UNIVERSIDAD DE GRANADA

DOCTORAL THESIS

Essays on pro-environmental behaviour: Associations with subjective well-being and nature connection

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Indudablemente, cada generación se cree destinada a rehacer el mundo. La mía sabe, sin embargo, que no podrá hacerlo. Pero su tarea es quizás mayor. Consiste en impedir que el mundo se deshaga.

Albert Camus

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SUMMARY

The scale and severity of environmental problems make the ecological crisis one of the most pressing challenges facing humanity. Given the anthropogenic nature of environmental problems, it is imperative to shift people's behaviours and lifestyles onto more sustainable paths. This thesis aims to analyse the factors that determine the adoption of pro-environmental behaviours, as well as the compatibility between a sustainable lifestyle and a high level of subjective well-being. Among the different types of behaviour, special attention is given to pro-environmental practices related to water use. To achieve the research objectives, four studies are developed using a database of 1283 observations of students at the University of Granada. The data are analysed by estimating different econometric models, mainly linear models (ordinary least squares) and ordered probit models.

The first study analyses the determinants of household water use, with connectedness and contact with nature proposed as explanatory factors. The results indicate that a greater sense of connection with nature and more frequent time spent in natural environments are significantly and positively related to different water-saving habits, opening up a new avenue for promoting pro-environmental use of water resources.

One of the most water-consuming activities in the domestic sphere is showering. The second study specifically explores showering habits, looking at the duration and frequency of showers separately for summer and winter. The results show that there is considerable room for improvement in the sustainable use of water for personal hygiene and highlight seasonal differences in behaviour. In addition, this study identifies a wide range of factors that promote more efficient shower water consumption, including socio-demographic, psychological and environmental factors.

The third study addresses the question of whether more sustainable water consumption comes at a cost in terms of well-being. The analysis focuses on water consumption in the

shower, as showering is not only one of the main uses of water in the household but is also widely perceived as a wellness activity. However, the results indicate that higher water consumption is negatively related to subjective well-being. The duration of showers is significantly and negatively related to all measures of well-being considered (life satisfaction, affection and vitality), while the frequency is not related to any of the well-being dimensions. The results hold regardless of the season considered, suggesting that there is no conflict between sustainable water use in showering and individual well-being.

To further explore the relationship between pro-environmental performance and subjective well-being, the fourth study expands the set of pro-environmental behaviours considered, distinguishing between individual behaviour (sustainable consumption) and collective behaviour (environmental activism). It also analyses the possible moderating effect that connection with nature may have on this relationship. The results show differences in the relationship depending on the type of behaviour analysed. A significant positive association is found between individual pro-environmental behaviour and subjective vitality (eudaimonic dimension of subjective well-being). In contrast, collective pro-environmental behaviour is significantly and negatively related to life satisfaction (cognitive dimension of subjective well-being). However, the initial negative relationship between collective pro-environmental behaviour and well-being is reversed for those with a strong sense of connection to the natural world, confirming the moderating role of connection to nature.

The results of the thesis are intended to guide the formulation of policies that have a positive impact on the environment and well-being. On the one hand, identifying current patterns of behaviour and their determinants, distinguishing between different types of actions, may allow the design of more effective strategies to promote sustainable behaviour. On the other hand, understanding and cultivating the contexts in which pro-environmental actions are associated with higher levels of subjective well-being may be essential to ensure long-term behavioural change. In this respect, one of the main recommendations of the thesis is the implementation of measures that strengthen people's relationship with nature and help them to regain a sense of connectedness with the natural world. These policies can drive the individual and collective actions needed to halt and ultimately reverse the ecological crisis, while boosting people’s well-being.

RESUMEN

El alcance y la gravedad de los problemas medioambientales erigen la crisis ecológica como uno de los desafíos más urgentes que enfrenta la humanidad. Dado el carácter antropogénico de los problemas medioambientales, resulta fundamental cambiar las conductas y estilos de vida hacia trayectorias más sostenibles. Esta tesis doctoral pretende analizar los factores que determinan la adopción de comportamientos pro-ambientales, así como la compatibilidad entre un estilo de vida sostenible y altos niveles de bienestar subjetivo. Entre los diferentes tipos de comportamientos, se presta especial atención a prácticas pro-ambientales relacionadas con el uso del agua. Para alcanzar los objetivos de investigación, se desarrollan cuatro estudios a partir de una base de datos compuesta por 1283 observaciones de estudiantes de la Universidad de Granada. El análisis de los datos se lleva a cabo mediante la estimación de distintos modelos econométricos, principalmente modelos lineales (mínimos cuadrados ordinarios) y modelos probit ordenados.

El primer estudio analiza los determinantes del uso del agua en el hogar, proponiendo como factores explicativos la conexión y el contacto con la naturaleza. Los resultados indican que un mayor sentido de conexión con el mundo natural y pasar tiempo en entornos naturales con mayor frecuencia está relacionado significativa y positivamente con distintos hábitos de conservación de agua, lo que abre una nueva vía para la promoción del uso pro-ambiental de los recursos hídricos.

Una de las actividades que implica mayor consumo de agua en el ámbito doméstico es la ducha. El segundo estudio explora específicamente los hábitos de ducha, considerando la duración y la frecuencia de las duchas de forma diferenciada para verano e invierno. Los resultados ponen de relieve que existe un amplio margen de mejora en el uso sostenible del agua para la higiene personal y destacan las diferencias estacionales en el comportamiento. Además, este estudio identifica un amplio conjunto de factores que

favorecen un consumo más eficiente del agua de ducha, incluyendo factores sociodemográficos, psicológicos y medioambientales.

El tercer estudio aborda la cuestión de si un consumo más sostenible de agua entraña un coste en términos de bienestar. El análisis se centra en el consumo de agua en la ducha porque, además de ser uno de los principales usos del agua en el hogar, es extendida la percepción de la ducha como una actividad que genera bienestar. Sin embargo, los resultados indican que un mayor consumo de agua se relaciona negativamente con el bienestar subjetivo. Una mayor duración de la ducha se relaciona de forma significativa y negativa con todas las medidas de bienestar consideradas (satisfacción con la vida, afecto y vitalidad), mientras que la frecuencia de duchas no se relaciona con ninguna de las dimensiones del bienestar. Los resultados se mantienen con independencia de la estación considerada, lo que indica que no existe un conflicto entre el uso sostenible del agua en la ducha y el bienestar individual.

Para profundizar en la relación entre actuación pro-ambiental y bienestar subjetivo, el cuarto estudio amplía las acciones pro-ambientales consideradas, distinguiendo entre comportamiento individual (consumo sostenible) y comportamiento colectivo (activismo ambiental). Además, se analiza el posible efecto moderador que la conexión con la naturaleza puede tener en esta relación. Los resultados muestran diferencias en la relación según el tipo de comportamiento analizado. Se encuentra una asociación significativa positiva entre el comportamiento pro-ambiental individual y la vitalidad subjetiva (dimensión eudaimónica del bienestar subjetivo). En cambio, el comportamiento pro-ambiental colectivo se relaciona de forma significativa y negativa con la satisfacción con la vida (dimensión cognitiva del bienestar subjetivo). No obstante, la relación negativa inicial entre el comportamiento pro-ambiental colectivo y el bienestar se revierte para aquellas personas con un alto sentido de conexión con el mundo natural, corroborando el papel moderador de la conexión con la naturaleza.

Los resultados de la tesis pretenden guiar la formulación de medidas que impacten positivamente en el medio ambiente y el bienestar. Por un lado, identificar los actuales patrones de comportamiento y sus determinantes, distinguiendo entre diferentes tipos de acciones, permite diseñar estrategias más efectivas para promover conductas sostenibles. Por otro lado, conocer y expandir los contextos en los que la actuación pro-ambiental va acompañada de mayores niveles de bienestar subjetivo puede ser esencial para asegurar

el cambio de comportamiento a largo plazo. En este sentido, una de las principales recomendaciones de la tesis es la implementación de medidas que refuercen la relación de las personas con la naturaleza y contribuyan a recobrar el sentido de interconexión con el mundo natural. Estas medidas pueden impulsar la adopción de las acciones individuales y colectivas que se precisan para frenar y revertir la crisis ecológica, al mismo tiempo que generan mayor bienestar para las personas.

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CHAPTER 1. Introduction

1.1. Background and research interest

Given the scale and severity of current environmental problems, the ecological crisis is one of the greatest challenges of our time. Although still relevant today, concern about environmental degradation is not a recent phenomenon. Back in the 1960s and 1970s, the environmental movement was already gaining momentum and a burgeoning literature exposed the devastating consequences of human activity on nature (e.g. Carson, 1962; Meadows et al., 1972; Ward & Dubos, 1972). The human-induced changes in the functioning of the Earth system are so profound that, at the turn of the century, the term Anthropocene was introduced to informally designate a new geological epoch in which humanity's capacity for transformation rivals that of the great forces of nature (Crutzen, 2002; Steffen et al., 2011).

Despite repeated warnings from the scientific community to halt environmental degradation before significant and irreversible damage is done to the biosphere, the disastrous trajectory has continued and even worsened (Ripple et al., 2017; Steffen et al., 2015). Today, ecological collapse is more evident than ever, with most planetary boundaries having been breached (Richardson et al., 2023). The destruction of nature is made clear in the trend of biodiversity indicators: over the last five decades, the relative abundance of animal species has declined by an average of 69% across the planet (World Wildlife Fund [WWF], 2020). The scale of biodiversity loss is so vast that scientists argue that a sixth mass extinction is underway (Ceballos et al., 2015).

A key challenge linked to the biodiversity crisis is the climate crisis. Human activities, particularly greenhouse gas emissions, have caused the current global warming (Intergovernmental Panel on Climate Change [IPCC], 2023). Greenhouse gas emissions

and global surface temperatures have continued to rise, with 2023 being the warmest year on record (Copernicus Climate Change Service [C3S], 2024). The adverse impacts of climate change are intensifying, causing widespread damage to both people and the rest of the natural world, including deterioration of housing and infrastructure, loss of health and well-being, weakened biodiversity and ecosystems, and disruptions to food production and water availability (IPCC, 2023). In terms of water availability, almost half of the world's population currently faces water scarcity for at least part of the year, a situation that is set to worsen as climate pressures on the global hydrological cycle intensify, leading to an increase in the frequency and severity of droughts and floods (United Nations, 2024).

In recent decades, new technologies have been developed, the efficiency of production processes has been significantly improved, and products and business models have been redesigned to reduce resource consumption and minimise the environmental impact of economic activity (Nižetić et al., 2019; Tukker, 2015). However, these efforts, while valuable, are insufficient to address the ecological crisis described above, and deeper changes are needed, including the reduction and reconfiguration of consumption (Hickel & Kallis, 2020). Compared to the development of technologies and infrastructure, behavioural change towards more sustainable patterns has the potential to be rapid and widespread, meaning measures aimed at changing people’s habits and lifestyles can be highly effective (Wynes & Nicholas, 2017).

In order to better understand and influence people's behaviour, various disciplines have tried to clarify the factors that determine the adoption of environmentally responsible behaviour. In fact, the number of publications on pro-environmental behaviour has grown exponentially in recent years.[1] The term “pro-environmental” encompasses a wide range of actions that benefit the environment or cause it as little damage as possible (Steg & Vlek, 2009). According to Larson et al. (2015), these actions span four distinct domains: conservationist lifestyles (e.g., reducing water or energy consumption at home), social environmentalism (e.g., participating in organisations that advocate nature conservation),

[1] A search in databases such as Scopus and Web of Science shows the growing interest in this topic. The number of publications on pro-environmental behaviour (search: TITLE-ABS-KEY ("pro-environmental behavio*" OR "sustainable behavio*" OR "ecological behavio*") has risen from less than a dozen a year in the early years of the 21st century to several hundred in recent years, with this figure nearing a thousand publications by 2023.

environmental citizenship (e.g., voting for political parties that support environmental protection), and land stewardship (e.g., habitat conservation actions).

Several theories and models from the field of psychology have been proposed that may explain pro-environmental behaviour. Among the most influential frameworks are the norm-activation model (Schwartz, 1977), the theory of planned behaviour (Azjen, 1991) and the value-belief-norm theory of environmentalism (Stern, 2000). These models focus on the internal psychological processes that lead to the adoption of a behaviour, taking into account factors such as attitudes, moral norms, values or perceived behavioural control. In contrast, other disciplines have placed more emphasis on the influence of external factors on behaviour. For example, economists have paid more attention to external conditions such as income, prices, and socio-economic characteristics (Clark et al., 2003), while sociological theories emphasise the role of social capital and social interactions in shaping behaviour (Tian & Liu, 2022).

Combining findings from different disciplines, Blankenberg and Alhusen (2019) identify several determinants of pro-environmental behaviour and classify them into four main categories: socio-demographic factors, such as age, education, income, gender and household structure; psychological factors, such as beliefs, attitudes, values, norms, identity and environmental awareness; habitual factors, which refer to automatic responses in specific situations; and contextual factors, which include individual, social and institutional factors, such as ideology, social environment and environmental policies. Thus, pro-environmental behaviour is shaped by a variety of psychological, social, cultural, demographic, economic and institutional factors, some of which come into conflict with one another, making it very difficult for a single model to encompass all the relevant factors (Li et al., 2019).

Understanding the explanatory factors of pro-environmental behaviour enables the design of effective interventions that promote the necessary behavioural change (van Valkengoed et al., 2022). However, influencing people's behaviour to move it in a more sustainable direction remains a challenge. Although different strategies have proven potential to change behaviour, their effectiveness depends on the context, the behaviour in question and the target population (Composto & Weber, 2022; Grilli & Curtis, 2021; Schultz, 2014). Indeed, empirical evidence on the determinants of pro-environmental behaviour is heterogeneous in terms of the significance and even the sign of the association

(Blankenberg & Alhusen, 2019). This lack of consistency may be due, in addition to differences between study contexts, to the multidimensionality of pro-environmental behaviour itself: there are many types of such behaviour that vary in their degree of difficulty, the intentions behind them, the impacts they generate, the costs they entail, etc. (Larson et al., 2015).

An additional difficulty is the existence of various barriers that impede the process of adopting sustainable behaviours, including personal, organisational and institutional barriers (Grilli & Curtis, 2021). Even environmentally-concerned individuals may not adopt pro-environmental behaviours if they validate their behaviour through neutralisation techniques such as denial of responsibility or denial of harm (Neumann & Mehlkop, 2023). A common barrier to the diffusion of pro-environmental behaviour is the perception that such behaviour is a sacrifice that must be made at the expense of personal well-being (Chwialkowska & Flicinska-Turkiewicz, 2020; Prinzing, 2023). As long as people identify well-being with abundant consumption and affluent lifestyles, they are unlikely to engage in the behaviours necessary to support environmental sustainability (Kasser, 2017).

There is a growing body of literature examining the relationship between pro-environmental behaviour and subjective well-being, with findings suggesting that developing more sustainable behaviour need not be costly in terms of well-being; in fact, frequent participation in pro-environmental actions may be positively associated with subjective well-being (Zawadzki et al., 2020). These findings would support the double dividend argument proposed by Jackson (2005), according to which reducing our environmental impact can lead to an improvement in our well-being. However, this double dividend does not occur in all cases. Some studies provide evidence of a negative association between engagement in pro-environmental actions and subjective well-being (e.g. Binder et al., 2020). The results may differ depending on the type of behaviour studied or the dimension of well-being considered. In addition, other factors such as culture or individual characteristics may influence the compatibility between pro-environmental behaviour and well-being. Understanding the contexts in which this double dividend may occur would facilitate behavioural change.

Several authors have argued for the need to integrate research on sustainability and well-being (Martin et al., 2020). In this sense, a prominent area where the two objectives

converge is research on the relationship between humans and the rest of the natural world. Humans are becoming increasingly disconnected from nature, in a process of alienation known as the "extinction of experience" (Pyle, 1993). This phenomenon has attracted the attention of researchers in various fields due to its alarming consequences: on the one hand, alienation from nature limits the health and well-being benefits that people derive from contact with nature; on the other hand, it diminishes their appreciation of the natural world and hinders the development of pro-environmental attitudes and behaviours (Soga and Gaston, 2016). Thus, disconnection from the natural world interferes with the development of healthy and sustainable societies.

1.2. Objectives and method

In the context described above, this thesis aims to contribute to research on the adoption of pro-environmental behaviours and the compatibility between sustainable lifestyles and high levels of subjective well-being. Among the different pro-environmental behaviours, special attention is paid to those related to water consumption, as water is an essential resource for life and climate change is having a severe impact on its availability (United Nations, 2024). For this reason, different domestic end uses of water are analysed, with shower water use playing a central role as a major component of domestic water consumption (Mazzoni et al., 2023). Other individual actions in the private sphere are also studied, such as making environmentally-friendly purchases, saving energy, recycling or choosing less polluting modes of transport. In addition, the range of behaviours is extended to include social actions related to environmental activism, such as participating in pro-environmental demonstrations. Such actions, if sufficiently widespread among the population, would have a significant positive impact on the environment (Larson et al., 2015).

In addition to examining patterns of behaviour, this research seeks to explore explanatory factors for such behaviour. Given the lack of consistency in previous findings, it is essential to conduct differentiated analyses for different types of actions and contexts. Among the various factors, the relationship between people and nature is a central variable in the research. The connections between people and nature are diverse, ranging from external links, such as material dependence and experiences in nature, to internal links, such as emotions and worldviews (Ives et al., 2018). This paper includes two main

facets of the relationship with nature: the psychological connection with nature, understood as the perception of belonging to the natural world; and contact with nature, which refers to a physical aspect of the relationship, alluding to visits to natural areas and interactions with nature. In addition to including the relationship with nature as an explanatory variable for behaviour, its potential as a catalyst for generating the double dividend of pro-environmental behaviour is analysed (Jackson, 2005).

The *general objective* of the research, which is to analyse the factors determining pro-environmental behaviour and the relationship of this behaviour with subjective well-being, is articulated around four *specific objectives*:

1. To study the role of the sense of connectedness and contact with nature as determinants of water use in households.
2. To identify current showering habits and the factors that foster more efficient water consumption.
3. To investigate the relationship between water consumption in the shower and reported subjective well-being, taking into account showering habits in terms of frequency and duration.
4. To analyse the role of connection with nature as a potential factor moderating the relationship between well-being and pro-environmental behaviour, distinguishing between individual and collective actions.

Figure 1.1 summarises the key themes addressed in each of the specific objectives. The central theme of the thesis is pro-environmental behaviour, which is present in all the specific objectives. In the first three objectives, the behaviour analysed relates to domestic water use. The relationship with nature is present in Objectives 1, 2 and 4. Finally, Objectives 3 and 4 address the relationship between pro-environmental behaviour and subjective well-being.

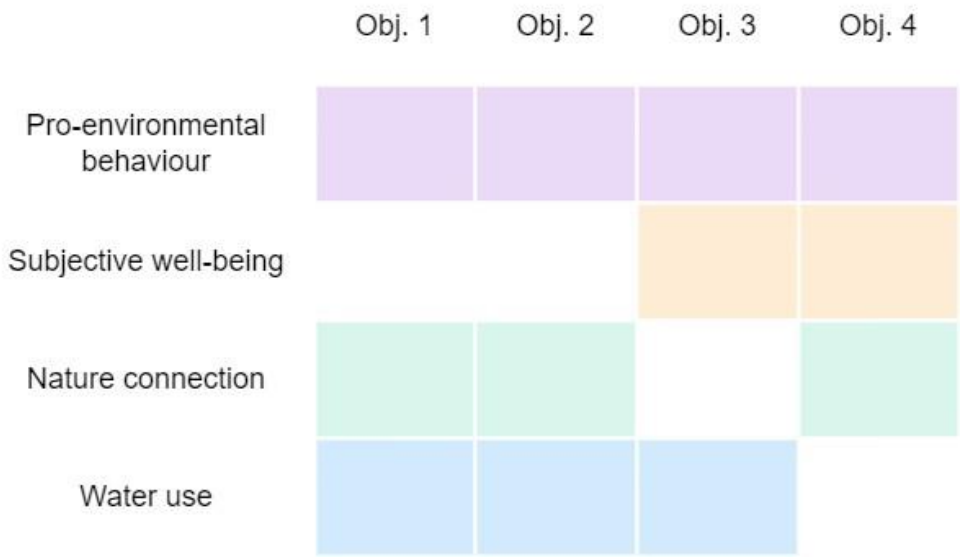

Figure 1.1. Key research topics for each specific objective.

In order to achieve the proposed objectives, a local database is used, consisting of 1283 observations from students at the University of Granada, belonging to different faculties and disciplines. The data used do not allow conclusions to be drawn about the general population, but they do provide valuable information, as they correspond to a segment of the population with a strong interest in sustainability issues. University students are mainly young people who, given the predictions of water scarcity and deteriorating environmental conditions in the coming years, will have to make major changes in their behaviour in order to adapt to this future context. In addition, university education prepares students for important societal roles as researchers and practitioners; as such, their environmental attitudes, values, and behaviours not only contribute to sustainability on an individual basis, but can also drive more far-reaching organisational, political and societal transformations (Hansmann et al., 2020).

With regard to the methodology used to analyse the data, in addition to descriptive statistics, various econometric models are estimated, choosing the most appropriate technique according to the nature of the variables under study. For the most part, ordinary least squares and probabilistic models such as ordered probit regressions are used.

1.3. Structure of the thesis

Each of the specific objectives corresponds to a chapter in the main body of the thesis, consisting of a previously published article. Thus, after this introductory chapter, four research papers that have already been published are presented (see Table 1.1). The sixth and last chapter summarises the main conclusions of the research.

Table 1.1. Published articles that are part of the thesis.

Article title	Year of publication	Journal	Journal Impact Factor [a]
The role of nature contact and connectedness to nature as determinants of household water use: A case study from Spain	2022	Water and Environment Journal	2.0
Towards a sustainable use of shower water: Habits and explanatory factors in southern Spain	2023	Sustainable Water Resources Management	2.1
How does sustainable water consumption in the shower relate to different dimensions of perceived well-being? Empirical evidence from university students	2023	Local Environment	2.4
Pro-environmental behavior, connectedness to nature, and wellbeing dimensions among Granada students	2020	Sustainability	3.9

[a] Journal Citation Reports (Clarivate Analytics). The Impact Factor for the year of publication is displayed, with the exception of publications from 2023, for which the most recent data, corresponding to 2022, is presented.

The title of **Chapter 2** is "The role of nature contact and connectedness to nature as determinants of household water use: A case study from Spain". This study is the first to investigate the influence of connectedness and contact with nature on behaviours related to household water use. Household water consumption is largely influenced by individual lifestyle and behaviour. Therefore, identifying the factors that affect water use behaviour is crucial for promoting water conservation. Previous research has identified a wide range of determinants of water use behaviour, including socio-demographic characteristics and psychological factors (Addo et al., 2018). Nevertheless, these factors account for only a minor proportion of the variance in behaviour, indicating a need to identify further factors that could drive efficient household water use. Previous research has demonstrated that

connectedness to nature and nature contact can act as drivers of pro-environmental behaviours of various kinds, such as recycling or buying environmentally-friendly products (Martin et al., 2020). However, no study has yet analysed the relationship between these variables and pro-environmental habits related to efficient water use.

Considering different water-saving habits to reflect different dimensions of domestic water use, several ordered probit models are estimated, the results of which show positive associations between several of these habits and connectedness and contact with nature. The results of this study suggest that efficient domestic water use can be promoted through measures that strengthen people's connection with nature. These measures could include changes in the educational curriculum to foster an ecocentric vision among students, or encouraging school trips for students to explore and get to know nearby natural spaces.

Chapter 3, "Towards a sustainable use of shower water: Habits and explanatory factors in southern Spain", focuses on a specific domestic water use: shower water use. Personal hygiene is one of the main water-consuming activities in households, with showering being the most common practice (Mazzoni et al., 2023). Studies analysing showering habits and their determinants are scarce and often limited to analysing the socioeconomic characteristics of individuals or focusing on a single aspect of showering behaviour (Hannibal et al., 2019). To address the question of how people can use shower water more sustainably, this study analyses showering behaviour in terms of duration and frequency of showers, separately examining habits during the winter and summer seasons. It also analyses a wide range of factors that may determine these habits, including not only socio-economic variables, but also psychological and environmental variables. Understanding behaviour and the factors that influence it will enable the development of effective messages and actions to promote water conservation.

The results show significant differences between showering habits in the summer and winter months. The time spent showering is longer in winter, while the number of showers per week is higher in summer. Determinants of shower water use include gender, ideology, pro-environmental behaviour, intrinsic values and connection to nature. These variables have different relationships with shower duration and frequency depending on the season of the year, highlighting the importance of seasonality. The results show that there is scope for encouraging more sustainable showering, in terms of frequency and

duration, through awareness-raising activities targeted at groups with less sustainable showering behaviour. The main recommendation is that awareness campaigns should be designed according to the user profile as well as the season of the year.

Chapter 4 is titled "How does sustainable water use in the shower relate to different dimensions of perceived well-being? Empirical evidence from university students". This chapter analyses the relationship between sustainable water use and well-being, focusing on shower water use. The interest in this use lies not only in the fact that it is one of the main uses of water in the home, but also in the fact that showering has important connotations related to well-being. These connotations are associated with excessive consumption, as people take more frequent and longer showers (Lindsay & Supski, 2017). However, there is no scientific evidence on the impact of shower water consumption on subjective well-being.

In order to understand the implications of sustainable shower use, this paper analyses the relationship between different dimensions of subjective well-being (life satisfaction, affect and vitality) and shower water use, taking into account different aspects of showering habits and seasonal differences. The results suggest that there is a negative relationship between water consumption and subjective well-being, in line with previous literature identifying a well-being dividend from pro-environmental behaviour (Jackson, 2005). All dimensions of subjective well-being are negatively related to time spent showering, regardless of the season. In contrast, the frequency of showering is not significantly related to well-being. Therefore, it appears that higher water consumption does not translate into higher perceived well-being, suggesting that there is no conflict between efficient water use in the shower and individual well-being.

The last contribution corresponds to **Chapter 5**, titled "Pro-environmental behaviour, connectedness to nature, and well-being dimensions among Granada students ". This study explores the relationship between pro-environmental behaviour and subjective well-being. To analyse this relationship, different types of actions are considered, distinguishing between individual behaviour (referring to personal efforts to consume less and reduce the environmental impact of consumption) and collective behaviour (understood as environmental activism). The role of connectedness to nature in this relationship is also explored. There is evidence that, in addition to promoting pro-environmental attitudes and behaviours, connectedness to nature is positively correlated

with several dimensions of well-being (Martin et al., 2020). However, the analysis of the moderating role of nature connectedness in the relationship between pro-environmental behaviour and well-being is novel in the literature.

The results of the regression analyses carried out show a positive association between individual pro-environmental behaviour and the eudaimonic dimension of well-being (subjective vitality), while the association with the cognitive and affective dimensions is not significant. In contrast, environmental activism is significantly associated only with the cognitive dimension of well-being (life satisfaction), in this case negatively. Furthermore, the results confirm the moderating role of connectedness to nature, as the initially negative relationship between environmental activism and life satisfaction is reversed when people feel highly connected to nature. The results of this study therefore highlight the differences between different types of behaviour in terms of their relationship with well-being. They also point to the importance of reconnecting people with nature in order to address the environmental situation and improve people's well-being.

Finally, **Chapter 6** presents the main conclusions and implications of the research, highlighting its policy usefulness in guiding policies that have positive environmental and welfare impacts.

