An Extended Behavior Model for Explaining the Willingness to Pay to Reduce the Air Pollution in Road Transportation

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Abstract

Road transportation constitutes a key sector in developed countries, as an essential catalyst for economic and social activities. Nevertheless, it is relevant to emphasize the negative impacts of this activity identified in Economics as negative externalities. At the European Union, road transportation is the main cause of the air pollution impact on the population. Thus, this study explores the factors that influence the willingness to pay (WTP) on behalf of the citizens to reduce air pollution generated by road transport. In doing so, we propose two fundamental theoretical frameworks to explain individual behavior towards the environment actions: the Theory of Planned Behavior (TPB) and the Value-Belief-Norm (VBN) models. A questionnaire survey with 1,612 residents was used to collect data in 65 localities located in the Spanish Pyrenees and performing a statistical analysis with the resulting data relied on application of Structural Equation Models (SEM). Moreover, the survey results highlight the importance of psychological aspects as predictors of pro-environmental behaviors. Our empirical results provide a novel contribution about how governments and educational policies can enhance the positive attitude towards

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environmental actions, unifying the struggle in favor of environmental protection from early childhood.

Keywords: Air Quality; Willingness to Pay; Road Transportation; Personal Values; Environmental Protection; Mediating Effect.

1. Introduction

After the achievements of the industrial revolution in Europe, road transportation constituted a key activity in many countries, as an essential catalyst in the economic and social activities. The transportation main functions are the establishment of links between consumers and producers by promoting accessibility to a wide variety of merchandises and secondly, by promoting people mobility. Additionally, considering social aspects, the popularity of leisure-related activities enhance road transportation as a critical factor in human mobility. Likewise, savings in cost and time are clear benefits derived from a scientific analysis of transport activities. Nevertheless, the real cost of moving goods and passengers is taken into account, not only, by the stakeholders or intermediate actors, but also by other agents who may not benefit directly from these movements. This situation is known in Economics as negative externalities. Among these negative external costs, air pollution is a major environmental risk to health due to the increasing number of affected people: recent estimations show that nearly 4.5 million and 800,000 people die prematurely each year worldwide and in Europe, respectively, because of polluted air (Lelieveld et al., 2019; CREA, 2020). Also, air pollution associated with road transport is the most important environmental externality, being 13% of total external costs of transport, 53% related to passenger mobility and 43% to freight transport. Recent estimations quantify this environmental externality around 1% of Gross Domestic Product (GDP) in the EU28 (European Commission, 2019).

Consequently, it is essential to reduce air pollution impact associated with road transport (freight and passenger transportation). In this context, there exists a growing general interest in understanding how people perceive this environmental problem and how these perceptions determine their behavior with regard to this externality reduction. Concerning the present study, this paper tries to contribute to the environment practices literature by focusing on the role of socio-psychological factors in determining a pro-environmental economic behavior in order to mitigate air pollution produced by road transportation. Thus, we have developed a theoretical model combining in a conjoint way, the Theory of

Planned Behavior (TBN) and Value-Belief-Norm (VBN) variables to explore the determinants which influence the individual's environment behavior.

Therefore, the main objective of this study is to determine whether the TPB and VBN constructs affect or not the personal willingness to pay (WTP) for reducing the air pollution released by road traffic in areas with high environmental value. Thereby, this study uses data from a 1,612 sized survey carried out in 65 localities located in the Spanish Pyrenees, covering the main routes crossing them (national roads and motorways) between France and Spain. The Pyrenees are a range of mountains located in Southwestern Europe being the natural boundary between Spain and France. This region has a great ecological value, being more than 50% formed by forest, including some important nature reserves for threatened species. At the same time, they suffer from intensive road traffic, taking part of two of the most important road transport passageways in Europe: the Atlantic and the Mediterranean corridors. In 2015, more than 140,000 vehicles crossed the Pyrenees daily, of which nearly 15% were heavy goods vehicles transporting a total of 98.4 millions of tons, with a high impact in the lives of local residents who live in adjacent areas (Spanish French Observatory of Road Transport in the Pyrenees, 2018). Furthermore, it is important to highlight that air pollution costs are, at least, four times higher in mountainous areas in comparison with flat areas (Suter et al., 2017).

Concerning practical results, the contribution of this paper is twofold. Firstly, we provide empirical evidence to explain the WTP associated with the environmental behavior in air pollution, combining two different theoretical perspectives: TPB and VBN theories. Likewise, our approach proposes a new theoretical framework by integrating multiple variables from TPB and VBN theories to investigate the interrelationships among the constructs of both models applied to the air pollution externality. To the best of our knowledge, this is the first study that integrates both TBN and VBN variables to explain air pollution. Secondly, this study is focused in rural and mountainous areas, when traditionally studies about air pollution in the environment research field are focused on urban areas (Lera-Lopez et al., 2014).

The whole paper is organised in five sections including this introduction (Section 1). Section 2 presents a review of the literature on the environmental psychosocial models, especially on TPB and its extensions, and develops the associated theoretical framework. Section 3 describes the methodological details of our procedure along with the

environmental problem to be tested, whereas Section 4 presents the main findings. Finally, the results discussion, their implications, along with conclusions and limitations are set out in Section 5.

2. Literature Review

Our study combines the sociological and psychological constructs (such as values, beliefs and attitudes) with economic value measures (WTP linked to behavioral intentions) and proposes the conceptual model presented in Figure 1. This model is based on TPB and includes an extension which considers three types of value orientations in VBN theory (Hiratsuka et al., 2018): biospheric, egoistic and altruistic values, to understand factors behind the WTP to reduce the road transportation air pollution. Both theoretical approaches are commonly used to predict the behavioral intentions in order to estimate non-marked goods and services values (Zahedi et al., 2019) and to explain environmentally friendly behavior (Grilli and Notaro, 2019). Previous environmental studies have already analyzed TPB and VBN models, indicating the significance of their variables in predicting pro-environmental behaviors (Bernarth and Roschewitz, 2008; López-Mosquera, 2016; Yadav et al., 2019), but it has not previously applied to analyse air pollution problem.

