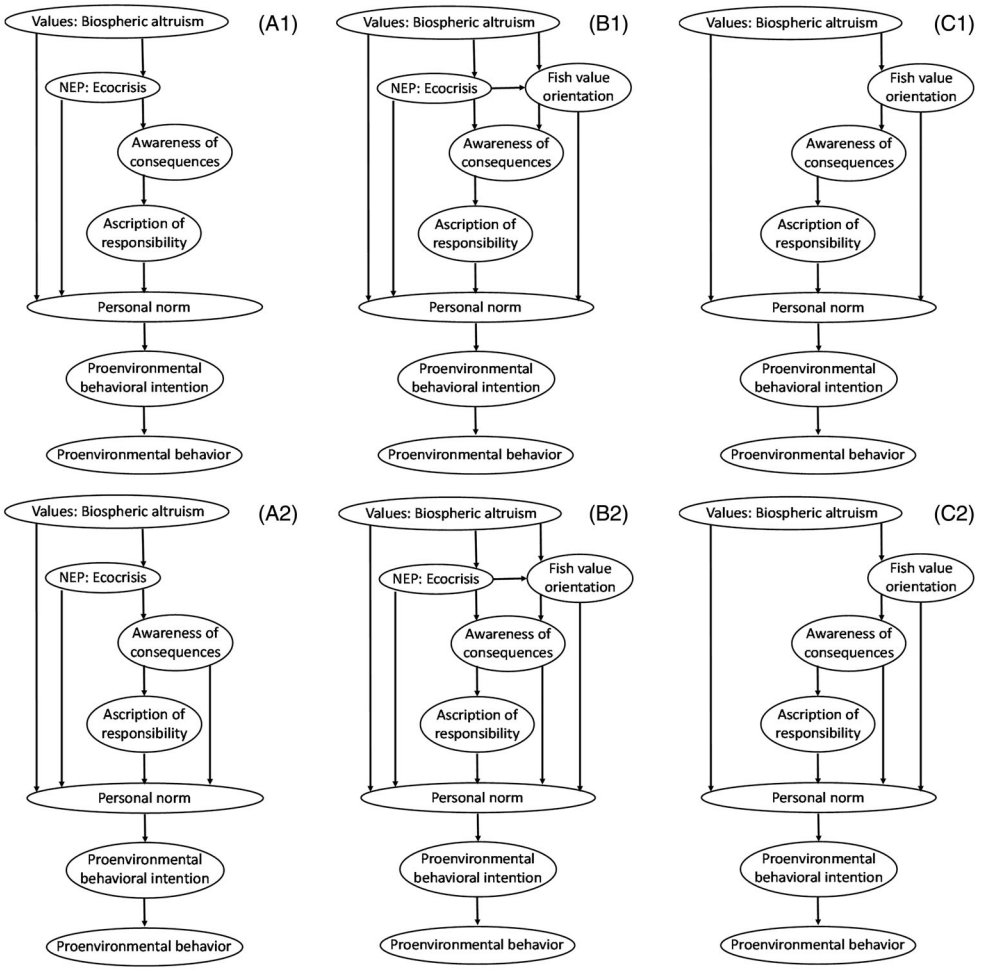


**Figure 2.** Value-belief-norm model variants tested for the prediction of behaviors directed toward the conservation of riverine biodiversity including native fish species. Arrows indicate hypothesized direction of causal influence between model components. NEP: New Ecological Paradigm.

located further down the causal chain (Stern 2000), though generally with little effect on the model's explanatory power (Steg and Nordlund 2019). An exception seems to be the direct influence of values and NEP on environmental personal norms (Klöckner 2013; van Riper and Kyle 2014; Steg and Nordlund 2019). We thus added corresponding relationships (also for FVO) to all model variants (Figure 2). Because a direct impact of awareness of consequences on personal norm also received support in earlier work (Klöckner 2013; Wynveen, Wynveen, and Sutton 2015), we tested Models A to C in two variants: without (Models A1-C1) and with (Models A2-C2) a direct effect of awareness of consequences on personal norm (Figure 2).

## *Survey Design and Data Collection*

We generated initial samples of $n = 1{,}000$ participants per country from the general online populations to collect representative data for the VBN model's indicator items.

Data were collected in September 2015 (Wave 1) and in December 2016 (Wave 2). The target population comprised persons aged 16–74 years living in private households with internet access. This population covered between 83% (France) and 97% (Norway) of all households in 2015 (Germany: 90%; Sweden: 91%; Eurostat 2016; see Supplemental Information file for details of the survey design and data collection procedure). Data collection conformed to the rules given by the national Data Protection Acts and to the standards for social research as outlined by the European Society for Opinion and Market Research (ESOMAR and GRBN 2015; ICC and ESOMAR 2016). Respondents received monetary incentives for participating in each wave. The questionnaires were identical for all countries and were administered in each country's local language (see Supplemental Information for details). The shares of invited panel members who started filling out the Wave-1 questionnaire but did not complete it (break-off rates) ranged from 14% in Germany to 21% in France (Norway: 18%; Sweden: 17%). The Wave-1 questionnaire included all VBN indicator items except the actual performance of proenvironmental behaviors. This information was collected in Wave 2 to which all Wave-1 respondents were re-invited. We analyzed the VBN model variants on the basis of all respondents who completed both questionnaires (effective sample sizes: Germany $n = 640$; France $n = 578$; Norway $n = 499$; Sweden $n = 586$).

## Variables

We used three indicator items to measure each latent construct (Table 1).

