Universidad de Alcalá

Programa de Doctorado en
Historia, Cultura y Pensamiento

Religión, Consumo Sostenible y Cambio Climático: la influencia de la religiosidad en la Huella de Carbono Personal

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Alcalá de Henares, 2022

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AGRADECIMIENTOS

Esta tesis no habría sido posible sin el apoyo de muchas personas maravillosas. En primer lugar, gracias a mi marido, por creer siempre en mí, y a mis hijos, por ser la motivación principal para transitar esta etapa. A mis padres y hermanas, por ser apoyo y descanso en cada momento.

A mis directores, el Dr. Emilio Chuvieco y la Dra. Carmen Valor, gracias por su dedicación para conmigo, por ser ejemplos no sólo en el ámbito académico, sino también fuera de él. Emilio y Mamen, siempre les estaré agradecida por ayudarme a transitar este camino.

Agradezco a mi familia ampliada, a los amigos de siempre y los que conocí en esta etapa, por ayudarme a perseverar.

Por último, gracias a la Cátedra de Ética Ambiental y al Departamento de Geografía, Geología y Medioambiente por dar soporte a mi trabajo y a la Fundación Tatiana Pérez de Guzmán el Bueno por financiar esta investigación.

RESUMEN

Esta tesis tiene como objetivo examinar la influencia de la religión a nivel individual en el consumo sostenible, es decir, en aquel comportamiento de consumo que busca minimizar el impacto negativo de las propias acciones en el mundo natural (Kollmuss & Agyeman, 2002). El marco teórico de esta investigación se ubica en la convergencia entre las ciencias ambientales y humanas, incluyendo literatura en psicología ambiental, psicología de la religión y de comportamiento del consumidor para entender de qué modo y bajo que supuestos la religiosidad individual influye en el consumo sostenible.

El presente documento se estructura en seis capítulos. El primer capítulo es una introducción general que contextualiza los principales efectos de la afiliación religiosa y la religiosidad en el consumo sostenible frente a uno de los mayores desafíos del presente: la mitigación del cambio climático. Si bien el vínculo entre la religión a nivel individual y la mitigación del cambio climático comienza a ser examinado empíricamente en la literatura, principalmente se ha analizado su influencia en variables como la percepción del mismo y aquellas orientadas a medir la intención de realizar acciones tendientes a su mitigación. Sin embargo, la literatura especializada incluye pocos estudios que consideren medidas comportamentales, es decir, que cuantifiquen las emisiones asociadas a las prácticas de consumo. Este capítulo presenta las razones para la elección de la huella de carbono personal como variable de medida del consumo sostenible, se discuten las medidas de religiosidad existentes y la elegida para el desarrollo de esta investigación, y se concluye con la estructura de la tesis y sus objetivos.

El segundo capítulo presenta una revisión sistemática de la literatura sobre el tema de estudio. Siguiendo el método PRISMA para revisiones sistemáticas y meta-análisis, se seleccionó un grupo de artículos relevantes para el análisis sobre los que se estructuró la evidencia reportada en los mismos. Se destaca que la religión a nivel individual influye en la preocupación, percepción y actitudes hacia el consumo sostenible, si bien la dirección de esta influencia (negativa/positiva) no está clara. Entre las razones de estas inconsistencias se encuentran problemas de conceptualización del vínculo analizado, de la elección de las medidas de medición de los constructos “religión” y “consumo sostenible” utilizadas y de la influencia del contexto geográfico-cultural donde se realizaron la mayor parte de los estudios. A la luz de esta revisión, se realizaron los estudios empíricos descritos en los siguientes capítulos.

El tercer capítulo focaliza en la elección de la huella de carbono personal como aquella medida de consumo que considera sus emisiones asociadas. De esta manera, se relaciona la problemática del consumo con la de la mitigación del cambio climático. Se presentan los resultados de un primer estudio empírico que buscaba analizar los factores explicativos influyentes en la huella de carbono personal, en una muestra representativa de la población española. Se siguió el modelo socio-psicológico que entiende al comportamiento influido por dos grandes grupos de factores, los externos (socioeconómicos) y los internos (relacionados al grado de conocimiento de la problemática del cambio climático, la percepción de responsabilidad y eficacia en su resolución y las acciones climáticas auto reportadas) para conocer su influencia en la huella de carbono personal. Los resultados mostraron una clara influencia de los factores socioeconómicos en la Huella de Carbono, y una menor influencia de los factores internos.

El cuarto capítulo supone un nexo entre el segundo y tercer capítulo, al examinar el vínculo entre afiliación religiosa y la huella de carbono personal, en interacción con los factores externos e internos que afectan al comportamiento analizados previamente. A los que se suma otro grupo de factores internos relevantes para el comportamiento proambiental en general que se esperaba que influyeran también en la huella de carbono personal: los motivos para conservar la naturaleza, la sensación de conexión y cercanía con la misma y la orientación de los valores auto-reportados (altruismo, egoísmo, vulnerabilidad y resiliencia). Los resultados muestran la complejidad en la interacción entre los factores analizados para explicar la huella de carbono personal, principalmente para el sector de la alimentación, según los factores externos e internos propuestos. Las conclusiones sugieren que estudiar el vínculo religión-mitigación junto con otros factores influyentes en el comportamiento brinda información más acabada que el sólo análisis de factores aislados.

El quinto capítulo expande el anterior, al considerar no sólo la afiliación religiosa sino también una medida mucho más elaborada de religiosidad, basada en los últimos avances provenientes de la literatura en psicología de la religión. Esta medida mejora la medición de dicho constructo al incluir de forma compleja sus dimensiones cognitiva, emocional, moral y social. Se presentan los resultados de un estudio empírico, basado en una segunda encuesta que intentaba analizar la relación entre religiosidad, atendiendo a estas distintas facetas, y la huella de carbono personal, en una muestra representativa de la población argentina. Los resultados mostraron que hay diferencias en la huella de carbono personal para el sector de la alimentación según la afiliación

religiosa y que las facetas de la religiosidad que impactan en la huella de carbono personal dependen del grupo religioso analizado: la religiosidad moral fue relevante para la submuestra de creyentes católicos mientras que las facetas cognitiva, emocional y social lo fueron para la muestra de creyentes de otras confesiones religiosas.

Finalmente, el sexto capítulo recoge las conclusiones detallando los diferentes hallazgos y subrayando su contribución, así como futuras líneas de investigación para dar continuidad al tema de investigación. Entre las principales conclusiones se destacan las siguientes. Primero, la importancia de analizar el vínculo entre religión y consumo dentro de un marco socio-psicológico que considera otros factores influyentes en el comportamiento. Segundo, que estudiar religiosidad atendiendo a sus diferentes dimensiones puede brindar un mayor entendimiento para focalizar las intervenciones al interior de cada afiliación religiosa y tercero, que la afiliación religiosa y religiosidad influyen en aquellos sectores de la huella de carbono personal ligados a una mayor agencia del individuo y sobre los que los factores internos tienen mayor relevancia, como lo es para el sector de la alimentación. Finalmente, para atender al sesgo geográfico mencionado anteriormente, esta tesis aporta evidencia empírica del sur de Europa (España) y del sur global (Argentina).

Palabras claves: religión, afiliación religiosa, religiosidad, consumo sostenible, comportamiento de mitigación del cambio climático, huella de carbono personal.

ABSTRACT

This thesis aims to examine the influence of religion on Sustainable Consumption at the individual level, that is, on consumption behaviour that seeks to minimize the negative impact of one's actions on the natural world (Kollmuss & Agyeman, 2002). The theoretical framework of this research is situated in the field of environmental sciences, nurtured, in addition, by literature in environmental psychology, psychology of religion and consumer behaviour to understand how and under what assumptions an individual's religion influences sustainable consumption.

This paper is structured in six chapters. Chapter one is a general introduction that contextualizes the main effects of religious affiliation and religiosity on sustainable consumption in the face of one of the greatest challenges of the present: Climate Change mitigation. Although the link between religion at the individual level and Climate Change mitigation is starting to be examined empirically in the literature, until now its influence was analysed on variables such as Climate Change perception and intention-oriented measures of behaviour. However, there is a lack of studies that consider impact-oriented behavioural measures. This chapter presents the reasons for choosing the Carbon Footprint as a variable to measure consumption in terms of its associated emissions, discusses the existing measures of religiosity and the selected for the development of this research, concluding with the structure of the thesis and its objectives.

Chapter two presents a systematic review of the literature on the topic. Following the PRISMA method for systematic reviews and meta-analysis, a group of articles relevant to the analysis was selected and the evidence reported in them was structured. It is highlighted that religion at the individual level influences concern, perception and attitudes towards sustainable consumption, although the direction of this influence (negative/positive) is not clear. Among the reasons for these inconsistencies are conceptualizations problems, the measures used to operationalize the constructs "religion" and "sustainable consumption" and the influence of the geographical-cultural context where most of the studies were conducted. Considering the findings of this review, the empirical studies of the following chapters were conducted.

Chapter three focuses on the selection of Carbon Footprint as a measure of consumption that accounts for its associated emissions. In this way, consumption is linked to Climate Change mitigation. Findings of the first empirical study that analysed the explanatory factors influencing the Personal Carbon Footprint in a representative sample of the Spanish population are presented. The socio-psychological model that understands

behaviour as influenced by two groups of factors - external (socioeconomic) and internal (related to CC knowledge, perception of responsibility, self-efficacy and self-reported climate actions) -was followed to determine their influence on Carbon Footprint. The results showed the greater influence of socioeconomic factors on Carbon Footprint compared to internal factors.

Chapter four provides a continuity between the second and third chapters by examining the link between religious affiliation and Carbon Footprint, in interaction with the external and internal factors affecting behaviour discussed previously. Also, another set of internal factors relevant to pro-environmental behaviour were added because they are expected to influence the Carbon Footprint: motives to conserve nature, nature-relatedness, and self-reported value orientation (altruism, egoism, vulnerability, and resilience). The results show variability in Carbon Footprint, mainly for the food sector, according to the proposed external and internal factors and religious affiliation. Conclusions suggest that studying the religion-mitigation link together with other factors influencing behaviour provides a more complete information than the analysis of isolated factors.

Chapter five expands the previous study by considering not only religious affiliation but also an elaborate measure of religiosity based on recent advances in the field of psychology of religion. The scale chosen improves the measurement of this construct by reflecting its multidimensionality: cognitive, emotional, moral and social dimensions. An empirical study that measures religiosity according to these different facets and its influence on Carbon Footprint were conducted in a representative sample of the Argentine population. Results showed that there are differences in the Carbon Footprint of the food sector according to religious affiliation and that religiosity dimensions impacting Carbon Footprint depend on the religious group examined: moral religiosity was relevant for Catholic believers whereas cognitive, emotional and social facets were relevant for believers of other believers group.

Finally, chapter six presents the conclusions of this research, detailing the different findings and highlighting their contribution, as well as future research lines to give continuity to the research topic. Four are the main conclusions of this dissertation. First, it foregrounds the need to analyse the link between religion and consumption within a socio-psychological framework that considers other structural factors influencing behaviour. Second, studying religiosity in terms of its different dimensions could provide greater understanding to focus interventions within each religious affiliation. Third religious affiliation and religiosity influence those sectors of the Carbon Footprint linked

to greater individual agency and where internal factors are more relevant, as is the case for food Carbon Footprint. Finally, to address the geographical bias mentioned above, this thesis provides empirical evidence of southern Europe (Spain) and the global south (Argentina).

Keywords: religion, religious affiliation, religiosity, sustainable consumption, climate change mitigation behaviour, carbon footprint.

1 INTRODUCCION

Este capítulo introduce el objeto de estudio de esta investigación, es decir, el vínculo entre religión a nivel individual y consumo sostenible, situándolo en el contexto del cambio climático. Para esto se adopta el enfoque del consumo que considera sus emisiones asociadas. Se describe el estado del arte del tema, las limitaciones encontradas en la literatura hasta el momento y los objetivos propuestos para el desarrollo de esta investigación. Finalmente, se describe el marco teórico de los estudios empíricos a los que dará lugar al desarrollo de esta investigación. Se fundamenta la elección de las medidas seleccionadas para operacionalizar los constructos y las asunciones de partida de dichos estudios.

1.1 Estado del arte de la influencia de la religión en el consumo sostenible

Existe amplio consenso en la comunidad internacional al señalar entre los mayores desafíos a los que asiste la vida en la tierra a aquellos derivados del cambio climático (CC): fenómenos meteorológicos extremos, inseguridad alimentaria, pérdida de biodiversidad, entre otros (UNFCCC, 2019; Naciones Unidas, 2020). Los informes de los especialistas indican que el principal factor de este cambio es el vertiginoso aumento de las emisiones de Gases de Efecto Invernadero (GEI) desde la Revolución industrial, pero de modo más nítido en los últimos 50 años. Estas emisiones proceden del uso de la energía fósil, de los cambios en el uso del suelo y de los patrones de producción y consumo que mantienen estilos de vida insostenibles (IPCC, 2021). Centrándose en este último aspecto, se estima que entre un 60 - 75 % de las emisiones de GEI están relacionadas con los hábitos de consumo y estilo de vida que los ciudadanos tienen en transporte, alimentación, vestimenta y climatización, por citar los más relevantes (Hertwich & Peters, 2009; Ivanova & Büchs, 2020).