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CHAPTER 2. The role of nature contact and connectedness to nature as determinants of household water use: A case study from Spain

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Abstract

One of the targets of Sustainable Development Goal 6 is to increase water-use efficiency in all sectors. In the domestic sphere, water consumption is largely conditioned by the habits and behaviour of individuals. In this study, we investigate for the first time the influence of connectedness to and contact with nature on five different uses of water at home. Using ordered probit regressions with a sample of 874 students from the University of Granada (Spain), we found that connectedness to nature and nature contact is positively or nonsignificantly related to different dimensions of water efficiency. The results indicate that in order to encourage pro-environmental water use habits at home, efforts should be made to develop an ecocentric vision in schools and to promote school trips to explore and understand the nearest natural areas. These policies should be adapted to a wider international context as a way of addressing the global problem of water scarcity.

Keywords: domestic water use; water conservation habits; water efficiency; human-nature relationship; nature relatedness.

2.1. Introduction

Water is essential for natural ecosystems and people. Food security, human health, economic development, and ecosystem conservation depend on this resource (UN, 2020). However, factors such as climate change and population growth compromise the availability of water resources globally (IPCC, 2018; UN, 2020). Among other measures, the United Nations (2015) proposes in Sustainable Development Goal (SDG) 6 the efficient use of water resources in all sectors to ensure the availability of water.

In the domestic environment, the behaviour of individuals is as important as the use of efficient technologies and infrastructure (Fielding et al., 2012). Many household water uses are influenced by individual lifestyle and behaviour (Willis et al., 2011), which explains why more water is often consumed than is actually needed. Identifying the factors that affect behaviour can be key to promoting household water conservation. In this regard, previous research has found a wide variety of determinants of water-use behaviour in households, including sociodemographic characteristics and psychological factors (Addo et al., 2018). Despite this, models explaining household water use tend to have low coefficients of determination (Jorgensen et al., 2009), indicating that other factors which may be driving efficient household water use have yet to be analysed.

Past studies have attempted to understand water-saving habits through sociodemographic variables, but in this study, we go one step further by including variables on people's relationship with nature as possible drivers of water-saving behaviour. In this research we propose the relationship with nature as a determinant of efficient water use, considering both the feeling of connectedness to and the contact with the natural world. Specifically, we seek answers to the following questions: (1) Is there a relationship between a person's connectedness to nature and his/her water use habits at home? (2) Is there a relationship between a person's nature contact and his/her household water use habits? We understand connectedness to nature as a holistic view of nature, or the extent to which a person perceives that he/she is part of an interconnected natural environment. Contact with nature is interpreted as the frequency with which a person visits natural spaces. Both factors have previously been recognised as drivers of pro-environmental behaviours of different types (Alcock et al., 2020; Martin et al., 2020); however, the evidence is scarce for sustainable water consumption. There has been some notable research on connectedness to nature and pro-environmental behaviours (Gkargkavouzi et al., 2019; Petersen et al.,

2015), but without a particular focus on water use habits; instead, such studies consider water saving along with other pro-environmental actions. To our knowledge, there is no evidence to date linking efficient water use and nature contact. Given that different types of water use can have different determinants (Makki et al., 2015), in the present research we address the relationship between nature connectedness and contact and efficient water uses, examining five different uses to reflect various dimensions of household water use. We conducted the analyses using ordered probit regressions with a sample of students from the University of Granada (Spain).

2.2. Literature Review

In this section, we review the literature on the topics of water saving and nature. To do so, we searched for relevant articles in scientific databases, particularly Scopus and Web of Science. The terms used for the search were combinations of "water" and "pro-environmental behaviour" with "nature" and "connectedness to nature".

Water conservation, like other pro-environmental behaviours, is driven by both intrinsic and extrinsic factors, encompassing sociodemographic, psychological and contextual factors, among others (Blankenberg & Alhusen, 2018; Joseph, 2019).

Numerous studies have analysed how sociodemographic characteristics influence household water use. In fact, it has been suggested that demographic and socioeconomic variables may be more important than climatic and other physical factors in explaining per capita water use (Murdock et al., 1991). Some of the sociodemographic factors that have been found to be related to water consumption in the household include age (Fielding et al., 2012; Gregory & Di Leo, 2003; Makki et al., 2015), level of education (De Oliver, 1999; Gilg & Barr, 2006; Gregory & Di Leo, 2003; Yu et al., 2015), income (De Oliver, 1999; Domene & Saurí, 2006; Fielding et al., 2012; Gilg & Barr, 2006; Gregory & Di Leo, 2003; Makki et al., 2015; Yu et al., 2015), and number of residents in the household (Domene & Saurí, 2006; Fielding et al., 2012; Gregory & Di Leo, 2003; Makki et al., 2015; van Vugt, 2001).

As for environmental variables, the most commonly studied variable is the role of environmental beliefs and attitudes as determinants of water consumption, taking into account an individual's predisposition to respond in a consistently favourable or unfavourable way towards the environment (Ajzen & Fishbein, 1973). In this respect,

Corral-Verdugo et al. (2003) found that, although general environmental beliefs, such as beliefs related to the need to set limits on human activities, do not directly predict water consumption, they do influence the development of specific beliefs regarding water, which affect water consumption. In a similar vein, Willis et al. (2011) showed that people with very positive environmental and water conservation attitudes, i.e. people with high levels of environmental concern and water conservation awareness, consumed significantly less water in end uses influenced by lifestyle and behaviour. Although Willis et al. (2011) found that concern for environment is related to actual water end use consumption, Liobikienė and Minelgaitė (2021) reported that environmental concern has no impact on water-saving behaviour. In addition to beliefs and attitudes, emotions have also been proposed as an important factor in water conservation (de Miranda Coelho et al., 2016).

The environmental variables considered in previous literature in relation to efficient water use reflect beliefs, attitudes, and emotions. In contrast, there is less evidence regarding other dimensions of people's relationship with nature that puts the accent on how people relate to nature. In the present research, we seek to determine the relationship between water use efficiency habits and some as yet underexplored variables, namely feelings of connection with the natural world and exposure to natural environments.

2.2.1. The role of connectedness to nature

Connectedness to nature is understood as an individual's feeling of oneness with nature, referring to how a person perceives himself/herself in nature. Therefore, it reflects the extent to which a person sees the world and himself/herself as interconnected. The idea of connectedness to nature has been conceptualised and measured in different ways in the literature; for example, Schultz (2002) developed the Inclusion of Nature in Self Scale to measure the degree to which an individual includes nature in the conception of self, while Mayer and Frantz (2004) developed the Connectedness to Nature Scale to assess an individual's affective and experiential connection with nature. Numerous previous studies have found a positive relationship between some form of connection with nature and a wide range of pro-environmental behaviours (e.g., Gosling & Williams, 2010; Ibáñez-Rueda et al., 2020; Kim et al., 2018; Krizanova & Guardiola, 2020; Mackay & Schmitt, 2019; Martin et al., 2020; Nisbet et al., 2009; Yusliza et al., 2020). In contrast to this

literature, the influence that connectedness to nature may have on residential water use remains largely unexplored.

Among the scarce evidence linking efficient water use and connectedness to nature, Petersen et al. (2015) found positive correlations between connectedness to nature and motivation to conserve water and electricity in a sample of university students. In the same vein, the study by Gkargkavouzi et al. (2019) showed the predictive power of nature connectedness in explaining different domains of pro-environmental behaviour, including behaviours in the household setting that encompass water and energy conservation actions. Given its domestic context, the study by Chen and Sintov (2016) may also be of interest for our research; their results indicate that people with higher levels of affiliation with nature are more willing to adopt home energy management technologies and programmes. In addition, other studies that point to connectedness to nature as a determinant of sustainable behaviour include in their measures of behaviour some actions aimed at making more sustainable use of water in the household (e.g., Geng et al., 2015; Kals et al., 1999).

These previous studies may be an indication of the power of connectedness to nature to encourage domestic water conservation. However, they do not explore in depth the relationship between connectedness to nature and sustainable water use habits, but rather address this issue alongside other types of pro-environmental behaviours. To better understand the relationship between connectedness to nature and efficient water use, this study centres on water use habits. Previous research shows that the impact of certain determinants depend on the specific type of behaviour being considered (Blankenberg & Alhusen, 2018). For example, higher income levels have been found to be positively associated with investment in water-efficient technologies, but negatively associated with water-saving habits (Martínez-Espiñeira & García-Valiñas, 2013). Since different behaviours in the private sphere may differ in their determinants (Stern, 2000), connectedness to nature could have different effects on the various end uses of water in the household.

2.2.2. The role of nature contact

Nature contact can be defined as any interaction with elements of the biophysical system, such as flora, fauna and geological forms (Martin et al., 2020; Zylstra et al., 2014).[2] Previous evidence indicates that different ways of interacting with nature are positively correlated with pro-environmental attitudes and behaviours. For example, Martin et al. (2020) found, for a sample from England, that frequent visits to nature and watching nature documentaries are positively associated with different types of pro-environmental behaviour. Also using a sample from England, Alcock et al. (2020) identified a positive relationship between pro-environmental behaviour and two forms of contact with nature, recreational visits and exposure of the neighbourhood to natural areas. These results are in line with previous research by Nord et al. (1998), who found that frequency of visits to forest areas and recreational activities in the forest are associated with pro-environmental behaviour. Rosa et al. (2018) highlighted the importance of nature contact during childhood, given its association with greater nature contact during adulthood, which in turn is related to pro-environmental behaviour. Although these studies show a positive relationship between nature contact and different pro-environmental behaviours, many of them in the private sphere (such as recycling or saving energy at home), there is no previous research addressing the possible association between nature contact and domestic water use.

2.3. Method

2.3.1. The fieldwork

Data collection was carried out by passing a questionnaire to 1283 students from different disciplines at the University of Granada, Spain, during the months of March and April 2019. A research team visited classrooms and provided students with the questionnaire, which was accessible online via Qualtrics. Students did not receive any payment for filling in the questionnaire. Before analysis, observations with missing and nonsense

[2] There are discrepancies in the literature regarding both the definition of nature and the forms of interaction considered (Gaston & Soga, 2020). In this vein, Keniger et al., (2013) consider three types of interactions, depending on whether the contact is intentional, the result of another activity, or occurs without the person being physically present in nature (e.g. through pictures or documentaries). In this research, we focus on the two first types.

values for the variables of interest were removed, leaving a homogeneous sample of 874 observations.

The sample we use in this research is therefore a selected sample. The University of Granada was chosen because the composition of its student body is very representative of the Andalusian population in the 18-30 age range (University of Granada, 2018). There are 1,129,505 Andalusians between the ages of 18 and 30. To ensure representativeness, with a margin of error of 5% and a significance level of 95%, we would need a sample of at least 385 people. University studies in the region of Andalusia are virtually free, as a discount of 99% is applied. There are also grants for people in low-income households.

Even though the sample is more than twice the size required to be representative, ideally we would have had a nationally representative sample to take into consideration different strata of society. Having a sample of students is somewhat less than ideal for addressing the research objectives, but on the other hand, we believe it has allowed us to provide evidence on a novel subject. Young people are especially important, as the United Nations calls for this age group in particular to contribute to the implementation of the Sustainable Development Goals (United Nations, 2015).

2.3.2. Variables

Water use. We assessed individuals' use of water in the home in relation to five different habits. Specifically, we asked them: “do you collect the water in the shower while you wait for it to come out hot (put a bucket in the shower to catch the cold water that comes out first)?” (*shower*), “do you defrost your food in advance to avoid defrosting it under the tap?” (*food treatment*), “do you wait until the dishwasher and washing machine are full to run them?” (*appliances*), “do you close the stopcock a little to reduce the flow rate of the taps?” (*use of taps*), and “do you turn off the tap while brushing your teeth?” (*dental hygiene*). Individuals responded no (1), sometimes (2) or yes (3). These five variables allow us to take into account various dimensions of water use in the household. We thus intend to cover water use behaviour at different points in a standard household with no garden.

Connectedness to nature. We capture connectedness to nature through the connectedness to nature scale (CNS, Mayer & Frantz, 2004; Mayer et al., 2009). CNS is a well-established measure that assesses individual's affective, experiential connection to nature through 14 items, such as “I often feel a sense of oneness with the natural world around

me" or "I think of the natural world as a community to which I belong". Participants responded to these items on a 5-point Likert scale, with 1 being "strongly disagree" and 5 being "strongly agree". CNS was calculated as the mean of all items, with reverse scoring where appropriate, so that higher scores denote greater connectedness to nature.

Nature contact. We measured nature contact by asking the question "how many times a month do you usually spend time in nature?" Individuals responded on a 7-point Likert scale, with 1 being "never", 2 "less than once a month", 3 "once a month", 4 "several times a month", 5 "once a week", 6 "several times a week", and 7 "every day".

Sociodemographic variables. We included questions on participants' income, age, gender, marital status and occupational status. Individuals indicated their parents' monthly income by selecting one of eight response intervals, with the lowest category being less than €499 and the highest category being €5000 or more. We estimated the income of each category using the midpoint of the interval (except for the top category which we estimated at €6000), and calculated per capita income by dividing by the number of people living in the household. In the analyses we include the natural logarithm of per capita income, age in years and three dummy variables respectively indicating whether the individual is female, single and working, or otherwise.

2.3.3. Hypotheses and method of analysis

As summarised in the literature review, the effects that connectedness to and contact with nature may have on how an individual uses water in the household remain largely unexplored. However, previous research suggests that those components of humans' relationship with nature are linked to more sustainable behaviour in general. Therefore, we draw inspiration from the related literature to formulate our hypotheses, considering water saving as a specific pro-environmental behaviour. We hypothesise that greater connectedness to nature (H1) and greater nature contact (H2) are generally related to more efficient residential water use. In other words, we expect that those people who feel more interconnected with the natural world and spend more time in natural areas will consume less water in their daily practices. However, the relationship that each type of water use may have with nature contact and connectedness may be different. We cannot propose a more detailed hypothesis on this relationship as it remains unexplored in the literature.

To explore the role of connectedness to nature and nature contact in household water use, we use ordered probit regressions with standard errors robust to heteroskedasticity. This

method is especially appropriate when the dependent variables are ordinal and qualitative, as in our case. We specified different models, incorporating the five water uses mentioned above as dependent variables. In all models we incorporated connectedness to nature and nature contact as potential predictors, in addition to sociodemographic variables. Analyses were performed using Stata15 statistical software.

2.4. Results

As an introduction to the analysis of the associations between people's relationship with nature and water use in the household, we show the descriptive statistics of the variables included in the study. As shown in Table 2.1, the most common water-saving habit is turning off the tap while brushing teeth, while the least common is collecting water from the shower while waiting for the hot water to come out. As for the profile of the study participants, the average age is 20, 62% of the individuals are female, 63% are single and 26% are working as well as studying.

Table 2.1. Descriptive statistics of the variables employed in the analysis.

	Mean/%	Std. Dev.	Min	Max
Water use				
Shower	1.293	0.610	1	3
Food treatment	2.779	0.523	1	3
Appliances	2.843	0.480	1	3
Use of taps	1.867	0.921	1	3
Dental hygiene	2.897	0.378	1	3
Relationship with nature				
Connectedness to nature	3.327	0.637	1.36	5
Nature contact	3.717	1.359	1	7
Sociodemographic variables				
Income	6.184	0.783	3.22	8.7
Age	20.753	3.128	18	59
Female	62%		0	1
Single	63%		0	1
Work	26%		0	1

Table 2.2 shows the results of the five ordered probit regressions. The chi-squared test of overall significance indicates that the models are significant, with all p-values below 0.05 except for the "Appliances" model. Since the ordered probit coefficients cannot be interpreted directly, Figures 2.1 and 2.2 shown below depict the marginal probabilities for the variables of connectedness to and contact with nature respectively. In this way, we can observe the contribution of each of these predictors to the value of the dependent variable. We describe below the results for each water use under study based on the results in Table 2.2 and Figures 2.1 and 2.2. The focus of this research is on connectedness to nature and nature contact, therefore most of our interpretations are centred on these variables. Nevertheless, we also provide some interpretation of the control variables, which may be of interest for future research focusing on those variables.

Table 2.2. Ordered probit regression models predicting five water-conserving habits.

	Shower	Food treatment	Appliances	Use of taps	Dental hygiene
Connectedness to nature	0.141*	0.133*	0.116	0.012	0.298***
	(0.0828)	(0.0788)	(0.0869)	(0.0675)	(0.0989)
Nature contact	0.0626*	0.0217	0.0072	0.111***	-0.0177
	(0.0373)	(0.0392)	(0.0454)	(0.0320)	(0.0461)
Income	-0.0824	-0.206***	0.0622	-0.110**	-0.0297
	(0.0596)	(0.0705)	(0.0712)	(0.0529)	(0.0884)
Age	0.0254*	-0.00453	0.0233	0.0257**	-0.0410**
	(0.0136)	(0.0156)	(0.0224)	(0.0125)	(0.0160)
Female	-0.0195	0.250**	0.205*	-0.113	0.340***
	(0.101)	(0.105)	(0.120)	(0.0873)	(0.131)
Single	0.008	-0.114	-0.0744	-0.0432	-0.0459
	(0.0987)	(0.107)	(0.1190)	(0.0856)	(0.128)
Work	0.0807	-0.129	-0.00406	0.0755	0.0859
	(0.111)	(0.122)	(0.130)	(0.0971)	(0.148)
/cut1	1.554***	-2.491***	-0.313	0.222	-1.945**
	(0.554)	(0.633)	(0.706)	(0.498)	(0.769)
/cut2	2.150***	-1.777***	0.103	0.576	-1.386*
	(0.558)	(0.632)	(0.710)	(0.498)	(0.764)
N	874	874	874	874	874
Pseudo-R^2	0.016	0.028	0.011	0.017	0.041
χ^2	19.47	26.32	9.52	29.88	25.41

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

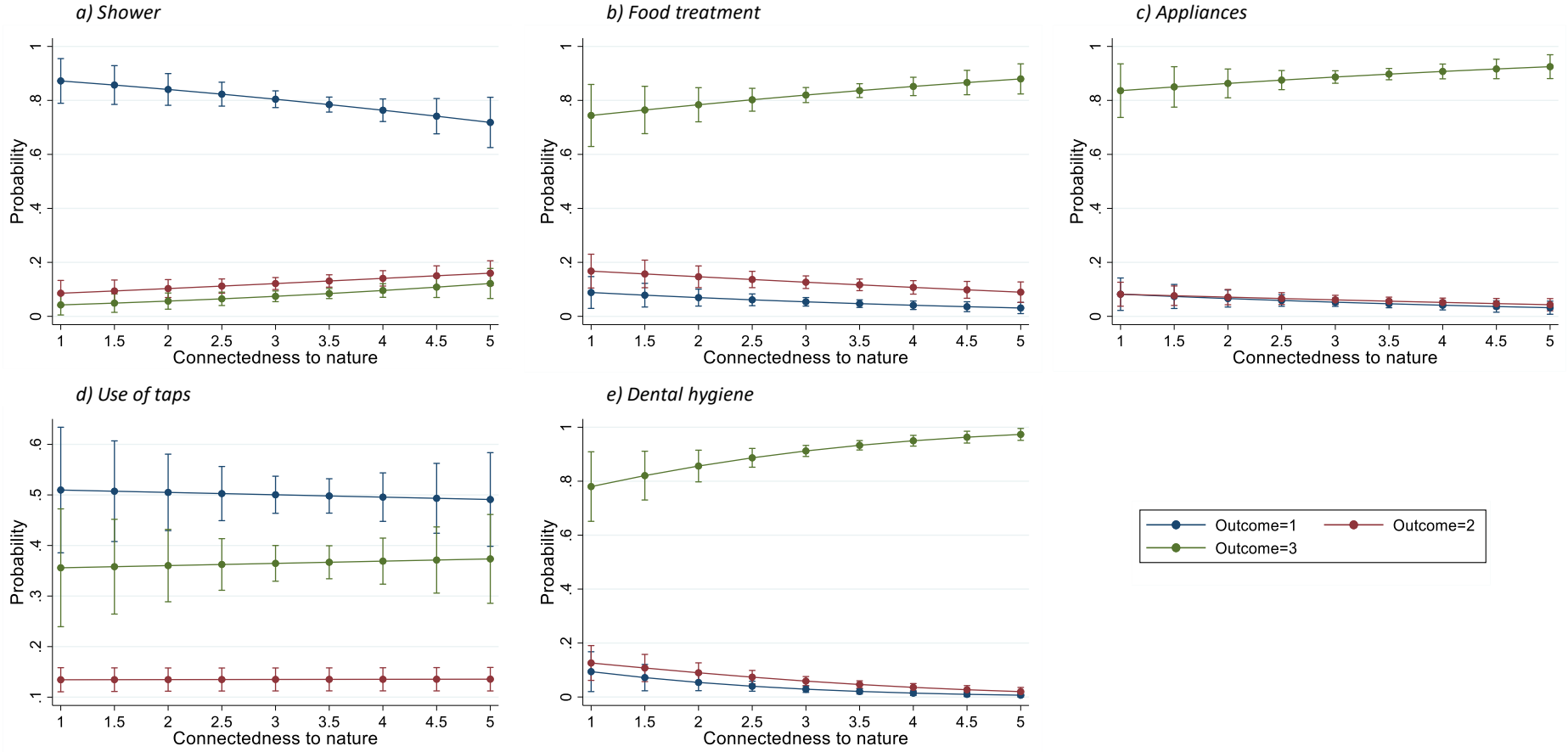
Shower. More efficient use of shower water is positively related to connectedness to nature ($b = 0.141$, $p < 0.1$) and nature contact ($b = 0.0626$, $p < 0.1$). As the feeling of connectedness and frequency of visits to natural environments increases, the likelihood of collecting the shower water while waiting for it to come out hot (either always or sometimes) increases (see Figures 2.1a and 2.2a). Age is also positively related to this habit.

Food treatment. Better use of water for preparing food is positively related to connectedness to nature ($b = 0.133$, $p < 0.1$), but not with nature contact. Higher levels of connectedness increase the likelihood of regularly defrosting food in advance to avoid having to do it under the tap (Figure 2.1b). On the other hand, when connectedness to nature increases, the probability of doing this action decreases in the "sometimes" and "never" options. Regarding sociodemographic variables, income level is negatively related to this behaviour, while being a woman is positively associated.

Appliances. Efficient use of water-using appliances is not associated with either connectedness to nature or with nature contact. Only the *female* variable is a significant predictor of this habit. As mentioned above, this model is not significant overall.

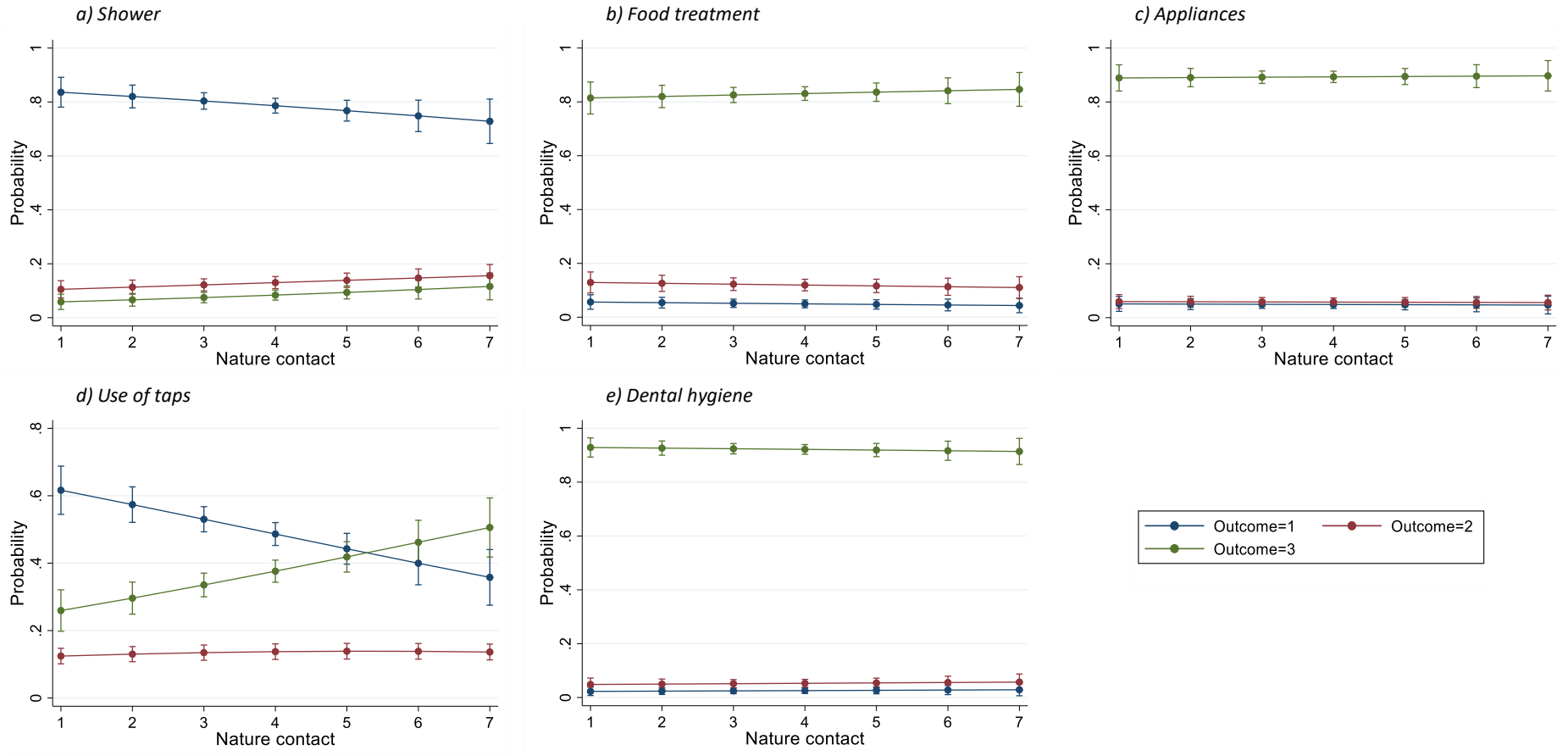
Use of taps. Using taps efficiently is positively related to spending time in nature ($b = 0.111$, $p < 0.01$), but is not associated with nature connectedness. Making frequent visits to natural environments increases the likelihood of regulating tap flow to consume less water, and reduces the likelihood of not doing so. It is worth highlighting that the slope of the marginal probabilities of "always" and "never" are the highest of all estimations in absolute value, suggesting that visiting nature has high importance. However, the probability of "sometimes" doing so remains constant for the different levels of nature contact (Figure 2.2d). Apart from the nature variables, we find that this habit is negatively associated with income and positively associated with age.

Dental hygiene. Turning off the tap while brushing teeth is positively related to connectedness to nature ($b = 0.298$, $p < 0.01$). For higher values of connectedness to nature, the probability of having this habit increases to maximum levels, while the probability of not turning off the tap or only sometimes doing so is practically zero (Figures 2.1e). Furthermore, being a woman is a factor that is positively related to this practice, while age is negatively associated.



Note: *Shower*: do you collect the water in the shower while you wait for it to come out hot (put a bucket to catch the cold water that comes out first)? *Food treatment*: do you defrost your food in advance to avoid defrosting it under the tap? *Appliances*: do you wait until the dishwasher and washing machine are full to run them? *Use of taps*: do you close the stopcock a little to reduce the flow rate of the taps? *Dental hygiene*: do you turn off the tap while brushing your teeth? Outcome 1=never, outcome 2=sometimes, outcome 3= always.