As we assumed our respondents would be unfamiliar with freshwater biodiversity hazards and with individual behavioral options to help counteracting them, we harmonized the measurement context for all respondents during the interview. First, we briefly informed respondents about different ecological effects that issues such as the anthropogenic introduction of nonnative fishes may have on native biodiversity (e.g., competition for resources; Supplemental Table S1). Second, we administered the items measuring proenvironmental behavioral intentions prior to the rest of the VBN items. Thereby we made respondents aware of potential behaviors that most citizens are able to integrate into their daily routines and that may foster riverine biodiversity including conservation of native fish species (Table 1; Supplemental Table S1).

We ascertained behavioral intentions as the likelihood of performing public-sphere behaviors (Stern 2000) in the near future. Two of these were from the environmental citizenship domain (Larson et al. 2015), which included (i) petitioning, attending a meeting, or rallying and (ii) donating money to a conservation organization (items BI1, BI3; Table 1). The third behavior focused on active participation in conservation projects indicating social environmentalism (Larson et al. 2015; item BI2). These kinds of activities were previously used to operationalize proenvironmental behaviors in applications of the VBN model (e.g., Clements et al. 2015; Wynveen, Wynveen, and Sutton 2015).

About one year later (in the Wave-2 questionnaire), we asked respondents to report the likelihood with which they had performed corresponding behaviors in the meantime (items B1, B2, B3; Table 1). Given that behaviors fostering native fish biodiversity are difficult for individuals to think of (Selinske et al. 2018), we assumed that recalling the

**Table 1.** Item wordings, means (*M*), standard deviations (*SD*) and Anova for the indicator items of the value-belief-norm model.

| | | Germany ($n = 640$) | | France ($n = 578$) | | Norway ($n = 499$) | | Sweden ($n = 586$) | | Anova | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Latent constructs / Indicator items | Increasing item scores indicate | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* | *F* | *df* |
| Values: Biospheric altruism | More importance as a guiding principle in life | | | | | | | | | | |
| V1 Protecting the environment, preserving nature[a] | | $4.0_{ab}$ | 0.9 | $3.9_{a}$ | 0.9 | $3.8_{a}$ | 0.8 | $4.1_{b}$ | 0.9 | 8.2 * | 3; 2296 |
| V2 Unity with nature, fitting into nature[a] | | $3.6_{a}$ | 1.0 | $3.7_{a}$ | 0.9 | $3.3_{b}$ | 0.9 | $3.8_{a}$ | 1.0 | 23.7 * | 3; 2296 |
| V3 Respecting the earth, living in harmony with other animal and plant species[a] | | $4.1_{a}$ | 0.8 | $3.9_{b}$ | 0.9 | $3.7_{c}$ | 0.8 | $4.0_{a}$ | 0.9 | 16.8 * | 3; 2298 |
| New Ecological Paradigm (NEP): Possibility of an ecocrisis | Stronger proenvironmental orientation | | | | | | | | | | |
| N1 Humans are severely abusing the environment.[b] | | $4.3_{a}$ | 0.9 | $4.2_{a}$ | 0.9 | $4.0_{b}$ | 1.0 | $4.3_{a}$ | 0.9 | 8.9 * | 3; 2295 |
| N2 The so-called "ecological crisis" facing humankind has been greatly exaggerated.[bc] | | $2.3_{a}$ | 1.0 | $2.4_{a}$ | 1.2 | $2.4_{a}$ | 1.2 | $2.3_{a}$ | 1.2 | 2.8 * | 3; 2297 |
| N3 If things continue on their present course, we will soon experience a major ecological catastrophe.[b] | | $3.8_{ab}$ | 0.9 | $4.0_{c}$ | 0.9 | $3.7_{b}$ | 1.1 | $3.9_{ac}$ | 1.0 | 6.6 * | 3; 2297 |
| Fish value orientation (FVO) | Stronger biocentric value orientation | | | | | | | | | | |
| FV1 As humans we have a duty to protect and preserve native fish populations even if we do not want to make use of them.[b] | | $4.2_{ab}$ | 0.9 | $4.0_{a}$ | 0.9 | $4.2_{b}$ | 1.0 | $4.1_{ab}$ | 1.0 | 2.9 * | 3; 2297 |
| FV2 Native fish populations should be protected for their own sake.[b] | | $4.2_{a}$ | 0.8 | $4.0_{b}$ | 0.9 | $4.1_{b}$ | 1.0 | $4.0_{b}$ | 0.9 | 9.2 * | 3; 2296 |
| FV3 I think it is good to preserve native fish populations to maintain an environment worth living in for our children and future generations.[b] | | $4.4_{a}$ | 0.8 | $4.1_{b}$ | 0.8 | $4.3_{a}$ | 0.9 | $4.3_{a}$ | 0.9 | 8.0 * | 3; 2297 |

(*continued*)