2.1. An Approach to the Theory of Planned Behavior

The Theory of Planned Behavior (TPB) has been used by different papers given its explanatory power in predicting sustainable behaviors (Nguyen el al., 2016; Choi and Johnson, 2019; Fu et al., 2019) and in explaining individual WTP in some environmental contexts (Pouta and Rekola, 2010; López-Mosquera and Sánchez, 2012; López-Mosquera, 2016; Li et al., 2018; Zhang et al., 2020). Likewise, TPB is considered to have a great pertinence in predicting consumers' intentions in a wide range of pro-environmental activities and behaviors (Yadav et al., 2019). According to previous studies on TPB (Li et al., 2018; Choi and Johnson, 2019; Rezaei et al., 2019; Zahedi et al., 2019), the individual´s intention can be predicted by three constructs which describe the following variables: a) the attitudes which reflect an individual's positive or negative appraisal of a behavioral option; (b) the subjective norm (SN) as the social pressure or the influential people feeling when a behavioral choice is faced and (c) the perceived behavioral control (PBC), which refers to the perceived ease or difficulty of performing a behavior.

As a rule of thumb, individuals with strong adherence to attitude, subjective norm and perceived behavioral control are generally more concerned about the environment (Nguyen et al., 2016). Many studies affirm that attitude is one of strongest predictors influencing environmental behavior (Taufique and Vaithianathan, 2018;; Ru et al., 2019; Pleeging. et al., 2021). Additionally, individuals are more likely to pay if their perception of this behavior has a positive consequence (favorable environmental attitudes) and/or implies a social endorsement (subjective norm), along with their own ability to perform a behavior (perceived behavioral control) (Judge et al., 2019). Therefore, considering all the previous statements, the components of the TPB model can be likely considered to be a positive predictor to WTP, but it is important to highlight that the most significant influence of the pro-environmental intentions comes from social recognition and the influence of others (Taufique and Vaithianathan, 2018). So that, in empirically terms, different studies have explained pro-environmental personal practices and WTP behavior, considering the relevance of attitude, subjective norms and perceived behavioral control (Yadav and Pathak, 2017; Li et al., 2018; Choi and Johnson, 2019; Gkargkavouzi et al., 2019; Zhang et al., 2020). The consideration of the following hypotheses implies that the attitude, the subjective norms and the perceived control behavior of an individual may determine WTP behavior decision (López-Mosquera, 2016; Bazrbachi et al., 2017, Li et al., 2018; Zahedi et al., 2019, Zhang et al., 2020):

H1. Attitude has a positive influence on WTP.

H2. Subjective norms show a positive influence on WTP.

H3. Perceived behavioral control has a positive influence on WTP.

2.2. The Value-Belief-Norm (VBN) Theory

The VBN theory proposes three types of values, namely, biospheric, altruistic, and egoistic values to predict personal attitudes and pro-environmental behaviors (Kiatkawsin and Han, 2017; Yadav et al., 2019), reflecting individual WTP decisions (Li et al., 2018; Obeng and Aguilar, 2018). Each value orientation predisposes individuals to be concerned about consequences of their environmental actions (consciousness of consequence) as well as being responsible for the corresponding consequences (assumption of responsibility) (Unal et al., 2019). Thus, by biospheric values, we understand those sets of principles that reflect a concern about the inherent value of the natural environment and biosphere; while altruistic values are related to a key concern

about other human beings' welfare, and finally, egoistic values are related to a concern about increasing personal resources (Unal et al., 2019).

Moreover, consumers who strongly endorse biospheric values are more likely to be motivated by social norms; which is translated into a moral imperative to act in an environmentally friendly manner (Nguyen, 2016). Similarly, Yadav et al., (2019) suggest that individuals with strong biospheric values are likely to accentuate human nature harmony and possess positive attitudes and intentions towards eco-friendly products, even though these products could be overpriced. Even earlier, Ojea and Loureiro (2007) found that altruistic value orientations are positively related with WTP values. They also suggested that altruistic values significantly contribute to pro-environmental attitudes when valuing goods. In contrast, egoistic values were found to be, somewhat, negatively correlated with pro-environmental behavior, because most of the pro-environmental behaviors are effortful and costly (Unal et al., 2019). Obeng and Anguilar (2018) uncovered that egoistic values are often negatively related to WTP values for the ecosystem. Furthermore, people who strongly endorse egoistic values act pro-environmentally when engaging with behaviors that require less effort and cost (Unal et al., 2019). These results are due, generally speaking, to the fact that people are not prepared to accept extra costs associated with sustainable environmental terms. Hence, hypotheses can be established in the following way:

H4. Biospheric (a) and altruistic (b) values have a positive influence on WTP, and egoistic (c) values have a negative influence on WTP.

2.3. Subjective norms, attitudes and perceived behavioral control towards WTP

Apart from the previous considerations, this study also tests the respective indirect effects of attitudes and perceived behavioral controls on the relationship between all psycho-social variables and the WTP. Likewise, some studies show that subjective norms, attitudes and perceived behavioral controls are highly correlated, having a reciprocal mutual power, that is to say, the received social pressure from close environment has a direct influence on people perceptions and their behavioral decision (López-Mosquera and Sánchez, 2012; López-Mosquera, 2016). Pouta and Rekola (2010) demonstrated that the subjective norm could precede the influence of attitude and the perceived behavioral control on the valuation of the environmental behavior. Furthermore, Nguyen et al., (2016) found that subjective norms affect indirectly green consumption behavior via behavioral intention. Therefore, people having positive attitudes towards a particular

behavior, receive the public support of their neighbors who think that they are capable of carrying out a particular behavior in a specific situation (López-Mosquera, 2016). Hence, the following hypothesis has been formulated to examine that indirect effect:

H5. A subjective norm exerts indirect influence on WTP through attitudes (a) and perceived behavioral control (b)

2.4. Biospheric, egoistic and altruistic values and attitudes towards WTP
Apart from the previous analysis, few studies have shown the positive effect of biospheric value on consumers' attitude towards pro-environmental behaviors. Nguyen et al., (2016) have stated that consumers' biospheric values indirectly influence the purchase of energy-efficient products through consumer attitude. Correspondingly, Soyez (2012) gave evidence that ecocentric value orientation, which corresponds with the biospheric dimension of Stern measure (Stern et al., 1999), has a positive influence on attitudes towards organic food purchase intention. Furthermore, Yadav et al., (2019) have stated that biospheric value positively influences consumers' intentions to choose green hotels. Hence, the following statement has been hypothesized in our study:

H6. Biospheric (a), egoistic (b) and altruistic (c) values exert indirect influence on WTP through attitudes.