Si bien en los últimos años se ha producido un aumento considerable de políticas y leyes que abordan la reducción y mitigación del CC, el grado de compromiso y apoyo a estas políticas por parte de los ciudadanos todavía es incipiente (IPCC, 2022), ya que las opciones de reducción y mitigación, además de requerir cambios estructurales, implican necesariamente cambios culturales y esfuerzos considerables de cambio de comportamiento (Richardsen Moberg et al., 2019; Schultz & Kaiser, 2012). Por lo tanto, una mejor comprensión de los factores que afectan el comportamiento individual, que vuelva más consciente a los ciudadanos de su compromiso en la reducción de las emisiones relacionadas al consumo, es crucial para promover respuestas más eficientes a las políticas de mitigación. Esta investigación se plantea si la religión puede ser uno de esos factores que promuevan el cambio de comportamiento dentro del campo del consumo sostenible, e inspire una acción climática eficaz.

Se estima que el 84% de la población mundial se encuentra afiliada a una tradición religiosa, con tendencias que van en aumento (Hackett et al., 2017). Se considera que las religiones pueden ser un actor fundamental en la acción climática por tres razones: tienen la capacidad única de construir marcos de referencia que pueden guiar a quienes las siguen (Tucker, 2003); son estimadas como transmisoras de cosmovisiones, valores y criterios que repercuten en el comportamiento, estilo de vida y hábitos de consumo de las personas (Ives et al., 2017; Minton et al., 2015), son portadoras de concepciones

sobre la relación del ser humano con el medio que afectan el actuar cotidiano de los individuos (Haluza-DeLay, 2014). Las grandes confesiones religiosas poseen recursos en su propia tradición que pueden guiar también las percepciones, actitudes y comportamientos de mitigación del CC (Globus Veldman et al., 2013). Ejemplos de esto se recogen en los documentos emitidos por líderes religiosos, tales como las declaraciones interreligiosas dirigidas a las diferentes Cumbres del Clima de la ONU (https://interfaithclimate.org/the-statement; último acceso 16 de abril 2022). Sin embargo, el impacto de estas iniciativas promovidas a nivel global aún requiere una mayor implementación en las iglesias locales, de sus líderes religiosos y a nivel individual (Koehrsen et al., 2021; Globus Veldman et al., 2013; Wilkins, 2022).

En general, la literatura que ha estudiado el vínculo entre religión a nivel individual y consumo sostenible (CS) proviene de un campo más amplio que abarca su influencia en distintas problemáticas ambientales. Mayoritariamente, el análisis se ha realizado partiendo de los sistemas de creencias o cosmovisiones que se desprenden de las tradiciones religiosas y alimentan actitudes y comportamientos positivos o negativos para con el medio. Una parte de la literatura sostiene que las tradiciones religiosas, en particular la judeocristiana, enfatizan una visión donde el ser humano se encuentra en una posición de dominio sobre la naturaleza, que lleva a utilizarla para su exclusiva conveniencia o al menos disminuye su preocupación y actitudes pro-ambientales (Djupe & Hunt, 2009; Hand & Van Liere, 1984; White, 1967) y la adopción de hábitos de CS (Leary et al., 2016; Ukenna et al., 2019; Yang & Huang, 2018). La tesis opuesta es defendida por otra parte de la literatura que sostiene que de las cosmovisiones religiosas se desprende una relación de cuidado donde el ser humano se sabe custodio de los bienes de la tierra ya que considera a la naturaleza como Creación, y esto afecta positivamente a las actitudes y comportamientos hacia el medio ambiente en general (Tarakeshwar et al., 2001) y el comportamiento de CS en particular (Arli & Tjiptono, 2017; Martin & Bateman, 2014; Minton et al., 2015).

En resumen, numerosos estudios han examinado en qué medida las distintas cosmovisiones religiosas explican la posible influencia de la religión en el CS, encontrando pruebas contradictorias y resultados no concluyentes, incluido el comportamiento de mitigación del CC (Eom et al., 2021; Morrison et al., 2015; Shin & Preston, 2019). Asimismo, en los últimos años diversos estudios empíricos se centraron en analizar hipótesis alternativas tales como la interacción entre religión y orientación política y/o el fundamentalismo religioso para explicar este vínculo, encontrando también pruebas divergentes. Particularmente en la relación con la mitigación del CC, la

ideología política es un factor ampliamente aceptado como influyente (Arbuckle, 2017; Gregersen et al., 2020; Kilburn, 2014). En términos generales puede decirse que la religión influye positivamente en la preocupación, actitudes y comportamiento de CS si promueve una visión de custodia de la Creación, y, por otro lado, disminuye si está imbuida de una visión de dominio, fundamentalismo e interpretaciones literales de las Escrituras (Bulbulia et al., 2016; Eckberg & Blocker, 1996; Preston & Shin, 2022).

En otro orden de cosas, considerando una división según la afiliación religiosa, la evidencia empírica muestra que en general, tanto en países orientales de mayoría budista como en aquellos donde el Budismo es minoritario, los afiliados a esta religión son más propensos a participar en comportamientos de CS, como la compra de productos alternativos, el reciclaje y el consumo de alimentos orgánicos, en comparación con cristianos y no afiliados (Minton et al., 2015; Zaleha, 2013) .Por su parte, aquellos afiliados a la religión musulmana muestran un comportamiento relativamente uniforme aunque no exento de cierta variabilidad en sus prácticas de CS, siendo positiva la asociación entre su afiliación religiosa y la elección de vestimenta, alimentos y productos electrónicos sostenibles (Arli & Tjiptono, 2017; Davari et al., 2017; Hasnah Hassan, 2014; Nanang & Ghazali, 2017; Qureshi et al., 2022; Razzaq et al., 2018).

En el caso de los cristianos la evidencia está dividida. Aquellos cristianos que se identifican con la visión de custodia suelen reportar actitudes positivas hacia el CS y el CC, mientras que aquellos que se identifican con la tesis opuesta tienden a lo contrario (Agliardo, 2013; Eom et al., 2021). La evidencia se muestra consistente en cuanto a la relación entre creyentes de confesiones de otras iglesias cristianas y el CC (McCammack, 2007; Smith & Leiserowitz, 2013; Globus Veldman et al., 2021); parece que los católicos expresan mayores niveles de preocupación por el CC que cristianos de otras denominaciones, pero los creyentes cristianos, en general, reportan una menor preocupación y actitudes positivas hacia el CC que las personas sin afiliación religiosa (Pew Research Centre, 2015; Zaleha & Szasz, 2015).

El estudio del comportamiento de consumo muestra que, en general, los consumidores pueden expresar sus motivaciones, creencias religiosas e intensidad de la experiencia religiosa en sus hábitos de consumo, más allá de su afiliación (Minton et al., 2022; Mokhlis, 2009). Investigaciones pasadas han demostrado que cuanto mayor es la religiosidad intrínseca, la importancia dada a las prácticas de contemplación y oración y la frecuencia de participación en servicios religiosos, mejores son los resultados obtenidos en la preocupación por el ambiente, que a su vez impacta en las actitudes y

comportamientos de CS (Felix et al., 2018; Kvaløy et al., 2012; Minton et al., 2017). Respecto a comportamientos ligados a la mitigación del CC, son pocos los estudios que examinan diferencias en niveles de religiosidad y su influencia en la acción climática; un estudio trasnacional muestra una asociación negativa entre la predisposición a colaborar con la acción climática y la frecuencia de participación en servicios religiosos (Sharma et al., 2021).

En resumen, el estado del arte en el tema muestra que la religión a nivel individual (afiliación religiosa y religiosidad) influye en el CS a través de los sistemas de creencias (dominio, administración) y mediante su interacción con factores como la orientación política o el fundamentalismo religioso. Pocos estudios prueban otra explicación como posible; respondiendo a este hueco, investigaciones más recientes comienzan a brindar evidencias de los efectos de interacción entre la religiosidad y otras variables como la preocupación por el ambiente, que arroja resultados distintos que si solo se mide religiosidad (Konisky, 2018). Esto da una idea de que avanzar sobre la comprensión conjunta de religiosidad con otras variables influyentes en el comportamiento permitiría una mejor explicación de la relación causal entre religión y CS. Tal es la propuesta reciente de ciertos investigadores, que sostienen que el vínculo entre religiosidad individual y consumo (Mathras et al., 2015) así como el relacionado a resultados ambientales puede comprenderse mejor si se adoptan perspectivas provenientes de la psicología ambiental en general y de la psicología de la religión en particular (Michaels et al., 2021).

Esta investigación pretende avanzar en esta línea, no buscando resolver las inconsistencias pasadas, sino presentando evidencias desde esta última perspectiva, que entiende al individuo influido por un conjunto de factores en interacción con su afiliación religiosa y religiosidad, para analizar el CS. Además, se sigue la idea teórica de que la religiosidad no sólo se expresa según niveles de mayor o menor adherencia a una confesión religiosa o según la frecuencia de participación en servicios religiosos, sino que la misma posee diferentes facetas relacionadas a la psicología de la personalidad: cognitiva, emocional, moral y social (Saroglou, 2011). Estas dimensiones proveen al individuo de 1) unas creencias que dotan de sentido su existencia, 2) unas prácticas y formas específicas de expresar su religiosidad, 3) un conjunto de normas que funcionan como parámetros de su comportamiento y 4) una comunidad que lo sitúa en un contexto de relación con otros (Saroglou et al., 2020), todo lo cual influye en su comportamiento y serán analizadas detalladamente en el capítulo correspondiente.

1.2 Limitaciones de la literatura en el tema de estudio y contribuciones esperadas de esta investigación

Si bien la religiosidad ha sido parte de la experiencia humana a lo largo de toda la historia, su tratamiento como objeto de estudio académico relacionado con objetivos ambientales no lo ha sido hasta muy recientemente, siendo en las últimas décadas dónde se ha producido un aumento exponencial de la investigación (Preston & Baimel, 2021). Este campo del conocimiento aún se encuentra en sus inicios, y la literatura señala que se precisa más investigación que pueda resolver las inconsistencias encontradas hasta ahora y continuar con nuevas preguntas.

Entre las limitaciones y contribuciones esperadas se encuentran:

1. El tipo de pregunta que resuelve la literatura: hasta ahora las investigaciones pasadas analizan si la religión a nivel individual promueve o va en detrimento del CS, analizando las hipótesis de dominio y administración (Eom et al., 2021; Leary et al., 2016), o examinando factores aislados que influyen en este vínculo, como la asociación entre afiliación religiosa/religiosidad y orientación política (Arbuckle, 2017; Gregersen et al., 2020; Kilburn, 2014) o fundamentalismo religioso (Eckberg & Blocker, 1996; Ecklund et al., 2016). Además, se suelen considerar grupos homogéneos de creyentes en base a su afiliación religiosa (Arli & Pekerti, 2017; Felix et al., 2018; Minton et al., 2015).

Nuevas preguntas permitirían complejizar y profundizar en la comprensión de esta relación. Hasta ahora el foco pareciera estar en detectar diferencias entre grupos de creyentes más que en querer comprender y atender las potencialidades y debilidades de cada grupo para que efectivamente se avance en el logro de los objetivos propuestos. Esta investigación pretende contribuir examinando mejor a cada grupo de creyente en sus particularidades. Además, considerando que aquellos afiliados a una misma tradición religiosa pueden tener comportamientos muy diferentes, este estudio analiza también la influencia de otros factores que influyen en el comportamiento de consumo, y que interactúan con la religión a nivel individual, para explicar el comportamiento de CS, como ser las motivaciones para conservar la naturaleza, la conexión con la misma y las diferentes categorías de valores que influyen en el comportamiento (altruismo, egoísmo, vulnerabilidad y resiliencia). Como esta investigación situará los estudios empíricos en el contexto de la mitigación del CC, también se considerarán factores como el nivel de conocimiento del CC, su percepción (si es un problema ocasionado principalmente por causas antropogénicas o no), la percepción de responsabilidad y eficacia en su resolución, y la frecuencia de acciones de mitigación auto-declaradas.