**Table 1.** Continued.

| Latent constructs / Indicator items | Increasing item scores indicate | Germany ($n = 640$) | | France ($n = 578$) | | Norway ($n = 499$) | | Sweden ($n = 586$) | | Anova | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* | *F* | *df* |
| Awareness of potential consequences of the introduction of nonnative fishes | Stronger perception as a serious problem | | | | | | | | | | |
| AC1 Reduction of the number of native fish species[d] | | $3.2_{a}$ | 0.7 | $3.1_{a}$ | 0.7 | $3.2_{a}$ | 0.7 | $3.1_{a}$ | 0.8 | 2.7 * | 3; 2298 |
| AC2 Reduction of the total quantity of individual native fishes[d] | | $3.1_{a}$ | 0.7 | $3.1_{a}$ | 0.8 | $3.1_{a}$ | 0.7 | $3.0_{a}$ | 0.8 | 2.7 * | 3; 2298 |
| AC3 Reduction of the number of distinct populations of native fish species, which naturally vary between rivers in shape, color and genes[d] | | $2.9_{a}$ | 0.7 | $3.0_{b}$ | 0.8 | $3.0_{b}$ | 0.8 | $2.9_{ab}$ | 0.8 | 5.0 * | 3; 2298 |
| Ascription of responsibility for … | Stronger feeling of responsibility | | | | | | | | | | |
| AR1 any reduction of the number of native fish species[b] | | $3.1_{a}$ | 1.1 | $3.1_{a}$ | 1.1 | $3.3_{b}$ | 1.1 | $3.0_{a}$ | 1.1 | 9.7 * | 3; 2297 |
| AR2 any reduction of the total quantity of individual native fishes[b] | | $3.0_{a}$ | 1.1 | $3.1_{a}$ | 1.1 | $3.3_{b}$ | 1.1 | $3.0_{a}$ | 1.1 | 8.7 * | 3; 2297 |
| AR3 any reduction of the number of distinct populations of native fish species, which naturally vary between rivers in shape, color and genes[b] | | $3.0_{a}$ | 1.0 | $3.1_{a}$ | 1.1 | $3.3_{b}$ | 1.1 | $3.0_{a}$ | 1.1 | 11.5 * | 3; 2297 |
| Personal norm: Feeling of moral obligation | Stronger personal norm | | | | | | | | | | |
| PN1 to prevent the number of native fish species from declining[b] | | $3.5_{ab}$ | 1.1 | $3.5_{ab}$ | 0.9 | $3.5_{a}$ | 1.1 | $3.3_{b}$ | 1.1 | 3.5 * | 3; 2298 |
| PN2 to make sure that the total quantity of individual native fishes is not reduced[b] | | $3.5_{a}$ | 1.1 | $3.5_{a}$ | 1.0 | $3.5_{a}$ | 1.1 | $3.3_{b}$ | 1.1 | 5.9 * | 3; 2298 |
| PN3 to prevent the loss of the number of distinct populations of native fish species, which naturally vary between rivers in shape, color and genes[b] | | $3.3_{ab}$ | 1.0 | $3.4_{ab}$ | 1.0 | $3.4_{a}$ | 1.1 | $3.3_{b}$ | 1.1 | 3.6 * | 3; 2298 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Wave 1 (2015): Proenvironmental behavioral intention | Stronger intention | | | | | | | | | | |
| BI1 to attend a meeting, take part in a legal rally, or sign a letter or a petition aimed at supporting the preservation of native biodiversity[e] | | $2.7_{a}$ | 1.2 | $3.0_{b}$ | 1.1 | $2.7_{a}$ | 1.2 | $2.4_{c}$ | 0.9 | 27.7 * | 3; 2297 |
| BI2 to actively participate in projects aimed at the conservation of native biodiversity[e] | | $2.3_{a}$ | 0.9 | $3.0_{b}$ | 1.0 | $2.6_{c}$ | 1.0 | $2.5_{ac}$ | 0.9 | 51.6 * | 3; 2298 |
| BI3 to contribute money to a charitable organization that takes a stand for nature, environmental, or species conservation[e] | | $2.9_{ab}$ | 1.1 | $2.8_{a}$ | 1.0 | $2.9_{ab}$ | 1.0 | $3.0_{b}$ | 1.0 | 3.3 * | 3; 2298 |
| Wave 2 (2016): Proenvironmental behaviors performed between Wave 1 and 2 | Higher likelihood | | | | | | | | | | |
| B1 attended a meeting, took part in a legal rally, or signed a letter or a petition aimed at supporting the preservation of native biodiversity[f] | | $1.5_{a}$ | 1.0 | $1.6_{b}$ | 1.2 | $1.5_{ab}$ | 1.0 | $1.6_{ab}$ | 1.1 | 2.7 * | 3; 2298 |
| B2 actively participated in projects aimed at the conservation of native biodiversity[f] | | $1.4_{a}$ | 0.9 | $1.7_{b}$ | 1.1 | $1.5_{ac}$ | 0.9 | $1.6_{bc}$ | 1.0 | 9.7 * | 3; 2298 |
| B3 contributed money to a charitable organization that took a stand for nature, environmental, or species conservation[f] | | $2.0_{a}$ | 1.5 | $1.8_{a}$ | 1.3 | $1.8_{a}$ | 1.3 | $2.2_{b}$ | 1.5 | 10.0 * | 3; 2298 |

Means in each row that share subscripts do not differ significantly ($p \geq 0.05$; Games-Howell/Hochberg's GT2 post hoc tests). *$p < 0.05$.

[a]Scale from 1 (*not at all important*) to 5 (*extremely important*). [b]Scale from 1 (*strongly disagree*) to 5 (*strongly agree*). [c]Item scores were reversed prior to analyses to facilitate model interpretation. [d]Scale from 1 (*no problem at all*) to 4 (*a very serious problem*). [e]Scale from 1 (*I will definitely not do it*) to 5 (*I will definitely do it*). [f]Scale from 1 (*I definitely did not do it*) to 5 (*I definitely did it*).

occurrence of these behaviors retrospectively over a one-year time span would have resulted in biased self-reports had we used a dichotomous (yes-no) or frequency-based response format (Lange and Dewitte 2019). We thus opted for a likelihood response scale (Table 1). At the end of the Wave-2 interview, respondents were additionally offered the opportunity to actually donate (part of) their study compensation to a wildlife conservation organization (World Wide Fund For Nature or North Atlantic Salmon Conservation Organization; Clements et al. 2015). This supplementary information allowed us to evaluate the association between self-reported and objectively measured donation behaviors (Kormos and Gifford 2014).