2.5. Biospheric, egoistic, and altruistic values and perceived behavioral control towards WTP
Finally, the model we have designed analyses the potential preceding influence of the values within VBN theory on another TPB component, which is the perceived behavioral control. The basic idea is the existence of the relationship between values and perceived controls to explain environmental behavior as was shown by Liebe et al., (2011). Additionally, De Dominicis et al., (2017) inferred that biospheric values and self-interested reasons could explain the individual environmental behavior. Roos and Hahn (2017) and Shi et al., (2017), using a similar structural equations model, which combined TPB and VBN, showed the importance of these values on personal environmental behavior. Hence, we have assumed the following hypothesis:

H7. Biospheric (a), egoistic (b) and altruistic (c) values indirectly influence WTP through perceived behavioral control.
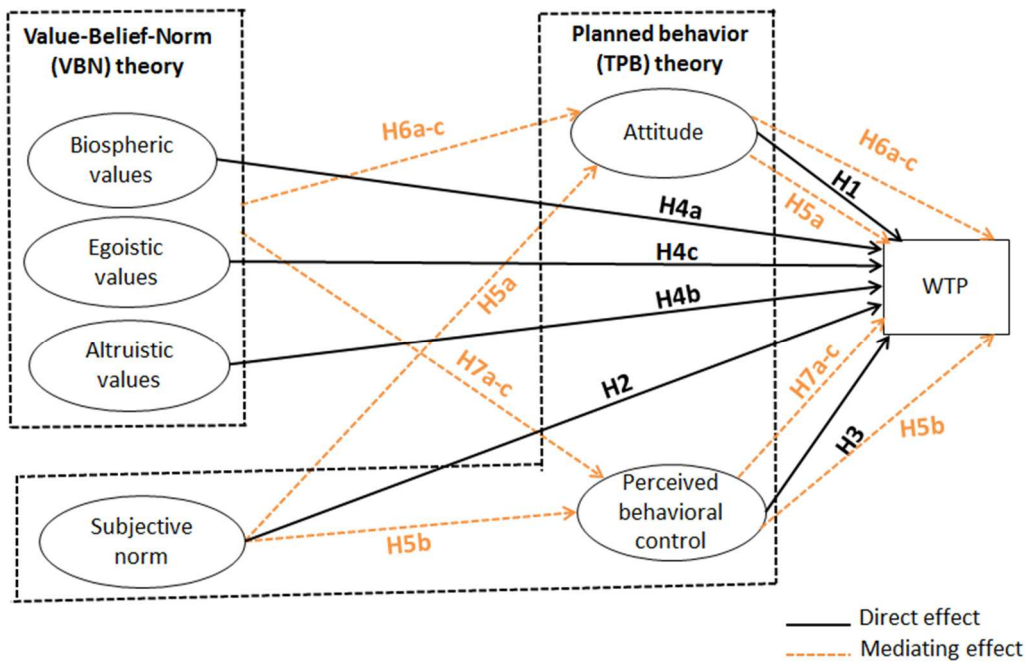
Figure 1. Research model

Based on the above discussion and the corresponding hypotheses development, our conceptual model, illustrating the relationships and the expected directions among the examined constructs, has been portrayed in Figure 1. In our model, we enhance the original TBP explanatory power, based on attitudes, subjective norms and perceived behavioral control, with the influence of biospheric, egoistic and altruistic values on WTP to reduce the air pollution impact of road transport experienced by each person in his/her residential area.

3. Methodology and construct validity

3.1. Data collection

As we have mentioned in the introduction section, our study case is located in the Pyrenees region between Spain and France, which suffers from an intensive manner the road traffic, particularly a heavy traffic of trucks transporting goods from the Iberian Peninsula and Northern Africa to Central and Northern Europe. The busiest routes are located in the Eastern Pyrenees (region of Catalonia) and in the Western Pyrenees (regions of Navarre and the Basque Country). Thus, we have considered, in our study, a total of 24 roads (national routes and highways, mainly). In a second step, we select a set of localities considering their proximity to these roads: 32 in the Western Pyrenees and 33 in the Eastern Pyrenees. Moreover, the population older than 18 years in these regions was 100,000 inhabitants in 2012, roughly speaking. We have selected these localities because they suffered from an intense traffic (freight and passenger transport) near their

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houses and buildings (in general, they are located at less than 100 meters from the road). Also, both areas, Western and Eastern Pyrenees are areas with high environmental value. In the initial statements when the questionnaire is explained to the respondent it is clarified that the survey is about road traffic air pollution in these high-environmental value areas that affects directly to respondents living there.

The survey was conducted in the period November and December 2012[2] by means of computer assisted telephone interviewing (CATI system) and the sample included originally 2,000 residents. Respondents were nominated using a stratified random sampling based on age intervals and gender. A pre-test process was developed to check the validity of the questionnaire and the reliability of the survey. The response rate was 81% and the final sample included 1,612 respondents. On average, respondents took 18 minutes to orally fill in the questionnaire with the interviewers' assistance. This long survey time explains that 19% of respondents left the interview unfinished. Anyway, regarding sample size estimation, considering unknown population variance and a big sample size, we have followed statistical criteria (Ntanos et al., 2018). Thus, the sampling error was very low, 2.42% with a 95% confidence level. Also, the sample follows the distribution of total regional population under study in terms of gender and age intervals. The main socio-demographic characteristics of the survey are as followed: 40.9% men and 59.1% women, aged 49.68 years on average (with a standard deviation of 16.03), 36.0% had completed secondary school studies and 54.4% had a medium income level (ranged from 1,701€ to 2,800€). Finally, we developed another survey (mirror survey), having smaller size (250 interviewees who finally answered 238), but carried out in a face-to-face system. This mirror survey helped us to contrast the CATI procedure with a more direct study.