2. El enfoque y las medidas de medición de los estudios. Generalmente el complejo vínculo entre religión y problemas ambientales en general, y CS en particular se ha abordado teóricamente desde la filosofía y las distintas disciplinas de las humanidades, trabajando por ejemplo el significado que diferentes conceptos como la gratitud, el perdón y distintos preceptos desprendidos de las tradiciones religiosas y su potencial relación con el CS (Dushan Chaminda & Ratnayake, 2015; Narayanan, 2010; Van den Noortgaete, 2016). Son menos los estudios empíricos, sean cuantitativos o cualitativos. Los estudios cualitativos se basan en entrevistas en profundidad y exploran aspectos como la identidad religiosa y las percepciones de personas religiosas acerca de las prácticas de CS (Lorenzen, 2012, 2018; Roshani Perera & Rathnasiri Hewege, 2018; Warner et al., 2012). Por su parte, los estudios cuantitativos se han centrado en el papel de la afiliación religiosa/religiosidad en el comportamiento de CS: adquisición o disposición final de bienes, reciclaje, compra de ropa, entre otros (Arli & Tjiptono, 2017; Minton et al., 2015; Minton et al., 2017; Razzaq et al., 2018). Menos estudios han analizado más allá de estas medidas de religiosidad, para comprender, por ejemplo, el efecto que las creencias, los rituales, las normas morales y la pertenencia a una comunidad tienen en el CS. Es necesario repensar la medición del constructo de forma tal que permita abarcar otras facetas de la religiosidad individual, para profundizar la comprensión de la influencia de la religión en el CS. Además, atendiendo a la medida de CS empleada, este estudio avanza sobre el estado del arte al elegir la huella de carbono personal como medida comportamental de CS, lo que permite situar el estudio en el contexto del CC, al conocer las emisiones relacionadas a cada tipo de consumo.

3. El contexto geográfico-cultural. La mayor parte de los estudios empíricos realizados hasta el presente provienen geográficamente del Norte global, mayoritariamente de los Estados Unidos, menos del Norte de Europa y del Reino Unido. Esto implica que los hallazgos estén imbuidos de un contexto cultural particular, sobre los que esta investigación pretende avanzar realizando los estudios empíricos en un país del sur de Europa (España) y un país del Sur global (Argentina).

1.3 Objetivos y estructura de la tesis

El objetivo general de esta investigación es profundizar en el conocimiento sobre la influencia de la religión en el consumo sostenible en el contexto del cambio climático, es decir, considerando las emisiones de GEI asociadas al consumo. Este objetivo general se llevará a cabo mediante el cumplimiento de los siguientes objetivos específicos:

1. Realizar una revisión bibliográfica acerca de la afiliación religiosa y la religiosidad como factor influyente en el consumo sostenible a nivel individual.
2. Examinar empíricamente la influencia de la afiliación religiosa y la religiosidad en el consumo sostenible medido a través de la huella de carbono personal.

Para el logro de estos objetivos, en primer lugar, se eligió un marco teórico para el desarrollo de los diferentes trabajos. Así, el vínculo entre religión y consumo sostenible se situó bajo el modelo propuesto por Clayton and Myers (2015), que entiende al comportamiento pro-ambiental influido por dos grandes grupos de factores: los externos (socioeconómicos y situacionales) y los internos o intrínsecos (referidos a las preferencias, percepciones y motivaciones individuales). Siguiendo este marco se realizó una revisión sistemática de la literatura para estructurar el estado del arte en el tema.

Para la consecución del segundo objetivo, si bien al inicio de la tesis se tenía una intención más genérica, pretendiendo el estudio empírico de distintas facetas del consumo sostenible, se decidió focalizar en el consumo y sus emisiones de GEI asociadas, en el marco de las actividades realizadas en la Cátedra de Ética ambiental (https://www.etica-ambiental.org/) y el lanzamiento del Observatorio online de huella de carbono personal "CO_2web" (https://www.huellaco2.org/).

De este modo, para los estudios empíricos se eligió como variable dependiente la Huella de Carbono. Se realizó una primera encuesta en una muestra representativa de la población española, para cuantificar las emisiones personales ligadas al consumo, su distribución y, sobre todo, los factores explicativos individuales asociados a esas emisiones. Así, el primer estudio empírico que se recoge en el capítulo tres, se centró en el análisis de la variable dependiente escogida (huella de carbono personal) y su asociación con los factores externos e internos que la explican. Sobre esta base se realizó un segundo análisis, que recoge el capítulo 4, focalizado en el vínculo entre huella de carbono personal y afiliación religiosa como variable independiente.

Finalmente, se realizó una segunda encuesta con el fin de mejorar la medida de la variable independiente, eligiendo una escala multidimensional de religiosidad que incluye sus diferentes dimensiones, para examinar su influencia en la huella de carbono. Además, esta segunda encuesta se realizó a población argentina, lo que permitía también verificar o matizar algunas conclusiones obtenidas en la primera encuesta. El capítulo cinco presenta los resultados de este último estudio, para finalizar en el capítulo seis con las principales conclusiones y futuras líneas de investigación.

La **Tabla 1** recoge la estructura de los artículos que han dado lugar a esta tesis doctoral, incluyendo las revistas donde se han publicado y la contribución de los autores.

Tabla 1. Publicaciones, Journal Citation Reports (IF), Scopus CiteScore (CS), y su correspondiente capítulo de tesis

Publicación	IF	SCS	Contribución de los autores	Nº de capítulo
Orellano, A.; Valor, C.; Chuvieco, E. The Influence of Religion on Sustainable Consumption: A Systematic Review and Future Research Agenda. Sustainability 2020, 12, 7901. https://doi.org/10.3390/su12197901	3.3	3.9	Conceptualization, A.O., C.V., and E.C.; methodology, A.O.; writing—original draft preparation, A.O.; writing—review and editing, C.V., and E.C.; supervision C.V., and E.C. Corresponding author, A.O.	2
Chuvieco, E.; Burgui-Burgui, M.; Orellano, A.; Otón, G.; Ruíz-Benito, P. Links between Climate Change Knowledge, Perception and Action: Impacts on Personal Carbon Footprint. Sustainability 2021, 13, 8088. https://doi.org/10.3390/su13148088	3.3	3.9	Conceptualization, E.C. and M.B.-B.; methodology, P.R.-B. and A.O.; software, P.R.-B., A.O. and G.O.; validation, P.R.-B., A.O. and G.O.; formal analysis, P.R.-B. and A.O.; investigation, E.C., M.B.-B., A.O., G.O., P.R.-B.; data curation, M.B.-B. and P.R.-B.; writing—original draft preparation, E.C.; writing—review and editing, E.C., M.B.-B., A.O., G.O., P.R.-B.; project administration, E.C. Corresponding author, A.O.	3
Orellano, A.; Chuvieco, E. Examining the relationships between religious affiliation, external and internal behavioural factors, and personal Carbon Footprint. Religions, 2022, 13(5), 416. https://doi.org/10.3390/rel13050416	1.65	0.7	Conceptualization, A.O. and E.C.; methodology, A.O. and E.C.; software, A.O.; validation, E.C.; formal analysis, A.O.; investigation, A.O.; resources, A.O.; data curation, A.O.; writing—original draft preparation, A.O.; writing—review and editing, E.C.; supervision, E.C. Corresponding author, A.O.	4

Además de estos artículos, durante el desarrollo de esta tesis doctoral se han presentado resultados parciales en las siguientes conferencias:

- Octavas jornadas de jóvenes investigadores de la Universidad de Alcalá:

Orellano, A., & Chuvieco, E. (2021). El papel de las creencias personales en la mitigación del cambio climático: Su influencia en la huella de carbono individual. En Octavas jornadas de jóvenes investigadores de la Universidad de Alcalá: Humanidades y Ciencias Sociales. Universidad de Alcalá.

- 2nd International Conference Implementing a New Paradigm in the Post-COVID 19 World: Earth Jurisprudence and Latin America's Rights of Nature

Orellano, A. (2022). La Huella de Carbono como indicador clave para la transición ecológica. Book Proceedings of 2nd International Conference Implementing a New Paradigm in the Post-COVID 19 World: Earth Jurisprudence and Latin America's Rights of Nature". Seúl. En prensa.

Por último, conviene indicar que esta tesis doctoral ha sido financiada por un contrato predoctoral de la Fundación Tatiana Pérez de Guzmán el Bueno, en el marco de su programa de becas de investigación ambiental.

1.4 Marco teórico de los estudios empíricos

Aproximarse al estudio de la religión y el CS implica comprender, en primer lugar, su complejidad metodológica. No hay uniformidad en el tratamiento de los constructos involucrados, ya que los investigadores conceptualizan "religión" y "consumo sostenible" de múltiples formas. En la revisión sistemática de la literatura del capítulo siguiente, se verán en detalle cuestiones como la diferencia entre religión y espiritualidad y las diferentes formas en que se han entendido y operacionalizado los constructos de interés en la literatura.

1.4.1 La conceptualización de la religión a nivel individual desde la afiliación religiosa y la religiosidad en sus diferentes dimensiones

La forma tradicional de medir la religión individual es a través de la afiliación religiosa o de diferentes escalas de religiosidad que abarcan la importancia de un ser superior o de la religión en la vida, la frecuencia de atención de servicios religiosos, o el nivel de religiosidad auto reportado, además de otras muchas medidas que varían según el campo, el propósito de estudio y la composición religiosa de la muestra (las múltiples escalas de medida se pueden encontrar en diferentes revisiones, como (Egbert et al.,

2004; Hill, 2013; Koenig et al., 2015). Un avance significativo en su medición proveniente del área de la psicología de la religión fue la teorización de la religiosidad como vivencia. Se propone que la religiosidad puede ser experimentada de dos formas: una relacionada a la vivencia interior del individuo, conocida como religiosidad intrínseca y referida a la experiencia de la religión como fin en sí misma (búsqueda de sentido, orientación y guía para el comportamiento, trascendencia, etc.) y otra extrínseca, referida a la religión como medio para satisfacer otras necesidades (prestigio, posición social, entre otras) (Allport & Ross, 1967; Worthington Jr et al., 2003). Así, el estudio de la religiosidad comienza a abordarse de modo multidimensional, hasta llegar al presente, donde se entiende que el constructo religiosidad es multifacético y el estudio de su influencia se vuelve más complejo (Kilburn, 2014; Mathras et al., 2015; Mokhlis, 2009).

Esto explica mejor que existen diferencias individuales en la forma de experimentar la religiosidad que luego son expresadas en el comportamiento en general (Emmons & Paloutzian, 2003), y en el comportamiento de consumo en particular (Vitell et al., 2018), incluido el relacionado a las problemáticas ambientales (Preston & Baimel, 2021). Si bien estas medidas de religiosidad suponen un avance, también presentas ciertas limitaciones. Desde el punto de vista teórico, se ha argumentado que medir religiosidad en términos intrínsecos y extrínsecos, así como según grados de religiosidad, supone realizar una valoración de la experiencia religiosa en términos positivos (religiosidad intrínseca, mayor nivel de religiosidad) y negativos (religiosidad extrínseca, menor grado de religiosidad) que no es deseable ya que la evidencia empírica se construye a partir de una valoración de la religiosidad (Neyrinck et al., 2010). Además, teniendo en cuenta la operacionalización de estos constructos, la religiosidad siendo un constructo complejo sufre reduccionismo o simplificación metodológica, por lo que es deseable el uso de medidas más complejas de religiosidad (Davis et al., 2016).

Desarrollos teóricos recientes en este campo coinciden en comprender religiosidad desde las diferencias individuales a la hora de vivir/experimentar el vínculo con lo trascendente, abarcando sistemas de creencias, ritos, normas y tradiciones que están relacionadas con la personalidad y el funcionamiento psicológico en sus esferas cognitiva, emocional, moral y social, respectivamente (Saroglou, 2011; Saroglou et al., 2020). Estas distintas facetas o dimensiones de la religiosidad se detallarán y examinarán en su vínculo con la mitigación del CC en el capítulo 5.

En vista de todo lo anterior, para los estudios empíricos de esta investigación se toman como variables independientes a la afiliación religiosa y a la religiosidad entendida desde sus dimensiones para examinar su vínculo con el CS.

1.4.2 El Consumo Sostenible desde la perspectiva de la mitigación del Cambio Climático: la Huella de Carbono

Como se dijo anteriormente, en la revisión sistemática de la literatura del capítulo siguiente, se describen en detalle los constructos analizados. Respecto al "Consumo Sostenible" para los estudios empíricos de esta investigación, se toma como su medida a la huella de carbono personal. La elección de esta medida se fundamenta en dos razones.

En primer lugar, se observa en la literatura la falta de estudios empíricos del vínculo entre religión y consumo en el contexto del CC, que consideren las emisiones asociadas a ese consumo. Si bien el vínculo entre la religión a nivel individual y la mitigación del CC está comenzando a ser estudiado en la literatura, hasta ahora se examinó su influencia en las percepciones del CC (Ergun & Rivas, 2019; Morrison et al., 2015), las actitudes hacia las políticas de mitigación (Urbatsch & Wang, 2021), y la voluntad de cambiar los hábitos de consumo y el estilo de vida para reducir la huella de carbono del hogar (Lee et al., 2021). Sin embargo, su influencia en variables comportamentales necesita aún ser estudiado.