To provide context, the indicator items for personal norm, ascription of responsibility, and awareness of consequences referred to the same three threats that the introduction of nonnative fishes to domestic rivers might pose to native fishes (Laikre et al. 2010; Cucherousset and Olden 2011). These ecological consequences comprised reductions of (i) the number of native fish species, (ii) the abundance of individual native fishes, and (iii) the number of distinct populations of native fishes (Table 1). To operationalize the three VBN constructs, we framed the threats differently in the question wordings (Supplemental Table S1). We explored (i) the feeling of moral obligation to reduce each of these consequences (personal norm; items PN1, PN2, PN3; Table 1), (ii) the feeling of being responsible for each of these consequences should they arise (ascription of responsibility; items AR1, AR2, AR3), and (iii) the awareness of these consequences that is, how problematic each of them was perceived (items AC1, AC2, AC3).

The NEP taps different facets of the ecological worldview concept (Dunlap et al. 2000). The dimension that we considered most relevant to the prediction of our target behaviors were beliefs related to the perceived likelihood of potentially catastrophic environmental changes caused by human activities. To capture these beliefs, we administered the items of the ecocrisis subscale of the revised NEP (Dunlap et al. 2000; items N1, N2, N3; Table 1), as was previously done by, for instance, Han (2015). The measurement of FVO was informed by Bruskotter and Fulton (2007, 2008) development of fisheries-related value orientations. When formulating our FVO items, we aimed at ascertaining protection value orientations toward native fish populations (items FV1, FV2, FV3; Table 1). Elicited as guiding principles in life (Supplemental Table S1), two items (V1, V2; Table 1) from the Universalism dimension of Schwartz's (1994) values inventory were administered to operationalize biospheric-altruistic values. They were complemented by a third item (V3; Table 1) developed by Stern et al. (1995). These items were previously applied in various ecological contexts (e.g., Clements et al. 2015; Fornara et al. 2020; Han 2015; Park et al. 2018; Zhang et al. 2020). Of all value types that the Schwartz (1994) values inventory encompasses, we selected only the biospheric-altruistic dimension because we regarded it as most important for the prediction of the FVO items and the ecocrisis items of the NEP.

### Data Analysis

Using SEPATH (by StatSoft, Inc.), we ran structural equation analyses to test the relationships between the constructs of the different VBN models (Figure 2). We used four indices to evaluate model fit: SRMR, RMSEA, NFI, and CFI. Following the

recommendations given by Schermelleh-Engel, Moosbrugger, and Müller (2003), we considered a model to fit well (acceptably in parentheses) if SRMR, RMSEA, NFI, and CFI indices were $\leq$0.05 ($\leq$0.10), $\leq$0.05 ($\leq$0.08), $\geq$0.95 ($\geq$0.90), and $\geq$0.97 ($\geq$0.95), respectively. Given acceptable fit and equal theoretical plausibility of all VBN model variants, the usefulness of fit indices alone is limited when deciding between competing models. Thus, we used Akaike weights $w_i$, which were derived from the Akaike information criterion (AIC), to decide which of our models was the best in each country (see Supplemental Information file for details). We judged the adequacy of Models A1 to C2 first by checking the acceptability of their fit indices and then by ranking all acceptable models per country according to $w_i$. We considered the model with the highest weight as most adequate for describing the structure of the sociopsychological processes preceding behavioral performance.

As the effective sample sizes implied substantial attrition rates (36%, 42%, 50%, 41% for Germany, France, Norway, Sweden, respectively), we conducted panel attrition (i.e., nonresponse) analyses and a robustness check for the best performing VBN model per country to assess whether our results would still hold for the total online populations. Details and results of these analyses can be found in the Supplemental Information file.

## Results

### *Descriptives*

The samples of the four countries did not differ in mean age or gender composition but in education levels (Supplemental Table S2), which mirrored preexisting between-country differences according to census data (Eurostat 2015). Barring some between-country differences, mean scores of the indicator items revealed a similar pattern of environmental beliefs and views held by the people in all countries (Table 1). Respondents considered the biospheric-altruistic values to be somewhat or very important on average and agreed with the NEP and FVO items (Table 1). They also considered the negative ecological consequences of nonnative fish introductions to domestic rivers a serious problem but were undecided as to whether they felt responsible for them (Table 1). Nonetheless, respondents tended to feel morally obliged to mitigate these consequences (Table 1).