Concerning the survey limitations which can be observed in our study, we can depict the next ones: a) Respondents could not provide the most accurate or sincere answers due to the fact of presenting themselves in an unfavorable way (egoistic behaviors, not enough committed to the environment,...), limiting the veracity of the answer; b) Respondents could be unaware of their reasons for providing specific answers to the questionnaire due to their lack of consideration on the subject (shallow answers), making the answer not

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[2] Spanish Ministry of Environment (2019) showed similar ecological impact values in the years 2011-2019, in its study of the air quality evaluation of the Spanish regions. Moreover, the variables attitude and environmental behavior need a large temporal period to be substantially modified (Zeus and Reif, 1990).

completely reliable; c) Data errors associated to non-answered questions, due to a varied group of reasons, sometimes related to the survey design, and sometimes related to one of the aforementioned limitations; d) Some respondents could interpret the answers options in a different way, for instance, the answer option *Slightly Concerned* may represent different concepts for different people, having its own significance to each interviewee. Nevertheless, we have taken into account all these typical weaknesses in survey design and we have tried to minimise them proposing a big size survey, using a face-to-face mirror survey of smaller size (helped to profile the big CATI survey), developing a realistic payment vehicle (a tax) in a living scenario and by offering a broad and realistic payment-scale format thereby reducing the starting point bias and protest responses, following previous empirical evidence, as it explained in the next epigraph.

3.2. Questionnaire design

In order to better understand the results, we are going to make a detailed description of the survey we use to extract data from the target population. All survey items are established using a four-part questionnaire. The first part of the questionnaire introduced the problem of road traffic in the localities under study and examined the respondents' perception of air pollution problems caused by road traffic in their locality and their undesirable effects (i.e., health problems). The second part enclosed their monetary evaluation of air pollution. The payment vehicle was established as a compulsory local annual tax for the next five years, following previous studies (i.e., Lera-Lopez et al., 2012, 2014; Zahedi et al., 2019). The WTP value was elicited using the standard yes/no question format in combination with open-ended questions (Bateman et al., 1999). We selected three bid prices: 15€, 30€ or 45€, based on a consideration of the different scenarios and methodologies proposed in other empirical studies (Lera-Lopez et al., 2012, 2014). Those three bids were uniformly and randomly distributed across respondents to ensure independence. A control question was added in order to identify the reasons for respondents' unwillingness to pay (Jorgensen et al., 2001). In particular, following Dziegielewska and Mendelsohn (2005), Lera-Lopez et al., (2014) and Tian et al., (2020), the protest responses were identified as those who felt no responsibility for air pollution, found air pollution reduction scenarios insufficient, or considered that they are already paying enough taxes.

A third part of the survey was devoted to measuring the environmental profile of respondents. In particular, we considered a set of attitudes, norms, and environmental

values of respondents in relation to their WTP to mitigate the air pollution caused by road traffic. These are the explicative variables under study in our research model (Figure 1) with the purpose of explaining the WTP to reduce air pollution caused by road traffic. In particular, the original TPB estimations are described by the specific attitudes towards behavior: the subjective norm, and the perceived behavioral control (Bernarth and Roschewitz, 2008; Han and Hansen, 2012). Additionally, the biospheric, altruist, and egoistic values were measured using the universal values scale by Schwartz (1992), later used by Stern et al., (1999) and Braito et al., (2017). All items in this part were measured using a 7-point Likert scale ranging between 1 (the lowest agreement level) and 7 (the highest agreement level). The final part of the questionnaire was used to identify the personal characteristics of the respondents (age, gender, income and zone). This questionnaire is available upon request from the corresponding author.

3.3. Structural Equation Modeling and model validation

As a summary of all the results obtained by the survey, Table 1 depicts all measurement items, item loadings, composite reliability, average variance extracted, and the values of Cronbach's alpha to determine the validity of model measurement. Our analysis of the measurement and structural models was tested using Structural Equation Modeling (SEM) in STATA version 14. SEM analysis is a statistical method that can be used to test the causal relationships between observed variables and latent variables, which has been widely used in numerous research fields. SEM has several advantages over traditional multivariate regression models. Firstly, SEM can ignore the measurement errors of independent variables and dependent variables, allowing a latent variable to consist of more observed variables (Wang et al., 2021). Secondly, SEM can resolve the endogeneity problem between variables (Cao and Yang, 2017). Thirdly, SEM also takes into account a mediation analysis, which refers to the causal process between a pathway of variables that offers the benefit of simultaneously capturing the direct, indirect and total effects among exogenous and endogenous variables (Wang et al., 2021). Thus, in a mediation relationship, the direct effect represents the influence of the independent variable on the dependent variable and the indirect effect represents the projection of an independent variable on the mediator variable, and between a mediator variable and a dependent variable. Therefore, the total effect represents the sum of direct and indirect effects. Within our analysis, we used SEM to estimate a direct pathway from biospheric values, egoistic values, altruistic values and the subjective norm (independent variables) to WTP

The measurement model goodness-of-fit-indices indicate a good data fit, which suggested a high construct (χ2=888.60, RMSEA=0.08 (acceptable fit), CFI=0.98 (>0.90), TLI=0.92; SRMR=0.012 (<0.08)) (Hu and Bentler, 1999; Henseler et al., 2016). Item loadings on constructs range from 0.77 to 0.96, are above the cut-off level of 0.5 (Fornell and Larker; 1981), indicating that internal reliability of the constructs and the model validity have both been confirmed.