Figure 2.1. Predictive margins and 95% Confidence Intervals for water conservation behaviours as a function of connectedness to nature.



Note: *Shower*: do you collect the water in the shower while you wait for it to come out hot (put a bucket to catch the cold water that comes out first)? *Food treatment*: do you defrost your food in advance to avoid defrosting it under the tap? *Appliances*: do you wait until the dishwasher and washing machine are full to run them? *Use of taps*: do you close the stopcock a little to reduce the flow rate of the taps? *Dental hygiene*: do you turn off the tap while brushing your teeth? Outcome 1=never, outcome 2=sometimes, outcome 3= always.

Figure 2.2. Predictive margins and 95% Confidence Intervals for water conservation behaviours as a function of nature contact.

2.5. Discussion, policy implications, limitations, and further research

Demand-side water management is essential to ensure the availability of water resources. In this regard, part of the research on the demand for water has focused on identifying the determinants of household water consumption. The present study extends this research by exploring the role of connectedness to nature and nature contact in five different household water uses.

Our results suggest that a closer relationship with nature, i.e., frequently visiting natural environments and feeling connected to the natural world, is positively or non-significantly associated with more efficient domestic water uses. These findings are consistent with previous, more general studies that found a positive relationship (and in a few cases a non-significant relationship) between nature connectedness and contact and environmental engagement (e.g. Alcock et al., 2020; Martin et al., 2020; Mayer & Frantz, 2004). Although both aspects of the relationship with nature are associated with the adoption of pro-environmental water use behaviours, there are some differences between them. Connectedness to nature is related to the efficient use of water in the shower, in food treatment and during tooth brushing, while visits to nature are related to better use of water in the shower and more efficient use of taps. Therefore, efficient use of water in the shower is the only area of household water consumption that is associated with both factors, connectedness to nature and nature contact. In contrast, the efficient use of household appliances is not related to either of these factors. The fact that some water consumption behaviours are more influenced by the relationship with nature than others supports Stern's (2000) assertion that different types of private sphere behaviour may have different determinants.

There is evidence that stated water conservation habits are a good predictor of actual water conservation (Fielding et al., 2012). Given that some water uses account for a large proportion of total consumption, changing consumption habits could mean considerable water savings. For example, studies show that showering accounts for approximately one third of total per capita household water consumption (Willis et al., 2011, 2013), so making better use of water in this area would lead to substantial savings.

Our results emphasise the importance of the link with nature in increasing people’s propensity to adopt sustainable water consumption behaviours. This potential of nature

connectedness and contact to change water use patterns should be taken into consideration in the design of water conservation campaigns. A good strategy could be to design interventions that strengthen individuals' relationship with nature by reinforcing their feeling of connectedness to nature and increasing their exposure to natural environments.

The results suggest that connectedness with nature should be enhanced by attempting to reorient the anthropocentric vision prevalent in education (Kopnina, 2014; Ross, 2020). As Martusewicz et al. (2014) argue, responsible pedagogy can contribute to the creation of sustainable communities. The appropriate education can influence environmental knowledge, attitudes, values and even behavioural patterns, making it an important tool for social change (Chawla & Cushing, 2007; Kopnina, 2012; Quinn et al., 2016). Ecocentric education programmes place the emphasis on humans as part of nature, and typically promote a sense of connection with nature (Barrable, 2019; Nakamura et al., 2019). Previous research has shown that people who claim to have a more ecocentric view demonstrate more pro-environmental behaviours (Casey & Scott, 2006). Taking a cross-cutting approach focused not just on science subjects, content could be included that would help students to develop an ecocentric view of the world around them (McClanahan, 2013). In history, for example, content could be introduced that delves into the environment in which historical events took place and offers an understanding of people's relationship with nature. In subjects such as languages and mathematics, the activities to be carried out by the student could include examples and readings that help to reinforce the ecocentric view. In addition, school curricula should include trips out into nature and greenspaces should be created near schools (Stokoe, 2019). As noted by Quinn et al. (2016), contact with nature should be a key component of education to facilitate the development of pro-environmental views and behaviours. One option would be to incorporate a new subject of connection to the environment in school curricula, along with regular trips to nearby natural spaces in which to explain and explore aspects related to the geology, vegetation, fauna and physical and chemical processes of the surrounding area.

Finally, one limitation of our study should be noted: Our sample is composed only by students, mostly young people. Future studies could explore whether the associations found in this research hold for individuals with a different profile, since there is evidence that the factors influencing water use in the household may vary between different

demographic groups (Yu et al., 2015). Therefore, it is not possible to generalize our results to other situations, requiring further research to do so.

In addition, future studies should further investigate the scope and intensity of measures aimed at promoting pro-environmental behaviour and, more specifically, the efficient and sustainable use of water. That is, there are studies that limit the impact of environmental awareness campaigns to a few months and sometimes question the intensity of the effects. It would be interesting to know whether measures aimed at enhancing connection and contact with nature are more far-reaching in terms of time and intensity. Concerning variable design, improving the indicators relating to human-nature interactions and pro-environmental behaviour would be very worthwhile. Constructing variables that have quantitative outcomes instead of being based on Likert scales would make them easier to interpret and analyse. Also, the extreme cases in some variables, such as an abhorrence of being in the countryside or not doing any pro-environmental actions, may be unrealistic and this could be considered in new indexes to avoid skewing the scales.

2.6. Conclusion

The aim of this study is to explore the influence of connectedness to nature and nature contact on different water uses in the household. Using ordered probit regressions with a sample of Spanish university students, we found that individuals with a greater sense of connectedness to nature are more likely to adopt efficient water use habits in showering, food treatment and dental hygiene, while individuals who visit natural environments frequently are more likely to make efficient use of taps and shower water. Thus, we find a positive association between the relationship with nature and sustainable water use in the household, with the exception of efficient use of household appliances, which is not significantly related to any of the nature variables. The fact that a close relationship with nature can motivate water conservation in different areas of the household highlights the importance of designing interventions that encourage citizens to have direct contact with nature and strengthen their psychological connection with the natural world.

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CHAPTER 3. Towards a sustainable use of shower water: Habits and explanatory factors in southern Spain

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Abstract

One of the targets of Sustainable Development Goal 6 is the efficient use of water resources in all sectors in order to tackle water shortages. In the home, showering is one of the main water consuming activities. How can people make more sustainable use of shower water? To answer this question, this research analyses showering habits and explanatory factors of shower use. The study is carried out with data from 945 students of the University of Granada, Spain. Significant differences are observed in shower use during the summer and winter months: the average duration is 8.8 and 11.6 minutes, respectively, and the frequency is greater in summer (with an average frequency of eight showers per week). Determinants of different shower water use include gender, ideology, pro-environmental actions, inherent values, and connectedness to nature, among others. Those variables relate differently to duration and frequency of showers, according to the season, thus highlighting the importance of seasonality. The results show that there is room to achieve a more sustainable use of the shower, in terms of frequency and duration, through awareness measures that are tailored to groups that make a less sustainable use of showers. The main recommendation is that awareness campaigns should be designed on the basis of the user profile as well as the season.

Keywords: water consumption; showers; pro-environmental actions; water efficiency.

3.1. Introduction

It is estimated that 53 countries have severe levels of water stress (United Nations, 2018). In addition, around four billion people suffer from severe water scarcity for at least one month a year (Mekonnen and Hoekstra, 2016). Due to climate change, the situation is expected to worsen, with already dry regions becoming even drier (United Nations, 2019). Consequently, UN sustainable agenda (SDGs) sets a variety of targets to address water scarcity in several ways. Among the targets, SDG 6 aims to achieve a more efficient use of water resources in all sectors, whereas SDG 12 pursues a sustainable management and efficient use of natural resources, including water (United Nations, 2015).

Looking at the different end-uses of residential water, there is significant potential for water savings in personal hygiene (Makki et al., 2013; Wong et al., 2019). Shower/bath end-use consumption often represents the highest share of indoor demand in residential households, accounting for between 25% to 40% of the total (Mazzoni et al., 2022). This has been shown in the case of Australia (Willis et al., 2013; Makki et al., 2015), the United States (Water Research Foundation 2016), the United Kingdom (Energy Saving Trust, 2015), the Netherlands (Vewin, 2012), Spain (Domene and Saurí, 2006), Portugal (Vieira et al., 2018) and Brazil (Marinoski et al., 2014).

Regarding personal hygiene habits, showering is the most widespread practice. Using a representative sample of ten OECD countries, Grafton et al. (2011) found that 85% of respondents tended to take showers rather than baths. In the report on water consumption in English households by Pullinger et al. (2013), 50% of respondents reported never taking a bath, while only 17% reported never taking a shower. In just one generation, there has been a shift from weekly bathing to daily or twice-daily showering (Hand et al., 2005; Shove and Walker, 2010). Although showering is generally seen as a more sustainable use of water resources, the adoption of daily showering as a regular practice may result in more water consumption than was originally consumed by (less than daily) bathing (Critchley and Phipps, 2007). On average, the water consumed in two or three showers can be equivalent to that of one bath (United States Environmental Protection Agency, 2017), although consumption could be higher in the case of long showers without an efficient showerhead (González-Gómez et al., 2022).

Water consumption in the shower is determined by technology and individual behaviour. The use of efficient showerheads allows massive water savings (Sadi et al., 2022; Watson,

2017). However, efficient technologies do not always achieve the expected savings, as their use can serve to justify a greater resource use, leading to a rebound effect (Freire-González, 2019). Given the importance of individual habits in resource conservation, there is a clear need to promote more sustainable showering behaviour.

Much research has been conducted focusing on household water end-uses (for a review see Koop et al., 2019; Roshan and Kumar, 2020). Additionally, several studies look at the determinants of these uses, mainly emphasizing demographic and environmental factors (Willis et al., 2013; Makki et al., 2015; Vieira et al., 2018). However, there are fewer studies that specifically analyse personal habits and behaviour in the shower (see Gram-Hanssen, 2007; Gram-Hanssen et al., 2020; Makki et al., 2013; Ableitner et al., 2016; Hannibal et al., 2019). Although these studies provide valuable insight into showering behaviour patterns, they often do not consider different aspects of showering habits (e.g., Hannibal et al., 2019), or the set of explanatory factors they consider is limited, usually restricted to socio-demographic characteristics (e.g., Makki et al., 2013). In this regard, Ableitner et al. (2016) pointed to the need for future research to identify new factors that may further explain showering behaviour. A more comprehensive study of shower patterns is therefore lacking in the literature.

This study aims to analyse different facets of showering behaviour and investigate the various factors that may determine it, in order to identify whether a more sustainable use of showers is possible and to provide useful information for the design of policies. Specifically, it analyses the behaviour of university students in southern Spain, an area suffering from high water stress. This population segment is of particular interest for water conservation in the context of personal hygiene. Previous research has indicated that young adults tend to use more water in the shower and are also reluctant to change their habits (Stanes et al., 2015; Lindsay and Supski, 2017). Efforts need to be made to understand their behaviour and the factors that influence it in order to develop successful messages and actions that promote water conservation.

With respect to previous research, several contributions are made. Firstly, this study delves further into showering habits by considering the duration and frequency of showering differentiated for the summer and winter months. This seasonal distinction was included because changes in weather tend to influence users' showering behaviour (Rathnayaka et al., 2015, 2017; Smit and de Bruyn, 2022). Secondly, this research extends

the evidence on the determinants of shower use by including, in addition to socioeconomic characteristics, environmental and psychological variables that had not been considered before. Thirdly, this is the first research to analyse determinants of shower water end-use in Spain. Consumer behaviour may differ both within and between countries (Shahmohammadi et al., 2019). Thus, regional analysis is needed to pinpoint potential savings in showering and to design more effective targeted conservation campaigns that consider region-specific water use patterns.

3.2. Literature review

A review of factors that might explain individuals' behaviour regarding shower frequency and duration is presented below. It mainly addresses water consumption in the shower, which is the main topic of the research. However, general household water use is also considered because it can be useful for gaining a better understanding of the dynamics underlying the sustainable use of water in the shower.

3.2.1. Socioeconomic factors

The water conservation literature has traditionally focused on a set of socioeconomic factors, such as gender, age, income, family status, occupation, relationships, or ideology. It is generally held that young people and women take more care of their grooming (Shan et al., 2015). Watson (2017) reported that young women see a daily shower as crucial to start the day. Older people tend to exhibit more water-saving behaviours, which may be due to past life experiences, housing ownership or different lifestyles (Gilg and Barr, 2006). Makki et al. (2013) found that females, children and teenagers were related to greater shower water consumption. Ableitner et al. (2016) also found that young people used more water for showering.

Education level may also be a predictor of water use, although the evidence is ambiguous. For other household water uses, Gilg and Barr (2006) and Lam (2006) found that households with higher education levels show more intention to conserve water. However, De Oliver (1999) and Gregory and Di Leo (2003) revealed that households with lower education levels engage in more water conservation behaviours. On the contrary, Fielding et al. (2012) found no significance in the relationship between educational level and water saving. For specific water use in the shower, evidence is very scarce, although

there is some research suggesting that educational level is positively correlated with water consumption in the shower (Makki et al., 2013).

The household size may play a role in determining shower water use. Willis et al. (2013) found a decrease in per capita consumption as family size increases. According to Linkola et al. (2013), single-person households register the highest frequency of showering and highest level of shower water consumption. In addition, income seems to have a significant effect on shower water consumption. Previous studies have indicated that per capita consumption rises as household income increases (Willis et al., 2013; Roshan and Kumar, 2020). Makki et al. (2015) showed that well-off households tend to shower more frequently, while lower-income families tend to make more sustainable use of water to reduce their water bill (Hannibal et al., 2019). However, other studies did not find income to be a significant variable (Loh and Coghlan, 2003; Willis et al., 2011).

Gram-Hanssen et al. (2020) identified occupation as a factor that may influence shower routines. In Beal et al. (2012) and Beal and Stewart (2011), higher shower use explains why more water is consumed in dwellings with working residents versus dwellings with retired residents. Being sociable emerges as a key determinant of shower water use. Those who have greater contact and proximity to other people will tend to shower more, as Makki et al. (2013) demonstrated.

Ideology is also considered a predictor of water conservation and pro-environmental behaviours (Liu et al., 2014). According to these authors, political (left) liberals tend to care more about the environment. Using a sample of Americans, Hannibal et al. (2019) found that more conservative people would be less willing to change their habits and take shorter showers in case of drought.

As this section shows, the literature has pointed to a large number of socioeconomic factors as predictors of water use in the shower, although in some cases the evidence is ambiguous. Furthermore, the effect of these factors on frequency and duration of showering, and whether their effect is the same in different seasons, has not been analysed in a differentiated way, so this study aims to provide some evidence by conducting a more in-depth study of showering habits.

3.2.2. Environmental and psychological factors

The research analysing the connection between shower water use and socioeconomic factors is more abundant. There are some studies involving environmental and psychological variables that are not empirically focused on the use of water in the shower, but which can nevertheless offer a better understanding of shower water consumption. People having intrinsic life aspirations rather than extrinsic ones generally tend to behave more pro-environmentally (see Kasser, 2017, for a review). Intrinsic life aspirations are related to personal growth and connection with community, while extrinsic aspirations relate to money, image, and status (Kasser and Ryan, 1996). Being excessively concerned with self-image or status could lead to greater use of beauty and body care products and spending more time than average in the shower.

Other features are related to the environment and psychology, such as people's feeling of connection with nature, which is also positively related to greater pro-environmental behaviour (Mayer and Frantz, 2004; Geng et al., 2015). Previous findings indicate that feeling connected to nature and spending time in nature is associated with adopting pro-environmental water consumption habits (Ibáñez-Rueda et al., 2022). Similarly, Smit and de Bruyn (2022) found in their study that nature-based tourists consume less shower water and shower for shorter compared to the general public.

In general, attitudes towards environmental issues are considered predictors of water conservation behaviour (Willis et al., 2011; Ableitner et al., 2016). However, the relationship is not entirely obvious as, according to the Theory of Planned Behaviour, intentions do not always produce behavioural changes (Ajzen, 2011). Positive attitudes towards water conservation do not necessarily lead to water-saving practices (Jensen, 2008; Dolnicar and Hurlimann, 2015). The dissociation between declared attitudes and sustainable use of water can be explained through individual resistance to the sacrifice associated with putting into practice pro-environmental attitudes (Ananga et al., 2019), or may simply be because behaviour is not always rational and can be guided by automatic routines (Steg and Vlek, 2009).

On the other hand, it is not clear whether people who develop pro-environmental behaviours in other areas also use water sustainably, as there could be a positive or negative spillover effect from pro-environmental behaviour (Maki et al., 2019). Gilg and Barr (2006) provided evidence of the greater probability of water-saving attitudes in

people who are committed to energy conservation, green consumerism and management of domestic waste. In contrast, Geng et al. (2016) found that purchasing green products can undermine commitment to water conservation, due to the phenomenon of moral licensing.

Finally, there is a private component in the act of showering, related to the search for personal wellness (Lupton and Miller, 1992; Quitzau and Røpke, 2009). Showering may be used as a relaxation activity instead of simply for hygiene purposes (Willis et al., 2011). People with depressive tendencies, anxiety or lack of intrinsic motivation may find showering a way to achieve well-being; indeed, Lindsay and Supski (2017) argued that showering has therapeutic value as a tool for calming daily tensions. Cold shower sessions even seem to have anti-depressive effects (Shevchuk, 2008). The search for wellness through showering may be especially common in people who suffer from stress episodes and have very demanding jobs (Quitzau and Røpke, 2008).

To date, there is little empirical evidence on the relationship of water consumption in the shower with the environmental and psychological variables reviewed in this section – namely, one's relationship with nature, pro-environmental performance, life aspirations, and feelings of stress and insecurity – so this study aims to shed some light on this issue.

3.3. Material and methods

3.3.1. Study area and fieldwork

The research uses data from a questionnaire administered to students of the University of Granada. As shown in Figure 3.1, the city of Granada is located in Andalusia, a semi-arid region in southern Spain facing severe water stress (World Resources Institute, 2019). The study area experiences dry summers (National Geographic Institute, 2019), and to cope with water scarcity during this season, certain measures, such as banning specific water uses and restricting supply at specific times, are implemented by municipalities. The year 2019, when the fieldwork was conducted, and the previous year were very warm, with August 2018 being one of the hottest months on record (State Meteorological Agency, 2019). The results of this research have implications for regions with similar conditions to the study area that also grapple with severe water stress. Moreover, southern Spain presents an interesting research scenario because this region is already experiencing

weather events such as prolonged heat waves, which are expected to occur in many other regions as a result of climate change (IPCC, 2021).

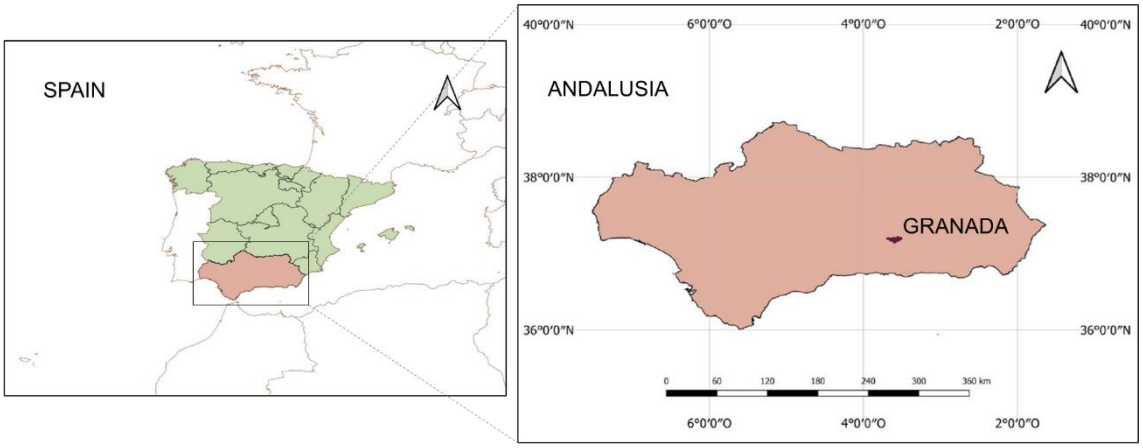

Figure 3.1. Location map of the study area.

The questionnaire was given mostly to young people, who make up the bulk of the student body[3]. According to United Nations General Assembly Resolution 70/1, this age group should play an important role in contributing to the implementation of SDG. Given the forecasts of water scarcity in the comingyears, young people are expected to make the greatest efforts to change their habits to achieve a more sustainable use of water resources. In addition, young adults have been identified as high water users due to lifestyle aspirations and heightened body image concerns (Simpson et al., 2019). Previous research has not only indicated that young people consume more water in the shower but has also established that they are unwilling to limit the length and frequency of their showers (Lindsay and Supski, 2017). On the other hand, it has also been suggested that a higher level of education may be associated with higher water consumption in the shower (Makki et al., 2013). University students are therefore an interesting group to study when it comes to achieving water savings. Moreover, it should be borne in mind that the target segment of this research represents a large group of society: more than half of the Spanish population between 18 and 34 years of age is in or has completed higher education (Ministry of Education and Vocational Training, 2020).

[3] The majority of the sample is made up of students between 18 and 25 years old (95.66%), with only four participants over 35 years old.

The fieldwork was undertaken during the months of March and April 2019. Questionnaires were delivered to 1283 students from different faculties and disciplines. A research team visited classrooms and provided students with the questionnaire, which was accessible online via Qualtrics. By collecting data anonymously and through self-administered questionnaires, potential social desirability biases in self-reported information are limited (Kormos and Gifford, 2014). After deleting 329 missing values, 4 observations because they correspond to people who take baths rather than showers, and 5 observations that were incongruous, the final sample was left with 945 observations.

The sample used in this study is a selected sample chosen by convenience. A variety of faculties were chosen to conduct the survey in order to be representative of a range of disciplines, from the social sciences to the hard sciences. Specifically, students from Political Science, Sociology, Social Work, Education, Economics, Medicine, Environmental Sciences, Computer Science and Engineering participated in the study. The composition of the sample is descriptive of the student body of the University of Granada in terms of age and gender distribution (University of Granada, 2019). Below, Table 3.3 shows the composition of the sample.

3.3.2. Variables and hypotheses

Self-reports were used to determine showering habits, as they are a valid measure of actual behaviour (Kormos and Gifford, 2014). Indeed, previous evidence has shown that self-reported water use is related to actual water consumption (Fielding et al., 2012). The questionnaire contained two key questions: firstly, participants were asked how many showers they took per week; and secondly, how long, in minutes, these showers lasted (for a complete list of questions, see Supplementary Information 3.1 in the appendix). Open-response questions with specified units of measurement allow for more accurate and objective answers about participants' behaviour (Kormos and Gifford, 2014). In both questions, they had to give a separate answer for two different seasons. Four dependent variables were used – *TIME_WINTER, TIME_SUMMER, NUMBER_WINTER,* and *NUMBER_SUMMER* – because climatic differences throughout the year can be a determining factor in water use, especially in shower duration and frequency (Rathnayaka et al., 2015; 2017).

A number of variables were employed to determine the shower habits profile of each participant. These variables were categorized into three groups: socioeconomic,

psychological and environmental/psychological. A comprehensive list of the variables used, along with an explanation of the indices' construction, is presented below. In addition, Table 3.1 describes the variables and includes a column with the direction of the expected effect of each variable on the dependent variables. The same direction was expected for all dependent variables, although with different degrees of strength. Due to the lack of evidence from previous research, it is not possible to predict the strength of these relationships. Information on the justification for the hypotheses can be found in the literature review, although some hypotheses are novel, as to the authors' knowledge there is no previous empirical evidence relating some of the variables with shower water use. Whenever this is the case, an asterisk marks the expected direction, which is based on literature on water use in general, or the intuition of the authors.

The variables shown in Table 3.1 are self-explanatory, except for some indexes that require additional explanation. The aspiration index (*ASPIRATIONS)* comprises a set of 14 questions on personal goals (Kasser and Ryan, 1996). Using a 5-point Likert scale (from strongly disagree to strongly agree), respondents indicated their opinions on the importance of extrinsic goals, related to fame, wealth and image (e.g., "having fashionable clothes and hair") and intrinsic goals, related to personal growth, affiliation and community involvement (e.g., "helping to make the world a better place") (Kasser and Ryan, 1996). The aspiration index was calculated by subtracting the average score for the extrinsic goal questions from the average score for the intrinsic ones.

The variable *PEBS_WATER* is an index that captures how efficiently respondents use water outside the shower. They answered questions such as "do you turn off the tap while you're brushing your teeth?". The possible answers were yes, sometimes, or no. An index was constructed by averaging the response to seven questions of this kind. The index *PEBS* is an indicator comprising 16 pro-environmental behaviours that do not involve direct use of water, such as "separating the garbage (e.g. paper, plastic, glass)". Individuals rated them using a 5-point Likert scale from never to always.

The last index included is the connectedness to nature scale (Mayer and Frantz, 2004), which comprises 14 items such as "I often feel part of the web of life". People replied to the items with a 5-point Likert scale, from strongly disagree to strongly agree. The connectedness to nature scale was calculated by averaging the score of all items (*CONNECTNAT)*.

Table 3.1. Description of the independent variables and their expected effect on the dependent variables.

Variable	Description	Hypotheses
Socieconomics		
GENDER	Equals 1 if the respondent is female	+
AGE	Years as specified by respondents	-
IDEOLOGY	Political orientation. (1 to 10: 1 is extreme left – 10 is extreme right)	+
HOUSEHOLD	Number of members of the household	-
INCOME	Natural logarithm of household income per capita	+
SINGLE	Equals 1 if the individual is not in a stable relationship	+
WORK	Equals 1 if the respondent works, besides studying	+
REL_FRIENDS	Frequency in touch with friends (1 to 5: 1 never -5 every day or almost every day)	+
REL_RELATIVES	Frequency in touch with relatives (1 to 5: 1 never -5 every day or almost every day)	+
Psychological		
ANXIOUS	Degree to which the respondent feels anxious (1 to 5: 1 nothing or very slightly, and 5 extremely)	+*
INSECURE	Degree to which the respondent feels insecure (1 to 5: 1 nothing or very slightly, and 5 extremely)	+*
Environmental/Psychological		
ASPIRATIONS	Index capturing the intrinsic-extrinsic nature of goals (explanation in the text)	-*
CONTROLTIME	Degree of control of the time spent in the shower (0 no control, 1 sometimes control, 2 control very often)	-*
PEBS_WATER	Indicator of water efficiency (explanation in the text)	-*
PEBS	Indicator of pro-environmental behaviours (explanation in the text).	-*
FREQNAT	Frequency on visiting nature (1 never, 2 less than once a month, 3 once a month, 4 many times a month, 5 once a week, 6 many times a week, 7 everyday)	-*
CONNECTNAT	Indicator on nature connectedness (explanation in the text)	-*
STUDYENV	Equals 1 if the respondent studies Environmental Sciences	-*

An * indicates that there is no previous evidence on the relationship of this variable with water shower use, and the hypothesis is based on water use in general or the intuition of the authors.

3.3.3. Empirical strategy

The analysis of the data was carried out in two stages. The first stage analysed respondents' shower habits, distinguishing between frequency and shower duration. Besides, differences between summer and winter months were examined. This stage was an eminently descriptive analysis, focusing on the dependent variables.