Most mean scores of the items measuring intended and actually performed behaviors hardly reached the scales' midpoints (= 3; i.e., *not sure whether I will do it,* or *not sure whether I did it*, respectively; Table 1). This indicated a tendency toward not intending to perform the described behaviors, or not having performed them. Moreover, average behavioral self-reports were about one scale point lower than the corresponding intentions (Table 1) bearing evidence for significant intention-behavior gaps (Bonferroni-corrected $p < 0.017$ for $t$-test results for the three item pairs of intended and performed behaviors within each country). The effect sizes (Cohen's $d$) of these mean score differences ranged from 0.54 to 0.99 indicating medium to large effect sizes (Cohen 1988). Of the three behaviors, donating money had been performed most likely (Table 1). This retrospective measure was significantly correlated (Bonferroni-corrected $p < 0.013$ for multiple comparisons across countries) with voluntary donation behavior observed during the administration of the Wave-2 questionnaire ($r = 0.2$, 0.2, 0.3, 0.1 for Germany,

**Table 2.** Fit indices and information-theoretic criteria of the model variants.

| | Fit indices | | | | Information-theoretic criteria | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Country/Model | SRMR | RMSEA | NFI | CFI | K | LL | $AIC_c$ | $\Delta AIC_c$ | $w_i$ |
| Germany | | | | | | | | | |
| A1 | 0.069 | 0.048 | 0.942 | 0.965 | 50 | −219.7 | 548.1 | 15.0 | 0.001 |
| A2 | 0.072 | 0.046 | 0.944 | 0.967 | 51 | −211.0 | 533.1 | 0.0 | 0.993 |
| B1 | 0.064 | 0.044 | 0.939 | 0.966 | 60 | −262.9 | 658.6 | 125.4 | <0.001 |
| B2 | 0.062 | 0.043 | 0.941 | 0.967 | 61 | −255.8 | 646.8 | 113.7 | <0.001 |
| C1 | 0.069 | 0.048 | 0.945 | 0.966 | 50 | −224.7 | 558.0 | 24.9 | <0.001 |
| C2 | 0.066 | 0.047 | 0.947 | 0.968 | 51 | −216.1 | 543.2 | 10.1 | 0.006 |
| France | | | | | | | | | |
| A1 | 0.078 | 0.048 | 0.956 | 0.974 | 50 | −216.2 | 542.1 | 13.2 | 0.001 |
| A2 | 0.077 | 0.048 | 0.956 | 0.974 | 51 | −214.2 | 540.6 | 11.7 | 0.002 |
| B1 | 0.064 | 0.049 | 0.948 | 0.969 | 60 | −285.3 | 704.8 | 175.9 | <0.001 |
| B2 | 0.064 | 0.049 | 0.948 | 0.969 | 61 | −284.9 | 706.5 | 177.6 | <0.001 |
| C1 | 0.068 | 0.047 | 0.959 | 0.976 | 50 | −209.6 | 528.9 | 0.0 | 0.660 |
| C2 | 0.068 | 0.047 | 0.959 | 0.976 | 51 | −209.1 | 530.3 | 1.3 | 0.337 |
| Norway | | | | | | | | | |
| A1 | 0.097 | 0.063 | 0.925 | 0.949 | 50 | −267.3 | 646.0 | 83.4 | <0.001 |
| A2 | 0.097 | 0.063 | 0.926 | 0.950 | 51 | −263.5 | 640.8 | 78.2 | <0.001 |
| B1 | 0.078 | 0.054 | 0.928 | 0.956 | 60 | −295.0 | 726.7 | 164.2 | <0.001 |
| B2 | 0.078 | 0.054 | 0.928 | 0.956 | 61 | −294.7 | 728.7 | 166.1 | <0.001 |
| C1 | 0.078 | 0.055 | 0.940 | 0.963 | 50 | −225.6 | 562.5 | 0.0 | 0.723 |
| C2 | 0.078 | 0.055 | 0.940 | 0.963 | 51 | −225.3 | 564.5 | 1.9 | 0.277 |
| Sweden | | | | | | | | | |
| A1 | 0.085 | 0.052 | 0.949 | 0.968 | 50 | −230.5 | 570.6 | 25.0 | <0.001 |
| A2 | 0.083 | 0.050 | 0.952 | 0.971 | 51 | −217.3 | 546.5 | 0.8 | 0.393 |
| B1 | 0.080 | 0.047 | 0.946 | 0.969 | 60 | −273.8 | 681.6 | 135.9 | <0.001 |
| B2 | 0.079 | 0.047 | 0.947 | 0.970 | 61 | −268.6 | 673.7 | 128.0 | <0.001 |
| C1 | 0.084 | 0.050 | 0.953 | 0.972 | 50 | −221.7 | 553.0 | 7.3 | 0.015 |
| C2 | 0.084 | 0.050 | 0.954 | 0.972 | 51 | −216.9 | 545.7 | 0.0 | 0.592 |

SRMR: standardized root mean square residual; RMSEA: root mean square error of approximation; NFI: normed fit index; CFI: comparative fit index; K: number of free parameters; LL: log likelihood; $AIC_c$: corrected Akaike information criterion; $\Delta AIC_c$: difference in $AIC_c$ from model with relatively lowest $AIC_c$; $w_i$: $AIC_c$ weight.

France, Norway, Sweden, respectively, which reflect small- to medium-sized effects; Cohen 1988).

## *Model Selection*

All VBN model variants achieved at least acceptable fit indices and therefore qualified for model ranking (Table 2).

In Germany, Model A2, which included NEP and a direct path from awareness of consequences to personal norm, achieved the highest Akaike weight $w_i$ and thus emerged as the best representation of the sociopsychological process that generated the data (Table 2). By contrast, in both France and Norway Models C, which include FVO, were more adequate to describe this process with Model C1 being most likely, although Model C2 (including the direct path from awareness of consequences to personal norm) also received some support (Table 2). In Sweden, the latter Model (C2) was most likely the best at minimizing information loss though Model A2 was also supported (Table 2). This finding emphasizes the adequacy of a direct influence of awareness of consequences on personal norm in this country while suggesting that NEP might also play a role. Models B, which included both NEP and FVO, were not supported (Table 2).