Esta investigación pretende proporcionar una evaluación más rigurosa del comportamiento individual, ya que generalmente se utilizan medidas de comportamiento auto-reportado y orientados a valorar la intención de realizar una determinada acción (por ejemplo, la compra de productos sostenibles, el utilizar transporte público en vez de coche privado, etc.), más que a evaluar dicho comportamiento en términos de su impacto ambiental (Steg & de Groot, 2019). Aunque el uso de medidas auto-reportadas ha permitido avanzar en la explicación de la relación entre religión y CS, otros estudios muestran que las auto-evaluaciones no están necesariamente relacionadas con el comportamiento real de los individuos (Kormos & Gifford, 2014; Moser & Kleinhückelkotten, 2018). Es por esto que conceptualizar el CS desde el punto de vista de la mitigación del CC requiere necesariamente un análisis más detallado del consumo en términos de sus emisiones de GEI asociadas, lo que se denomina como huella de carbono personal.

En segundo lugar, la elección de esta medida pretende, por un lado, cuantificar las emisiones asociadas al consumo y por otro, contribuir a la literatura sobre el diseño de intervenciones y políticas efectivas de mitigación, que buscan que el consumidor tenga un rol más activo en la mitigación del CC (Nielsen et al., 2021). Que el individuo pueda implicarse en su cuota de responsabilidad hacia la mitigación del CC representa un

desafío, ya que el CC generalmente se percibe como algo distante, temporalmente lejano e incierto (Loy & Spence, 2020) y a la vez supone un dilema el elegir entre beneficios personales y a corto plazo, frente a beneficios colectivos y a largo plazo (Capstick, 2013; Rashidi-Sabet et al., 2022). Con este objetivo en los últimos años vienen desarrollándose instrumentos como las calculadoras de huella de carbono personal, que más allá del cálculo en sí, pretenden hacer más evidente y cercana la realidad del CC, vinculando los hábitos de consumo con sus emisiones asociadas (Birnik, 2013; Salo et al., 2019). Así, desde este enfoque de la mitigación del CC basado en el consumo, se espera que los ciudadanos puedan implicarse en la reducción de sus emisiones asociadas; se estima que la Unión Europea podría reducir su huella de carbono en aproximadamente un 25%, de los cuales un 26% se conseguiría mediante la reducción del consumo individual (Moran et al., 2020).

Los estudios empíricos de esta investigación se realizan desde este enfoque, tomando como medida de variable independiente a la huella de carbono personal, en el marco del desarrollo y prueba de un Observatorio de la Huella de Carbono en línea "CO2web" (https://www.huellaco2.org/). Este observatorio consta de tres secciones principales: la primera sección presenta los fundamentos científicos del CC, el concepto de Huella de Carbono y su metodología de cálculo; la segunda recopila datos sobre las emisiones asociadas a los principales hábitos de consumo y transporte de los ciudadanos; la tercera contiene la calculadora de huella de carbono en sí, que computa las emisiones personales (en kg de CO_2 equivalente) para las principales categorías o sectores de consumo: energía y climatización del hogar, transporte (en coche, tren, autobús, metro), vestimenta, alimentación, y otros (incluidos el consumo de tabaco, los dispositivos electrónicos y las mascotas). Todos los valores de huella de carbono se calculan en unidades de CO_2 equivalente y se basan en evaluaciones estándar del ciclo de vida (Burgui-Burgui & Chuvieco, 2020).

1.4.3 El análisis del vínculo entre la religión a nivel individual y la huella de carbono personal: los estudios empíricos

Como se dijo hasta aquí, el vínculo que se pretende analizar es complejo, como lo demuestran, por ejemplo, los estudios pasados mencionados anteriormente, que no logran resolver las inconsistencias encontradas. Los estudios empíricos realizados en el desarrollo de esta investigación son de naturaleza exploratoria, es decir que principalmente intentan explorar la conexión entre las variables implicadas más que evaluar predicciones específicas. Esto es así ya que prácticamente no existen estudios que vinculen huella de carbono personal y religión a nivel individual, por lo que los

resultados surgidos de esta investigación no buscan resolver las inconsistencias pasadas, sino ser un punto de partida para nuevas discusiones en la literatura.

Avanzar sobre la comprensión conjunta de la afiliación religiosa y la religiosidad con otras variables influyentes en el comportamiento, permitiría una mejor explicación de la relación causal entre los constructos analizados. Se consideran como antecedentes del comportamiento ambiental los que se agrupan en dos conjuntos principales (Clayton & Myers, 2015): los externos o situacionales, relacionados con el entorno y las condiciones socioeconómicas (Corral-Verdugo et al., 2020) y los internos o intrínsecos, relacionados con los conocimientos, las motivaciones y las creencias de los individuos (Schultz & Kaiser, 2012; Steg, 2016).

El primer estudio empírico (**Figura 1.1, cap. 3**) pretendía examinar como medida de CS la huella de carbono personal dentro de este marco. Se eligieron como factores externos e internos los que la literatura considera relevantes para el comportamiento pro-ambiental (Gifford & Nilsson, 2014) y como influyentes en la huella de carbono (Bhoyar et al., 2014; Büchs et al., 2018). Las asunciones de partida son:

- Factores externos: existen diferencias según el sexo, la edad, el nivel de estudios e ingresos, la ocupación, el lugar de residencia y la orientación política en la huella de carbono total o sus diferentes sectores: alimentación, transporte, vestimenta, energía utilizada en el hogar y otros (tenencia de mascotas y dispositivos electrónicos).
- Factores internos: existe una asociación entre el nivel de conocimiento del CC reportado, la percepción de responsabilidad, autoeficacia y la frecuencia de realización de acciones climáticas y la huella de carbono total o sus diferentes sectores. Se espera que un mayor nivel de conocimiento, responsabilidad y frecuencia de acción climática percibidas esté asociado a una menor huella de carbono.

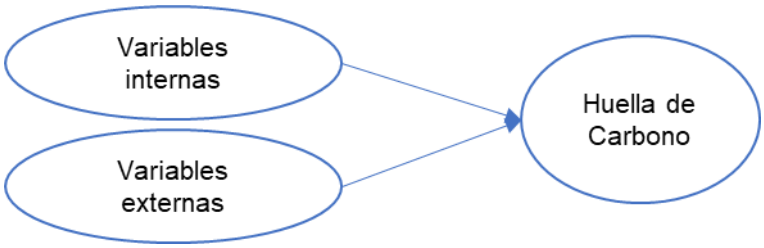

Figura 1.1. Primer estudio empírico de la relación entre huella de carbono personal y factores externos e internos del comportamiento

El segundo estudio empírico (**Figura 1.2, cap. 4**) analizó la relación entre la huella de carbono personal y la afiliación religiosa considerando sus interacciones con los factores externos e internos. Los externos fueron los mismos que el estudio anterior y los internos se dividieron a su vez en dos grupos. Por un lado, al igual que el primer estudio, aquellos considerados relevantes para comprender el comportamiento de mitigación del CC y por otro, aquellos comprobados en la literatura como influyentes del comportamiento proambiental en general (motivos para conservar la naturaleza, conexión con la misma y valores auto-reportados). Las asunciones de partida fueron:

- Existe una asociación entre afiliación religiosa y huella de carbono, sólo para aquellos sectores ligados, por un lado, a la agencia del individuo y por otro, relevantes para con el vínculo con la religión.
- No existen diferencias entre los factores externos que se asocian a la huella de carbono personal para cada afiliación religiosa.
- Existen diferencias en los factores internos que se asocian a la huella de carbono personal para cada afiliación religiosa.

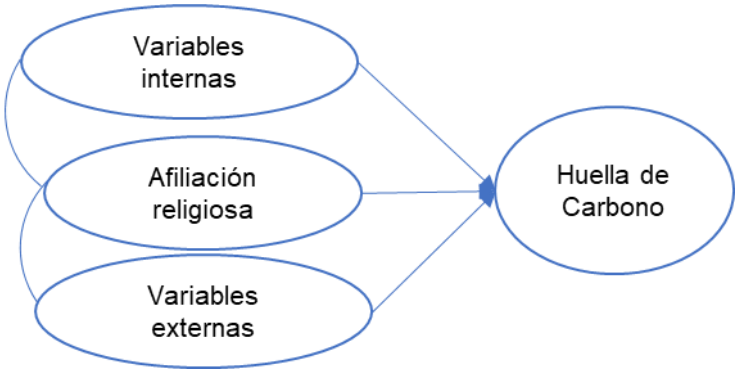

Figura 1.2. Segundo estudio empírico de la relación entre afiliación religiosa, huella de carbono personal y factores externos e internos del comportamiento

El tercer estudio empírico (**Figura 1.3, cap.5**) buscaba mejorar la medida de religión utilizada hasta el momento, considerando las diferentes dimensiones de la religiosidad (cognitiva, emocional, moral y social) para examinar en qué medida se asociaban con la huella de carbono personal. La asunción de partida era que existe una asociación entre cada una de las dimensiones y la Huella de Carbono que esté asociada a la agencia del individuo. Además, se esperaba que las dimensiones de la religiosidad influyeran en la huella de carbono personal para cada grupo religioso. Estas hipótesis requirieron realizar una nueva encuesta, en este caso centrada en la población

argentina, siguiendo una implementación similar a la realizada para la población española.

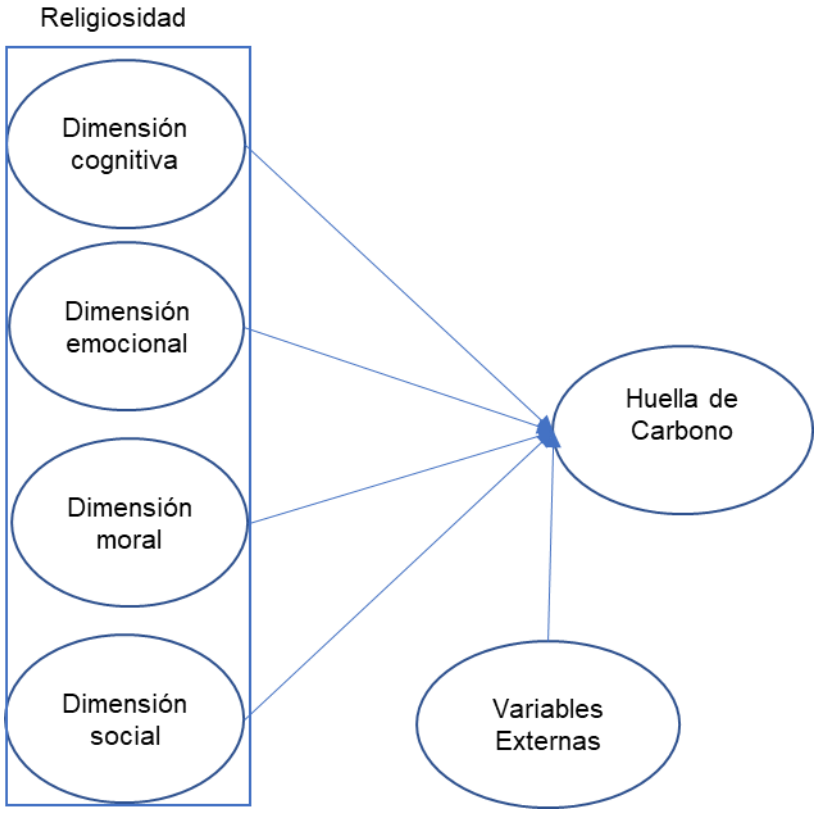

Figura 1.3. Tercer estudio empírico de la relación entre las distintas dimensiones de la religiosidad y la huella de carbono personal

Resumiendo, para abordar el complejo vínculo analizado, el primer estudio empírico profundizó en la comprensión de la huella de carbono personal como medida de CS elegida. El segundo examinaba las interacciones entre la afiliación religiosa y los factores externos e internos que influyen en la huella de carbono personal y el tercer estudio analizaba este vínculo teniendo en cuenta las diferentes dimensiones de la religiosidad. Como se indicó antes, estos tres estudios se encuentran incluidos en los capítulos de esta tesis, los dos primeros como artículos ya publicados (capítulos 3 y 4) y el último como un artículo en preparación (capítulo 5).