In a second stage, estimations were performed using Ordinary Least Squares (OLS) to test the expected relationships between the dependent variables and the set of independent variables listed in Table 3.1. The application of OLS to estimate the regression coefficients is an appropriate choice because the dependent variables are quantitative and

can be treated as continuous. Estimations were performed with errors robust to heteroskedasticity. The estimated model can be summarized as follows:

$$DEPENDENT_j = \alpha + \beta_1 S_i + \beta_2 P_i + \beta_3 EP_i + \varepsilon_i$$

where $DEPENDENT_j$ takes four different values (j=1,…,4) for the frequency of showers per week and the average duration of the shower, in both summer and winter, by individual i ($i = 1,...,945$). S_i is the set of socioeconomic variables, P_i represents a set of variables of individual i's psychological characteristics, and EP_i is the set of environmental/psychological variables. Finally, ε_i is the error term. Four models were estimated, one for each dependent variable. Additionally, models were replicated in the presence of correlation among the independent variables, in order to check whether this correlation conditioned the significance of the coefficients. The analysis was carried out using Stata15 software.

Figure 3.2 illustrates the main points of the methodology used to develop the present study, from the design of the questionnaire to the analysis of the data.

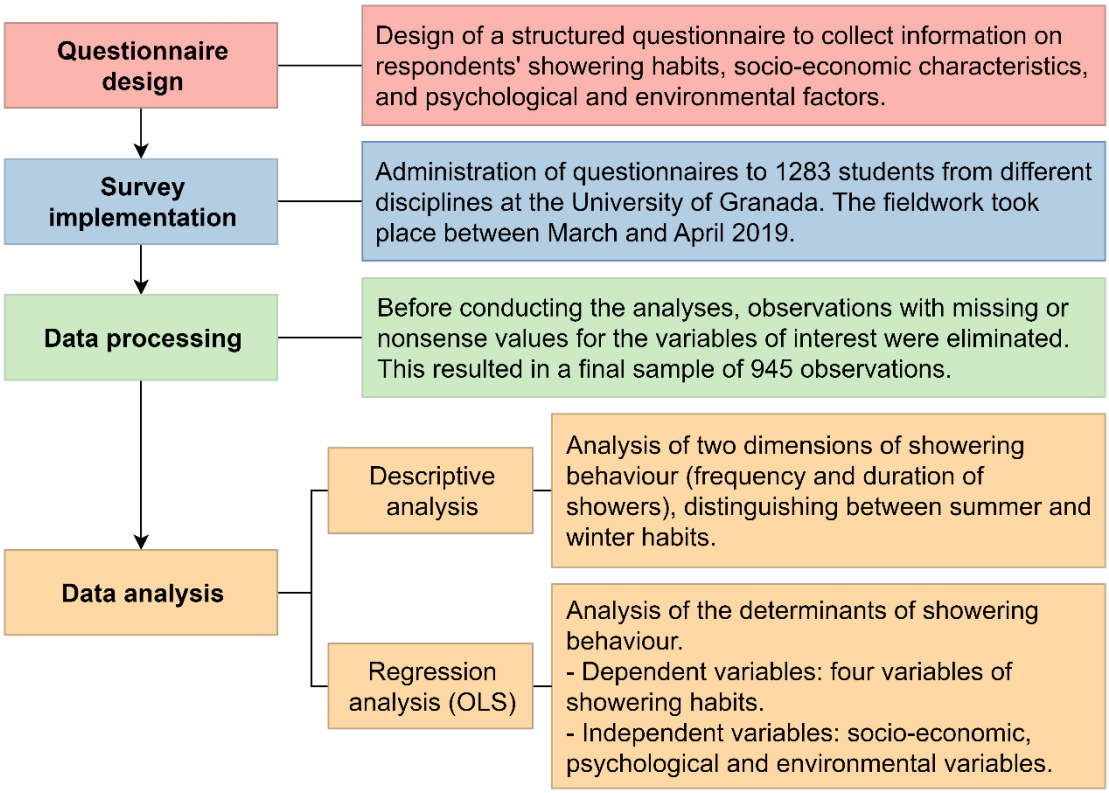

Figure 3.2. Flowchart of the study methodology.

3.4. Results

3.4.1. Habits related to shower use

Table 3.2 indicates that time spent in the shower in summer and winter is positively correlated, according to a Pearson test (significant at 1%). The findings are analogous for the number of weekly showers in both seasons. However, the correlation is not perfect (0.762 for time and 0.650 for number), pointing to seasonal differences. Furthermore, the correlation between duration and number of showers within or between seasons is negligible. This suggests that a greater (smaller) number of showers may not translate into more (less) time spent in showers.

Table 3.2. Correlation matrix of time and number of showers.

	TIME_SUMMER	*TIME_WINTER*	*NUMBER_SUMMER*	*NUMBER_WINTER*
TIME_SUMMER	1			
TIME_WINTER	0.762	1		
	(0.000)			
NUMBER_SUMMER	0.065	0.066	1	
	(0.047)	(0.042)		
NUMBER_WINTER	0.059	0.045	0.650	1
	(0.069)	(0.167)	(0.000)	

p-values between brackets.

Regarding showering habits, on average, people in the sample shower around once per day (see Table 3.3 below for descriptive statistics). With regard to seasonal differences, the average shower frequency is slightly higher in summer. A t-test indicates that those differences are significant (t= 22.67, p=0.000); the histograms and Kernel density of the shower frequency are shown in Figure 3.3.

The average shower duration is 11.6 minutes in winter and 8.8 minutes in summer. A test for equality of means indicates that the seasonal means are statistically different (t= 20.76, p=0.000). Figure 3.4 depicts the kernel density of the time spent showering in summer and winter. To gain a better understanding of this variable, Figure 3.5 shows the time respondents spend showering, distinguishing by season, grouping the times in 5-minute intervals. According to this figure, it is more common to spend over 20 minutes in the shower in winter than in summer.

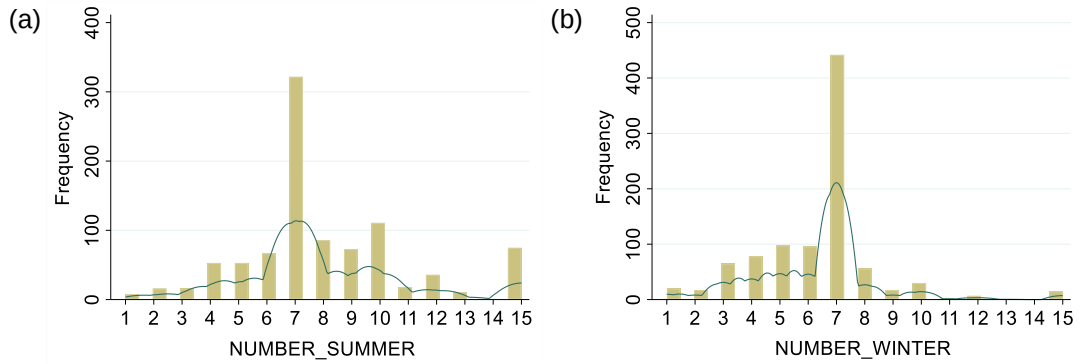

Figure 3.3. Histogram of number of showers per week, in summer (a) and winter (b).

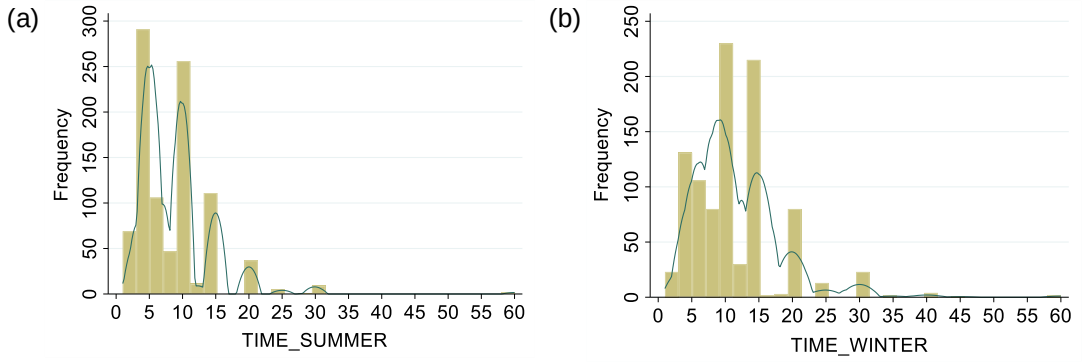

Figure 3.4. Histogram of time per shower (in minutes), in summer (a) and winter (b).

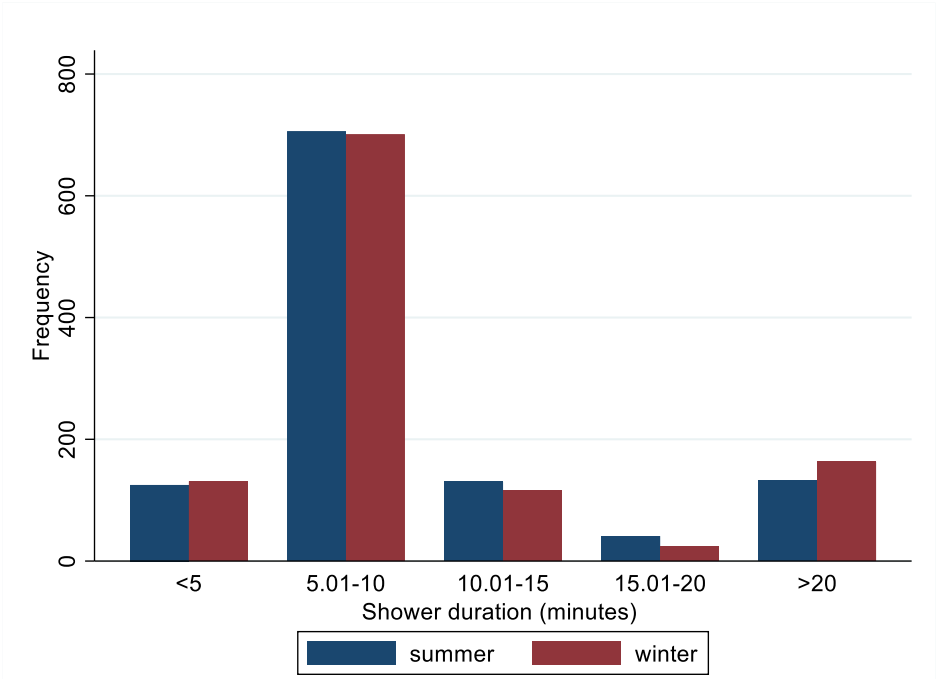

Figure 3.5. Time in the shower grouped in 5-minute intervals, in summer and winter.

3.4.2. Determinants of shower frequency and duration

Descriptive statistics of the dependent and independent variables are presented in Table 3.3. Around 60% of the sample are female students, the average age is 20 years old, the average household size is 3.5, and about 25% work in addition to studying. Only 2% of the sample study environmental sciences.

Table 3.3. Descriptive statistics of the study variables.

Variable	Mean / %	Std. Dev.	Min	Max
Socieconomics				
TIME_SUMMER	8.806	5.462	1	60
TIME_WINTER	11.690	6.556	1	60
NUMBER_SUMMER	8.015	2.999	1	15
NUMBER_WINTER	6.325	2.197	1	15
GENDER	0.620		0	1
AGE	20.692	2.870	18	54
IDEOLOGY	4.385	1.856	1	10
HOUSEHOLD	3.507	1.227	1	10
INCOME	6.211	0.776	3.219	8.294
SINGLE	0.639		0	1
WORK	0.251		0	1
REL_FRIENDS	4.307	0.819	1	5
REL_RELATIVES	3.260	1.034	1	5
Psychological				
ANXIOUS	3.051	1.236	1	5
INSECURE	2.602	1.263	1	5
Environmental/ Psychological				
ASPIRATIONS	17.80	5.094	-2	33
CONTROLTIME	1.329	0.788	0	2
PEBS_WATER	1.278	0.332	0	2
PEBS	2.927	0.644	1	4.867
FREQNAT	3.749	1.373	1	7
CONNECTNAT	3.326	0.646	1.357	5
STUDYENV	0.020		0	1

Table 3.4 shows the correlations between the environmental variables and the aspiration index, which are found in the literature to be positively associated with pro-environmental orientation (see section 3.2. Literature review). A positive relationship is observed for all variables, suggesting that the key independent variables are quite interrelated, although they conceptually measure different phenomena.

Table 3.4. Correlation matrix of key environmental and psychological variables.

	ASPIRATIONS	*CONTROLTIME*	*PEBS_WATER*	*PEBS*	*FREQNAT*	*CONNECTNAT*	*STUDYENV*
ASPIRATIONS	1						
CONTROLTIME	0.200	1					
	(0.000)						
PEBS_WATER	0.215	0.319	1				
	(0.000)	(0.000)					
PEBS	0.313	0.244	0.384	1			
	(0.000)	(0.000)	(0.000)				
FREQNAT	0.127	0.111	0.169	0.227	1		
	(0.000)	(0.001)	(0.000)	(0.000)			
CONNECTNAT	0.384	0.188	0.211	0.336	0.282	1	
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		
STUDYENV	0.058	0.074	0.122	0.158	0.087	0.105	1
	(0.078)	(0.023)	(0.000)	(0.000)	(0.008)	(0.001)	

p-values between brackets.

The results of the estimations are shown in Table 3.5 for the time spent in the shower and in Table 3.6 for the number of weekly showers. The high correlations presented in Table 3.4 may condition the results, as there could be a problem of multicollinearity. Even though the variance inflation factor results suggest this is not the case (the highest value is 1.43 for pro-environmental behaviour), alternative models are estimated in which the variables from Table 3.4 are isolated. By isolating those variables, some of the variables that were not significant in the full model become significant (Tables 3.5 and 3.6 only present those models that show a change in the significance of the variable with respect to the full model).

Table 3.5. Estimations for time spent in showers in summer and winter.

	Summer			Winter			
	(1)	(2)	(3)	(1)	(2)	(3)	(4)
GENDER	1.309***	1.231***	1.231***	2.899***	2.935***	2.888***	2.721***
	(0.400)	(0.380)	(0.399)	(0.408)	(0.415)	(0.420)	(0.417)
AGE	-0.0309	-0.0406	-0.0298	-0.168***	-0.164***	-0.158**	-0.168***
	(0.067)	(0.070)	(0.070)	(0.060)	(0.063)	(0.064)	(0.064)
IDEOLOGY	0.0364	0.122	0.185**	0.152	0.249**	0.335***	0.358***
	(0.091)	(0.097)	(0.094)	(0.113)	(0.120)	(0.126)	(0.126)
HOUSEHOLD	0.127	0.132	0.113	0.141	0.141	0.126	0.138
	(0.149)	(0.158)	(0.159)	(0.164)	(0.172)	(0.176)	(0.174)
INCOME	-0.341	-0.246	-0.237	-0.098	0.0149	0.0327	0.0221
	(0.248)	(0.252)	(0.257)	(0.282)	(0.298)	(0.301)	(0.301)
SINGLE	0.409	0.721**	0.732**	0.142	0.546	0.56	0.566
	(0.324)	(0.343)	(0.345)	(0.394)	(0.420)	(0.425)	(0.425)
WORK	0.0123	-0.2	-0.175	0.305	0.063	0.0479	-0.0578
	(0.363)	(0.380)	(0.375)	(0.457)	(0.475)	(0.484)	(0.476)
REL_FRIENDS	0.00176	-0.0513	-0.0775	0.163	0.15	0.109	0.102
	(0.206)	(0.220)	(0.221)	(0.271)	(0.291)	(0.293)	(0.292)
REL_RELATIVES	0.390*	0.321	0.360*	0.114	0.0714	0.105	0.0701
	(0.205)	(0.203)	(0.205)	(0.214)	(0.221)	(0.223)	(0.224)
ANXIOUS	-0.102	-0.0669	-0.113	-0.175	-0.126	-0.178	-0.183
	(0.145)	(0.149)	(0.150)	(0.188)	(0.200)	(0.198)	(0.199)
INSECURE	0.167	0.330**	0.323**	0.415**	0.628***	0.628***	0.649***
	(0.157)	(0.158)	(0.162)	(0.190)	(0.205)	(0.209)	(0.207)
ASPIRATIONS	-0.106***			-0.0755*			
	(0.035)			(0.041)			
CONTROLTIME	-1.544***			-2.629***			
	(0.244)			(0.295)			
PEBS_WATER	-1.003**			-1.202**			
	(0.485)			(0.546)			
PEBS	-0.21	-1.186***		-0.21	-1.348***		
	(0.299)	(0.264)		(0.341)	(0.335)		
FREQNAT	-0.353**			-0.288*			
	(0.159)			(0.171)			
CONNECTNAT	0.161		-0.778***	0.426		-0.624*	
	(0.352)		(0.297)	(0.379)		(0.363)	
STUDYENV	-1.113*			-0.882			-2.395**
	(0.579)			(0.883)			(1.017)
Constant	15.13***	10.99***	9.752***	17.69***	13.04***	10.86***	9.181***
	(3.066)	(2.718)	(3.224)	(3.002)	(2.935)	(3.177)	(2.926)
R-squared	0.132	0.054	0.044	0.21	0.097	0.084	0.084

*** p<0.01, ** p<0.05, * p<0.1

(1) is the full model. (2), (3) and (4) are alternative models in which highly correlated environmental and psychological variables are isolated.

Table 3.6. Estimations for number of showers in summer and winter.

	Summer				Winter			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
GENDER	0.592***	0.446**	0.507**	0.420**	0.0862	0.0486	-0.0462	-0.00386
	(0.206)	(0.198)	(0.199)	(0.198)	(0.150)	(0.149)	(0.146)	(0.147)
AGE	0.0940***	0.0825**	0.0864**	0.0857**	-0.0155	-0.024	-0.028	-0.0252
	(0.036)	(0.036)	(0.036)	(0.037)	(0.024)	(0.024)	(0.024)	(0.024)
IDEOLOGY	0.0335	0.117**	0.119**	0.123**	0.0499	0.0954**	0.114***	0.118***
	(0.055)	(0.056)	(0.055)	(0.055)	(0.039)	(0.038)	(0.039)	(0.038)
HOUSEHOLD	-0.0854	-0.0795	-0.079	-0.0798	-0.0979	-0.0914	-0.0911	-0.0907
	(0.086)	(0.087)	(0.088)	(0.087)	(0.062)	(0.063)	(0.063)	(0.063)
INCOME	0.133	0.166	0.156	0.159	0.146	0.172*	0.177*	0.172*
	(0.136)	(0.136)	(0.137)	(0.136)	(0.101)	(0.101)	(0.101)	(0.101)
SINGLE	0.431**	0.403*	0.408**	0.429**	0.162	0.155	0.166	0.174
	(0.204)	(0.205)	(0.205)	(0.204)	(0.147)	(0.150)	(0.149)	(0.149)
WORK	0.125	0.0477	0.0573	0.0246	-0.0237	-0.104	-0.091	-0.0881
	(0.242)	(0.241)	(0.241)	(0.239)	(0.179)	(0.178)	(0.179)	(0.179)
REL_FRIENDS	0.216*	0.178	0.182	0.187	0.175*	0.151	0.133	0.136
	(0.119)	(0.124)	(0.124)	(0.124)	(0.091)	(0.093)	(0.094)	(0.094)
REL_RELATIVES	0.263***	0.279***	0.286***	0.276***	0.135*	0.135*	0.131*	0.136*
	(0.097)	(0.098)	(0.099)	(0.099)	(0.071)	(0.072)	(0.072)	(0.072)
ANXIOUS	0.127	0.0999	0.104	0.0985	0.197***	0.184***	0.185***	0.188***
	(0.084)	(0.086)	(0.086)	(0.086)	(0.059)	(0.060)	(0.060)	(0.060)
INSECURE	-0.0406	-0.0467	-0.0484	-0.0312	-0.138**	-0.128**	-0.134**	-0.132**
	(0.084)	(0.086)	(0.086)	(0.086)	(0.059)	(0.060)	(0.060)	(0.060)
ASPIRATIONS	0.0166				-0.0164	-0.044***		
	(0.022)				(0.017)	(0.017)		
CONTROLTIME	-0.0581	-0.231*			-0.065		-0.198**	
	(0.132)	(0.129)			(0.099)		(0.097)	
PEBS_WATER	-0.067		-0.728**		-0.0178			-0.504**
	(0.303)		(0.283)		(0.228)			(0.215)
PEBS	-0.889***				-0.423***			
	(0.176)				(0.130)			
FREQNAT	0.134*				0.0374			
	(0.075)				(0.056)			
CONNECTNAT	-0.350*				-0.310**			
	(0.184)				(0.140)			
STUDYENV	-0.643			-1.266**	-0.840*			
	(0.556)			(0.627)	(0.431)			
Constant	5.793***	2.943**	3.447**	2.558*	6.832***	5.017***	4.609***	4.877***
	(1.598)	(1.475)	(1.506)	(1.434)	(1.172)	(1.071)	(1.036)	(1.072)
R-squared	0.086	0.045	0.048	0.045	0.087	0.057	0.053	0.053

*** p<0.01, ** p<0.05, * p<0.1

(1) is the full model. (2), (3) and (4) are alternative models in which highly correlated environmental and psychological variables are isolated.

3.4.2.1. Socioeconomic factors

Gender was found to be the most clear-cut socioeconomic variable, with women showering more frequently and for longer durations than men do, and these relationships were highly significant, except for the number of showers taken during winter. Age was also found to be a significant factor, though the results were mixed, with older individuals taking more showers in the summer but shorter showers in the winter. Ideology emerged as another important explanatory factor, although not significant in the full models[4], alternative models suggested that people with a left-wing ideology are more sustainable in terms of duration and number of showers in both seasons. Social contact was also found to be related to less sustainable habits, with people who have more interaction with their family showering more frequently in both seasons. Moreover, weakly significant relationships were observed between the number of showers and interactions with friends, as well as between the duration of showers in summer and interactions with relatives. There was some weak evidence that singles showered more often and for longer durations in the summer, while household income did not seem to be a relevant factor in explaining showering habits; there is only a weak relationship in the alternative models of number of showers in winter. Size, as well as employment status, were non-significant in all models.

3.4.2.2. Psychological factors

With respect to the psychological variables, showering behaviour was associated with both insecurity and anxiety. Insecure individuals tend to take fewer showers in winter but have longer shower durations across both seasons. Meanwhile, individuals with higher levels of anxiety tend to take more showers in winter.

3.4.2.3. Environmental/Psychological factors

In general, the set of environmental/psychological variables were found to be significant determinants of showering habits. People with higher intrinsic values spend less time in the shower in both seasons, and shower less often in winter. Individuals who control their time when showering to avoid spending too much time in the shower effectively manage

[4] This could be because of the correlation of this variable with most of the environmental variables. The ideology variable correlates significantly and negatively with all variables from Table 3.4, except for the frequency of visits to nature, which is nonsignificant.

to spend significantly less time. Although they reduce their number of showers as well, the significance of this relationship is weaker.

People who have efficient habits in other water uses, also tend to make sustainable use of the shower. Similarly, adopting other pro-environmental behaviours is related to more efficient showering practices in terms of frequency and duration in both seasons. It is also found that more frequent visits to nature are related to more efficient use of shower water in terms of duration, but the frequency of showers is higher in summer. Finally, feeling connected to nature and studying environmental issues is related to fewer and shorter showers in both seasons.

3.5. Discussion and policy implications

Awareness-raising campaigns are an effective measure to promote sustainable water use for residential purposes (Katz et al., 2016; Cominola et al., 2021). However, González-Gomez et al. (2022) show that there is a need to generalize awareness campaigns to make more efficient use of the shower. In this research, showering behaviour has been analysed to identify whether there is room for more sustainable shower use and provide well-informed users-profile to design effective public policies that promote sustainable water use for personal hygiene.

Based on the results of the descriptive analysis, changing showering habits could have a significant impact on water conservation without undermining personal hygiene. Dermatologists suggest that a few showers per week are enough to maintain personal hygiene (Shmerling, 2019), but daily showering has become a common behaviour due to social norms (Shove and Walker, 2010). The study found that almost half of the participants reported showering daily or more frequently, with higher shower frequency reported during the summer season. The frequency of showers observed in this study is consistent with that reported in other research and countries. For example, in Binks et al. (2016) the shower frequency is between 0.9 and 1.8 per day. In England, Abu-Bakar et al. (2023) found that 55% of households surveyed used the shower once a day, 34% twice, and 11% three times or more daily.

Water can be saved not only by reducing frequency but also by limiting the time spent in the shower. UN recommends showering for no longer than five minutes to save water (United Nations 2020a, b). However, most of the participants significantly exceed this

recommendation, particularly in winter. Moreover, the mean values and frequency distribution indicate that showering durations among participants were higher than those reported in most literature for the general population. For instance, Ableitner et al. (2016) reported an average shower time of just over four minutes for a sample of Swiss households, while in the UK and the US, the average shower time was around seven minutes (Energy Saving Trust, 2015; Water Research Foundation, 2016). Binks et al. (2016) reported a duration of between 4.4 and 11 minutes, and Ananga et al. (2019) found that 66% of households in Ada, Oklahoma, took showers lasting five minutes or less. In contrast, shower durations in this study are similar to those reported in other studies on young adults, which were around 10-12 minutes (Simpson et al., 2019). Therefore, these findings support previous research suggesting that young people tend to shower longer (Stanes et al., 2015; Ableitner et al., 2016).

The difference in showering habits between seasons is consistent with the findings of previous studies on the effect of weather conditions on showering behaviour (Rathnayaka et al., 2017; Smit & Bruyn, 2022). The higher shower frequency in summer can be explained by the high temperatures reached in southern Spain during this season, an explanation that becomes even stronger considering the above-average temperatures of summer 2018 (State Meteorological Agency, 2019). On the other hand, the longer shower time in winter may be to get warm. This is consistent with research by Wong et al. (2016), who found that when the outside temperature dropped by 6ºC, shower duration was 10% longer.

Regarding the personal factors influencing showering behaviour, the regression analyses generally confirm most of the hypotheses put forward. However, there are again differences between the seasons and between the two aspects of behaviour considered.

In terms of socio-economic factors, gender is a very important determinant of showering habits. These results are in line with previous studies indicating that women consume more water in the shower (Makki et al., 2013). As a novelty, this study suggests that this higher consumption is mainly due to longer showers, with the time difference being greater in winter. The findings on the ideology variable are also in line with previous studies, which point to left-wing ideology as a factor favouring water conservation (Hannibal et al., 2019). Furthermore, the idea of showering before socialising as a

standard practice is supported (Gram-Hanssen et al., 2020), as more contact with friends and family is associated with a higher frequency of showering.

However, contrary to expectations, income level and being single do not seem to have much influence on showering habits, with only some weak positive relationships found for these factors. No significant association is found for the variables number of people in the household and employment. The fact that the expectations for these variables are not confirmed is probably due to the composition of the sample. The participants are students who go to class and interact with other people daily, so the fact that they also have a job may not make a difference. Regarding household composition, about half of the respondents lived away from home during the academic year, which may explain why this variable is not significant in this context. The fact that the sample consists of university students may also explain the unexpected results regarding age. Older age is positively associated with the number of showers in summer and negatively associated with the duration of showers in winter. However, when considering this result, it should be noted that the age range of the participants is very limited.