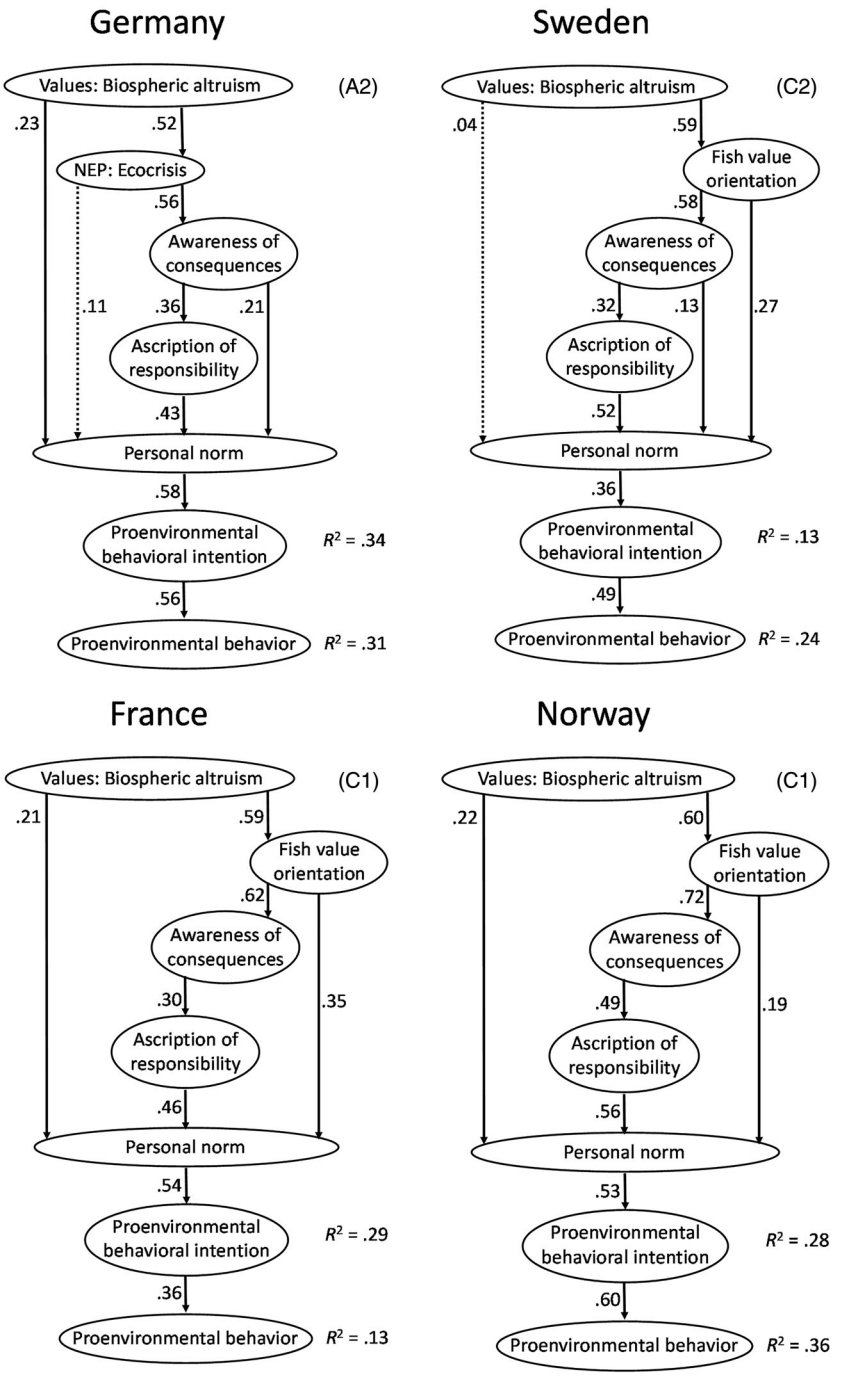


**Figure 3.** Standardized path coefficients and explained variances of proenvironmental behavioral intentions and behaviors for the best model variant per country (with highest $w_i$). NEP: New Ecological Paradigm. Germany $n = 637$; France $n = 577$; Norway $n = 499$; Sweden $n = 584$. $p < 0.05$ for all coefficients, except where indicated by dotted lines ($p \geq 0.05$).

### Drivers of Conservation-Oriented Behaviors

All path coefficients in the best performing models were positive and significant except for the nonsignificant paths from NEP to personal norm in Germany and from values to personal norm in Sweden (Figure 3).

All arrows in the best performing models that point toward the next construct in the hierarchy had numerically higher coefficients than those originating from the same construct then circumventing others in the hierarchy (Figure 3). Explained variances ($R^2$) for behavioral intentions ranged from 0.13 in Sweden to 0.34 in Germany (France 0.29, Norway 0.28), and for reported behaviors from 0.13 in France to 0.36 in Norway (Germany 0.31, Sweden 0.24). While these $R^2$ coefficients represent medium to large effect sizes (with Cohen's $f^2$ ranging from 0.15 to 0.56; Cohen 1988), a significant share of the variances of all endogenous constructs, including intentions and behaviors, remained unexplained (Supplemental Table S3). The majority of item loadings on their corresponding latent constructs were around 0.7 or higher, which is tantamount to explained item variances of about 50% or more (Supplemental Table S3).