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2 THE INFLUENCE OF RELIGION ON SUSTAINABLE CONSUMPTION: A SYSTEMATIC REVIEW AND FUTURE RESEARCH AGENDA

Este capítulo presenta una revisión sistemática de la literatura acerca de la relación entre la religión a nivel individual y el consumo sostenible. Para realizarla se siguió el protocolo PRISMA para revisiones sistemáticas y meta-análisis. Esto permitió seleccionar un grupo de artículos y estructurarlos siguiendo el marco socio-psicológico elegido para el desarrollo de esta investigación, que considera el comportamiento ambiental, en este caso el consumo sostenible, influido por factores externos o socioeconómicos e internos o intríncecos. Esto dio lugar a analizar la influencia directa e indirecta de la afiliación religiosa y la religiosidad en el consumo sostenible, así como detectar que las inconsistencias encontradas en la literatura se deben a problemas metodológicos, conceptuales y contextuales, para finalizar con la propuesta de líneas de investigación futuras para que la investigación en este tema avance.

Este capítulo corresponde al artículo:

Orellano, A.; Valor, C.; Chuvieco, E. The Influence of Religion on Sustainable Consumption: A Systematic Review and Future Research Agenda. Sustainability 2020, 12, 7901. https://doi.org/10.3390/su12197901

2.1 Abstract

Background: Due to the current environmental crisis, sustainable consumption (SC) behaviour and its drivers has gained significant attention among researchers. One of the potential drivers of SC, religion, have been analysed in the last few years. The study of the relationship between religion and adoption of SC at the individual level have reached mixed and inconclusive results. Methods: Following the PRISMA guidelines, a systematic review of articles published between 1998 and 2019 was conducted using the Web of Science and Scopus databases. Search terms included sustainable consumption, green consumption, ethical consumption, responsible consumption, pro-environmental behaviour and religion. Results: This systematic review reveals that contradictory results are due to methodological and theoretical reasons and provides a unifying understanding about the influence of religion on SC practices. Results highlight the role of religion as a distal or background factor of other proximal determinants of environmental behaviour. Conclusions: This paper contributes to the literature concerning SC by synthesing previous scholarship showing that religion shapes SC indirectly by affecting attitudes, values, self-efficacy, social norms and identity. The review concludes with a research agenda to encourage scholars the study of other unexamined mediating constructs, such as beliefs in after life, cleansing rituals and prayer, moral emotions, moral identity, the role of virtues and self-restrain.

Keywords: *religion; sustainable consumption; behavioural factors; review.*

2.2 Introduction

The 2030 Agenda for Sustainable Development adopted by all United Nations Member States in 2015, aims to coordinate efforts to advance sustainable development. The 12th Sustainable Development Goal promotes sustainable consumption and production patterns; one of its targets fosters educating and engaging citizens on sustainable consumption and lifestyles. However, there are not clear progresses to meet this Goal in view of the growing unsustainable consumption patterns [1,2]. For this reason, understanding the drivers for sustainable consumption (SC hereafter) behaviour is becoming increasingly important [3].

One of such drivers that have received growing attention in the literature is religion. It is estimated that 84% of the world's population belong to a religious group [4]. Of this, approximately, 32% are Christians, 23% Muslims, 15% Hindus, 7% Buddhist, 0.2%

Jews, 6% folk or traditional religions and less than 1% others [4]. These religions are a significant source of wisdom, morality and ethics for individuals [5,6].

In the last decade, environmental sciences have acknowledged the potential of religion to address the ecological crisis [7]. Recently, environmental psychology has provided insights on how to enhance behavioural change [8–10] pointing to the manifold routes whereby religion influences individual perceptions, beliefs and practices [11]. As it has been long recognized in conservation psychology "conservation without moral values cannot sustain itself. Unless we reach people through beauty, ethics, spiritual, or religious values or whatever, we are not going to keep our wilderness areas" [12] (p. 130).

Thus, religious beliefs, ideas and practices may be a driver for adoption of SC, by fostering salient and inner motivations for behavioural change. Other scholarship has shown that religion is one of the factors influencing consumer behaviours [13], and more specifically, consumer ethics [14], evaluation of product quality [15], product pricing [16], and materialism [17]. In view of this evidence, it is plausible to think that religion at the individual level may influence adoption of SC as well.

However, past studies have reached mixed, inconclusive, and contradictory results about the relationship between individual's religion and SC [18–21]. A systematic review may contribute to reconcile these disparate results as it will clarify the relationship between these two constructs, and it will identify the mediating variables that can explain why religion affects SC and the moderators or boundary conditions of such influence [22].

This paper intends to enrich our understanding of the influence of religion on SC. Even though religion may play a key role in the transition to more SC at an institutional level [23], at the organisational level [24] and at the individual level, this study focuses on the latter as it examines the influence of religion on the individual's adoption of SC. As mentioned above, research on consumer behaviour shows that religion can be considered an individual difference variable and recently, studies have emerged addressing this influence on SC, but how this influence operates needs to be clarified. This is in line with recent calls from psychology about the importance of understanding the individual motivations that underpin behavioural processes leading to improved or constrained sustainable lifestyles [9,12,25]. Our research aims to answer three research questions (RQ):

RQ 1: What is the relationship between religion and SC? Does this relationship change depending on methodological issues (e.g., measurement of the constructs), the particular religion being studied, or the country under examination?

RQ 2: What are the mediating variables or constructs whereby religion influences others proximal and proven antecedent of SC?

RQ 3: Are there any moderators that weaken or strengthen the influence of religion on SC?

To achieve this goal, a systematic literature review was carried out, following the PRISMA guidelines. Reported studies were grouped according to whether they analysed the direct or mediated relationship between religion and SC. Thus, this review differentiates between studies treating religion as a distal or background factor and those including mediating variables or proximal determinants of environmental behaviour, following the socio psychological model proposes by Clayton and Myers [12]. This integrative model proposes two main sources of behaviour: internal (within the individual) including knowledge, attitudes, values, emotions, responsibility and efficacy, and external (related to the environment) including social norms, affordances, reinforcement contingencies, prompts, goals and feedback.

This paper makes three contributions to the literature. First, this study concludes that the disparate results of past studies are due to the limited consideration of the influences of the cultural context, to methodological aspects regarding the measure of religion and to the insufficient theoretical support of most studies. Second, this review contributes by proposing that religion should be treated as a background factor influencing indirectly other proximal antecedents of behaviour. Finally, this paper defends that, because of the complex nature of the relationship between the constructs examined, approaches that consider a mediated relationship/moderating role of religion are needed as they can provide a more accurate and comprehensive understanding of the psychological underpinnings of the relationship between the constructs.

Sustainable Consumption and Religion: Definitions and Measurement

The SDG 12 aims to reduce the ecological footprint by changing the methods of production and consumption of goods. This implies using resources efficiently, respecting resource constraints and reducing pressures in natural capital in order to increase overall wellbeing, keep the environment clean and healthy, and safeguard the needs of future generations [26].

Choosing a sustainable option when purchasing, decreasing waste generation by reducing consumption, reusing, recycling and being more efficient in the use of energy, are some of the actions that individuals may carry out to achieve the SDG12 goal. These actions are included in the umbrella term “sustainable consumption”, also referred to as “ethical” or “green” or “responsible” consumption”. In this paper, we adopt a broad view of SC understanding that it goes beyond the mere purchasing of green goods and that it also includes actions related to the use and disposal of merchandises, or even to avoiding consumption. This broader definition of SC is consistent with recent conceptualizations of this construct [27].

SC overlaps with other similar constructs such as pro-environmental behaviour (PEB hereafter) defined as “behaviour that consciously seeks to minimize the negative impact of one’s actions on the natural and built world” [28] (p. 240). Actions usually including in the PEB are similar to the ones described above, namely the limitation of energy consumption, the reduction of waste production and recycling, as well as the concept of SC. Thus, considering the similarity between the two constructs, in this paper we used the terms “responsible consumption”, “green consumption”, “ethical consumption” and “pro-environmental behaviour” as synonyms of SC.

Defining the causal construct under examination, i.e., “religion” is more difficult, first because it is a construct highly contest in literature (see for example [29,30]), and then because, being such a complex construct, a standard definition is not possible [11]. Also, religion can be studied at different level of analysis; here we focus on the individual level, understanding religion as beliefs in superhuman beings [31] or the “systems of meaning embodied in a pattern of life, a community of faith, and a worldview that articulate a view of the sacred and of what ultimately matters” [32] (p. 10). This definition foregrounds that religion concerns beliefs, goals, communitarian norms and guidelines. Indeed, “religions provide specific norms and moral arguments defining what is right and wrong, and it posits higher moral such as altruistic sacrifice, humility, or strong self-control of impulsivity-related behaviours” [33] (p. 1327).

An important clarification is the difference between religion and spirituality. Although both concepts comprise a search for the sacred [34], it is accepted that religion is rooted in institutionalized authorities (faith communities) that transcend the person and where the person is embedded, whereas spirituality is understood outside faith communities [11]. Another clarification merits the spirituality of Indigenous Peoples, which cannot be encompassed within the category “religion”; an approximation would be to say that it is a communitarian experience of the world that comprises balance, harmony and

interrelationship among all that exists [30]. This is not intended to be a definition, but to reflect the importance of terminological clarification, so as not to fall into a universalizing gloss of “religion” as a catch-all category [35]. This review will focus on institutionalized religions and spirituality will be excluded from the analysis.

Empirically, disparate operationalizations of the construct religion can be found in past research. They are briefly reviewed in turn, although theoretically all religious dimensions are interrelated [33]. First, it is important to differentiate between affiliate religion and practiced religion or religiosity.

Whereas affiliate religion is the particular faith an individual belongs to [36], religiosity is “the degree to which beliefs in specific religious values and ideals are held and practiced by an individual” [37] (p. 27). The difference is noteworthy because affiliate religion may reflect cultural conventions or norms and not necessarily capture the strength of the individual’s adherence to the beliefs and principles that derive from a particular religion. In turn, as Mokhlis [38] points, religiosity can be measured with different indicators, such as self-perceived level of religiosity [37], frequency of church attendance [39], religious identity [40] or ad hoc scales. To illustrate, the Religious Commitment Inventory (RCI) measures the degree to which a person is consistent with his/her religious values, beliefs, and practices them in daily life [41].

Another fundamental distinction was established by Allport and Ross [42] between intrinsic and extrinsic Religious Orientation, operationalized in the Religious Orientation Scale. Intrinsic religiosity refers to the individual’s effort to internalize and fully follow a religious creed [42]. In contrast, individuals with extrinsic religiosity use religion as a tool to increase their acceptance in particular social environments [42]. The most used religious measures are summarized in **Table 2.1**.

Table 2.1. Religious measures and its definitions

Religious measures		Definitions
Religious affiliation		Belong formally to a religious denomination (Alston, 1975).
Religiosity	Self-perceived	The degree to which beliefs in specific religious values and ideals are held and practiced (Delener, 1990).
	Church attendance	Frequency of church services attendance (Alston, 1975).
	Intrinsic religiosity	Individual effort to internalize and fully follow a religious creed (Allport & Ross, 1967b).
	Extrinsic religiosity	Use of religion as a tool to increase acceptance in particular social environments (Allport & Ross, 1967b).
	Intrapersonal commitment	The degree to which a person is consistent to his/her religious values and beliefs. Intrapersonal dimension of religiosity (Worthington Jr. et al., 2003).
	Interpersonal commitment	The practice of religious values and beliefs into daily life. Interpersonal dimension of religiosity (Worthington Jr. et al., 2003).
	Religious identity	Importance of religious faith as it pertains to the self-concept and personal identity (Cosgel & Minkler, 2002)

2.3 Methods

2.3.1 Search strategy and study selection

This systematic review aims to structure the research field by identifying emergent themes, point out gaps and contribute to theory development, including quantitative and qualitative analysis [43] following the PRISMA guidelines [44]. To minimize the risk of bias, this study reports the steps followed in the PRISMA checklist (see Appendix A, Table A).

The first step was a search for articles using the Web of Science and Scopus database, using the string search: “sustainable consumption” OR “green consumption” OR “ethical consumption” OR “responsible consumption” OR “pro-environmental behav*” and relig* (September 2019). The second step was to determine the papers eligible for analysis. These were used as inclusion criteria: (1) any studies assessing directs impact of religion on SC outcomes; (2) papers referring to SC outcomes related to the indirect effect of religion; (3), no restrictions of language and publication status were used; (4), neither

time nor geographical restrictions were applied; (5) peer-reviewed studies identified by searching the bibliographies of selected articles were included.

An illustration of the entire study selection process from initial searches and those studies put forward for data extraction and coding is provided in **Figure 2.1**. Screening against the inclusion criteria resulted in a final set of 83 documents. The titles and abstracts were checked for relevance; as a result, 25 out of these 83 documents were excluded because they did not address the topic under examination. 6 additional records were excluded because, after an exhaustive search the full text was not accessible. For the remaining 52 references, the full texts were collected and analysed. Another 4 records were excluded after full text reading. However, 4 new records identified by bibliographies of selected articles were included. Finally, a total of 52 records were judged relevant and were selected for the analysis.