Furthermore, the convergent validity of the model is estimated to confirm that the indicators are assumed to measure each respective construct. Three indices were used to determine the convergent validity: (1) the composite reliability score, (2) the Cronbach's alpha and (3) the average variance extracted (AVE). Likewise, the Cronbach's alpha values of all indicators should exceed the recommended value of 0.6 (Martinez-Conesa et al., 2017) and the composite reliability should exceed 0.8, indicating a high level of construct reliability (Fornell and Larker, 1981). Thereby, both values of Cronbach's alpha and composite reliability are greater than 0.6 suggesting that the indicator has good consistency in measuring model constructs. The AVE value indicates the set variability of the observed data within the latent variable. If the AVE value is greater than 0.5, then all indicators can explain the variance of the construct (Zahedi et al., 2019). Conversely, if the AVE value is less than 0.5, we can infer that we have carried out a poor measurement and the sample selection could be biased (Lucianetti et al., 2018). All AVE values range from 0.85 to 0.96, which indicates that the construct explains more than 50% of the variance of its indicators.

Table 1. Means, standard deviation, measurement items, reliability and convergent validity

Measurement Items	Mean	SD	FL	CR	AVE	α
Attitude				0.98	0.90	0.97
I think the idea of paying to mitigate air pollution is brilliant	6.38	1.14	0.955			
I think the idea of paying to mitigate air pollution is very useful	6.38	1.18	0.948			
I think the idea of paying to mitigate air pollution is very intelligent	6.39	1.15	0.960			

I think the idea of paying to mitigate air pollution is very responsible	6.41	1.10	0.956			
I think the idea of paying to mitigate air pollution is very ecological	6.49	1.03	0.924			
Subjective norm				0.94	0.88	0.93
Most of the people who are important for me think I should pay to contribute to air pollution reduction	4.94	2.10	0.964			
Most of the people who are important for me expect that I pay to contribute to air pollution reduction	4.87	2.12	0.961			
People whose opinion is important for me should pay to contribute to air pollution reduction	5.30	1.88	0.890			
Perceived behavioral control				0.86	0.74	0.65
It would be really difficult for me to pay for air pollution reduction in the following months	3.25	2.31	ni			
I consider that the fact I pay to mitigate air pollution would not improve the current situation	5.34	1.90	0.86			
I have resources, time and opportunities to contribute with money to air pollution reduction	4.73	2.11	0.86			
Biospheric values				0.84	0.70	0.89
Oneness with nature	6.17	1.17	0.82			
A world of beauty	6.00	1.32	0.77			
Respect for the earth	6.40	1.03	0.88			
Environmental protection	6.43	0.99	0.89			
Prevent pollution	6.38	1.11	0.83			
Egoistic values				0.87	0.76	0.85
Social power	3.60	1.84	0.82			
Authority	3.48	1.76	0.93			
Influential	3.59	1.77	0.87			
Wealth	3.71	1.64	ni			
Altruistic values				0.82	0.67	0.89
Equality	6.54	0.97	0.78			
A world at peace	6.67	0.81	0.85			
Social justice	6.64	0.85	0.83			

Aid	6.61	0.85	0.82

Summary Statistics

χ2	888.6
RMSEA	0.08
CFI	0.98
TLI	0.92
SRMR	0.012

ni: Items with outer loadings <0.5 have been excluded from the analysis
FL= factor loading; CR= Composite reliability; AVE=average variance extracted; α= Cronbach's alpha

Similarly, if we want to perform a discriminant validity, Table 2 shows the correlations among the six latent constructs that will be used in the model analysis. Fornell and Larker (1981) proposed that the AVE of a latent variable should be greater than its square root. The bold values are the square root of the AVE values of the latent construct which are greater than the inter-construct correlation coefficients, suggesting a satisfactory level of coefficients discriminant validity.

Table 2. Correlations matrix of constructs

Constructs	1	2	3	4	5	6
Attitude (1)	**0.948**					
Subjective norm (2)	0.438*	**0.938**				
Perceived behavioral control (3)	0.236*	0.294*	**0.860**			
Biospheric values (4)	0.473*	0.349*	0.178*	**0.837**		
Egoistic values (5)	-0.098*	-0.071*	0.071*	-0.068*	**0.872**	
Altruistic values (6)	0.429*	0.197*	0.146*	0.564*	-0.057*	**0.818**

Notes: Square roots of average variance extracted (AVEs) are shown on the diagonal, and the other values are the correlation coefficients for each construct which are all significant at $p<0.05$.

4. Findings

Using Structural Equation Modeling (SEM), we have tested the validity of the research model estimating the direct effects of the variables from the VBN theory (biospheric, egoistic and altruistic values) and from the TPB theory (subjective norm, attitude and perceived behavioral control). Similarly, we tested the indirect effects through the mediation of attitudes and perceived behavioral control.

4.1. Hypotheses testing of direct effects

In this section, we are going to test the direct effects of our research model and reject or accept the associated hypotheses. The first three hypotheses predict that the variables describing attitude, subjective norms and perceived behavioral have a positive effect on WTP. The results of the corresponding tests reveal that attitude (β=1.453, p<0.01), subjective norms (β=2.600, p<0.01) and perceived behavioral control (β=2.066, p<0.01) are significantly associated with WTP, leading support to hypothesis H1, H2 and H3, respectively. Additionally, the relationship of biospheric (β=1.292, p<0.01) and altruistic (β=1.292, p<0.01) values with WTP is statistically significant, which endows support for H4a and H4b hypotheses. In contrast, the hypothesis that egoistic value is negatively associated with WTP is rejected (β=-0.148, ns).

Similarly, the results show that the subjective norm association with attitude is statistically significant (β=0.449, p<0.01). Furthermore, the coefficients for the paths from biospheric values (β=0.495, p<0.01), egoistic values (β=-0.104, p<0.01) and altruistic values (β=0.447, p<0.01) to attitude are statistically significant. Likewise, Table 3 shows that the subjective norm was found to be positively associated with the perceived behavioral control (β=0.317, p<0.01). Correspondingly, the biospheric values, egoistic values and altruistic values have a positive relationship with perceived behavioral control.