The results partially support the hypotheses on psychological variables. Being insecure is associated with a lower frequency of showering in winter and a longer duration of showering regardless of the season. The most insecure people probably shower less often because they avoid contact with other people, but they may spend more time in the shower if they find it as a means of escape, or to pay close attention to their personal hygiene before meeting other people. While being anxious is significantly and positively associated with the number of showers per week. The difference in behaviour is more evident in the winter months, when people may be under more stress for a variety of reasons, such as their studies or work, lack of daylight, and limited outdoor activities. Showering may be considered as an option to reduce anxiety (Shevchuk, 2008).

Environmental variables emerge as significant explanatory factors, generally associated with more sustainable habits in terms of frequency and duration of showering. The exception is contact with nature, which, although associated with shorter showering time in both seasons, is positively related to showering frequency in summer, which may be explained by the climatic factor. People who spend more time in nature may need more showers in summer because the outdoor activity makes them sweat.

Higher intrinsic values are associated with shorter showers throughout the year and fewer showers in winter. It is probably the case that people who are more concerned about their image take time in the shower to apply more personal care. Unsustainable showering habits, such as prolonged showering, have previously been linked to notions of beauty, image and body care (Watson, 2017). Pro-environmental behaviour variables, both related to water use and not, are associated with more sustainable showering habits in both dimensions and seasons. Therefore, it appears that shower habits are not affected by the moral licensing effect (Tiefenbeck et al., 2013; Gholamzadehmir et al., 2019), but that participants show consistency in their behaviour, suggesting that people take action to protect the environment in multiple dimensions. Similarly, connectedness to nature and studying environmental science seem to encourage sustainable shower habits. As with pro-environmental behaviour in other areas (Mackay and Schmitt, 2019; Alcock et al., 2020), a close relationship with nature encourages sustainable showering habits.

The existence of specific profiles who are less efficient in their showering habits is a key finding of this research with implications for the design of policies aimed at water conservation. Awareness campaigns on shower conservation should specifically target these profiles. Taking into account the significance of the gender variable, shower conservation campaigns could be gender-differentiated to make them more appealing to women. Furthermore, based on the results of the psychological variables, an important message to convey is that showering should be avoided as a way of de-stressing or enhancing well-being. There is evidence that those who make more sustainable use of water resources have greater personal well-being (Chenoweth et al., 2016; Ibáñez-Rueda et al., 2023).

The use of showering as a form of self-care and image maintenance is often associated with unsustainable showering habits (Quitzau and Røpke, 2008; Watson, 2017). Therefore, educational values that guide people towards intrinsic goals rather than materialistic values could contribute to efficient shower water use. Finally, given the strong influence of environmental variables on sustainable water use, encouraging people to visit nature through educational initiatives that show the benefits of nature visits and incorporate nature values could be part of a policy aimed at reducing shower water use. In addition, encouraging people to be environmentally friendly in other aspects of their lives may also help to reduce shower water use, as there appears to be a positive spillover effect (Truelove et al., 2014).

3.6. Limitations and future research

Before concluding, some limitations of this research need to be considered. The study is conducted with a focus on a specific target group of university students. The results of the study refer to this specific segment and caution should be exercised before extrapolating them to the general population. It should be borne in mind that many students live away from home during the academic year (in shared flats, halls of residence, single rooms, etc.), which could have an impact on showering habits. In addition, the sample consists almost entirely of young people, so the results would probably be different if other age groups were included. It would be desirable to carry out similar studies with larger samples in order to better capture the possible effect of variables such as age, employment status or different levels of education.

For more insight into the causes of (un)sustainable shower use, extended personal interviews should be considered. Moreover, future research endeavours could benefit from employing direct measurements of shower water consumption, allowing for more precise estimations and accurate correlations with the proposed factors. Finally, given the influence of cultural context on water consumption patterns (Smith and Ali, 2006), it would be advisable to conduct studies focusing on other geographical areas. Although habits and explanatory factors identified here could be valid for university students in other Western countries, the generalisability of the results remains to be determined.

3.7. Conclusion

Ensuring the availability of water resources requires both supply-side and demand-side measures. In terms of demand management, aligning conservation measures with existing water consumption behaviours is key to their effectiveness (March et al., 2015). This study focuses on showering habits, as this is often the most water-intensive activity within households. The main novelty of the study lies in the detailed analysis of showering habits, considering both the frequency and duration of showering seasonally (winter and summer). In addition, a wide range of factors that may affect showering behaviour are considered, including socio-economic characteristics as well as environmental and psychological factors.

The first conclusion based on respondents' number of showers and time spent in the shower is that a substantial part of the sample can make more sustainable use of the shower. There is a need to raise awareness about the benefits of reducing the frequency and duration of showers, without sacrificing personal hygiene. One benefit is personal – reducing damage to the skin – and the other is for the public good – saving water.

Secondly, the investigation reveals discernible disparities in showering habits between winter and summer, in terms of not only frequency but also duration. Individuals tend to spend more time showering during winter, whereas showering frequency tends to be more pronounced in summer. Consequently, policy formulations necessitate careful consideration of these seasonal variations in showering behaviour.

Lastly, the research highlights the existence of factors that determine people's showering behaviour, including gender, ideology, social relations, psychological factors, pro-environmental behaviour and relationship with nature. The relationships between these factors and showering behaviour exhibit a heterogeneous pattern, contingent upon the specific aspect of behaviour and the season under investigation. A profound comprehension of these factors and their relation to season facilitates the tailoring of recommendations to specific target populations, and the formulation of targeted awareness campaigns with heightened efficacy.

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Appendix

Supplementary Information 3.1. Main content of the questionnaire (translated from Spanish).

Shower habits questions

- How long do you stay under water each time you take a shower IN SUMMER MONTHS? (In minutes)

  _____minutes approximately

- How long do you stay under water each time you take a shower IN WINTER MONTHS? (In minutes)

  _____minutes approximately

- How many times do you shower a week IN SUMMER MONTHS?

  _____

- How many times do you shower a week IN WINTER MONTHS?

  _____

Socioeconomic questions

- Which gender do you identify with?

  ☐ male ☐ female ☐ other_____

- Please specify your age in years: _____

- Are you a leftist, a right-winger or neither? Express your opinion on a scale of 1 to 10 where 1 is far left and 10 is far right.

01	02	03	04	05	06	07	08	09	10

- How many people (including yourself) live in your household?
  _____ people

- What is the approximate monthly income of your household?

  ☐ Less than 499€
  ☐ From 500 to 999
  ☐ From 1000 to 1499€

☐ From 1500 to 1999€
☐ From 2000 to 2499€
☐ From 2500 to 2999€
☐ From 3000 to 4999€
☐ 5000€ or more

- What is your family situation?

☐ Married
☐ With a stable partner
☐ Divorced or separated
☐ Widowed
☐ Single, no steady partner

- Do you work as well as study?

☐ Yes ☐ No

- How often do you meet with...?

	Never (1)	Once a month or less (2)	Once or twice a month (3)	Once or twice a week (4)	Every day or almost every day (5)
… your family (who do not live in your home)?					
… your friends?					

Psychological questions

- Indicate how you felt during the last seven days:

	Very slightly or not at all (1)	A little bit (2)	Moderately (3)	Quite a lot (4)	Extremely (5)
Anxious					
Insecure					

Environmental/ Psychological questions

- The following questions refer to personal goals. Please mark the answer that best reflects the degree of importance of each of the goals to you. Consider your answers bearing in mind that some will be unimportant, some will be moderately important and some will be very important to you.

	Not important at all (1)	A little important (2)	Moderately important (3)	Very important (4)	Extremely important (5)
1. Feeling free					
2. Having fashionable clothes and hair					
3. Having someone in my life who accepts me for who I am					
4. Being free from disease					
5. Having people around me who show me affection, and me showing affection to them					
6. Handling efficiently the problems that come up in my life					
7. That people often comment on how attractive I am.					
8. Helping those in need, without asking for anything in return.					
9. Having enough money to buy everything I want					
10. Being known by many different people					
11. Being physically fit					
12. Helping to make the world a better place					
13. Being admired by many people					
14. Having a well-paid job					

- Do you think you have some control over time while showering to avoid spending too much time in the shower?

  ☐ Yes ☐ Sometimes ☐ No

- In relation to your household water use habits:

	Yes	Sometimes	No
1. Do you keep a bottle of cold water in the fridge to avoid leaving the tap running?			
2. Do you defrost your food in advance to avoid defrosting it under the tap?			
3. Do you fill the sink before washing the dishes?			
4. Do you wait until the dishwasher and washing machine are full to run them?			

5. Do you close the stopcock a little to reduce the flow rate of the taps?			
6. Do you have a waste bin in your bathroom so that you don't use the toilet as a rubbish bin?			
7. Do you turn off the tap while you're brushing your teeth?			

- Specify how often you perform the following actions:

	Very slightly or not at all (1)	A little (2)	Moderately (3)	Quite (4)	Extremely (5)
1. Turn off lights in rooms that are not being used					
2. Put on more clothes when it's cold at home, instead of turning on or turning up the heating					
3. Decide not to buy something because it has an excess of packaging					
4. Buy recycled products such as recycled toilet paper or tissues					
5. Take your own bag with you when you go shopping					
6. Separate the garbage. For example, paper, plastic, glass					
7. Use public transport (e.g. bus, train) instead of using the car					
8. Walk or cycle for short distances					
9. Avoid taking planes when possible					
10. Participate in demonstrations in support of the environment					
11. Reduce consumption of meat or animal products					
12. Buy organic or eco-labelled food					
13. Buy organic or eco-labelled products (furniture, clothing)					
14. Preference for buying local products					
15. Don't throw away food					
16. In general, try to reduce consumption in everyday life					

- How often do you visit natural areas?

  ☐ Never
  ☐ Less than once a month
  ☐ Once a month
  ☐ Many times a month
  ☐ Once a week
  ☐ Many times a week
  ☐ Everyday

- Please answer each of these questions in terms of how you feel about the natural world in general:

	Strongly disagree (1)	(2)	Neutral (3)	(4)	Strongly agree (5)
1. I often feel a sense of oneness with the natural world around me					
2. I think of the natural world as a community to which I belong					
3. I recognize and appreciate the intelligence of other living organisms					
4. I often feel disconnected from nature					
5. When I think of my life, I imagine myself to be part of a larger cyclical process of living					
6. I often feel a kinship with animals and plants					
7. I feel as though I belong to the Earth as equally as it belongs to me					
8. I have a deep understanding of how my actions affect the natural world					
9. I often feel part of the web of life					
10. I feel that all inhabitants of Earth, human, and nonhuman, share a common 'life force'					
11. Like a tree can be part of a forest, I feel embedded within the broader natural world					
12. When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature					
13. I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees					
14. My personal welfare is independent of the welfare of the natural world					

CHAPTER 4. How does sustainable water consumption in the shower relate to different dimensions of perceived well-being? Empirical evidence from university students

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Abstract

Water scarcity is already a worrying issue and it is predicted to get worse in the future. This creates an imperative to use water efficiently and sustainably. In the domestic sphere, one of the main uses of water is showering, not only for hygiene reasons but also as a wellness activity. In order to gain insight into the implications of sustainable shower use, in this paper we analyse the relationship between subjective well-being and water consumption in the shower. We aim to answer the following questions: 1) How does shower water consumption relate to subjective well-being, 2) Does this relationship differ depending on showering habits (time spent in the shower, and number of showers per week), and 3) Does this relationship differ depending on the season (winter and summer). The dataset contains information on 937 students from different disciplines at the University of Granada, Spain. The different interpretations of subjective well-being considered are life satisfaction, affect, and vitality. Results suggest that there is a negative relationship between water consumption and subjective well-being, in line with the literature that identifies a well-being dividend from green behaviour (being pro-environmental helps the environment and increases happiness). All subjective well-being

dimensions are negatively related to time spent in the shower, regardless of the season. In contrast, the frequency of showering is not significantly related to well-being. Therefore, it appears that higher water consumption does not translate into higher perceived well-being, indicating that there is no conflict between efficient shower water use and individual well-being.

Keywords: subjective well-being; shower water use; water consumption; pro-environmental behaviour.

4.1. Introduction

Global freshwater use has increased six-fold in the last 100 years, mainly due to population growth, economic development, and changing consumption patterns (United Nations, 2021). In the coming decades, water demand will continue to grow, which, coupled with the effects of climate change, will result in water becoming an even scarcer resource (Burek et al., 2016).

To tackle water scarcity, it is important to promote water efficiency in all sectors. In particular, Sustainable Development Goal 6 aims to ensure that all people have access to water and sanitation (United Nations, 2015). In the domestic sphere, one of the main uses of water is for personal hygiene, which accounts for around one third of indoor household water consumption (Makki et al., 2015; Matos et al., 2013; Willis et al., 2011; 2013). As such, personal hygiene practices are an interesting target for water-saving policies.

Thanks to the development of technology and domestic infrastructure, along with the evolution of social norms on grooming and lifestyle changes, daily showering has become established as the most common personal hygiene practice (Hand et al., 2005). At the same time, the purpose of showering has also evolved, with it becoming common to shower not only for hygienic reasons, but also as a wellness-generating activity (Quitzau and Røpke, 2009). These changes often mean more frequent, longer showers, which implies higher water consumption (see, for example, Gram-Hanssen et al., 2020; Lindsay and Supski, 2017; Quitzau and Røpke, 2009).

Unsustainable water use associated with the hedonic aspect of showering is explained by the fact that people tend to prioritise pleasure over water and energy conservation (Quitzau and Røpke, 2008). But to what extent does higher water consumption in the shower have an impact on the perception of well-being? Does sustainable use of water resources in the shower really have a cost in terms of well-being? Previous research has shown that, in general, adopting pro-environmental behaviours positively influences well-being (Zawadzki et al., 2020). Furthermore, there is evidence that higher household water consumption is not associated with improved well-being (Chenoweth et al., 2016). However, there are no related studies that analyse the particular case of showering.

Given the different possible applications of water, its relationship to subjective well-being is strongly determined by the specific use under consideration. Therefore, as a novelty, this study builds on previous evidence on water consumption and well-being by taking into account a specific application of this resource. In this paper, we explore the relationship between shower water consumption and subjective well-being by considering showering habits (i.e., frequency and duration) in winter and summer, and including several measures of well-being. Specifically, we use life satisfaction, positive and negative affect, and subjective vitality to cover, respectively, the cognitive, affective, and eudaimonic dimensions of subjective well-being. For the analyses, we use data from a sample of 937 students from the University of Granada (Spain).

The results of the regression analyses show that higher water consumption in the shower is significantly and negatively related to subjective well-being. Specifically, it is associated with lower life satisfaction, lower subjective vitality, and higher negative affect. On further analysis of the relationship, we find that frequency of showering is not associated with subjective well-being. However, longer duration is negatively related to all dimensions of well-being. The results remain the same regardless of the season considered. Adapting daily habits to mitigate environmental problems is an essential part of the transition to a sustainable society. It is particularly important to adopt sustainable showering habits, given how water- and energy-intensive this activity is. The research results are therefore promising, as they suggest that efficient showering is not detrimental to individual subjective well-being, which in turn will facilitate the implementation of public policies aimed at water conservation.

The rest of the article is structured as follows: section 4.2 reviews previous literature that provides some insight into the relationship between shower water consumption and subjective well-being, providing arguments that support both directions of this relationship. Section 4.3 describes the method and materials. Section 4.4 presents the results of the analyses. Section 4.5 discusses the results. Section 4.6 outlines the limitations of this research and identifies some opportunities for future research. Finally, section 4.7 highlights the conclusions of the research.

4.2. Literature review

Water is closely linked to well-being. As well as being essential to physical health, it also plays a key role in subjective well-being. A number of studies have found that better access to fresh water is associated with greater life satisfaction (Guardiola et al., 2013, 2014; Nadeem et al., 2018; 2020). In fact, in some contexts, the influence of satisfaction with water on subjective well-being may be more important than satisfaction with other domains of life, such as money or leisure (Guardiola et al., 2013). In this regard, it has also been found that the introduction of piped water leads to an increase in people's happiness (Devoto et al., 2012; Mahasuweerachai & Pangjai, 2018).

While water is a key factor in subjective well-being, once basic needs are met, higher water consumption does not necessarily contribute to greater well-being. DeLeire and Kalil (2010) analysed the relationship between different components of consumption expenditure and life satisfaction using an American sample, and found that consumption of utilities and housing - which includes water consumption - is not related to this dimension of subjective well-being. For a British sample, Chenoweth et al. (2016) found that in general there is no association between well-being and water consumption, although they reported negative correlations between water use and some individual well-being parameters. Similar conclusions have been drawn from research exploring the relationship between water-saving behaviour and subjective well-being. In this vein, Kaida and Kaida (2016) found that domestic water- and energy-saving behaviours were positively correlated with life satisfaction in a Swedish sample. These findings are in line with those of Suárez-Varela et al. (2016), who found in a Spanish sample that actions aimed at saving water in the household are positively or non-significantly related to life

satisfaction. Likewise, the study by Buhl et al. (2017) using a German sample shows a negative relationship between natural resource consumption and life satisfaction.

Although the above findings decouple higher consumption from higher well-being, none of this evidence specifically addresses the relationship between shower water consumption and subjective well-being. Despite the fact that several studies have found a positive relationship between the adoption of pro-environmental behaviours and well-being (e.g., Ambrey & Daniels, 2017; Guillen-Royo, 2019; Kaida & Kaida, 2016; Schmitt et al., 2018; Xiao & Li, 2011; Zannakis et al., 2019), some research has identified exceptions, indicating that the association between the two concepts depends on the type of behaviour considered. For example, Verhofstadt et al. (2016) showed that some activities (e.g., consuming fresh and seasonal products) reduce individuals' ecological footprint while increasing their well-being, while other actions that shrink the ecological footprint (e.g., limiting meat and fish consumption or living in a small house) are detrimental to subjective well-being. Similarly, Lenzen and Cummins (2013) found that some actions are beneficial for well-being and the environment (e.g., living with other people), whereas others entail trade-offs between well-being and environmental impact (e.g., using the car).

In the case of water consumption in the shower, some studies suggest that higher consumption may be associated with greater well-being. However, scientific evidence in this regard is scarce and limited to qualitative research. For example, Quitzau and Røpke (2009) analysed the transformations in the use and meaning of Danish bathrooms over the last decades, finding that the concept of showering has evolved from merely washing to an activity that also provides pleasure and well-being, which in many cases has led to a change in showering habits. Based on their qualitative interviews in Danish households, Gram-Hanssen et al. (2020) reported that some people prolong shower time as a form of relaxation, accompanying it with music or the use of certain products. In response to the stresses of modern life, showering becomes an activity that offers peace and quiet, an opportunity to take time for oneself and enjoy a moment of privacy (Quitzau and Røpke, 2008). Lindsay and Supski (2017) used focus groups to study the water consumption practices of people in different Australian cities, highlighting the therapeutic value of showering and its use as a tool for managing stress and emotions. Other benefits of showering that have been reported in the scientific literature include its potential to

improve sleep (Whitworth-Turner et al., 2017) and even the possibility of using it as a treatment for depression (Shevchuk, 2008).

In sum, what has been presented in this section underlines the complexity of the relationship between water consumption and subjective well-being. Water is a resource with different functions, and can be considered a basic necessity or a luxury good, depending on the case. Therefore, in order to study the relationship between water consumption and subjective well-being, it is necessary to distinguish between the different uses. In this study, we focus specifically on the shower, as it is where most water is typically consumed in households (Makki et al., 2015; Willis et al., 2011; 2013). Thus, we provide the first quantitative evidence on shower water consumption and subjective well-being.

4.3. Study area, material and methods

4.3.1. Data

This research is based on information from a survey of 1150 students at the University of Granada, Spain, who habitually had showers instead of baths. The city of Granada is located in southern Spain, a semi-arid area suffering from recurrent droughts and facing extremely high-water stress (World Resources Institute, 2019). As for the study population, it is mainly composed of young people. Pérez-Urdiales et al. (2016) identified different residential water consumption profiles in Granada and age was a significant factor in defining these profiles. In particular, young adult households characterised the group with the lowest water consumption. Although young people may use water more efficiently in general, evidence suggests that their showering practices tend to be less sustainable (Stanes et al., 2015).

The fieldwork was carried out in March and April 2019. A research team visited classrooms in different faculties to conduct the questionnaire. Specifically, students from the disciplines of economics, political science, sociology, social work, pedagogy, medicine, environmental sciences, and computer science were surveyed. To ensure the consistency of the questionnaire, a pre-test was carried out with 95 participants. The

students accessed the questionnaire online via the Qualtrics platform[5] and did not receive any payment for their participation. Prior to the start of the survey, respondents were informed that confidentiality and anonymity would be protected. In addition, participants were made aware of their right to withdraw.

Before running the analyses, observations with missing or nonsense values for the variables of interest were removed. Observations with extreme values (5 participants who reported taking showers lasting between 45 and 60 minutes) were also removed to avoid distorting the results. Thus, the final sample consists of 937 observations. The sample size is therefore sufficient for statistical inference analyses. Furthermore, the composition of the sample is similar to the entire student body of the University of Granada, made up mainly of people aged between 19 and 25, with a greater presence of women (University of Granada, 2019). The composition of the sample can be seen in more detail in Table 4.1, which contains the descriptive statistics of the variables.

4.3.2. Measures

The following sub-sections provide a detailed explanation of the variables used in the study, divided into three groups: subjective well-being variables, shower use variables, and control variables. A summary table with a description of the variables and their units of measurement is provided in the appendix (Table A.4.1). The questions and items used in the survey are also provided (Supplementary Information 4.1).

4.3.2.1. Subjective well-being

We use several indicators to assess subjective well-being in order to take into account different dimensions of the experience of being well. Specifically, we incorporate measures of life satisfaction (cognitive), positive and negative feelings (affective) and subjective vitality (eudaimonic).

The measure of life satisfaction is related to the judgements and evaluations a person makes about his or her life in general (Dolan et al., 2008). Participants answered the question "How satisfied are you at this moment with your life as a whole?" on a scale from 0 (very dissatisfied) to 10 (very satisfied). The use of this 11-point scale is very

[5] In the design of the questionnaire, the survey was tested to work on all types of electronic devices, following del Saz-Salazar et al. (2022) and Liebe et al. (2015). When any student did not have an electronic device to fill out the survey, the researcher provided one.

convenient because, as del Saz-Salazar et al. (2019) point out, Spanish people are used to it since childhood as a rating system.

Respondents' affective state was assessed using the Positive and Negative Affect Schedule (PANAS, Watson et al., 1988), which consists of two separate 10-item scales, one for positive affect and one for negative affect. The former includes feelings of achievement, enthusiasm and commitment (e.g., motivation, alertness, determination, pride), while the latter includes feelings of distress and discomfort (e.g., irritability, shame, guilt, insecurity). Participants indicated the degree to which they had experienced these feelings in the past 7 days using a 5-point Likert scale (from 1, “very slightly or not at all” to 5, “extremely”). *Positive affect* and *Negative affect* variables were calculated as the sum of their respective item scores.

Subjective vitality, understood as the feeling of energy and aliveness derived from full physical and psychological functioning, was measured using the Subjective Vitality Scale (Ryan & Frederick, 1997). Respondents rated 6 items related to feeling full of life (e.g., "I feel alive and vital", "I get excited every new day") on a 5-point Likert scale (from 1, "totally false" to 5, "totally true"). We calculated the variable *Vitality* as the sum of these scores.

4.3.2.2. Shower use

We captured shower habits through four questions. First, respondents had to answer two questions about how many times they shower per week, one referring to the summer and one to the winter months (variables *Number Summer* and *Number Winter*). Secondly, participants were asked about how long they stay under the water each time they shower, again with separate answers for each season (*Time Summer* and *Time Winter*). We made this distinction between seasons because previous research has shown that weather is a determinant of shower water use (Rathnayaka et al., 2015).

From the shower frequency and duration variables, we calculated the time spent in the shower per week and created two variables that reflect the weekly shower water consumption in hectolitres for summer and winter (*Consumption Summer* and *Consumption Winter*). To approximate consumption, we multiplied the weekly time spent in the shower by 14, which is the average number of litres per minute consumed in the shower in the region (Watson, 2017). Note that although the consumption indicator we

used is not very precise, multiplying by a scalar does not affect the relationships we aim to study.

4.3.2.3. Control variables

We also used a set of sociodemographic variables to control for their effect on subjective well-being in order to avoid spurious regressions. We asked about the parents' monthly income, proposing eight intervals as possible answers (the lowest category being less than €499 and the highest €5000 or more). We estimated income as the midpoint of the selected range, except for the highest category, which we estimated at €6000. We calculated per capita income by dividing by the number of inhabitants in the household and took the natural logarithm of this amount to account for the diminishing marginal effect of income on subjective well-being (Diener et al., 1993; Easterlin, 1974). Also, we included in the analyses the respondents' age and age squared, given the U-shaped relationship between age and subjective well-being reported by previous studies (Dolan et al., 2008). To capture participants' social relationships, we asked how often they are in contact with their family, friends and neighbours. Respondents indicated the frequency for each group using a 5-point Likert scale (from 1, "never" to 5, "every or almost every day") and we calculated the variable *Relationships* as the average of the three scores given. Respondents indicated their health status by selecting one of the proposed categories (0, "major problems"; 1, "moderate problems"; 2, "mild problems"; 3 "no problems"). In addition, dummy variables were included to indicate gender (equal to 1 if female), marital status (equal to 1 if single), and employment status (equal to 1 if working as well as studying).

4.3.3. Method of analysis

Regression analyses were used to explore the relationship between showering practices and subjective well-being, providing information on the nature and strength of the relationship. We tested whether subjective well-being is explained by individuals' shower habits and socio-economic characteristics, using the general specification of the estimated equation, as follows:

$$SWB_{ij} = \beta_0 + \beta_1 SU_{il} + \beta_2 X_i + \varepsilon_i$$

where i refers to the i-th individual in the sample (i = 1, ..., 937), SWB_{ij} represents the variables (j=4) we use as measure of subjective well-being (life satisfaction, positive

affect, negative affect and subjective vitality), SU_{il} corresponds to the six shower use variables (estimated consumption, shower duration, and shower frequency, in summer and winter, denoted by l), X_i denotes the set of socio-economic variables, and ε_i is the error term.

We used several model specifications to incorporate the different well-being dependent variables and the different shower use variables. All these model specifications were estimated using ordinary least squares (OLS). Although the ordinal nature of the life satisfaction variable makes it more appropriate to use ordered probit or ordered logit techniques for this dependent variable, we applied OLS for ease of interpretation and because there is evidence that the results yielded by both methods are very similar (Ferrer-i-Carbonell & Frijters, 2004). Indeed, when repeating the analyses for life satisfaction using ordered probit regressions, we obtained identical results for all models (these results are not presented in the paper).

4.4. Results

Table 4.1 shows the descriptive statistics of the study variables. Of the 937 people included in this study, 62.86% were female, 64.35% reported being single and 25.19% were working as well as studying. The average age of the respondents was around 20 years old. Regarding the well-being variables, the mean score for positive affect is higher than for negative affect, the mean score for subjective vitality is closer to its maximum value than to its minimum, and life satisfaction is around a score of 7, which is slightly lower than the mean life satisfaction reported in other studies with Spanish university students (e.g., del Saz Salazar & Pérez y Pérez, 2021). Shower use variables indicate that participants' showering behaviour is quite unsustainable, with the estimated shower water consumption exceeding 1100 litres per week in both seasons. The average shower duration exceeds eight minutes in summer and eleven minutes in winter, while the average number of showers per week is around seven in winter and nine in summer. It is particularly striking that certain extreme behaviours, such as 30-minute showers or showering up to 16 times a week, are not entirely uncommon among the study participants. Histograms for the well-being and shower variables can be found in the appendix (Figures A.4.1 and A.4.2 respectively).