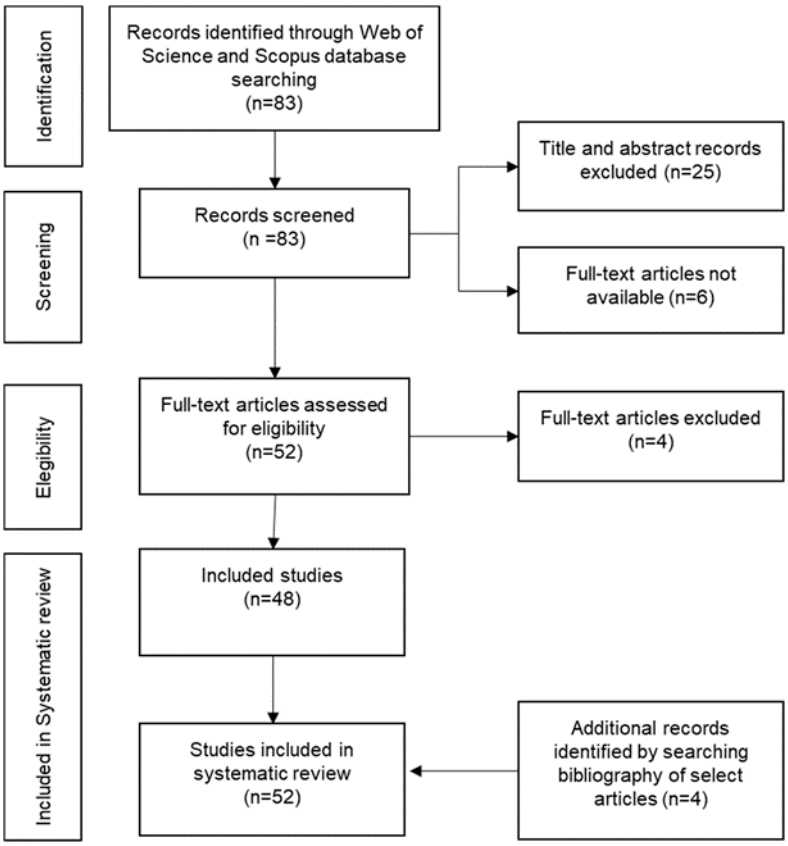

Figure 2.1. PRISMA flow diagram. Adapted from Moher et al. [44]

2.3.2 Coding process

A data extraction table was designed to extract relevant information. The first author extracted the following data from included studies and the other authors checked the extracted data. Information was extracted from each included article on: (1) author, year and journal of publication; (2) religion construct used (3) SC aspects involved; (4) theories or conceptual models used; (5) measures; (6) mediating and moderator variables; (7) sample size and sample description; (8) sampling and estimation method and (9) results. Qualitative studies were coded following the same items except (5) and (6).

The finally selected papers were classified according to the methodological approaches used, in quantitative, qualitative and conceptual/theoretical studies. Mixed-method papers were classified into the other two categories, as appropriate. Most quantitative studies were correlational, using survey-based methods and statistical samples of respondents. There were also 3 intervention or quasi-experimental studies comparing attitudes and behaviours before and after the implementation of sustainability-related educational programmes in religious communities. Theoretical studies were also included in the review but excluded from this coding system. These conceptual papers examined an aspect of SC from a religious concept; to illustrate, these papers examined SC and the meaning of self-realization through a Hindu perspective [45] or the relevance of gratitude as antecedent to pro-environmental behaviour [46]. The description of each studies is offered in Appendix B, Table B.

In order to structure the results and answer the research questions, quantitative papers were classified according to whether they analysed a direct or indirect influence of religion on SC. Those papers proposing a mediated relationship, the influence of religion was consider as a background of other proven determinants of behaviour, following the social psychological model of behaviour proposes by Clayton and Myers [12].

2.3.3 Description of Studies Included in the Systematic Review

Research on religion and SC is growing. The oldest publication dates from 1998 and most studies were published in recent years, with half of the publications from the period 2016–2019, with a growing trend towards quantitative studies.

Of the 52 studies considered in the review, 11 were conceptual (24%), 35 papers were quantitative (65%) (3 of which were experimental studies) and the remaining were qualitative. Regarding the quantitative studies, the most frequently applied method was

ad hoc survey design (83%) followed by data extraction from National General Social Surveys (17%). In total, the sample size of these quantitative studies was 86,203. Samples were selected using probabilistic methods: 71.4% Stratified and 7.6% Random techniques, corresponding to the studies that used nationally representative data from a general social survey. Non-probabilistic methods were also used in the remaining studies: 10.9%, convenience, 7.4% judgement, 2.4% Snowball and 0.3% Quota sampling. Regarding the 11% qualitative papers, their aggregated base of informants yields 179. In-depth semi-structured interviews was the most used technique. All qualitative papers used purposive sampling.

Regarding the geographical distribution of studies, United States was the most represented country (28% of the case studies), followed by research in Pakistan and Australia (8% respectively) and Indonesia (5%). Four studies did a cross-country examination; namely, United States and Germany [47]; United States and South Korea [48]; Indonesia and Malaysia [49]. One of the papers included a multilevel analysis of 34 countries [50].

Of the total sample, 65.10% of the informants described themselves as religious, 25.40% as non-religious and the rest did not report. In terms of affiliation, Christians (11.21%) and Islamic (4.66%) confessions were the most studied, followed by Buddhists (1.60%) and Hindus (1.16%), others (1.14%) and the rest was group as religious that did not specify their affiliation (45.33%).

2.4 Results

This section presents a synthesis of the most relevant insights classifying them according to whether they have studied a direct or a mediated relationship between religion and SC.

2.4.1 A Direct Relationship between Religion and Sustainable Consumption

Regarding RQ1 about the relationship between religion and SC, it is important to note that historically, this research domain emerged as a reaction to White's thesis [51] who sustained that Judeo-Christian religion was responsible for the environmental crisis. White's emphasis on the significance of a dominion view of nature—derived from the Bible in his view—for predicting environmental attitudes and behaviour has been central to support a causal relationship between religion and SC. Scholarship tested empirically the stewardship or the dominion hypothesis, with the aim of clarifying if religion would improve or constrain SC intention, attitudes and/or behaviours. In doing so, a direct test

of this influence was proposed and analysed in 69% of quantitative studies (24 papers) with disparate and inconclusive results that can be summarized as follows:

- Some studies focused on religious and non-religious differences, finding that religious individuals adopt SC to a greater extent have a more SC than less or non-religious ones [52–56], while others proved the opposite [57–61].
- Other studies examined differences across faiths on the understanding that if White's hypothesis was right, it would not hold in Eastern religious followers (Buddhist and Hindi), as these religions are not anchored on the dominion belief, according to White. This line of inquiry also resulted in mixed findings: whereas some studies found that believers of Eastern religions were more likely to carry out sustainable behaviours and hold more positive environmental views than Western religious followers, Christians in particular [48,62], others found contradicting findings [63,64]. A similar conclusion was found in a global study comparing the environmental performance of countries with different religions, concluding that similar values were found across Eastern and Christian traditions [65].

Three reasons could explain these inconclusive outcomes: the concurrent influence of cultural and country effects, methodological issues and theoretical reasons. First, different results are observed between countries. These country differences point to the need to take into account the impact of the complex cultural and geographical contexts where studies were carried out. Believers in the same religion/individuals with a similar religious affiliation are considered to share a common cognitive system of beliefs, values and expectations and are supposed to behave similarly [66]. However, this assumption ignores the contextual influences that may explain why those sharing a religious affiliation behave differently in different countries [67]. Following this rationale, cross-cultural studies have shown that religion cannot be studied in isolation of other contextual influences. For example, in a study carried out in the United States and South Korea [48], researchers found that not only religious affiliation and religiosity but also the country and the interactions among the two, significantly predicted sustainable behaviours. Similarly, another cross-country study in United States and Germany [47], found remarkable differences between individuals of the same religion in these two countries: among US respondents, a positive stronger correlation between religious attendance and ethical consumption was found, whereas among Germans the relationship was negative and not significant. Researchers explained this difference by

pointing out a geographical effect: the US subsample was taken in California, and this is one of the greenest states in the country.

A second reason for the contradictory results is the methodology employed, in particular the conceptualization on which the measure of religion is based. Two observations are worth noting. First, religion has been measured differently across studies and this dissimilar operationalization of the construct implies that results cannot be integrated [68]. To illustrate, examining only religious affiliation, the results show a negative [57] or positive [69] influence of religion on environmental attitudes and behaviours. But when the measure of religion reflects the individual's deeper commitment, such as the self-perceived level of religiosity, results are different. Indeed, the self-perceived level of religiosity has been found to positively correlate with self-reported sustainable household behaviours [54] and behaviours such as avoid buying products, pay higher taxes and accept cut in living standards for environmental reasons [70,71]. Reinforcing this argument, studies differentiating between an intrinsic and extrinsic orientation to religiosity [42] have shown that intrinsic religiosity predict positive SC outcomes while extrinsic religiosity does not [52,72,73].

Nonetheless, external religiosity could also predict SC [63,64], but the mediating mechanism is different. While internal religiosity is linked to the inherent views and values provided by religion, external religiosity would be a by-product of the intersection between public participation in religious activities and local culture. However, the relationship between external religiosity and other constructs makes it difficult to disentangle which of them is actually the cause of the behaviour so that it is not possible to rule out that the relationship between external religiosity and SC is spurious. Methodologically, using only affiliation as a measure of the construct should be discouraged as it does not capture the degree to which its members accept the associated beliefs and practices.

A final reason for the inconsistent results is the limited theoretical grounding for the relationship between religion and SC. Most of the studies testing a direct effect are empirical or data-driven and lack a solid theoretical approach to explain the relationship. In contrast, studies that propose a mediating relationship (31% of quantitative papers) are usually grounded on a theoretical framework. To these studies we turn our attention next.

2.4.2 A Mediated/Moderate Relationship between Religion and Sustainable Consumption

Concerning RQ2 and RQ3, studies that defended a mediating and/or moderating role of religion on SC were analysed. Although the majority of the papers proposed and tested a direct relationship between these two constructs, 11 papers have defended a mediated relationship on the basis that religion is a background factor that influence other proximal (and already proven) antecedents of environment behaviour [74]; and/or proposes some moderators that weaken or strengthen the religion-SC link. These behavioural antecedents are grouped into external and internal, as suggests the social psychological model of behaviour by Clayton and Myers. This integrative model proposes two main sources of behaviour: internal (within the individual) including knowledge, attitudes, values, emotions, responsibility and efficacy, and external (related to the environment) including social norms, affordances, reinforcement contingencies, prompts, goals and feedback [12]. The influence of religion on these determinants are describe below.

Attitudes. Religion may affect behaviour by influencing the cognitive schemata. Research has shown that individuals make reasoned choices that sustain their SC decisions and practices. Religion may be one of the factors affecting such reasoning. Attitudes, a prominent construct to study this cognitive schemata, have been systematically found a significant predictor of intention, which in turn affects behaviour [75]. Religious values has been found to significantly influence attitudes, either directly or indirectly through the mediation of environmental concern and natural environmental orientation [49,76,77] or the individual's beliefs and perceptions about nature [78].

Thus, in Muslims countries, having religious values- refers to values based on Islamic scriptures such as Quran and Hadiths -was found to positively and significantly influence the perception that humans are entrusted to steward the earth, which in turn nurtures pro-environmental attitudes [49,76,77].

Beliefs of dominion and stewardship emerge as a key construct in understanding adoption of SC among religious consumers. Drawing from White's thesis, studies examining the links between religion, belief of dominion (stewardship) and SC were conducted among Christians. Studies have shown that these beliefs are not equally present among Christian affiliates; rather, the belief seems to depend on the conservative or progressive interpretation of the scriptures. The dominion beliefs is held by Protestant Christian to a greater extent, whereas the stewardship beliefs is shared by Catholics and Orthodox to a lesser extent [79]. As expected, beliefs of dominion were

associated with lesser adoption of SC behaviours; similarly, beliefs of stewardship are significantly and positively correlated with SC adoption. Specifically, these beliefs mediate the relationship between religiosity and behavioural intention, with stewardship (dominion) exhibiting a positive (negative) influence on the willingness to pay for sustainable alternatives of common consumer goods [60].

Environmental concern, or the evaluation of the environmental consequents of one's behaviour [80], is considered a consistent predictor of SC attitudes, intention and behaviour [9]. Several studies have examined the relationship between religion and environmental concern. To illustrate, religiosity has been found a moderator construct as it strengthens the intention to consume ecological products [81].

It is important to note that there are other constructs that have been found to weaken or strengthen the relationship between religion and environmental concern. For example, political orientation was found to be a powerful predictor of concern among religious people. More specifically, American Christians with a conservative ideology displayed lower levels of environmental concern, compared to those having a liberal political orientation [58]. This shows again the complex relationship between an individual's religion and political orientation.