Table 3. Path coefficients of structural model and hypothesis testing (direct effect)

Structural path	Path Coefficient	Std.err.	Hypothesis	Hypothesis result
Attitude →WTP	1.453***	0.448	H1	Supported
Subjective norm →WTP	2.600***	0.408	H2	Supported
Perceived behavioral control →WTP	2.066***	0.419	H3	Supported
Biospheric values →WTP	1.377***	0.514	H4a	Supported
Egoistic values →WTP	-0.148	0.419	H4b	Rejected
Altruistic values →WTP	1.294**	0.516	H4c	Supported
Subjective norm →Attitude	0.449***	0.029	-	-
Biospheric values →Attitude	0.495***	0.041	-	-
Egoistic values →Attitude	-0.104***	0.028	-	-
Altruistic values →Attitude	0.447***	0.041	-	-
Subjective norm → Perceived behavioral control	0.317***	0.024	-	-
Biospheric values → Perceived behavioral control	0.196***	0.025	-	-

Egoistic values → Perceived behavioral control	0.079***	0.030	-	-
Altruistic values → Perceived behavioral control	0.151***	0.027	-	-

Standard error in parentheses. *Significance at 1%; **Significance at 5%; ***Significance at 10%.

4.2. Mediating effects

After having developed a first analysis of the direct effects of our studying, now, it is time to test the mediating effects of attitude and perceived behavioral control. In order to do so, we have conducted a Sobel test to prove the existence of a mediation effect. The mediation effect will be considered if the Sobel test generates a critical statistical value greater than 1.96 (Stone and Sobel, 1990). We also need to verify the existence of mediation effects using the bias-corrected bootstrapping technique with 500 subsamples as recommended by Preacher and Hayes (2008) to find whether the indirect effects are really present in our case or not. In line with the prediction assumed in hypothesis H5 that attitude and perceived behavioral control act as a mediator of the relationship between subjective norm and WTP, Table 4 reveals that the indirect value of the path coefficients: Subjective norm →attitude and attitude →WTP, is 0.652 (0.449*1.453). This outcome shows a significant mediating role of attitude between subjective norm and WTP. Following Hair et al., (2016) and Ramli et al., (2019), we assessed the variance account for (VAF) to determine the magnitude of the significant mediation. According to these authors, a VAF value greater than 80% implies that a full mediation can be assumed, if the VAF value varies between 20% and 80% a partial mediation is considered, and a value less than 20% means there is no mediation. The VAF ratios in Table 4 shows that *perceived behavioral control* and *attitude* can explain the 33.6% and 33.5%, respectively, of the impact of *subjective norm* on WTP, providing support for hypotheses H5a-H5b.

Furthermore, focusing our attention on hypotheses H6a and H7a, Table 4 shows that the *biospheric values* have a significant effect on *attitude* and the *perceived behavioral control* (β=0.768, p<0.01 and β=0.446, p<0.01, respectively), which in turn have a significant effect on WTP. In both cases, VAF values are greater than 20% which means that H6a and H7a are accepted and these variables partially mediate the impact of *biospheric values* on WTP. *Attitudes* and *perceived behavioral control* explain the 45.7% and 32.8%, respectively, of the impact of *biospheric values* on WTP.

Regarding H6b and H7b, the direct relationship between *egoistic values* and WTP (Table 4) is not significant (β = -0.313, *ns*), but their indirect effect of *egoistic values* via the mediator *attitude* (β=-0.200, p<0.01) is significant, leading to conclude for indirect

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mediation between *egoistic values* and WTP through *attitude*. Thus, assuming that the direct effect is not significant and the indirect effect is so, the mediator absorbs some of the direct effect (Ali and Park, 2016). Additionally, the VAF value indicates that 38.9% of the total effect of the *egoistic values* on WTP is explained by *attitude*. Besides, the indirect effect of *egoistic values* via the mediator *perceived behavioral* (β=0.225, p<0.05) is positive and significant, whereas the direct effect between *egoistic values* and WTP has a negative value. Equally, the VAF variable value is negative (i.e. -78.5%), making that this partial mediation is categorized as a competitive mediation (Ramli et al., 2019). Therefore, we can accept the hypotheses H6b and H7b.

Finally, Table 4 reveals that 39.1% of the effect of *altruistic values* on WTP is explained via *attitude* and 24.6% via *perceived behavioral control*, suggesting a partial mediation between *altruistic values* and WTP. Hence, we can also accept hypotheses H6c and H7c.

4.3. Additional testing

Apart from the aforementioned hypotheses tests, additional robustness tests were carried out to study the endogeneity bias using a two-stage test squares approach (2SLS) with instrumental variables. Specifically, three instrumental variables were taken: age, income, and zone, all of the socio-demographic factors are the major influencing factors that determined the willingness to pay (WTP) to reduce road transportation pollution (Lera-Lopez et al., 2014) and WTP for visiting urban parks (Dinda and Subrata, 2021). Thereby, two tests have been performed: an *endogeneity test* and an *over-identification restrictions test*. Furthermore, the endogeneity for each independent variable included in the study (i.e. biospheric value, egoistic value, altruistic value and subjective norm; attitude; perceived behavioral) is individually tested to verify whether an independent variable is endogenous or exogenous. The first stage involves regressing each endogenous variable on all instruments, and exogenous variables in the main model to predict the relevant residuals. The second stage involves regressing the dependent variable on all the exogenous variables, and the predicted values of endogenous variables from the first stage.