Table 4.1. Descriptive statistics.

Variables	Mean / %	Std. Dev.	Min	Max
Subjective well-being				
Life satisfaction	7.045	1.674	1	10
Positive affect	31.057	6.724	10	49
Negative affect	23.011	7.215	10	49
Vitality	3.309	0.735	1	5
Shower use				
Consumption Summer	11.027	7.538	0.84	67.2
Consumption Winter	11.867	7.463	0.7	67.2
Time Summer	8.687	4.888	1	30
Time Winter	11.537	6.008	1	40
Number Summer	9.031	3.003	2	16
Number Winter	7.326	2.195	2	16
Control variables				
Income	6.201	0.785	3.22	8.70
Age	20.677	2.861	18	54
Female	62.86%		0	1
Single	64.35%		0	1
Relationships	3.479	0.761	1	5
Health	2.445	0.674	0	3
Work	25.19%		0	1

The results of the estimations including weekly shower water consumption (Table 4.2), shower duration (Table 4.3), and the number of showers taken per week (Table 4.4) are presented below. The models in (*a*) include the shower use variables for the summer months, and the models in (*b*) those for the winter months. For all estimated models, the joint significance test indicates that they are globally significant. The coefficients of determination range from 8% to 15%, with the models for subjective vitality having the best fit, and those for negative affect the worst. Although these R^2 values are quite low, they are within the range of the typical values found in studies of subjective well-being and do not pose a problem for the purpose of the study (OECD, 2013).

When we consider the relationship between subjective well-being and shower water consumption, we find the same results for both seasons. The more water a person consumes in the shower, the lower their life satisfaction (β = -0.0146, $p < 0.1$ in (*a*); β = -0.0215, $p < 0.01$ in (*b*)), the more negative emotions they experience (β = 0.0790, $p < 0.01$ in (*a*); β = 0.0794, $p < 0.05$ in (*b*)), and the lower their subjective vitality (β = -0.0368, $p < 0.1$ in (*a*); β = -0.0453, $p < 0.05$ in (*b*)). As can be seen from the coefficients,

the relationship of water consumption is higher in absolute value for negative affect, both in summer and winter. In contrast, positive affect is not significantly related to shower water consumption.

Table 4.2. Linear regression models for subjective well-being and shower water consumption by season.

	(*a*)				(*b*)			
	Life satisfaction	*Positive affect*	*Negative affect*	*Vitality*	*Life satisfaction*	*Positive affect*	*Negative affect*	*Vitality*
Consumption Summer	-0.0146*	-0.034	0.0790***	-0.00614*				
	(0.008)	(0.028)	(0.028)	(0.003)				
Consumption Winter					-0.0215***	-0.0442	0.0794**	-0.00754**
					(0.008)	(0.030)	(0.033)	(0.004)
Income	0.101	0.862***	-0.379	0.0653**	0.106	0.874***	-0.403	0.0673**
	(0.066)	(0.271)	(0.298)	(0.030)	(0.066)	(0.270)	(0.298)	(0.030)
Age	0.00292	0.541**	0.111	0.0854***	0.000893	0.536**	0.123	0.0845***
	(0.065)	(0.262)	(0.279)	(0.027)	(0.065)	(0.262)	(0.280)	(0.027)
Age^2	0.000339	-0.00593	-0.00521	-0.0011***	0.000291	-0.006	-0.00515	-0.0011***
	(0.001)	(0.0040)	(0.0042)	(0.0004)	(0.001)	(0.0039)	(0.0042)	(0.0004)
Female	0.0893	-1.672***	-0.423	-0.0197	0.122	-1.614***	-0.488	-0.0105
	(0.109)	(0.445)	(0.489)	(0.048)	(0.111)	(0.447)	(0.490)	(0.048)
Single	-0.436***	-0.686	0.452	0.00267	-0.434***	-0.688	0.484	0.00178
	(0.106)	(0.445)	(0.487)	(0.046)	(0.105)	(0.442)	(0.485)	(0.045)
Relationships	0.348***	1.956***	-1.038***	0.289***	0.346***	1.952***	-1.023***	0.288***
	(0.071)	(0.286)	(0.303)	(0.032)	(0.071)	(0.285)	(0.303)	(0.032)
Health	0.568***	0.744**	-2.484***	0.183***	0.563***	0.732**	-2.463***	0.181***
	(0.080)	(0.319)	(0.361)	(0.033)	(0.080)	(0.319)	(0.361)	(0.033)
Work	-0.113	0.302	0.595	-0.00259	-0.11	0.311	0.57	-0.000845
	(0.128)	(0.501)	(0.594)	(0.052)	(0.128)	(0.501)	(0.594)	(0.052)
Constant	4.026***	10.28**	33.98***	0.255	4.146***	10.50**	33.71***	0.29
	(1.059)	(4.306)	(4.535)	(0.452)	(1.063)	(4.330)	(4.543)	(0.455)
N	937	937	937	937	937	937	937	937
R^2	0.111	0.102	0.084	0.147	0.115	0.102	0.084	0.149
F	13.25	11.65	11.79	18.45	13.86	11.82	11.27	18.49

All models are statistically significant at 1%. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

In Table 4.3 we further investigate the relationship between water consumption in the shower and subjective well-being, separately analysing individuals' habits regarding duration and frequency of showers. We observe a statistically significant relationship

between prolonged showers and poorer levels of well-being. Again, the results are the same in both seasons: shower duration is negatively related to life satisfaction (β = -0.0294, p < 0.01 in (*a*); β = -0.0343, p < 0.01 in (*b*)), positive affect (β = -0.0828, p < 0.1 in (*a*); β = -0.0813, p < 0.05 in (*b*)), and vitality (β = -0.0876, p < 0.01 in (*a*); β = -0.0770, p < 0.01 in (*b*)), and positively associated with negative affect (β = 0.119, p < 0.01 in (*a*); β = 0.135, p < 0.01 in (*b*)) . As in the previous models, the strongest relationship is on negative affect.

Table 4.3. Linear regression models for subjective well-being and time spent showering by season.

	(*a*)				(*b*)			
	Life satisfaction	*Positive affect*	*Negative affect*	*Vitality*	*Life satisfaction*	*Positive affect*	*Negative affect*	*Vitality*
Time Summer	-0.0294***	-0.0828*	0.119***	-0.0146***				
	(0.011)	(0.0439)	(0.0432)	(0.0046)				
Time Winter					-0.0343***	-0.0813**	0.135***	-0.0128***
					(0.009)	(0.0362)	(0.0378)	(0.0038)
Income	0.0902	0.831***	-0.339	0.0597**	0.0982	0.856***	-0.372	0.0644**
	(0.0664)	(0.272)	(0.301)	(0.0297)	(0.0662)	(0.269)	(0.296)	(0.0296)
Age	-0.00597	0.517**	0.15	0.0812***	-0.00952	0.511*	0.163	0.0806***
	(0.065)	(0.262)	(0.279)	(0.027)	(0.065)	(0.263)	(0.279)	(0.027)
Age^2	0.00045	-0.0056	-0.0058	-0.0011***	0.00042	-0.0057	-0.0056	-0.0011***
	(0.001)	(0.004)	(0.0042)	(0.0004)	(0.001)	(0.0039)	(0.0042)	(0.0004)
Female	0.0956	-1.640***	-0.405	-0.0142	0.155	-1.516***	-0.632	0.00333
	(0.109)	(0.443)	(0.488)	(0.048)	(0.111)	(0.445)	(0.493)	(0.049)
Single	-0.433***	-0.665	0.471	0.00602	-0.432***	-0.675	0.47	0.0032
	(0.106)	(0.444)	(0.488)	(0.046)	(0.105)	(0.441)	(0.485)	(0.045)
Relationships	0.339***	1.934***	-0.993***	0.285***	0.335***	1.927***	-0.980***	0.284***
	(0.071)	(0.286)	(0.304)	(0.032)	(0.071)	(0.286)	(0.302)	(0.032)
Health	0.576***	0.765**	-2.515***	0.187***	0.571***	0.751**	-2.496***	0.184***
	(0.080)	(0.318)	(0.360)	(0.033)	(0.080)	(0.317)	(0.36)	(0.033)
Work	-0.114	0.298	0.586	-0.00327	-0.1	0.333	0.532	0.00269
	(0.128)	(0.501)	(0.594)	(0.052)	(0.128)	(0.501)	(0.591)	(0.052)
Constant	4.328***	11.18**	32.90***	0.413	4.488***	11.38***	32.32***	0.424
	(1.067)	(4.350)	(4.576)	(0.452)	(1.065)	(4.375)	(4.587)	(0.455)
N	937	937	937	937	937	937	937	937
R^2	0.114	0.104	0.084	0.152	0.121	0.105	0.089	0.154
F	14.09	11.87	11.77	19.12	15.29	12.11	12.51	19.54

All models are statistically significant at 1%. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Finally, as Table 4.4 indicates, we find no significant association between the number of showers and subjective well-being. The negative relationship between water consumption and well-being is explained only by the time spent in the shower and not by the frequency of showers.

Table 4.4. Linear regression models for subjective well-being and weekly number of showers by season.

	(*a*)				(*b*)			
	Life satisfaction	*Positive affect*	*Negative affect*	*Vitality*	*Life satisfaction*	*Positive affect*	*Negative affect*	*Vitality*
Number Summer	-0.0049	0.102	0.0866	0.0053				
	(0.019)	(0.073)	(0.079)	(0.008)				
Number Winter					-0.00565	0.0511	0.0796	0.000168
					(0.026)	(0.099)	(0.109)	(0.012)
Income	0.105	0.843***	-0.418	0.0652**	0.105	0.857***	-0.415	0.0665**
	(0.066)	(0.272)	(0.300)	(0.030)	(0.066)	(0.273)	(0.304)	(0.030)
Age	0.00192	0.499*	0.0953	0.0824***	0.00152	0.523**	0.107	0.0842***
	(0.065)	(0.261)	(0.283)	(0.028)	(0.065)	(0.261)	(0.282)	(0.028)
Age^2	0.00038	-0.0052	-0.0051	-0.0011**	0.00038	-0.0055	-0.0052	-0.0011**
	(0.001)	(0.0039)	(0.0043)	(0.0004)	(0.001)	(0.0039)	(0.0043)	(0.0004)
Female	0.0597	-1.790***	-0.288	-0.0353	0.0575	-1.746***	-0.25	-0.0331
	(0.109)	(0.443)	(0.484)	(0.048)	(0.109)	(0.442)	(0.483)	(0.048)
Single	-0.458***	-0.783*	0.54	-0.00937	-0.459***	-0.748*	0.564	-0.00713
	(0.106)	(0.444)	(0.487)	(0.046)	(0.106)	(0.444)	(0.486)	(0.046)
Relationships	0.343***	1.903***	-1.037***	0.284***	0.342***	1.931***	-1.020***	0.286***
	(0.072)	(0.287)	(0.308)	(0.033)	(0.072)	(0.286)	(0.306)	(0.033)
Health	0.567***	0.782**	-2.454***	0.185***	0.568***	0.755**	-2.470***	0.183***
	(0.080)	(0.319)	(0.362)	(0.033)	(0.080)	(0.319)	(0.361)	(0.033)
Work	-0.106	0.322	0.558	0.000596	-0.107	0.325	0.565	0.000468
	(0.127)	(0.503)	(0.593)	(0.052)	(0.127)	(0.502)	(0.594)	(0.052)
Constant	3.934***	9.888**	34.38***	0.205	3.943***	9.900**	34.29***	0.213
	(1.052)	(4.262)	(4.556)	(0.451)	(1.053)	(4.301)	(4.565)	(0.452)
N	937	937	937	937	937	937	937	937
R^2	0.107	0.102	0.079	0.144	0.107	0.10	0.078	0.143
F	12.28	12.02	10.69	18.88	12.33	11.57	10.57	18.68

All models are statistically significant at 1%. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

4.5. Discussion

In this research, we explored the relationship between shower use and individual well-being using a sample of university students. Our regression results suggest that higher levels of water consumption in the shower are associated with lower subjective well-being (lower life satisfaction and subjective vitality, and higher negative affect). When we studied showering habits in more depth, we found that the duration of showering is significantly and negatively related to all dimensions of subjective well-being considered, while the frequency of showering is not a significant predictor of any of the well-being measures. These associations appear to be robust and hold for the different seasons, as we found no differences between summer and winter habits in terms of their relationship with well-being.

In line with some previous research, we found that caring for the environment and people's well-being are compatible goals. Positive associations between commitment to pro-environmental actions and well-being have been demonstrated for a variety of behaviours, such as purchasing behaviour (e.g., Xiao & Li, 2011), environmental volunteering (e.g., Binder & Blankenberg, 2016), or waste behaviour (e.g., Jacob et al., 2009). However, this is the first time that evidence has been provided for water consumption in the shower. The results reported in this study add to the evidence supporting the double dividend theory (Jackson, 2005), which holds that pro-environmental behaviour is beneficial for both the environment and the person engaging in it.

The findings of this study are policy-relevant and can guide the design of public awareness and education campaigns aimed at encouraging efficient water use. Informational campaigns have been found to be a widespread and effective tool for promoting the sustainable use of water resources at the household level (Katz et al., 2016). In the fight against the climate crisis, it is essential to develop environmental policies that do not adversely affect, or that even improve, citizens' welfare as such measures are likely to enjoy greater public support (Lenzen & Cummins, 2013). Previous research on showering practices has identified showering as a wellness-generating activity, with long showers being defined as a form of daily therapy "necessary for a good life" (Lindsay & Supski, 2017). Nevertheless, our results contradict this idea. As Kasser (2002) argued, sometimes certain aspects of personality and environmental circumstances lead people to

try to meet their needs in ways that do not ultimately satisfy them. Unsustainable long showers are an example of a social trend that does not really meet the needs it is supposed to, at least for educated young people living in an area of high water stress. People are unlikely to change their showering habits if they believe that such actions are beneficial to them. Therefore, policy-makers should convey the message that increased water consumption in the shower, and especially prolonged showers, may be negatively associated with well-being. It should be emphasised that it is not a good idea to use showering as a leisure and relaxation activity that improves well-being; rather, there are other more appropriate practices that should be adopted for these purposes, such as meditation (Dhandra, 2019) or spending time with loved ones (Becchetti et al., 2011). Citizens should also be made aware of the potential gains of adopting sustainable showering practices, both for subjective well-being and for physical well-being, in terms of the associated skin health benefits.

4.6. Limitations and future research

This research provides interesting results that could help in the design of water saving campaigns. Future research could test the impact and scope of a campaign based on the findings of the study. Nevertheless, the study has a number of limitations that make it necessary to be cautious about its implications. Firstly, this study was carried out using a sample of students, mostly young people (the average age of the participants was around 20 years old). It is interesting to study this age group because young people have previously been identified as some of the highest users of water in the shower and have also been found to be less willing to reduce the duration and frequency of their showers (Lindsay & Supski, 2017; Stanes et al., 2015). The results of this study could therefore help to lessen resistance to the necessary change in showering habits among a relevant segment of the population. However, we cannot generalise the results to the whole population, as individual characteristics such as age and educational level could be influencing the relationships found. Future research could extend the analyses carried out here to samples with a more varied profile to see if the findings of the present research hold.

Secondly, the fieldwork for this study was conducted in the city of Granada, southern Spain. The fact that it is in an area of high water stress makes it an interesting context for

research, although it could be conditioning the results obtained. Future studies could test whether the relationship between showering habits and well-being is different in areas with other characteristics. It would also be worth studying this relationship in other countries with a different cultural context, as culture may be an influential factor in this relationship.

Thirdly, it should be noted that the data used in this study are cross-sectional, which limits the ability to make causal interpretations. For this reason, the results of the regression analyses have been interpreted as correlations. The negative relationship between water consumption in the shower and subjective well-being could plausibly be a case of reverse causality. In other words, it could be that people with lower well-being make less sustainable use of the shower; for example, unhappy people might spend more time in the shower as a form of escape, using the shower as a refuge. In any case, regardless of the direction of causality, the results of the study seem to disprove the idea that higher water consumption in the shower is associated with higher well-being, implying that using the shower in a sustainable way is compatible with achieving a high quality of life.

4.7. Conclusion

Moving towards an environmentally sound future requires us to change our daily practices. Showering is a water- and energy-intensive activity and is one of the main uses of water in the household, making sustainable shower use particularly important. In this paper, we examined the relationship between efficient shower water use and subjective well-being. To our knowledge, this is the first study to empirically link shower habits and well-being. Using regression analyses with a sample of university students, we found that shower water consumption is negatively associated with life satisfaction and subjective vitality, and positively associated with experiencing negative emotions. Decomposing water consumption into shower duration and frequency habits, we found that the negative relationship between consumption and well-being seems to be explained by the time spent in the shower. Shower duration is associated with worse levels of all the indicators of well-being used (life satisfaction, positive and negative affect, and subjective vitality). In contrast, the frequency of showering is not significantly related to any dimension of well-being. Although showering habits are different in summer and winter, both in terms of frequency and duration, there are no differences in their relationship with subjective well-

being, with the same results being obtained for both seasons. The results run counter to the growing tendency to view showering (especially long showers) as a wellness activity, since higher water consumption does not translate into higher perceived well-being. The absence of conflict between efficient water use in the shower and well-being could facilitate the implementation of public policies aimed at reducing water consumption in the shower.

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Appendix

Table A.4.1. Summary description of the variables.

Variables	Description and units of measurement
Subjective well-being	
Life satisfaction	Level of life satisfaction. From 0 (very dissatisfied) to 10 (very satisfied).
Positive affect	Extent to which the respondent feels 10 positive emotions. From 1 (very slightly or not at all) to 5 (extremely). Sum of the 10 scores.
Negative affect	Extent to which the respondent feels 10 negative emotions. From 1 (very slightly or not at all) to 5 (extremely). Sum of the 10 scores.
Vitality	Extent to which the respondent agrees with six statements about feeling alive and full of energy. From 1 (totally false) to 5 (totally true). Sum of the six scores.
Shower use	
Consumption Summer, Consumption Winter	Amount of water consumed in the shower per week in hectolitres, in summer and winter. It is approximated from the reported frequency and duration of showering.
Time Summer, Time Winter	Duration of showers in minutes, in summer and winter.
Number Summer, Number Winter	Number of showers per week, in summer and winter.
Control variables	
Income	Natural logarithm of household income per capita.
Age	Age of the respondent in years.
Female	Gender. 1 if female.
Single	Relationship status. 1 if single.
Relationships	Indicator of frequency of contact with family, friends, and neighbours. From 1 (never) to 5 (every day or almost every day). Average of three items.
Health	Health status. 0 (major problems); 1 (moderate problems); 2 (mild problems); 3 (no problems)
Work	Occupational status. 1 if the respondent works.

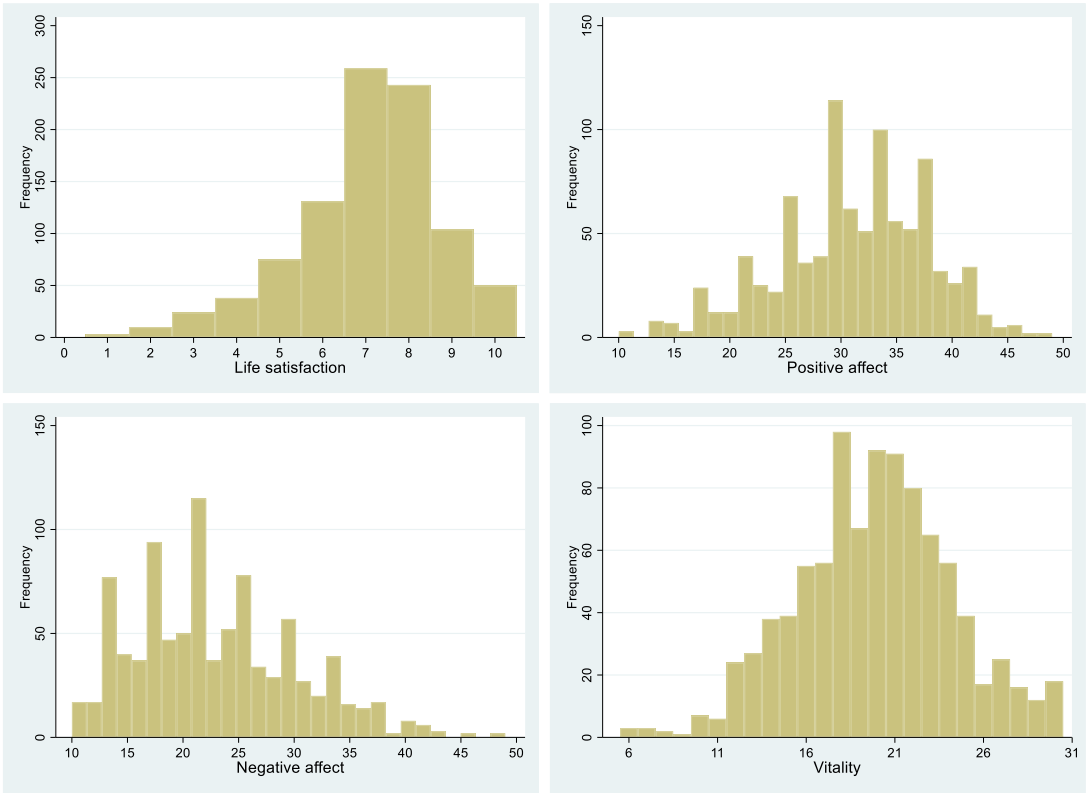

Figure A.4.1. Histograms of the subjective well-being variables.

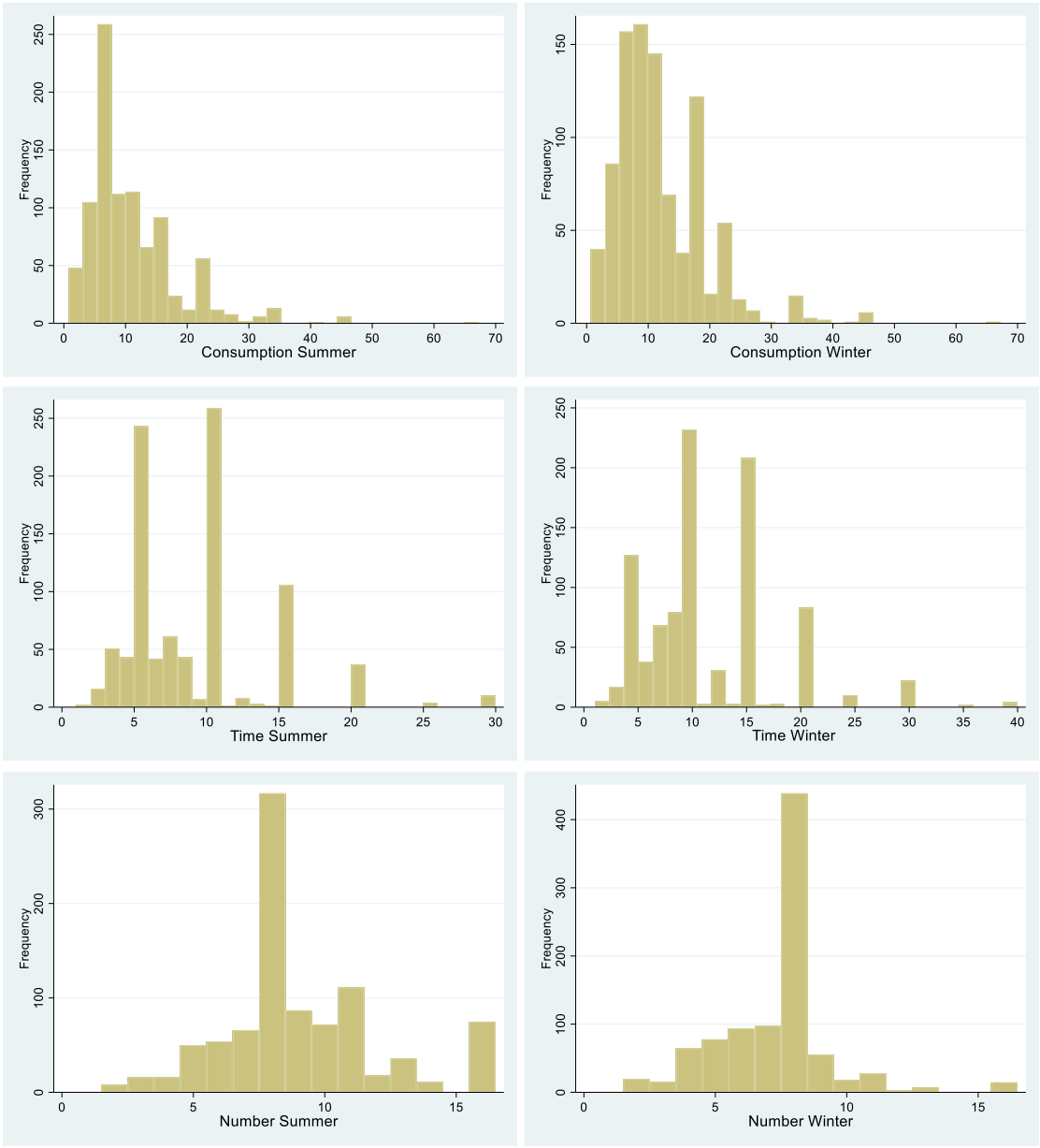

Figure A.4.2. Histograms of the shower use variables.

Supplementary Information 4.1. Questions from the survey (translated from Spanish).

Subjective well-being

- How satisfied are you at this moment with your life as a whole?

	0	1	2	3	4	5	6	7	8	9	10	
very dissatisfied												very satisfied

- Indicate how you felt during the last seven days:

	Very slightly or not at all (1)	A little bit (2)	Moderately (3)	Quite a lot (4)	Extremely (5)
Motivated					
Irritable					
Annoyed, upset					
Alert					
Excited					
Embarrassed					
Angry					
Inspired					
Strong					
Nervous					
Guilty					
Determined					
Fearful					
Attentive					
Aggressive					
Restless					
Enthusiastic					
Active					
Proud					
Insecure					

- Please respond to each of the following statements by marking the extent to which they are generally true for you:

	Totally false (1)	Not so true (2)	Somewhat true (3)	Fairly true (4)	Totally true (5)
I feel alive and vital					
Sometimes I am so alive I just want to burs					
I have positive energy and vigor					
I get excited every new day					
I am usually alert and awake					
I feel full of energy					

Shower use

- How long do you stay under water each time you take a shower in SUMMER months? (In minutes)

  _____minutes approximately

- How long do you stay under water each time you take a shower in WINTER months? (In minutes)

  _____minutes approximately

- How many times do you shower a week in SUMMER months?

  _____

- How many times do you shower a week in WINTER months?

  _____

Control variables

- What is the approximate monthly income of your household?

  ☐ Less than 499€
  ☐ From 500 to 999
  ☐ From 1000 to 1499€
  ☐ From 1500 to 1999€
  ☐ From 2000 to 2499€
  ☐ From 2500 to 2999€
  ☐ From 3000 to 4999€
  ☐ 5000€ or more

- How many people (including yourself) live in your household?
  _____ people

- Please specify your age in years: _____

- Which gender do you identify with?

  ☐ male ☐ female ☐ other_____

- What is your family situation?

  ☐ Married
  ☐ With a stable partner
  ☐ Divorced or separated
  ☐ Widowed
  ☐ Single, no steady partner

- How often do you meet with...?