Another two constructs were found to moderate the relationship between religion and environmental concern in a multilevel analysis of data from 34 countries [50]. Life satisfaction [82,83] and indulgence as a construct highly dependent on emotion [84] were found to be significant moderators of the relationship between religiosity and environmental concern, measured at the country level. At low levels of life satisfaction, non-religious people have low concern for the environment. This finding is explained by contending that individuals with low life satisfaction are more focused on satisfying basic needs, rather than higher level needs associated with environmental protection. However, religious people show higher levels of environmental concern based on their religiosity, even when their most basic needs are not satisfied [50]. Yet, these results should be interpreted with caution: this study did not control for the influence of religion on life satisfaction which raises concerns of endogeneity.

Values. Several studies have found that self-transcendence (universalism and benevolence) values positively affect adoption of SC [85,86], whilst self-enhancement values (related to the self-interest, such as achievement and hedonism) negatively affects it. Similarly, it has been repeatedly found that social-altruistic and biospheric value orientation are positively associated with pro-environmental attitudes and behaviour

[87,88]. The analysed studies show that the more individuals adhere to self-transcendent values beyond their self-interest (self-enhancement values), the more likely they are to adopt SC. Similarly, an altruistic value orientation, measured through attitude toward charitable institutions, was found to predict sustainable purchase intention and religion, as an antecedent, significantly and positively affect altruism, which in turn affect the intention to purchase green [72]. In contrast, hedonistic shopping values (an egoistic value orientation) is negatively associated with the purchase of sustainable products; however religiosity was found to moderate this negative effect, diminishing it [89].

The results shown above demonstrate that religion may influence SC by impinging on cognitive processes. However, SC behaviour is guided by other factors than cognitive processes, in particular, by automatic or habitual action. Religion may also affect habits. Indeed, for religious people of Muslims countries green purchase intention depended less on attitudes as a predictor. In other words, the purchases of green products not only involve cognitive judgments but also habitual decision making and religious consumers choose sustainable alternatives first based on their habits (habits that are already informed by their religious values), and not only by assessing the green information of products on every purchase occasion [77].

Self-efficacy. The perceived ability to successfully complete an action [90] or the understanding that one could make a difference on environmental and social injustices is an important variable influencing SC behaviour. In the sample, only one study examined the relationship between religion and self-efficacy, finding that self-considered religious individuals have self-efficacy beliefs; these, in turn, affect the intention to purchase products that contained a message of socio-ecological justice [91].

Social norms. Regarding the external behaviour factors, only limitedly studies have examined the influence of religion on subjective or social norms [12]. Nonetheless, existing evidence seems to suggest that religion may enable adoption of SC affecting the social norms; the importance that a particular sustainable behaviour, like recycling, has for a religious community was found to be the most important predictor of recycling intention [69]. This is what literature called perceived peer endorsement or the relevance of the reference group on the decision-making process [92].

Identity. Many studies have demonstrated the key role of identity-related constructs in explaining adoption of SC [8]. Yet, none of the quantitative studies has examined the association between religion and environmental identity. However, the fact that religion contributes to nurturing a form of green identity is a fundamental conclusion of the

analysed qualitative studies. Indeed, these studies have examined the meaning-making practices of informants of their religious identity construct and its influence on SC outcomes. Religious identity [93], strongly influences environmental beliefs and practices of religious leaders [94] and religious environmentalists [95–97]. These studies show that caring for the environment is a religious calling so that their belief in the creation as sacred and the stewardship of the earth drives their everyday practices. Of important note, interviewees understand their identity as holistic, as they involve existential and practical concerns, and include self-identity and identity in context, in relation to others and they try to be coherent in all aspects of their identity and its expression. In doing so, informants try to make gradual, serial and controlled changes on their everyday actions to have a more intense and holistic SC [98]. In general, Christians and Muslims consumers intend to avoid over-consumption and extravagance following their religious principles like austerity and following their perceived association with socio-environmental injustices [96,97,99]. In summary, this review shows that religion influences internal determinants of SC such as attitudes, values and self-efficacy, and external determinants, such as social norms. Also, religious identity seems to be a central construct to explain SC practices but quantitative papers measuring this association are missing.

2.5 Discussion

2.5.1 Main findings

This systematic review presents an integrative understanding of the influence of individual's religion on adoption of SC. The contribution to literature is threefold. First, this review helps to reconcile conflicting findings of past research by unveiling the methodological and theorical problems that may explain the contradictory results about the relationship between these constructs.

First, the review foregrounds the difficulties in disentangling the religious influence from cultural influences. Saroglou and Cohen [67] already aid that there is a bidirectional influences between religion and culture, which imply that religion is influenced by culture and reciprocally, culture-level dimensions shape religion at the individual level. They point out that cultural elements (for instance, cultural specifics in cognition, emotion, self-concept, morality, personality, and social behaviour) shape religions and religious experience. As far as these cultural influences are universal, they may explain why, to some extent, religion seems to share commonalities across cultural contexts; however, as far as these cultural elements are different across cultural contexts, they lead to group

differences in religious expressions. These may be differences between religions, between denominations, or even, between cultural groups of the same religion (e.g., a British Christian and a Peruvian Christian). So, establishing simple causal relationships between religion and SC does not seem a valid approach, insofar as the religion construct cannot be demarcated from other cultural-related constructs.

Second, this review shows the limited validity of affiliate-based measures of religion and the need for religiosity measures [38]. Thus, by differentiating how the dimension of religion had been measured, this review is able to make sense of seemingly divergent findings. Results show that when the measure captures the extent to which the person adheres to the tenets of a religion, the relationship between the constructs is significant and positive. Internal religiosity was found to positive predict SC, leading to conclude that when religion is a fundamental source of identity, values and worldviews the relationship between the constructs is positive. This is consistent with other studies having demonstrated the impact of intrinsic religiosity on consumer ethics [14], consumer's ethical beliefs [100], frugality consciousness and connectedness to nature that affected PEB intention [101].

Another reason for the contradictory results concerns the approach to causation on which the study is based. As said above, simple causal relationships seem to lack internal validity as the routes by which religion may influence behaviour are multiple. Moreover, results seem to point to religion not as a causal variable that can be measured in isolation but as a cross-cutting construct affecting a myriad of others, namely, attitudes, values, habits or social norms. Affiliated or practiced religion nurtures a lifeworld that can mould every aspect of daily life, including SC [102]. Environmental psychology identifies internal or intrapersonal (e.g., attitudes, beliefs, and values), interpersonal (e.g., social norms) and external factors (e.g., rewards and punishments) as the most influential predictors of environmental behaviour [12,103]. RQ2 and RQ3 explored this assumption by showing the multiple psychological underpinnings whereby religion influences SC such as shaping cognitions, habits or identity.

This review has shown that religion may influences beliefs and attitudes that would eventually explain greater SC adoption. The stewardship belief is the most studied belief and its positive association with SC seems well-established. Similarly, past studies have agreed in showing the positive influence of religion on self-transcendence values that, in turn, are associated with sustainable purchase intention. Also, the more the individual practices a religion, the less likely is that s/he has a hedonic goal orientation and the

more likely s/he has an altruistic orientation that leads to SC adoption. Abounding on this, religiosity seem to foster altruistic and pro-social behaviours [104].

Whereas the relationship between religiosity and pro-environmental beliefs/values seem well-established in the literature, the relationship between religiosity and self-efficacy beliefs is underexamined. Notwithstanding, initial evidence seems to suggest that religiosity positively influences these beliefs that, turn, are associated with greater green purchase intention [105–107].

Likewise, the study of the association between religious participation/religiosity and interpersonal influences on SC is still in its infancy. There is some evidence that when religious groups hold a pro-environmental norm about a given behaviour (e.g., recycling), it is more likely that its members carry out this behaviour [107,108] especially those members that identify the most with the group [107]. Abounding on this, each religion not only provides a distinct group identification, but also a "coherent and stable set of norms, institutions, traditions, and moral values that provide the basis for an individual to establish and maintain a secure identity" [13] (p. 5). SC practices are a way to express the religious identity, as qualitative studies have shown, although quantitative studies are still necessary to measure this causal relationship.

2.5.2 Future research agenda

This systematic review indicates that religion at the individual level can drive adoption of SC through its impact on individual's attitudes, values, self-efficacy, social norms and identity. Nonetheless, other routes of influence have gone unexamined. For instance, the influence of religiosity on nature relatedness or social connectedness, two constructs already found predictors of SC, has not been examined. Similarly, there are missing studies examining whether religiosity shapes the construal of ecological problems. It is plausible to assume that religion would nurture intrinsic value aspirations but research has yet to establish this relationship [109].

The influence of religion on emotions remains to be investigated, although affect is considered a determinant of environmental behaviour [9]. Future research should explore, for example, the relevance of gratitude or forgiveness, basic emotions across faiths, on environmental behaviour. There are some insights about gratitude as a positive emotion relate to both pollution avoidance and green purchasing intentions [110]. More research is needed about the ability of religion to affect these and the other

internal/external antecedents of environmental behaviour and to examine the boundary conditions of this influence.

In addition to enrich the mediating factors whereby religion shapes SC, it is necessary to disentangle this construct to examine its multiple facets so to unveil the multiple ways in which religion may affect SC at the individual level. The integrative measure of religion proposed by Saroglou [33] could be very appropriate for this, for several reasons. First, this scale was found to be reliable across the different religious faiths, solving the problems of others scales that were developed for particular religion affiliations. Second, it associates the four aspects of religion (beliefs, rituals, morality and identity) with distinct psychological processes (cognitive, emotional, moral, and social). Drawing on this basis, Mathras et al. developed a conceptual framework for exploring the effects of religion on general consumer behaviour [111], and it may serve to ask deeper questions about what salient aspects of religion drives SC behaviour.

Among the religious beliefs, beliefs about the after-life are a common characteristic across confessions [111]. It has been proven to reduce levels of death anxiety that result in less materialism [112]. Given that materialism is negatively associated with SC adoption because implies values and goals focused on possessions and status that standing in conflict whit the well-being of others and the natural word [113], beliefs in after-life may be a particular religion facet that can contribute to greater SC.

Ritual is another dimension of all religions that affects consumer behaviour. Religious practices of cleansing rituals [111] has the potential to transform individuals from a small self to a greater self [114] that is expressed on leaving, for example, a green transgression. A preliminary study shows that Catholics demonstrate more environmentally friendly behaviours after confession (versus only intellectual reflection) about sins against the environment [115]. Likewise, praying as a religious practice may foster SC, as it is suggested by studies on mindfulness and SC [116,117]. Future studies should examine the link between the practice of praying and SC adoption.

Regarding the morality and the identity facets of religion, there are missing studies examining the mediating role of moral identity [118] in the relationship between religion and environmental behaviour. This omission is relevant since moral identity was found to increase, for example, the willingness to choose green products [119]. Moral identity is related to certain beliefs, attitudes, and behaviours, particularly when that identity is highly self-important [120], as it is for religious people [121]. Also, the role of virtues like prudence, simplicity, non-violence, compassion, humility, nurtured by all religions [122]

is other research avenue, because of their direct relationship with SC adoption [123,124]. Finally, the evidence shows that some types of religious beliefs, cognition and behaviour foster self-regulation and self-control [125] and future studies should link it with SC outcomes such as frugality and reduction of consumption, that necessarily implies the self-regulatory strength. These are some of the many ways in which religion could foster SC at the individual level, and this systematic review encourages scholars to advance research in these unexamined areas.

In summary, this research agenda encourage scholars to study other unexamined mediating constructs -such as beliefs in after life, cleansing rituals and prayer, moral emotions, moral identity, the role of virtues and self-restraint- that could enhance the understanding of the influence of religion on SC.

2.5.3 Limitations

No study goes without limitations. As it has been the case of other systematic reviews, we privileged Web of Science and Scopus as the source of studies; however, publications that were not indexed in the chosen databases are not included in this study. The results of this systematic review should be taken as a starting point for academic debate and research and not as closed conclusions. Finally, researchers should be careful about constructs that may overlap with religion such as political orientation; the evidence found for this systematic review is inconclusive in this regard and indicates the need to analyse this in more depth to reach certain conclusions. Also, we did not carry out a quality check of studies as a criterion to screen in/out studies. Indeed, some of the reported studies may raise concerns of construct validity, endogeneity, and reverse causality. However, given the limited set of studies we decided to include them all and discuss the methodological limitations as a reason for the inconclusive findings.

2.6 Conclusions

This systematic review has shown there is evidence to suggest that individual's religion may play an important role in shaping SC. It integrates the existing studies by analyzing a potential causal relationship between religion and SC. This study shows that religion at the individual level drives SC behaviour indirectly through its impact on other proven antecedents of SC, such as attitudes, values, self-efficacy, social norms and identity. In addition to enrich the mediating factors whereby religion shapes SC, the research agenda encourage scholars to disentangle the construct "religion" in its facets (related to specific psychological processes) so to unveil the multiple ways in which religion may

affect SC. The development of a comprehensive understanding of the influence of religiosity on SC will allow advancing research in this domain and suggestions are given in this respect. In sum, this paper foregrounds the potential of religiosity to foster adoption of sustainable lifestyles, which, in turn, benefits the whole society and the natural world.