Table 4. Direct, indirect and total effects on dependent variable WTP

Hypothesis path	Direct effect	Indirect effect	Total effect	Sobel test	VAF (%)	Hypo-thesis	Findings
Subjective norm →attitude →WTP	1.293 (0.447)***	0.652 (0.145)***	1.945 (0.409)***	3.92***	33.5%	H5a	Supported

							(partial mediation)
Subjective norm →perceived behavioral control →WTP	1.293 (0.447)***	0.655 (0.147)***	1.948 (0.429)***	5.03***	33.6%	H5b	Supported (partial mediation)
Biospheric values→attitude →WTP	0.914 (0.428)***	0.768 (0.172)***	1.682 (0.390)***	4.23*** (0.806)	45.7%	H6a	Supported (partial mediation)
Biospheric values →perceived behavioral control →WTP	0.914 (0.428)***	0.446 (0.089)***	1.360 (0.433)***	4.61*** (0.56)	32.8%	H7a	Supported (partial mediation)
Egoistic values→attitude →WTP	-0.313 (0.445)^{ns}	-0.200 (0.058)***	-0.513 (0.439)^{ns}	3.49 *** (0.63)	38.9%	H6b	Supported (indirect mediation)
Egoistic values →perceived behavioral control →WTP	-0.313 (0.445)^{ns}	0.225 (0.085)**	-0.325 (0.471)^{ns}	2.14 (0.75)***	-78.5%	H7b	Supported (competitive mediation)
Altruistic values→attitude →WTP	1.065 (0.392)***	0.684 (0.168)***	1.749 (0.348)***	3.86 (0.84)***	39.1%	H6c	Supported (partial mediation)
Altruistic values→perceived behavioral control →WTP	1.065 (0.392)***	0.348 (0.085)***	1.413 (0.411)***	4.11 (0.51)***	24.6%	H7c	Supported (partial mediation)

Standard error in parentheses. *Significance at 1%;**significance at 5%;***significance at 10%.

Similarly, after running the 2SLS method using STATA 14, we conduct the Durbin-Wu-Hausman post-estimation test of endogeneity. The test results indicate that all the exogenous variables are insignificant (P-values >0.05). Furthermore, Sargan and Basmann Chi- square tests are insignificant (P-values>0.05), indicating that the selected instrument variables correctly explain the exogenous variables.[3]

5. Discussion and Conclusions

5.1. Discussion

Air pollution is one of the largest environmental health risks in Europe and the disease burden resulting from air pollution is very substantial (European Environment Agency, EEA, 2018). We can highlight that 83% of the total air pollution in Europe is produced by road transportation (European Commission, 2019). Consequently, it is crucial for policy makers to analyze individual's WTP to reduce air pollution by road transport. In

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[3] Robustness checks are available upon request

this context, this study searches to make a contribution to show the relevance of the combination of different attitudinal and psychological models to explain pro-environmental behaviors. For doing so, this research merged the TPN procedure with the VBN framework to gain an in-depth understanding of the factors that influence individuals' WTP to mitigate the air pollution caused by road traffic in their residential areas, particularly in areas with high volume of traffic and great ecological value, as the Pyrenees.

The results of this study support the relevance of TPB in shaping pro-environment behavior (Fielding et al., 2008; Yadav and Pathak, 2017; Zhang et al., 2020). Additionally, the results suggest that individuals with positive attitudes and some personal values can lead to a greater WTP for the air pollution reduction. Thus, these upshots are in consonance with the results obtained by Roos and Hahn (2017), Li et al., (2018), Zahedi et al., (2019), and Pleeging et al., (2021), for example, who identified the attitude as a predominant variable that predicts pro-environmental behavior. Furthermore, these achievements are connected with the results of previous research which highlight the relevance of actions that encourage positive attitudes towards environmental protection and pro-environmental behavior (Tanner and Kast, 2003; Ha and Janda, 2012). Consequently, this study highlights how attitudes could play a role in sustainable behavior (Zhang et al., 2020; Pleeging et al., 2021), in our case, in order to reduce air pollution by road transportation.

The perceived behavioral control, referring to the ease or difficulty to perform an action, is found to be significant in regard to the direct effect, in accordance with previous studies about the role of perceived behavioral control for explaining WTP (Li et al., 2018; Zhang et al., 2020). Also, our results show that the subjective norm has a significantly direct and positive influence on WTP, confirming previous studies stating that the subjective norm is a strong predictor of pro-environmental behavioral intentions (Yadav and Pathak, 2017; Goh et al., 2017; Zhang et al., 2020). Moreover, they also indicate that the subjective norm has a significantly indirect and positive influence on WTP via attitude and perceived control. Thereby, the importance of subjective norms (social considerations) and perceived control (social pressure) to predict attitudes has been supported by previous environmental studies about WTP (López-Mosquera and Sánchez, 2012, López-Mosquera, 2016). Nevertheless, the influence of these two factors might vary in other geographical settings, where social considerations and pressure could be different. For

example, these variables were not statistically significant to explain WTP for green housing in China (Li et al., 2018), where these determinants could play a different role than in European societies.

Concerning VBN constructs, our results show the importance of biospheric and altruistic variables when predicting WTP. These findings are consistent with prior outcomes that highlight the role of both altruistic and biospheric values in pro-environmental behavior (De Dominicis et al., 2017; Sánchez et al., 2018). Conversely, *egoistic values* did not result in a significant link to WTP as initially we hypothesized. This situation could be explained by saying that individuals that adopt high altruistic and biospheric values are more concerned about environmental actions than people who perceive a high level of egoistic values. At the same time, it might suggest that these values could vary between different countries, in comparison with other empirical studies, where egoistic values were significant to explain WTP for pro-environmental behavior (Li et al., 2018).

Furthermore, the findings of this study show that VBN variables indirectly influence WTP through TPB variables (attitude and perceived behavioral control), being VBN variables an antecedent of attitude and perceived behavioral controls ones in relation to WTP. On the one hand, these outcomes provide support for the role of personal value in determining pro-environmental behavioral intentions (Yadav et al., 2019). On the other hand, the indirect effect of VBN variables provides evidence for the relationship which intertwines values, moral norms and physiological factors to act in a pro-environmental behavior. In other words, VBN constructs can be considered as immediate predictors of attitudes and the perceived behavioral control variables also show evidence for promoting pro-environmental behavior.