	Never (1)	Once a month or less (2)	Once or twice a month (3)	Once or twice a week (4)	Every day or almost every day (5)
… your family (who do not live in your home)?					
… your friends?					
… your neighbours?					

- How would you describe your general health?

  ☐ Major problems
  ☐ Moderate problems
  ☐ Mild problems
  ☐ No problems

- Do you work as well as study?

  ☐ Yes ☐ No

CHAPTER 5. Pro-Environmental behaviour, connectedness to nature, and well-being dimensions among Granada students

This chapter has been published in *Sustainability*:

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Abstract

This paper aims to answer the following research questions: Are there differences between individual and collective pro-environmental behaviours (PEBs) in their relationship with well-being? What role does connectedness to nature play in those relationships? We understand individual PEBs as efforts to consume less and to reduce the environmental impact of consumption, whereas we define collaborative PEBs in terms of environmental activism. We consider connectedness to nature as a potential factor moderating the relationship between PEBs and well-being. The study incorporates several dimensions of well-being: cognitive, affective and eudaimonic. We use regression analysis to study the extent to which individual and collective PEBs explain the three well-being dimensions and we explore the moderating role of connectedness to nature using data from a sample of 973 students at the University of Granada (Spain). Results indicate that individual PEBs are positively related to the eudaimonic dimension of well-being but they do not explain the cognitive and affective dimensions. In contrast, collaborative PEB is negatively related to life satisfaction, our measure of the cognitive dimension, but not significantly related to the other well-being measures. Based on this evidence, we can answer our first research question in the affirmative. As for the second

question, our results suggest that connectedness to nature plays a moderating role in the relationship between life satisfaction and collaborative PEBs, as the initially negative relationship is reversed when people feel highly connected to nature.

Keywords: happiness; well-being; pro-environmental behaviours; connectedness to nature; activism; sustainable consumption.

5.1. Introduction

Climate change, along with other man-made environmental problems, is currently a major global concern. High levels of greenhouse gas emissions have been the main cause of global warming since the second half of the twentieth century, which has severely affected the natural and human systems of all continents and oceans (IPCC, 2014). The transition to a sustainable society cannot be put off any longer and requires changing the way we live, as well as a radical transformation of the economy, in terms of both supply and demand.

On the demand side, reducing consumption and turning to renewable and eco-friendly energy systems is crucial. However, to what extent does engaging in pro-environmental behaviours (PEBs) represent a sacrifice? From an economic perspective, protecting the environment may be understood as involving a sacrifice in terms of time or money (Sulemana, 2016). As argued by Binder and Blankenberg (2017), the standard view in economics is that lower income means lower welfare. Nevertheless, most scientific evidence so far suggests that engaging in individual PEBs, that is, consuming differently (recycling, buying second hand, shopping for local produce, etc.) or consuming less (eating less meat, reducing areas being heated or cooled, flying less, etc.), is not experienced as a sacrifice (Guillen-Royo, 2019; Kasser, 2017). Research linking subjective well-being[6] and individual PEBs has found a not-significant or even a positive association between indicators approximating the two concepts (Binder & Blankenberg, 2017; Brown & Kasser, 2005; Guillen-Royo, 2019; Kasser, 2017; Schmitt et al., 2018),

[6] We use the terms well-being, subjective well-being and happiness synonymously, to encompass different facets of being well, such as a cognitive evaluation of well-being, or more emotional experiences (Diener et al., 2002).

with very few exceptions (Binder et al., 2020; Verhofstadt et al., 2016). These findings suggest the possible existence of a "double dividend" (Jackson, 2005), which implies that being pro-environmental is good for both the environment and for individuals' well-being.

However, the relationship between well-being and collaborative PEBs, where people join forces with others to work towards social or environmental change, is still largely unexplored. Some evidence suggests a positive relationship between well-being and low-risk activism because of the latter's implicit values of caring for others and its positive contribution to the psychological needs of socializing, learning and implementing new skills (Corning & Myers, 2002; Klar & Kasser, 2009). Nevertheless, when activism involves actions such as blocking roads or access to public/private buildings, which might pose a risk to the participants' physical integrity, the positive relationship with well-being may be challenged (Klar & Kasser, 2009). In short, individual PEBs that aim to reduce environmental impact through consuming more responsibly (Xiao & Li, 2011; Yusliza et al., 2020) and collective PEBs that aim to create large-scale societal change (Crompton & Kasser, 2009; Pirgmaier & Steinberger, 2019) may have different links with well-being, as these two kinds of actions involve different risks. The question of the extent to which individual and collective PEBs differ in their relationship with well-being remains unexplored, and is the first research question in this paper.

The second question we explore is how connectedness to nature influences those relationships. Connectedness to nature refers to the extent to which an individual includes nature within his/her concept of 'self' (Schultz, 2002), and is found to be positively associated with well-being and PEBs (Mackay & Schmitt, 2019; Martin et al., 2020; Mayer & Frantz, 2004; Pritchard et al., 2020). This positive relationship might be explained by the experience of kinship and belongingness linked to feeling connected to nature, which may simultaneously increase people's well-being and reduce their engagement in environmentally harmful practices (Nisbet et al., 2009, 2011). Moreover, the association between PEBs and well-being may differ according to people's level of connectedness to nature: people who feel a strong connection to the natural environment might experience higher levels of well-being when engaging in PEBs. This implies that 'connectedness to nature' could be considered as a moderating factor that strengthens the positive association between PEBs and well-being often found in the literature.

To the best of our knowledge, these two questions have not been dealt with in previous research. Connectedness to nature has been used as a mediator (Barbaro & Pickett, 2016; Mayer et al., 2009; Nisbet et al., 2011; Otto & Pensini, 2017) and as a moderator (Martin et al., 2020) in past literature addressing the beneficial role of nature and its relationship with PEBs or well-being, but it has never been proposed as a moderator in the PEBs-well-being relationship. In addition, most of the literature on well-being and PEBs focuses on a single well-being indicator, whereas in this study we analyse the relationship between PEBs and three distinct dimensions of well-being. In order to explore the research questions, we use regression analysis with data from a sample of 973 students from the University of Granada, Spain. We consider life satisfaction and positive and negative affect (PANAS) to encompass the cognitive and affective dimensions of well-being, respectively, and the Subjective Vitality Scale to address its eudaimonic dimension (Ryan & Frederick, 1997).[7] Most previous studies on well-being and PEBs approximate well-being through life satisfaction, but it is our understanding that actions related to sustainable consumption—such as buying recycled products, recycling, or using public transport instead of travelling by car—as well as pro-environmental activism, might also relate to the positive emotions derived from socially responsible behaviours. Furthermore, engaging in sustainable consumption and activism might have a positive impact on the psychological needs for competence, relatedness and autonomy, which would explain their potential contribution to higher levels of vitality.

The remainder of this article is divided into the following sections: In section 5.2 we present a general description of the literature on subjective well-being, with a special emphasis on the empirical evidence on the relationship between PEBs and well-being, as well as the role that connectedness to nature may play; in section 5.3 we describe the data used in the research, present the hypotheses and the method of analysis; in section 5.4 we show the results obtained; in section 5.5 we discuss the main findings, and reflect on the limitations of the study; and finally in section 5.6 we conclude.

7 The original conceptualization of eudaimonia comes from Aristotle, who understood it as the state of well-being that relates to the good life, derived from people exercising their highest faculties in terms of ethics and reason. In this paper, we follow the recent conceptualization from human psychology, which emphasizes the outcomes indicative of a good life, such as vitality, intimacy, health, and sense of meaning, among others (Ryan et al., 2008). Following this new understanding of eudaimonia, we use Ryan and Frederick's (1997) Subjective Vitality Scale as a proxy of one of these outcomes.

5.2. Literature review

The relationship between engaging in individualistic and collaborative PEBs and individuals' well-being is the focus of a burgeoning body of literature. Researchers have also turned their attention to the influence of connection with nature on well-being and PEBs. In the two subsections that follow, we highlight the most prominent findings of the literature on PEBs and well-being (section 5.2.1) and those on connectedness to nature, PEBs and well-being (section 5.2.2). Our aim is to evaluate the state of the research in order to identify what remains to be done. Next, we propose our hypotheses that seek to contribute new knowledge to the literature, and give shape to our two main research questions: Are there differences between individual and collective PEBs in their relationship with well-being? What role does connectedness to nature play in those relationships?

5.2.1. Pro-environmental behaviours and subjective well-being

PEBs can be considered an umbrella term encompassing both individual activities, such as recycling or flying less, and collectively oriented endeavours, such as organizing a clothes swap or campaigning for better collective transport. Most studies addressing the relationship between PEBs and well-being focus on behaviours of an individualistic nature. Thus, the question of whether individuals engage in sharing, reusing, repairing, recycling or choose products and services with a lower environmental impact (for example train versus plane or vegetarian versus animal protein-based food) has been the focus of a growing number of studies concerned with the well-being implications of making individuals' and households' lifestyles more sustainable (Schmitt et al., 2018; Verhofstadt et al., 2016).

Nevertheless, it is generally accepted that structural or large-scale societal change is necessary to address current environmental challenges associated with climate change, biodiversity loss and natural resource exhaustion (Crompton & Kasser, 2009). This is unlikely to be achieved through changes in selected individual consumption practices and might instead require actions at the collective level, through political and environmental activism (Pirgmaier & Steinberger, 2019; Tagkaloglou & Kasser, 2018). Participating in environmental organizations, actively engaging in protests, peaceful acts of resistance or local ecological regeneration projects and campaigning for green political parties are activities that go beyond the individual. Their success in changing unsustainable

structures, policies, regulations and practices depends on people joining forces with other concerned citizens or grassroots organizations. It is thus important to distinguish between individual PEBs, which aim to reduce environmental impact by consuming more responsibly, and collective PEBs, which aim to create large-scale societal change. Identifying differences in well-being between these two kinds of PEBs could enable a better understanding of how PEBs interact with human motivations. To the best of our knowledge, the present study is the first to examine those differences, although there is some evidence in the literature addressing the two kinds of PEBs separately.

5.2.1.1. Sustainable Consumption and Subjective Well-being: The Individual Level

The sustainable consumption concept encompasses both 'strong sustainability' measures, involving reductions in the total level of consumption and 'weak' measures concerning, for example, energy saving or recycling practices (Lorek & Spangenberg, 2014). Studies on the relationship between well-being and individuals' engagement in specific or general sustainable consumption practices suggest that sustainable consumption is compatible with the hedonic, cognitive and eudaimonic dimensions of well-being.

Previous literature has provided evidence that engaging in PEBs involving sustainable consumption is associated with higher levels of subjective well-being (Brown & Kasser, 2005; Kaida & Kaida, 2016; Xiao & Li, 2011). These studies assess the PEBs of individuals through their participation in practices such as purchasing green products, using water sparingly, turning off lights when not in use, setting heating at a moderate temperature, reusing paper and plastic bags or buying second-hand instead of new, among others. The findings of this research show that changing consumption habits (by consuming less and/or reducing the environmental impact of consumption in different areas of life) could contribute to individual well-being, while also contributing to the well-being of the planet (Kasser, 2017).

However, the positive relationship between sustainable consumption and well-being is not found consistently across studies. Some have found a nonsignificant link between happiness and specific sustainable consumption practices. For example, according to a study conducted by Jacob et al. (2009) with a sample of members of a Buddhist fellowship, there is a positive relationship between subjective well-being and sustainable food purchases, while recycling behaviour and sustainable household choices are not statistically significant. The research by Schmitt et al. (2018), using a sample from

Canada and the United States, finds that 2 out of the 39 PEBs analysed are not significantly related with life satisfaction. These two behaviours were related to the use of public transit or carpool and running the washer or dryer only when full. In a similar vein, Suárez-Varela et al. (2016) focus on actions aimed at water saving and, using data from Spain, show that only the installation of water-saving technologies is positively related to happiness, with water-saving behaviours being insignificant. For their sample from the UK, Binder and Blankenberg (2017) find that PEB, as measured by participation in 11 sustainable consumption practices, does not have a statistically significant impact on life satisfaction. Similarly, Guillen-Royo (2019) analyses a representative sample of the Norwegian population and finds that, after controlling for psychological and lifestyle factors, participation in sustainable consumption practices is significantly associated only with the eudaimonic dimension of subjective well-being.

Few studies have found a negative link between well-being and sustainable consumption patterns. Binder et al. (2020), using a sample of students from the University of Granada, Spain, report a negative relationship between life satisfaction and an index of PEBs composed mainly of sustainable consumption practices. Likewise, for a sample from Flanders, Verhofstadt et al. (2016) found that specific environmentally friendly choices (namely, limited meat or fish consumption, living in a small apartment or house, not having or not using a car and spending holidays at home or nearby) correlated negatively with life satisfaction.

5.2.1.2. Environmental Activism and Subjective Well-being: The Collaborative Level

Collaborative PEBs involve joining others in organizing actions ranging from conventional activist initiatives, such as starting a petition, to high-risk activities, such as blocking roads or occupying public spaces (Corning & Myers, 2002). Engaging in political activism, which includes environmental action, has generally been considered a well-being-enhancing activity. This reflects the traditional association of activism with volunteering, and latter is found to be positively associated with measures of subjective well-being in both cross-country (Meier & Stutzer, 2008; Thoits & Hewitt, 2001) and within-country studies (Binder & Blankenberg, 2016; Binder & Freytag, 2013).

The reasons why activism or volunteering are expected to generate higher levels of well-being are manifold. Studies find that that expressing an interest in the welfare of others and caring about them is positively associated with several measures of affective and

eudaimonic well-being (Aubin & McAdams, 1995; Leak & Leak, 2006). This might be linked to the fact that acts of volunteering could be driven by the pursuit of intrinsic goals such as community feeling, which is traditionally associated with high levels of psychological need fulfilment, happiness or affective well-being and life satisfaction (Kasser, 2002). It might also relate to the fact that engaging in altruistic behaviour provides opportunities to socialize and acquire new knowledge and skills, which contribute to meeting the three psychological needs for competence, autonomy, and relatedness, and also increase life satisfaction (Meier & Stutzer, 2008; Ryan & Deci, 2017).

Not all factors that drive volunteering and pro-environmental activism are of an altruistic nature. Binder and Blankenberg (2016) suggest that the reasons why people engage in volunteering might well be of an egoistic nature, as some see it as a way to advance their career, increase their status, or enhance their self-esteem. The authors find that selfish concerns, such as those related to job security, the economy and personal finances, have a negative impact on life satisfaction but that volunteering attenuates this negative effect. They also find that although being concerned about the environment increases life satisfaction and the propensity to volunteer and become a member of an environmental organization, it does not increase the likelihood of participating in local political initiatives. This suggests that volunteering and activism might have some conceptual differences worth investigating.

Klar and Kasser (2009) maintain that volunteering is a broad term encompassing activities that do not necessarily involve advocacy, which is a defining trait of activism. Activism itself is not a homogenous concept either, as empirical studies indicate a clear-cut split between conventional activist behaviours, such as sending letters to elected representatives or fundraising, and high-risk behaviours, such as blocking access to a building with one's body (Corning & Myers, 2002). In a study using a sample of college students and one of activists, Klar and Kasser (2009) found that conventional activist behaviours were significantly correlated with measures of subjective and eudaimonic well-being, but that this was not the case for high-risk activism. Among the likely explanations, the authors mentioned that "it may be that this group feels a greater sense of injustice and hopelessness, which not only makes them less happy but impels them to more extreme activist behaviours including illegal ones" (Klar & Kasser, 2009, p. 773).

5.2.2. Connectedness to nature, pro-environmental behaviour, and subjective well-being

There are different interpretations of the concept of connectedness to nature in the literature. For Schultz (2002, p. 67), connectedness to nature refers to "the extent to which an individual includes nature within his/her cognitive representation of self". In contrast, Mayer and Frantz (2004) understand this concept as an affective and experiential connection of an individual with nature. Linking both interpretations, Geng et al. (2015) define connectedness to nature as an individual's feelings about connections with nature and belongingness to nature, from both an emotional and a cognitive perspective. Connectedness to nature is a key variable in our study and there is evidence that it is positively related to PEBs and well-being. In fact, it has been shown that connectedness to nature could play a similar, or even more important, role than some socio-demographic factors in the link between well-being and the adoption of PEBs (Martin et al., 2020).

Extant literature suggests that connectedness to nature encourages pro-environmental attitudes and behaviours (Barbaro & Pickett, 2016; Geng et al., 2015; Mackay & Schmitt, 2019; Mayer & Frantz, 2004; Nisbet et al., 2009). It is argued that when individuals feel part of nature, they are less likely to harm it, since damage to the environment would be considered as damage to themselves (Mayer & Frantz, 2004). As such, connectedness to nature might provide an intrinsic motivation to adopt more ecological behaviours, and this motivation is found to last throughout a person's life (Otto & Pensini, 2017). In addition, links with nature have been found to be positively associated with both effortless and more demanding ecological behaviours (Gosling & Williams, 2010; Martin et al., 2020; Ramkissoon et al., 2013; Scannell & Gifford, 2010; Yusliza et al., 2020). In the same way, the loss of connection with nature could explain the deterioration of the environment. In this sense, Soga and Gaston (2016) argue that the decline in individuals' emotional connection, along with reduced opportunities to experience nature directly, discourages positive emotions, attitudes and behaviours related to the environment, creating a cycle of disaffection.

The human-nature link is not only good for nature conservation, but also for people's well-being, as connectedness to nature has been found to predict many indicators of well-being, encompassing both hedonic and eudaimonic well-being (Basu et al., 2020; Capaldi et al., 2014; Martin et al., 2020; Mayer et al., 2009; Mayer & Frantz, 2004; Nisbet et al., 2011; Pritchard et al., 2020; Zelenski & Nisbet, 2014). The sense of kinship,

egalitarianism, embeddedness and belongingness associated with a strong connectedness to nature is believed to contribute to high levels of well-being (Mayer & Frantz, 2004). Similarly, the innate affinity that human beings feel for nature and other forms of life often translates into positive emotions when they find themselves in the natural environment (Nisbet et al., 2011; Zelenski & Nisbet, 2014). Furthermore, Mayer et al. (2009) highlight the possibility that people gain purpose and meaning in life through an experiential sense of belonging to the natural world. Connectedness to nature appears to be a key factor contributing to positive psychological functioning (Pritchard et al., 2020).

Furthermore, connectedness to nature has been shown to be a mediating factor in a number of different relationships; for example, between exposure to nature and positive affect (Mayer et al., 2009), environmental education and vitality (Nisbet et al., 2011), mindfulness and PEBs (Barbaro & Pickett, 2016) or nature-based environmental education and ecological behaviour (Otto & Pensini, 2017). Recently, Martin et al. (2020) have tested the moderating role of connectedness to nature in the relationship between nature contact and some measures of well-being and PEB. However, this construct has never been analysed as a moderating factor in the relationship between PEBs and well-being, as we do in this research.

5.2.3. The present study

The literature review above suggests that there are still important contributions to be made to the literature on the PEBs-well-being relationship. Firstly, the possible differences between the relationship of sustainable consumption with well-being and that of activism with well-being remain unexplored. These differences are worth examining as the two kinds of PEBs have different implications for social structure. Secondly, even though connectedness to nature is found to be positively related to PEBs and well-being, no evidence has been reported to date on the role of connectedness to nature as a moderator in the PEBs-well-being relationship. In an attempt to address this research gap, in this paper we propose the following hypotheses (see also Figure 5.1):

- **Hypothesis 1.** *Connectedness to nature is positively associated with both PEBs and well-being.*
- **Hypothesis 2.** *Individual and collective PEBs are both positively associated with well-being, but there are differences in regard to their relationship with the three dimensions of well-being.*

- **Hypothesis 3.** *Connectedness to nature strengthens the positive relationship between PEBs and well-being.*

The first hypothesis stems directly from the literature on connectedness to nature (Basu et al., 2020; Capaldi et al., 2014; Gosling & Williams, 2010; Mackay & Schmitt, 2019; Martin et al., 2020; Pritchard et al., 2020; Yusliza et al., 2020). The second hypothesis is established in order to answer the first research question: Are there differences between individual and collective PEBs in their relationship with well-being? This hypothesis allows us to evaluate the difference between individual and collective PEBs in their relationship with well-being, an issue which has yet to be explored. The third hypothesis deals with the possibility that connectedness to nature acts as a moderator[8] in the relationship between PEBs and well-being, which has not been examined in the literature to date. It is aimed at answering the second research question: What role does connectedness to nature play in the relationship of well-being with individual and collective PEBs? Hypothesis 3 draws on the fact that feeling connected to nature, and acting to protect it through sustainable consumption practices and activism, might lead individuals to experience higher levels of choice and autonomy over their behaviours, thereby facilitating more persistent and higher quality motivation and increased well-being (Kasser, 2017). Thus, we would expect that people who see themselves as part of nature might experience higher levels of well-being, as they engage in more individual and collaborative PEBs than their less connected counterparts.

[8] We considered connectedness to nature as a moderator, i.e. a variable 'that changes the size and/or the direction of the relationship between two variables' (Field, 2018, p. 1026), rather than exploring the idea of mediation (concerning the possibility that connectedness to nature explains the positive relationship between PEBs and well-being) because the latter would assume that consuming more sustainably or engaging in environmental activism predicts a higher connectedness to nature, which to the best of our knowledge is not supported by the literature on the topic.

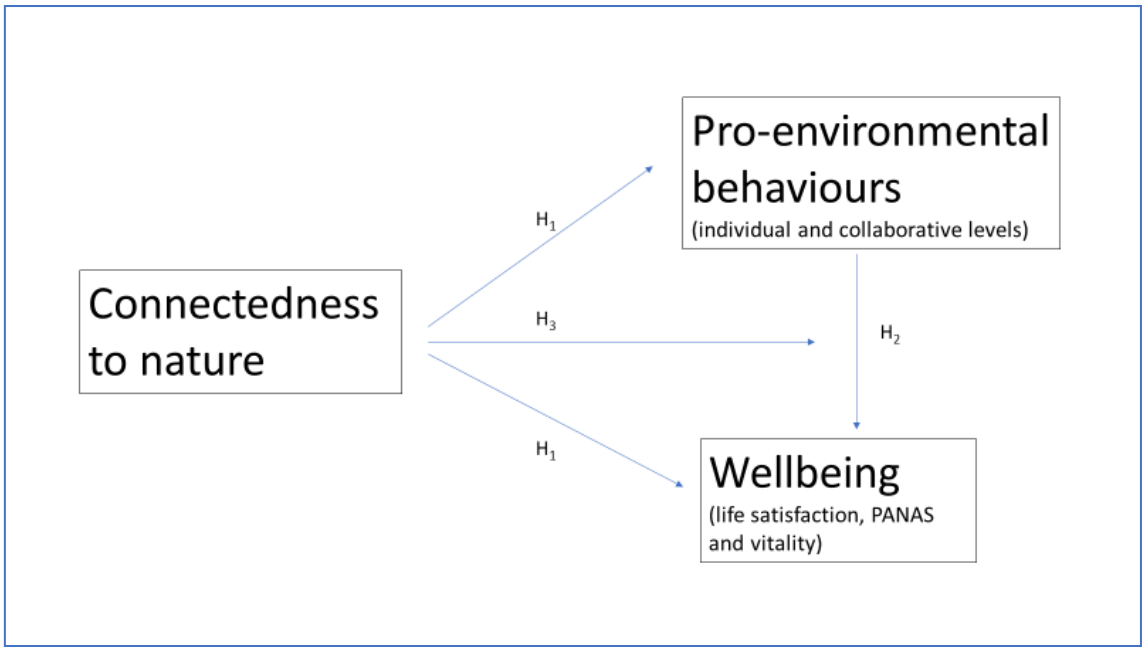

Figure 5.1. Study hypotheses.

The analysis takes into account the cognitive, affective and eudaimonic dimensions of well-being to answer the two main questions in this research: (1) Whether there are differences between consuming sustainably (individual PEBs) and engaging in environmental activism (collaborative PEB) in regard to their relationship with the three dimensions of well-being. (2) Whether the extent to which connectedness to nature modifies the relationship between PEBs and well-being varies across PEB types and well-being dimensions.

5.3. Materials and methods

5.3.1. The fieldwork

In this research, we used a new database comprising 1283 students from different faculties and disciplines, such as economics, sociology, social work and environmental studies, at the University of Granada, Spain. The fieldwork was undertaken during the months of March and April 2019. A research team visited classrooms and provided students with the questionnaire, which was accessible online via Qualtrics. Students did not receive any payment for filling in the questionnaire. After deleting missing values and 5 observations that made no sense, the final sample was left with 973 observations.

5.3.2. The variables

To evaluate the subjective well-being of individuals we used 3 indicators: life satisfaction (cognitive dimension), positive and negative emotions (affective dimension) and subjective vitality (eudaimonic dimension). Life satisfaction is related to the cognitive assessments and judgments people make about their life (Dolan et al., 2008). We measured the variable *lifesat* through the question "How satisfied are you at this moment with your life as a whole?" Survey participants answered the question using an 11-point Likert scale ranging from 0 (completely dissatisfied) to 10 (completely satisfied).

The affective component of well-being was captured through the Positive and Negative Affect Schedule (PANAS) proposed by Watson et al. (1988). PANAS is composed of 20 items describing different feelings and emotions, 10 positive affections (motivated, alert, excited, inspired, strong, determined, attentive, enthusiastic, active, proud) and 10 negative affections (irritable, annoyed/upset, embarrassed, angry, nervous, guilty, fearful, aggressive, restless, insecure). For each item, the individuals indicated how they had felt during the last 7 days using a 5-point Likert scale (1 = very slightly or not at all, 2 = a little, 3 = moderately, 4 = quite a lot and 5 = extremely). The variable *emotions* was calculated as the difference between the sum of the positive affection scores and the sum of the negative affection scores. Regarding the reliability of this measure, the Cronbach's alpha of 0.86 confirmed its internal consistency.

Finally, we used the Subjective Vitality Scale developed by Ryan and Frederick (1997) to reflect the eudaimonic dimension of well-being. Subjective vitality can be defined as the conscious experience of possessing energy and vivacity, and is considered an aspect of eudaimonic well-being because it is part of being in a state of full psychological and physical functioning (Guillen-Royo, 2019; Ryan & Frederick, 1997). The Subjective Vitality Scale (the variable *vitality*) was calculated as the arithmetic mean of the scores given to 6 statements related to feeling vital: "I feel alive and vital"; "Sometimes I feel so alive I just want to burst"; "I have positive energy and spirit"; "I get excited every new day"; "I nearly always feel alert and awake"; "I feel energized". The answers to each statement are scored on a 5-point scale (1 = Totally false; 2 = Not so true; 3 = Somewhat true; 4 = Fairly true; 5 = Extremely true). The vitality scale had a Cronbach's alpha of 0.87, confirming its internal consistency.