## Discussion

### General Findings

We confirmed the VBN theory's general suitability for modeling the interrelations of European citizens' values, beliefs and norms preceding our target behaviors (Steg and Nordlund 2019). This finding was corroborated by a similar pattern of variation of item mean scores across all countries. Our hypothesis was confirmed that FVO may be a substitute for NEP, depending on the socio-cultural context. This suggests that in some countries conservation-oriented behavior toward fishes as a tangible organism group of freshwater biodiversity is informed by fish-related beliefs (Norway, Sweden, France), while in others it is influenced by more general environmental beliefs (Germany).

With two exceptions, positive and significant path coefficients between the constructs of all best performing models confirmed our hypotheses regarding the relationships between the VBN constructs, in line with many studies supporting the VBN model in different cultures and geographical contexts (e.g., Chen 2015; Fornara et al. 2020; Han 2015; van Riper and Kyle 2014; Wynveen, Wynveen, and Sutton 2015; Zhang et al. 2020).

We were able to explain up to one third of the variance of both intentions and retrospectively reported behaviors. Regarding the behaviors, these shares match the findings of meta-analyses that included VBN model constructs and additionally incorporated behavioral intention as direct antecedent of behavior (Bamberg and Möser 2007; Klöckner 2013). Apart from intentions, the target behaviors may also be determined by, for instance, the emotional state or the psychologically relevant characteristics of the situation that a person is in when performing a behavior (e.g., signing a petition). Future research ascertaining these factors in situ (e.g., by means of event-contingent ambulatory assessments; Himmelstein, Woods, and Wright 2019) may reveal if and how far these factors add to the explanation of behavioral variance over and above intentions. Although the $R^2$ values for our behavioral intention construct signaled medium to

large effect sizes, they dropped behind these meta-analyses, which estimated average $R^2$ values above 0.5 (Bamberg and Möser 2007; Klöckner 2013). The most likely reason why our estimates were lower is that, apart from adding behavioral intention to the VBN model, we adhered to its original version (Stern 2000) and assumed personal norm to be the only antecedent of intention. Had we also specified direct paths from higher-level constructs (e.g., awareness of consequences) to behavioral intention (e.g., Wynveen, Wynveen, and Sutton 2015), or had we included additional personal and social factors (Gifford and Nilsson 2014) such as place attachment (e.g., Raymond, Brown, and Robinson 2011), we might have achieved higher shares of explained variance in intentions. The same effect may have occurred had we incorporated constructs from well-established theories such as the reasoned action approach (Fishbein and Ajzen 2010) or the comprehensive action determination model (Klöckner 2013), which include, for example, perceived behavioral control over or attitude toward the behavior (Bamberg and Möser 2007; Gkargkavouzi, Halkos, and Matsiori 2019; Park et al. 2018). Nevertheless, our results demonstrate that respondents' perceived probabilities of performing proenvironmental behaviors in the future (i.e., their behavioral intentions) can be modeled in a VBN context, which is particularly pertinent to longitudinal studies (Sheeran and Webb 2016).

### Country-Specific Findings

While the same model (C1) was the best representation of the data generation process in France and in Norway, Model C2 was most adequate in Sweden and Model A2 in Germany. In other words, in Germany the NEP ecocrisis subscale, being part of the original VBN model and reflecting general beliefs about global ecological challenges, was an appropriate mediator between values and awareness of consequences, while in France and Norway as well as in Sweden beliefs giving meaning to fundamental values in the context of native fish populations (i.e., FVO) turned out to be the more suitable construct. Nonetheless, Model A2 achieved a nonzero probability also in Sweden indicating potential appropriateness of the NEP construct in this country as well. Furthermore, FVO exerted a direct influence on personal norm in the latter three countries, in contrast to NEP in Germany, as did values in all countries except in Sweden (Klöckner 2013; van Riper and Kyle 2014). Put another way, the only nonsignificant path coefficients (from NEP in Germany, from values in Sweden) belonged to relations that skipped intermediate constructs supporting the basic mediator character of the original VBN model (Chen 2015; Stern 2000). Thus, while personal norm as the immediate antecedent of behavioral intention was directly and jointly activated by values, FVO, awareness of consequences, and ascription of responsibility in all countries, our findings revealed between-country differences in the microstructure of the mental decision-making process. When pondering over the threats that the introduction of nonnative fishes to domestic rivers might pose to native biodiversity, the Germans, and to some degree the Swedes, considered the topic within a global ecological context, while in France and Norway, and most likely also in Sweden, protection value orientations toward native fishes were more on top of citizens' mind when personal norms were activated.

Given the biogeographical and socio-cultural differences between the four countries mentioned earlier, and the interdependency of the determinants of proenvironmental behaviors (Clayton and Myers 2015; Cooke et al. 2013; Gifford and Nilsson 2014; Steg and Vlek 2009), it is not surprising to find between-country variation in the decision-making process and, consequentially, in the shares of explained behavioral variance. In this context, one potentially relevant difference between the study countries is the economic importance of the fisheries and aquaculture sectors (European Union 2018). For example, both catch and production figures are highest in Norway, followed by Sweden and France, while in Germany they are nearly negligible when evaluated in relation to each country's population size (5.3, 10.1, 66.9, 82.8 million for Norway, Sweden, France, Germany, respectively; Eurostat 2020). Moreover, Norwegians felt better informed than citizens of the other three countries about potential biodiversity threats to domestic rivers originating from nonnative fishes (Kochalski et al. 2019). In Germany, participation rates for freshwater-related activities such as recreational fishing and boating were comparatively lowest (Arlinghaus, Tillner, and Bork 2015; Kochalski et al. 2019) as was the number of fishes in domestic rivers for which people were willing to pay in the context of hypothetical management plans to improve the rivers' ecological status (Riepe et al. 2019). Together these findings suggest a generally higher connectedness to fishes and the aquatic environment among Norwegians, but also in Swedish and French citizens, as opposed to the Germans, which may have resulted in FVO being more adequate than NEP as a mediating variable in the former three countries.