5.2. Conclusions and policy implications

After the general discussion of the results of our study, we can now summarize the research conclusions in the following points:

a) Initially, the relevance of TPB is critical to shape pro-environment behavior. Moreover, the results suggest that individuals with positive attitudes and some personal values can lead to a greater WTP for the air pollution reduction.

b) Likewise, our study highlights how attitudes could play a role in sustainable behavior (Zhang et al., 2020; Pleeging et al., 2021), in order to reduce air pollution by road transportation.

c) Furthermore, the subjective norm has a significantly direct and positive influence on WTP, confirming previous studies stating that the subjective norm is a strong predictor of pro-environmental behavioral intentions. Moreover, they also indicate that the subjective norm has a significantly indirect and positive influence on WTP via attitude and perceived control.

d) Concerning VBN constructs, our results show the importance of biospheric and altruistic variables when predicting WTP. These findings are consistent with prior outcomes that highlight the role of both altruistic and biospheric values in pro-environmental behavior (De Dominicis et al., 2017; Sánchez et al., 2018).

e) Finally, we can assert that VBN variables indirectly influence WTP through TPB variables (attitude and perceived behavioral control), being VBN variables an antecedent of attitude and perceived behavioral controls ones in relation to WTP.

Thus, these results have some possible policy implications. Firstly, the values obtained revealed that attitudes, perceived behavioral control and the subjective norm are strongly positively and directly related to pro-environmental behavior. In particular, within the field of behavioral economics, this study creates new insights into possible practical implications of positive attitudes to develop pro-environmental behaviors. As Zhang et al., (2020) argue, people are worried about environmental problems, but they do not usually have a strong perception in their daily lives. Therefore, efforts should be made to promote societies with good values by increasing awareness and environmental concern as well as information about the benefits of pro-environment behavior to reduce, in our case, air pollution. These measures would have a direct effect on WTP but at the same time, would have a mediating effect through attitudes (Zhang et al., 2020). In particular, according to our results, regional authorities should develop initiatives for increasing environmental awareness. Correspondingly, we think that some pro-environmental tools may be very useful in order to increase the friendly environment awareness, in formal and informal education contexts, such as visiting nature reserves, watching environmentally friendly movies, planting trees, cleaning environmental goods as river or urban natural areas, active mobility initiatives, etc. In addition, specific instruments could be developed

to increase, in particular, awareness about air pollution produced by road transportation. In this context, policy-makers should consider cultivating appropriate residents' values (Li et al., 2018). The regional and local authorities could develop action-oriented educational programs to reduce pollution at the individual level, as well as new investment in different environmental measures to mitigate the impact of road transportation on air quality. Also, it is very important for the development of biospheric values strengthening residents' responsibilities for reducing air pollution. This would have a direct effect on WTP and complementary mediating effects through the development of pro-environmental attitudes. Therefore, an adequate combination of social pro-environmental pressure with individual awareness could generate a greater effect in front of separate actuations. Therefore, not only the actions of the country or region are relevant, but also continental or global strategies for environmental protection are necessary to protect these public goods. The joint effect could allow the increase of positive environmental personal values, or could cause changes in attitudes, subjective norms or perceived control behavior.

Secondly, pro-environmental behavior results from the activation of personal norms, which are rooted in the influence of the people who are important for them, such as family and social groups where many values are born and developed inside it. In particular, these personal norms not only affect directly to WTP but also have a mediating effect on WPT through group pressure. Formal and informal groups of people sharing the same subjective norms would reinforce the relevance of pro-environmental attitudes and perceived behavioral control on WTP. Correspondly, the government should actively publicize environmental actions, strengthen public opinion supervision and create a good atmosphere for pro-environmental residents' activities (Li et al., 2018), such as the protection of environmentally high-valued areas and action-oriented financial programs to reduce car use. Likewise, the mass media information, social networks and social media apps (Facebook, Twitter, Instagram, etc.) could foster the positive environmental attitudes (Hynes and Wilson, 2016) but also could help to share biospheric values and subjective norms among residents and develop a sense of group pressure to fight against air pollution effects. So that, the individual and collective measures would be a key factor to improve the relevance of pro-environmental behaviors.

Finally, the exchange of experiences among schools and cities on air quality initiatives through sharing platforms (European Environment Agency, 2018) might contribute to

change the individuals' WTP for reducing air pollution. Also, it is important to highlight the critical role played by environmental volunteerism, not only in helping to solve real pollution problems, but also in increasing social awareness in order to promote more pro-environmental actions through, for example, the development of these experience-sharing platforms. All these actions make individuals feel responsible for achieving a transition towards a more sustainable lifestyle. Following Zahedi et al., (2019), these attitudinal and behavioral changes might improve the effectiveness of economic tools such as ecological taxes (e.g. tax based on vehicle pollution category) specifically established to tackle the air pollution problem. At the same time, these changes in attitudes and awareness could also promote an increasing use of alternative transport models.

5.3. Limitations and further research

We are going to discuss in this subsection our work limitations in order to define and analyse them. Firstly, although our sample is representative of the regions under study and the findings may be generalizable to areas with high volume of road transportation in rural and mountainous areas, we could not infer that our conclusions also apply to other regions with very different geographical and road traffic characteristics. Therefore, future research should further be focused on other regions in Europe and Spain to confirm the relevance of attitudes, perceived behavioral control and subjective norms to explain WTP to reduce air pollution produced by road traffic. Secondly, although contingent valuation is regularly used to assess the value of environmental externalities (Ntanos et al., 2018), is by no means free from criticism (Pleeging et al., 2021). We have tried to limit them by using a realistic payment vehicle (a tax) in a real scenario with a large sample size and by offering a broad payment-scale format thereby reducing the starting point bias and protest responses, following previous empirical evidence (i.e., Jorgensen et al., 2001; Lera-Lopez et al., 2014; Tian et al., 2020; Pleeging et al., 2021).

Concerning future lines of research, it would be interesting to make a comparison between different ways of obtaining the economic valuation of the problem presented in this paper. One way to perform that work, would be contrasting alternative economic models in assorted geographical scenarios. Another option would be the design of environmental tax policies which complement the awareness campaigns developed in schools for young people. Moreover, further investigations on the individual-level drivers of WTP can be helpful to reduce the impact of air pollution associated with road transportation. This could include studies covering different regions and countries in Europe to consider

cultural specificity of the territory, the influence of payment methods on WTP or the potential linkages with other environmental externalities associated with road transport such as noise and extreme temperatures.

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