We captured PEBs by using a sustainable consumption index, and a variable indicating the frequency of political participation in demonstrations supporting the environment. In order to capture sustainable consumption, we asked individuals to score the degree with which they perform several actions. Those actions were: "turn off lights in rooms that are not being used"; "put on more clothes when it's cold at home, instead of turning on or raising the heating level"; "decide not to buy something because it has an excess of packaging"; "buy recycled products such as toilet paper or recycled tissues"; " carry your own shopping bag"; "separate the rubbish, for example, paper, plastic, glass"; "use public transport (e.g., bus, train) instead of using the car"; "walk or cycle for short distances (up to about 3 - 4 km)"; "take fewer planes when possible"; "reduce consumption of meat or animal products"; "buy organic or eco-labelled food"; "buy organic or eco-labelled products (furniture, clothing)"; "preference for buying local products"; "throw away food"; "in general, try to reduce consumption in everyday life". Participants indicated how engaged they were in these behaviours "very slightly or not at all" (1), "a little" (2), "moderately" (3), "quite" (4), or "extremely" (5). They were also given the option to indicate if any of the behaviours were not applicable to them. We re-coded the answers to the item "Throwing food away" so that high scores denote environmentally friendly behaviour in all cases. Based on these responses, we calculated the variable *sustconsumption* as the mean of the scores obtained in the different behaviours. To calculate this average, the sum of the scores was divided by the number of behaviours to which the individual responded, such that the overall score was not affected if one of the behaviours was not applicable to the individual. The sustainable consumption index had a good level of internal consistency (Cronbach's alpha of 0.78).

The questionnaire used the same scale for respondents to rate the frequency with which they participate in demonstrations in support of the environment (*activism*). This last variable was a proxy for activist engagement.

Another central variable in this research is connection to nature, for which we used the proxy of the connectedness to nature scale (Mayer & Frantz, 2004). This scale comprises 14 items referring to an individual's relation with nature: "I often feel a sense of oneness with the natural world around me"; "I think of the natural world as a community to which I belong"; "I recognize and appreciate the intelligence of other living organisms"; "I often feel disconnected from nature" (reverse scored); "When I think of my life, I imagine myself to be part of a larger cyclical process of living"; "I often feel a kinship with animals

and plants"; "I feel as though I belong to the Earth as equally as it belongs to me"; "I have a deep understanding of how my actions affect the natural world"; "I often feel part of the web of life"; "I feel that all inhabitants of Earth, human, and nonhuman, share a common 'life force'"; "Like a tree can be part of a forest, I feel embedded within the broader natural world"; "When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature" (reverse scored); "I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees"; "My personal welfare is independent of the welfare of the natural world" (reverse scored) (Mayer & Frantz, 2004). People replied to these items on a 5-point Likert scale, ranging from strongly disagree (1) to strongly agree (5). The *connectedness* to nature scale was calculated by averaging the score of all items, with reverse scoring in some items as applicable. The Cronbach's alpha for this scale was 0.84, indicating its internal consistency.

In order to test the hypotheses in section 5.2.3, in addition to the main variables of well-being, PEBs and connectedness to nature, we included a set of control variables in the analysis, capturing respondents' personal information. In the survey, participants indicated their parents' monthly income by selecting 1 of the 8 intervals given as an option, with the lowest category being less than EUR 499 and the highest being EUR 5000 or more. We estimated the income for each category using the midpoint of the interval (except in the case of the top category, where we estimated it at EUR 6000). We calculated per capita income by dividing the amount by the number of people living in the household and we applied the natural logarithm to consider the decreasing marginal utility of income (Clark et al., 2008). In addition, in the analysis we considered *age* in years as specified by respondents, and we also incorporated the variable age^2. Respondents indicated their *gender* selecting male (1), female (2) or other (3), and we included a dummy equaling 1 if the individual reported being *female*. We introduced the *single* variable if the individual was not in a stable relationship. The variable *relationships* provided information about the social life of the respondents. They were asked about the frequency with which they are in touch with their relatives, friends, and neighbours on a scale from never (1) to every day or almost every day (5). We calculated the variable as the average of the scores obtained in the 3 items (family, friends, and neighbours). Individuals described their health status by selecting one of the following categories: no problems (3), mild problems (2), moderate problems (1) and major problems (0). Finally,

the variable *work* was a dichotomous variable that indicated whether the respondent works (1) or not (0).

5.3.3. Method of analysis

To examine the relationship between PEBs (sustainable consumption and activism) and well-being (H2), we used regression analysis (ordinary least squares, OLS), which allowed us to determine both the nature and strength of the relationship between these 2 variables. In all analyses, we specified a different model for each dimension of well-being (life satisfaction, emotions and vitality), with the well-being variables as the dependent variables of the model. We tested H1 using bivariate Pearson correlations. Finally, we again used regression analysis to test H3, incorporating interaction terms. The interactions were between sustainable consumption and connectedness to nature, as well as the activism variable and connectedness to nature. In order to avoid high variable inflation factors in the analysis that condition the results, the interaction variables were mean corrected; that is, we constructed the interactions using the variables that interact by subtracting their mean value (Iacobucci et al., 2016). Again, we specified a different model for each dimension of well-being, which were the dependent variables.

Linear regression analysis was the most suitable method for the variables of *emotions* and *vitality* for testing H2 and H3, since they were quantitative variables. In contrast, given the ordinal nature of the variable *lifesat*, it may have been more appropriate to use an ordered probit or logit model. However, we applied OLS because the results were easier to interpret with this method. Additionally, the results obtained with both methods are very similar (Ferrer-i-Carbonell & Frijters, 2004). In any case, in order to provide more evidence, we repeated the analyses of life satisfaction using an ordered probit technique, arriving at similar results and conclusions about the relations of the key variables. Data analysis was performed using Stata15 statistical software. The general specification of the equation estimated in this study is as follows:

$$SWB_i = f(PEBs_i, connat_i, interactions_i, X_i),$$

where SWB_i stands for the 3 measures of subjective well-being, $PEBs_i$ refers to the sustainable consumption index and the *activism* variable for testing H2, $connat_i$ is the connectedness to nature index whose inclusion together with that of $interactions_i$ allows

us to test H3. X_i is a vector of variables that includes all control variables and is used in all regressions.

In terms of the control variables included in the analysis, we expected income to have a positive, though not very strong, relationship with subjective well-being. For age, we assumed a U-shaped well-being curve: younger and older people have higher levels of well-being, while lower levels occur in middle age. For gender, we could not anticipate the relationship with subjective well-being, because the evidence was not clear. We believed that being single and having health problems both had a negative relationship with well-being. Conversely, we expected that socializing with family, friends and neighbours was positively associated with well-being. Finally, although having a job is often associated with higher levels of well-being, it was not clear whether it would be in this case, due to the fact that the respondents are students.

5.4. Results

We begin with a descriptive analysis of the variables used in the regression analysis (Table 5.1). The mean value of sustainable consumption is higher than that of activism, which means that, on average, people are more likely to engage in PEBs relating to consumption practices than to participate in pro-environmental protest. Approximately 60% of the sample are women, a similar percentage reports being single, around a quarter of people work as well as study, and the average age is 20 years. The average of the variables related to health and relationships are nearer to the maximum value than to the minimum. The same is true of the well-being variables.

Table 5.2 shows the Pearson correlation coefficients between the two types of PEBs, connectedness to nature and well-being dimensions. The three subjective well-being measures are significantly correlated with each other, with a Pearson correlation between 0.5–0.62 and a p-value lower than 0.01. However, the two types of PEBs do not significantly correlate with each other, with a correlation lower than 0.5. Sustainable consumption positively correlates with vitality ($r = 0.077$, $p < 0.05$) and activism negatively correlates with life satisfaction ($r = -0.09$, $p < 0.01$), results that are in line with those presented in Table 5.3 below. Connectedness to nature is positively related to all well-being and PEBs variables, with p-values lower than 0.01 in all cases. This

supports H1, which posits a positive relationship between connectedness to nature, PEBs and well-being in our student sample.

Table 5.1. Descriptive statistics.

	Mean/%	Std. Dev.	Min	Max
Subjective well-being				
lifesat	7.031	1.698	1	10
emotions	7.992	11.0	-25	35
vitality	3.309	0.738	1	5
Pro-environmental behaviours (PEBs)				
sustconsumption	3.015	0.611	1.133	4.866
activism	1.864	1.193	1	5
Moderator variable				
connectnature	3.319	0.639	1.3571	5
Control variables				
income	6.191	0.796	3.218	8.699
age	20.7	2.812	18	54
age^2	436.5	146.7	324	2916
female	62.2%		0	1
single	63.2%		0	1
relationships	3.481	0.754	1	5
health	2.435	0.679	0	3
work	25.4%		0	1

Table 5.2. Correlation (Pearson) of pro-environmental behaviours and well-being measures.

	Lifesat	*Emotions*	*Vitality*	*Sustconsumption*	*Activism*	*Connectnature*
Lifesat	1					
Emotions	0.556 **	1				
Vitality	0.501 **	0.621 **	1			
Sustconsumption	−0.014	0.043	0.077 *	1		
Activism	−0.090 **	0.016	0.039	0.478	1	
Connectnature	0.094 **	0.137 **	0.201 **	0.369 **	0.276 **	1

* means statistically significant at 5%, and ** means statistically significant at 1%

Table 5.3 presents the results of the OLS estimations for testing H2 using the three well-being variables as the dependent variables for the different model specifications, and including the PEBs and the control variables. The sustainable consumption index is positively related to the eudaimonic dimension of well-being (b = 0.094, $p < 0.05$), but is not significantly associated with the cognitive and affective dimensions. Contrary to our expectations, activism is negatively associated with life satisfaction (b = −0.155, $p < 0.01$) and is not significantly related to the other well-being dimensions.

Regarding the control variables, as we expected, we found a positive association between the *relationships* and *health* variables and all dimensions of well-being. In contrast, the relationship between the other variables and well-being depended on the dimension considered. Income was positively related to emotions and vitality. Age was also positively associated with vitality. Being a woman was negatively associated with the affective dimension of well-being, while being single was negatively associated with the cognitive dimension.

Table 5.3. Well-being and pro-environmental behaviours.

	Lifesat	*Emotions*	*Vitality*
sustconsumption	0.0801	0.906	0.094 *
	(0.098)	(0.667)	(0.042)
activism	−0.155 **	−0.067	−0.007
	(0.051)	(0.327)	(0.022)
income	0.090	0.990 *	0.054 *
	(0.063)	(0.424)	(0.027)
age	−0.025	0.054	0.0562 *
	(0.063)	(0.437)	(0.027)
age^2	0.001	0.003	−0.001
	(0.001)	(0.006)	(0.001)
female	0.083	−1.703 *	−0.063
	(0.107)	(0.707)	(0.046)
single	−0.468 **	−1.238	−0.025
	(0.105)	(0.713)	(0.045)
relationships	0.385 **	2.933 **	0.297 **
	(0.072)	(0.463)	(0.031)
health	0.608 **	3.383 **	0.217 **
	(0.079)	(0.517)	(0.032)
work	−0.056	0.001	0.018
	(0.126)	(0.845)	(0.050)
constant	4.224 **	−20.1 **	0.359
	(1.072)	(7.080)	(0.456)
F	13.38	12.75	19.66
R^2	0.128	0.114	0.163
N	973	973	973

All models are statistically significant at 1%. ** $p < 0.01$, * $p < 0.05$
Robust standard errors in parentheses.

Finally, in Table 5.4 we present the results of testing H3 by including the connectedness to nature index in the empirical model, and the interactions of this variable with the two PEBs variables.

The coefficient of the connectedness to nature index appears to be highly significant ($p < 0.001$) in all models estimated. Engaging in environmental activism is negatively related to life satisfaction, as in the estimations from Table 5.3, but the coefficient of the sustainable consumption variable is not significant when adding the interactions. The interaction between activism and connectedness to nature is positively related to life satisfaction; therefore, the marginal influence of being activist on life satisfaction is dependent on connectedness to nature. By setting the derivative equal to zero, a critical value of connectedness to nature of 4.53 (on a 1–5 scale) can be calculated. This means that if individuals experience a very strong connection to nature (greater than 4.53), then the marginal effect of activism on life satisfaction turns positive.

Table 5.4. Well-being and pro-environmental behaviours, including interactions with connectedness to nature.

	Lifesat	*Emotions*	*Vitality*	*Lifesat*	*Emotions*	*Vitality*
sustconsumption	−0.013	0.268	0.033	0.001	0.274	0.037
	(0.105)	(0.689)	(0.044)	(0.102)	(0.678)	(0.044)
activism	−0.176 **	−0.203	−0.020	−0.202 **	−0.192	−0.024
	(0.051)	(0.329)	(0.021)	(0.052)	(0.326)	(0.021)
connectnature	0.274 **	2.124 **	0.193 **	0.258 **	2.127 **	0.190 **
	(0.094)	(0.591)	(0.041)	(0.093)	(0.597)	(0.041)
*mcsustcon * mcconnat*	0.144	0.075	0.042			
	(0.133)	(0.831)	(0.055)			
mcactivism mcconnat*				0.166 *	−0.047	0.030
				(0.066)	(0.410)	(0.028)
F	11.68	11.75	19.12	12.33	11.80	19.50
R^2	0.138	0.126	0.186	0.143	0.126	0.186
N	973	973	973	973	973	973

All models are statistically significant at 1%. ** $p < 0.01$, * $p < 0.05$
Robust standard errors in parentheses.

The control variables are included in the estimations but not depicted in the table, as the coefficients are similar to those from Table 5.2.

5.5. Discussion, future research, and limitations

This research used an original dataset comprising 973 students from the University of Granada in Spain to study the relationship between individual and collaborative PEBs and well-being. It explored the connection of PEBs with three aspects of well-being; the affective, cognitive and eudaimonic dimensions.

In sum, our results indicate that (1) there is a positive correlation between connectedness to nature and all five indicators capturing PEBs and well-being, thus supporting H1. Regression analysis confirmed that sustainable consumption is directly related to the Subjective Vitality Scale, although it is not significantly related to life satisfaction and affect. The study also indicated that (2) individual and collaborative PEBs might differ in their relationship with well-being. We found activism to have a negative link to life satisfaction and a not significant association with affect and vitality. These findings suggest we should reject H2, which posits a positive association between PEBs and well-being. Additionally, we found that (3) when introducing connectedness to nature in the well-being regressions, the negative association between pro-environmental activism and life satisfaction turns positive, but only for those with a very strong connection to nature. The interaction effect is not significant concerning individual PEBs, however, which does not support H3.

The findings of this study contribute to the literature on PEBs and well-being in several ways. Firstly, the not-significant relations found between sustainable consumption and several well-being measures indicate that the well-being dividend (gaining in well-being while conserving and enhancing the natural environment), as defined by Jackson (2005), may not be present across socio-economic, cultural or demographic groups. Some previous studies have suggested the same. For instance, a negative relationship between PEBs and life satisfaction was found in previous research for students from Granada drawn from a different sample (Binder et al., 2020), but a positive relationship was found among US high school students (Brown & Kasser, 2005). Another example is the not-significant relation between happiness and recycling found among Buddhists in the US (Jacob et al., 2009), while Schmitt et al. (2018) found a significant relationship between life satisfaction and recycling for a sample of people in Canada and the US. The fact that different social groups and different cultures present differences in how engaging in PEBs is associated with happiness could form the basis of a hypothesis to be explored in future research.

Secondly, the negative association between participating in pro-environmental demonstrations and life satisfaction seems to contradict previous literature, unless joining pro-environmental protests in Granada is considered high-risk activism. In the context of this research, the authors have had informal conversations with several activists and members of grassroots organizations. In general, they consider participating in marches

or demonstrations to be a low-risk activity in Granada, as risks for human security or freedom seem to be minimal. The literature is still scarce on the relationship between environmental activism and well-being, but existing studies point to a positive relationship between low-risk activism and most dimensions of well-being (Klar & Kasser, 2009). This suggests that more research is required to understand the implications of becoming involved in collaborative PEBs as an undergraduate student in this Southern European city. Conducting in-depth interviews with activist students appears to be a good way forward.

The study found that the negative relationship between participating in protests and life satisfaction is reversed for people who identify themselves as highly connected to the natural environment. This group might feel that the opportunity to express their connection to nature through collaborative endeavours, such as participating in marches and demonstrations, reduces the need to resign themselves to a situation of environmental degradation. The perception that they might be able to contribute to structural change could increase their feelings of autonomy and control over their own actions. Following Self-Determination theory, higher levels of autonomy contribute to higher psychological need satisfaction and subjective well-being (Ryan & Deci, 2000).

Thirdly, connectedness to nature seems to play an important role in explaining care for the environment and individual well-being, as it is significantly and positively correlated with all measures of PEBs and the three dimensions of well-being. The importance of this variable, in terms of its positive correlations, and the fact that it turns the negative relationship between activism and life satisfaction into a positive one, suggests that it might play an important role in generating win-win situations characterized by higher levels of well-being and lower environmental impact. In this respect, our results are in line with previous literature claiming that people who experience a high level of connectedness to nature achieve the well-being dividend (Martin et al., 2020; Mayer & Frantz, 2004).

Finally, some limitations of the research design need to be addressed. Firstly, as is the case in many other studies on the connection between PEBs and well-being, we use a convenience sample. As such, we cannot be sure that the students included in our study are representative of the whole University of Granada or the student population in general. Secondly, the sample is adequate for statistical analysis, but a greater sample size and an

attempt to represent the whole spectrum of university students would be ideal. Thirdly, as we work with cross-sectional data, causality cannot be asserted. This is why we discuss relationships in terms of associations between variables, and not in terms of causal impacts. Fourthly, our indicator of environmental activism leaves room for improvement: it is based on a question on participation in pro-environmental demonstrations and could be enriched by including other dimensions of activism. Pro-environmental activism could involve different types of actions; from collecting signatures to demanding stricter recycling laws to blocking roads and accesses to public buildings. We believe that including measures of different types of activism to capture the time, effort and personal risk they entail would enrich future studies on the topic. Additionally, the potential causality between activism and well-being should be researched in the future, provided that there is panel data to implement the analysis.

5.6. Conclusions

This paper posed the following research questions: Are there differences between individual and collective pro-environmental behaviours (PEBs) in their relationship with well-being? What role does connectedness to nature play in those relationships? Exploring these questions represents a novel contribution to the literature, where, as to the best of our knowledge, it has not been addressed in previous research. We have considered three dimensions of well-being—cognitive, affective and eudaimonic—and two conceptualizations of PEBs—individual actions (sustainable consumption) collaborative actions (pro-environmental activism). No related studies to date have examined the different dimensions of well-being and/or pro-environmental behaviours, so our study is the first to add such depth in the understanding of their relationship. In addition, despite the role of connectedness to nature having previously been explored in connection with well-being and/or PEBs, it has never been analysed as a moderator in the PEBs-well-being relationship, with the present study being the first to undertake such a rich exploration.

In order to answer the questions proposed in this research, we drew on a sample comprising 973 university students to explore the relationship between PEBs and well-being. Results indicate that individual PEBs are positively related to eudaimonia and that pro-environmental activism, our measure for collaborative PEB, is negatively related to

life satisfaction. Other relationships are found to be non-significant. We included a connectedness to nature index in order to ascertain its possible moderating role in the PEBs-well-being relationship. Results indicated that connectedness to nature is positively associated with individual and collaborative PEBs and all well-being dimensions. In addition, it moderates the life satisfaction-activism relationships; when connectedness to nature is included, the negative association between activism and life satisfaction becomes positive for those declaring a very strong connection to nature. This suggests that feeling highly connected with the natural environment might be a key factor in the societal quest to achieve the well-being dividend.

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CHAPTER 6. Conclusions

The ecological crisis is a multifaceted challenge that has its roots in the foundations of industrialised societies. It is a consequence of how our economic system works, how our societies are organised and, ultimately, how we humans have positioned ourselves in relation to the rest of nature. The ecological crisis is therefore not only an environmental challenge, but also a social, cultural, economic, political, ethical, and personal challenge. Thus, tackling environmental problems requires action at individual, community, national and global levels (Kool & Agrawal, 2020).

The present thesis aims to contribute to the literature on sustainability by focusing on individual behaviour. In general terms, this thesis seeks to shed light on the extent to which people adopt pro-environmental behaviours, the factors that determine the adoption of these behaviours, and the impact that engaging in pro-environmental actions may have on people's individual well-being. Particular emphasis is placed on pro-environmental behaviours related to water use, given the essential nature of this resource and the concerns about its availability. The city of Granada, where the studies that make up the thesis took place, is in an area of extremely high water stress, which is sure to be exacerbated by climate change (United Nations, 2024; World Resources Institute, 2023). In this context, the efficient use of water resources is a priority in the study area, as it is in many other regions of the world facing similar situations.

One of the key concepts addressed in the thesis is the relationship between humans and nature. Human alienation from nature may be one of the main reasons underlying environmental degradation, and restoring this connection may be an effective solution (Pyle, 2003). The first study presented here (**Chapter 2**) makes a novel contribution to the literature by specifically investigating the role of connection and contact with nature in five domestic water-saving behaviours. Four of the five household water use habits

studied are significantly and positively related to at least one of the dimensions of people's relationship with nature (either feeling connected or visiting natural environments).

Chapter 3 examines one of the main water-consuming activities in the household: showering. This chapter presents a comprehensive study of showering patterns, taking into account different aspects of behaviour that determine water consumption (frequency and duration) and considering possible differences in showering habits between the winter and summer seasons. In an attempt to better understand the determinants of this behaviour, a wide range of explanatory factors are used; in addition to the socio-demographic variables typically analysed in this type of study, other potentially relevant psychological and environmental variables are also examined, including the physical and psychological relationship with nature, performance in pro-environmental behaviour in other domains, personal values or the experience of feelings of anxiety or insecurity. The results show that water savings could be achieved by encouraging sustainable showering practices, and that related awareness campaigns should take into account the season. The identification of different determinants allows for better tailoring of these campaigns as well as the implementation of other effective interventions.

The potential impact of sustainable showering habits on a person's well-being is explored in **Chapter 4**. Despite the well-being connotations of unsustainable showering habits, which involve long and frequent showers with the associated high levels of water and energy consumption (Quitzau & Røpke, 2009), no evidence is found that they actually contribute to people's perceived well-being. On the contrary, the results of the study indicate that higher water consumption due to longer showers is associated with poorer well-being. This result holds for all dimensions of well-being analysed (cognitive, affective and eudaimonic), regardless of the season of the year. Therefore, sustainable water consumption during showering does not seem to be costly in terms of well-being.

The final study presented (**Chapter 5**) provides a deeper insight into the relationship between pro-environmental behaviour and subjective well-being. The first contribution of this research is the distinction between individual and collective behaviour when analysing its relationship with well-being. Secondly, this study contributes to the literature by analysing the possible moderating effect that feeling connected to nature may have on this relationship. The results suggest differences between the two types of behaviour: individual behaviour (recycling, reducing consumption, etc.) is only

significantly associated with the eudaimonic dimension (subjective vitality) of well-being, and this relationship is positive; whereas collective behaviour (participation in demonstrations in support of the environment) is only significantly associated with the cognitive dimension (life satisfaction), but this relationship is negative. However, this negative relationship is reversed for people who have a high level of connection with nature. In other words, the initial negative relationship between environmental activism and life satisfaction becomes positive for people who feel strongly connected to nature.

In summary, the main **general conclusions** that can be drawn from the results of the thesis are as follows:

I. There is a wide range of factors that condition the adoption of pro-environmental behaviours, although the significance and sign of the associations generally vary depending on the particular behaviour analysed. Nevertheless, nature connection seems to have a robust influence on the formation of pro-environmental behaviours, including water conservation.

II. The relationship between pro-environmental behaviour and subjective well-being is complex and varies according to the type of behaviour and the characteristics of individuals. It is important to note that pro-environmental behaviour and subjective well-being need not be incompatible. Efforts should be made to understand and expand the contexts in which the two are compatible.

III. In this sense, it is worth highlighting the potential of a person's relationship with nature, not only to promote pro-environmental behaviours, but also to reverse possible detrimental effects that certain behaviours may have on well-being. Consequently, the relationship with nature can be considered a fundamental pillar in the construction of sustainable societies.

In light of the findings, some **recommendations** are proposed to guide the formulation of measures aimed at positively impacting the environment and well-being. One implication of the findings concerns the framing of pro-environmental behaviour as a sacrifice. The ecological crisis is often presented as a crossroads where people must choose between their own well-being and the well-being of the environment, an approach that discourages environmental protection (Prinzing, 2023). This perspective is misleading, as human well-being is inextricably linked to the health of the planet (Ferrer-

i-Carbonell & Gowdy, 2007; Majeed & Ozturk, 2020). Furthermore, the results demonstrate that numerous actions are conducive to good environmental conditions while also being positively correlated with individual well-being. This finding aligns with previous studies that have suggested that individuals who engage in more environmentally-responsible behaviours may enjoy higher levels of well-being (Kasser, 2017; Zawadzki et al., 2020). It is imperative that this message be widely disseminated. Communication strategies that tackle the perception that pro-environmental actions involve personal sacrifice would enhance the efficacy of campaigns promoting sustainable behaviour (Chwialkowska & Flicinska-Turkiewicz, 2021).

On the other hand, the perception that pro-environmental behaviour entails a sacrifice may be influenced by personal values and the values espoused by society. The prioritisation of values of self-transcendence (such as altruistic and biospheric values) reinforces the intrinsic motivation to act appropriately (normative goal frame versus hedonic and gain goals), which induces pro-environmental behaviours even if they are costly in terms of time, effort or money (Steg et al., 2016). In line with this, intrinsic goal orientation was found to be positively related to more sustainable water use. Efforts to act pro-environmentally driven by intrinsic motivation can result in feelings of satisfaction and a sense of fulfilment, a phenomenon known as the "warm glow", which gives rise to win-win situations (Taufik et al., 2015). However, rather than elevating intrinsic values, capitalist societies tend to promote extrinsic values on which the economic system is based, driving people to work, earn and consume more (Kasser, 2017). To alter this dynamic, there are a number of measures that could be employed to facilitate a shift from extrinsic to intrinsic values. These include the imposition of restrictions on advertising, the encouragement of voluntary simplicity, and the reduction of the working hours, while promoting a conception of the good life based on "time affluence" rather than "material affluence" (Kasser, 2010).

Policies aimed at strengthening people’s relationship with nature can also promote synergies between sustainability and well-being. The findings indicate that people who feel more connected to nature are more likely to engage in pro-environmental behaviour and benefit from the resulting double dividend (i.e. higher levels of well-being associated with higher levels of pro-environmental performance; Jackson, 2005). This supports the importance of reconnecting people with nature as a powerful source of leverage for sustainability transformation (Abson et al., 2017). It is therefore worthwhile to implement

measures to reverse the process of alienation from nature, which is particularly prevalent in urban areas (Soga & Gaston, 2016). In this sense, one way to strengthen people's relationship with nature is through the planning and management of urban green infrastructure (Andersson et al., 2014). However, in order to achieve more profound changes, it is necessary not only to provide more opportunities to experience nature, but also to adopt measures that strengthen cognitive, emotional and philosophical connections with nature (Ives et al., 2018). One area of intervention that has the potential to influence different dimensions of nature connection is education. Initiatives such as outdoor education programmes and ecocentric education programmes can promote contact with nature, develop students' knowledge and awareness of the environment, strengthen their sense of belonging to nature and promote ecocentric worldviews (Barrable, 2019; Braun & Diekes, 2017).

Before concluding, it is important to point out some of the **limitations** of the research carried out. When interpreting the results, the cross-sectional nature of the data analysed should be taken into account, as it means causal interpretations should be made with caution. It should also be borne in mind that the results were obtained from a sample of university students, mainly young people, in an area of high water stress. Future research should examine whether the results apply to other populations and geographical areas with different environmental and cultural contexts. Despite the aforementioned limitations, it is to be hoped that the findings of this doctoral thesis will facilitate the formulation of policies that achieve high levels of human welfare, while simultaneously ensuring the sustainable use of natural resources and minimising the environmental impact of human activity.

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