### *Validity of Behavioral Measures and Generalizability of Results*

Few studies involving VBN-theory constructs followed proenvironmental behaviors as they unfolded in natural settings over time (e.g., Aguilar-Luzón et al. 2012; Gkargkavouzi, Halkos, and Matsiori 2019) or prompted such behaviors during an interview (e.g., Clements et al. 2015). Instead, many studies used either habitual behaviors (e.g., Chen 2015; Fornara et al. 2020; Raymond, Brown, and Robinson 2011; van Riper and Kyle 2014) or behavioral intentions (e.g., Han 2015; Wynveen, Wynveen, and Sutton 2015; Park et al. 2018) as proxies for future behavior. By contrast, we ascertained intended behaviors, measured their subsequent performance and observed one of those behaviors during the Wave-2 interview. This latter behavior (donating part of the survey incentive) was taken from the same domain as item B3 of the VBN questionnaire. While the within-country correlation coefficients between both measures ($r = 0.1$–$0.3$) indicated small- to medium-sized effects, criterion-related validity coefficients that are based on single-item predictors and criteria are rarely larger than the $r$ values observed here (Nunnally and Bernstein 1994). Thus our findings emphasize the validity of our self-reported behavioral data (Kormos and Gifford 2014). In addition, results of the attrition analyses and the robustness check (Supplemental Information file) demonstrated the stability of the VBN indicator items and model parameters despite considerable panel attrition rates and thus corroborated the generalizability of the study's findings to the general populations living in private households with internet access. However, between 3% (Norway) and 17% (France) of households had no internet access

and were thus not covered by the sampling frame. This undercoverage may limit the generalizability of the results to the offline populations.

### Implications for Fostering Conservation Behaviors in the Public

Our results have implications for the design of outreach and information campaigns aimed at influencing the performance of the public-sphere behaviors that we investigated. Any such intervention would try to influence the decision-making process to increase proenvironmental behavioral intentions and ultimately the likelihood of actual behavioral performance (Fishbein and Ajzen 2010; Schultz 2014; Steg and Vlek 2009). To reach their recipients, most information-focused strategies (e.g., provision of knowledge, persuasion, environmental education, social marketing) need a narrative framework to promote their objective and to motivate recipients to pay initial attention (Clayton and Myers 2015; Schultz 2014; Steg and Vlek 2009). Our work suggests a promising avenue would be to embed the biodiversity-related core message of an information campaign in a narrative that makes country-specific reference to environmental beliefs (Clayton and Myers 2015; Manfredo et al. 2017).

Because values, value orientations and the endorsement of an ecological worldview are thought to be deeply rooted within an individual's personality, they can hardly be changed through deliberate campaigning (Fischer 2018; Manfredo et al. 2017). However, the citizens of all study countries rated biospheric-altruistic values to be important to them on average, and agreed with the NEP and FVO items. Thus, FVO-related information about the ecological state of native freshwater fishes and how important their conservation is should be incorporated in France, Norway and Sweden, while in Germany, and perhaps also in Sweden, it would be advisable to put the narrative in a more general proenvironmental (i.e., NEP-related) context. The country-specific differences may also help to identify outlets to approach for partnerships for information campaigns, be it nongovernmental conservation organizations, noncommercial stakeholder groups (e.g., angling clubs), or commercial enterprises in the fish production, trade, or consumption sectors.

Given the public's general interest in biodiversity conservation issues (Burivalova, Butler, and Wilcove 2018; Eurobarometer 2013), people should be open to the intervention's core message once they have been attracted by a compelling narrative framework. The core message would supply knowledge of potential ecological consequences of nonnative fish introductions (and perhaps of other threats) and would thus initialize or reinforce recipients' problem awareness. Enhanced problem awareness will lead to an increased ascription of responsibility for these consequences and might also evoke a feeling of guilt in case recipients sense they have not sufficiently met personal or societal standards for proenvironmental behavioral performance in the past (Bamberg and Möser 2007; Clayton and Myers 2015). Together these factors will activate a feeling of being morally obliged to take proenvironmental action and hence will increase behavioral intention.

In addition, as many people find it difficult to think of biodiversity conservation behaviors that they can easily perform themselves (Selinske et al. 2018), we recommend to clearly describe potential target behaviors and also how they might be integrated into citizens' daily routines to diminish the substantive intention-behavior gaps that we found in the data. One way of achieving this goal would be to help recipients form

implementation intentions that is, if-then plans that specify where, when, and how to carry out intended behaviors (Fishbein and Ajzen 2010; Sheeran and Webb 2016). To further increase behavioral intention, the description of a particular conservation behavior might also be augmented by information about the frequency of its performance among relevant others or within society in general (e.g., by stating the share of neighbors who already donated money to a biodiversity conservation organization; Schultz 2014; Steg and Vlek 2009).

## Conclusion

We clarified the cognitions that precede proenvironmental intentions and behaviors related to riverine fish biodiversity in four European countries. We found that the societal importance attached to fish and aquatic environments varied among the four countries studied. Conservation messaging should take into account between-country differences in the importance that beliefs about fish versus beliefs about global ecological challenges have for the prediction of conservation behaviors and intentions. We suggest to design country-specific intervention campaigns aimed at altering these behaviors accordingly and evaluate their effectiveness in future research.

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