Author Contributions

Conceptualization, A.O., C.V., and E.C.; methodology, A.O.; writing—original draft preparation, A.O.; writing—review and editing, C.V., and E.C.; supervision C.V., and E.C. All authors have read and agreed to the published version of the manuscript.

Funding

This research was funded by a pre-doctoral fellowship of “Fundación Tatiana Perez de Guzmán el Bueno”.

Conflicts of Interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

2.7 Appendix A

Table A PRISMA Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	1
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	1-3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	2
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	-
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	4
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	4
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	4
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	4,5
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	5
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	5
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	5
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	5,6
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	6
Section/topic	#	Checklist item	Reported on page

			#
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	5
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	-
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	Figure 2.1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	6
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	6
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	Appendix B
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	6-10
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	-
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	-
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	11-13
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	13
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	14
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	14

2.8 Appendix B

Table B. Final List of Articles Included in the Systematic Review

Author/ Year of publication	Direction of the influence of Religion on SC
Quantitative studies	
Klineberg, McKeever & Rothenbach (1998)	Not significant
Rice (2006)	Positive
Bove, Nagpal & Dorsett (2006)	Not significant
Chauhan, Rama das, Haigh & Rita (2010)	Positive
Witkowski & Reddy (2010)	Positive
Doran & Natale (2011)	Positive
Warner, Brook & Shaw (2012)	Positive
Clements, McCright & Xiao (2013)	Negative
Garfield, Drwecki, Moore, Kortenkamp & Gracz (2014)	Positive
Hassan (2014)	Positive
Martin & Bateman (2014)	Positive
Minton, Kahle & Kim (2015)	Positive
Minton, Jiuan, Kahle & Tambyah (2015)	Positive
Diaz, Vélez & Costa (2015)	Negative
Akremi & Smaoui (2015)	Positive
Leary, Minton & Mittelstaedt (2016)	Negative
Liobikienė, Niaura, Mandravickaitė & Vabuolas (2016)	Positive
Peeper & Leonard (2016)	Negative
Ariswibowo & Ghazali (2017)	Positive
Arli & Tjiptono (2017)	Positive
Bhuian & Sharma (2017)	Positive
Davari, Iyer & Strutton (2017)	Positive
Graafland (2017)	Positive
Ghazali, Mutum & Ariswibowo (2018)	Positive
Hwang (2018)	Positive
Lakhan (2018)	Positive
Yang & Huang (2018)	Not significant
Felix, hinsch, Rauschnabel & Schlegelmilch (2018)	Positive

Minton, Leary & Upadhyaya (2018)	Positive
Minton, Xie, Gurel-Atay & Kahle (2018)	Positive
Razzaq, Z., Razzaq, A., Yousaf & Hong (2018)	Positive
Ali, Danish, Khuwaja, Sajjad & Zahid (2019)	Positive
Gutsche (2019)	Positive
Hammed,Waris & Amin ul Haq (2019)	Positive
Ukenna, Nkamnebe & Idoko (2019)	Negative
Qualitative studies	
Lorenzen (2012)	Positive
Warner, Brook & Shaw (2012)	Positive
Waylen Fischer McGowan & Milner -Gulland (2012)	Positive
Akremi & Smaoui (2015)	Positive
Lorenzen (2017)	Positive
Perera and Hewege (2018)	Positive
Conceptual papers	
Emmons & Paloutzian (2003)	
Narayanan (2010)	
Witkowski (2010)	
Papaoikonomou, Ryan & Valverde (2011)	
Azizan &Wahid (2012)	
Chaminda & Ratnayake (2013)	
Zaleha (2013)	
Gifford & Nilsson (2014)	
Van der Noortgaete & De Tavernier (2014)	
Van der Noortgaete (2016)	
Taylor (2016)	
Taylor, Van Wieren & Zaleha (2016)	
Quoquaba & Mohammadb (2016)	

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3 LINKS BETWEEN CLIMATE CHANGE KNOWLEDGE, PERCEPTION AND ACTION: IMPACTS ON PERSONAL CARBON FOOTPRINT

Este capítulo explora la medida de consumo sostenible elegida para el desarrollo de esta investigación: la huella de carbono personal. Los datos analizados se han extraído de una encuesta representativa de la población española, realizada con el propósito de conocer las emisiones asociadas al consumo individual, cuantificadas por medio de la huella de carbono personal. Se sigue el modelo socio-psicológico elegido, que considera en este caso al consumo asociado a sus emisiones dependiente de factores externos o situacionales, e internos o intrínsecos para conocer su influencia en la huella de carbono personal. Los resultados muestran una clara influencia de los factores socioeconómicos, y una menor influencia de los factores internos.

Este capítulo corresponde al artículo:

Chuvieco, E.; Burgui-Burgui, M.; Orellano, A.; Otón, G.; Ruíz-Benito, P. Links between Climate Change Knowledge, Perception and Action: Impacts on Personal Carbon Footprint. Sustainability 2021, 13, 8088. https://doi.org/10.3390/su13148088

3.1 Abstract

The current understanding of determinants of climate action and mitigation behaviour is largely based on measures of climate change including concerns, attitudes and beliefs. However, few studies have shown the actual effects of external and internal drivers on citizens' lifestyles related to climate change, particularly in terms of their carbon footprint (CF). A questionnaire (n = 845) assessing the impact of potential explanation factors for personal CF was carried out in Spain. The study showed the importance of better understanding the factors affecting citizen's consumption and climate change mitigation policies. Internal factors were not very explicative. Knowledge was linked to clothing and perceived commitment to food, with both sectors being more directly linked to personal choices than other CF sections. Both accounted for 40% of personal emissions. Frequency of action was not shown to be significantly related to any CF section. External factors, such as income, level of studies, age and type of work, were found to be more important than internal drivers in explaining personal CF, particularly type of work, age and income, which were linked to all CF sectors but household energy. Sex was highly associated to clothing, but also significant for transport. Political orientation was not found to be linked to any section of personal CF.

Keywords: *climate change; carbon footprint; knowledge; perception; action; behaviour*

3.2 Introduction

In spite of the scientific consensus on climate change (CC) [1] and the extent of international agreement on this topic [2], public debate on the relevance and urgency of the problem is still present on media and social networks [3,4]. As a result, the reductions in national emissions are not ambitious enough to curve the observed trends of the last two decades, while the current CC mitigation policies are far from meeting the ambition of the Paris agreement [5] and the 13rd Sustainable Development Goal (Climate Action). For instance, a recent study indicates that CO2 atmospheric density should be reduced from the current 415 ppm to 350 ppm to recuperate the Earth's energy balance [6] and avoid further climate destabilization [7].

Reducing GHG emissions implies further efforts being taken not only by governments and private companies, but also by citizens. Different assessments have shown that a high proportion (60–70%) of total emissions are related to individual decisions and

personal lifestyles, including household consumption [8,9]. Emphasizing this, several strategies to reduce personal emissions have been suggested in recent decades, including carbon footprinting, carbon offsetting, carbon dieting, Carbon Reduction Action Groups, and Personal Carbon Allowances [10–12]. Among these strategies, the calculation of personal carbon footprint (CF) has shown a great potential for extending citizens' awareness of the impacts of their personal habits in terms of CC mitigation [13,14], and encouraging them to take specific actions to further reduce their footprint. Different CF calculations and databases have been developed in recent years to facilitate a quantitative estimation of personal emissions [13,15,16], and also as a means to evaluate different mitigation policies [17].

However, as occurs in other environmental problems, CC concern and action are not always linked, not even public CC activism and personal change mitigation behaviour [18]. Inconsistent responses and limited actions have been observed in several studies [19]; others have shown relationships between motivations and actions, but these, in many cases, have only a marginal impact on personal emissions [20]. For this reason, a better understanding of the drivers affecting personal CF could greatly benefit CC mitigation policies.

Following the model of Clayton and Myers [21] personal environmental behaviour is explained by a wide set of factors, including external and internal drivers. The external ones refer to physical and socio-economic constraints and benefits, while the internal ones are linked to individual knowledge, values, attitudes and emotions. Previous studies have identified income as the most explicative factor of personal CF, with a higher income associated with higher emissions [21–23]. House size has also been found to be related to emissions, with higher per capita emissions for those with lower family sizes [24]. Place of residence (rural or urban location) has an influence in some cases [10,25,26], but not always [27], with influence differing with regard to the various types of emissions (household energy, transport, food, etc.) [23]. Age was found to be closely associated to CF in a sample of the UK population, linked to income and working status, while gender was not found to be relevant [27].

Internal factors associated with personal CF should be linked to the knowledge, values, emotions and perceptions of individuals towards the environment, and particularly towards CC. These drivers have been less explored than the external ones, although different environmental psychologists consider them to be more influential, particularly when affecting curtailed behaviours [21,28,29]. Previous studies have shown that

knowledge of CC correlates well with higher concern and positive attitudes towards the climate [30].

Closely related to knowledge of CC is confidence that CC is currently occurring and is mainly caused by anthropogenic actions. Scepticism about CC science is identified as a significant barrier to public engagement [4]. The influence of a perceived social consensus about CC also has relevant impacts on personal opinions and attitudes [3]. On the other hand, a meta-analysis carried out by Van Valkengoed and Steg [30] found a strong correlation between perceived outcome efficacy (the extent to which individuals believe that mitigation actions will be effective) and CC commitment. In the same way, Xiang et al. [31] found a significant relationship between perceived intractability and climate action. This implies that those respondents who considered that CC is either too global to affect them or too great to be affected by their personal efforts tended to be much less involved in climate action than those with higher tractability perceptions. Research has shown that self-transcendent or altruistic values affect personal perceptions of and concern regarding CC; those who report holding altruistic values have higher levels of concern and are more likely to trust science regarding the anthropogenic causes of CC [32–34].

Most of the revised literature explaining drivers of CC action aims to understand individuals' concerns and perceptions, but much less research has been focused on the actual implications of those perceptions on personal behaviour, and particularly on personal CF. On the other hand, previous studies have focused on external factors, with only a few dealing with internal motivations. In this paper, we examine the impacts of internal factors on CC knowledge, perception and commitment, using personal CF as a measure of CC mitigation behaviour. Since those internal factors are mediated by external drivers, we analyse the cross-correlation between them. The study is based on a sample of the Spanish population, which was interviewed using an internet survey in May 2020. Our initial hypotheses were that people with a better knowledge of CC science, who valued the impact of their personal responsibility on the problem and who had participated in climate actions would have a lower CF than the rest of the sample. We also analysed the role of external factors that mediate these relations, particularly the impact of sex, age group, type of work, monthly income, place of residence and political orientation. Finally, we researched whether explanation variables may change regarding different components of the CF, particularly the two most important factors: Food and Transport.

3.3 Materials and Methods

3.3.1 Carbon Footprint Calculator

This survey was carried out within the framework of developing and testing an online Carbon Footprint Observatory “CO2web” (https://www.huellaco2.org/).This CO2 observatory has three main interrelated blocks: the first section presents the scientific basis of CC, the concept of CF and its calculation; the second one compiles data on emissions associated with the main consumption and transport habits of citizens; the third one contains a CF calculator that computes personal emissions (in kg of CO2 equivalent) for the main consumer categories: household energy, transport (car, train, bus, subway), clothing, food and drinks, and others (including tobacco consumption, computers and pets). All CF values are computed in CO2 equivalent units (CO2e) and are based on standard life-cycle assessments, published in scientific sources, mostly peer-reviewed papers (see Burgui-Burgui and Chuvieco [35] for a full description of the CO2 observatory and the associated CF calculator). Emission factors for the Spanish electrical system were taken from the annual average of 2018, provided by the Spanish regulator (https://www.ree.es/,accessed on 12 February 2019).

3.3.2 Data Collection

An internet survey was conducted by a social studies company, specializing in internet questionnaires. The sample was extracted following a non-random stratified selection, which aimed to represent the whole Spanish population. Sampling strata included sex, age and place of residence, including a quota from their own database of respondents to mimic the whole Spanish population distribution of those strata. The target population was 1000 people, which was recommended by the company experts, based on their previous surveys. Annex I include a full technical description of the survey.

The questionnaire comprised two blocks. The first one included three groups of questions: a. Those related to external factors (age group, sex, level of studies, type of work, monthly income, size of the town of residence, and political orientation); b. Those related to motivations and perceived connection to nature, c. Those linked to internal factors: CC knowledge, perception and actions.

The second block of questions referred to the personal consumption of the interviewed persons, including the different categories of the CF calculator. Personal GHG emissions were grouped in five categories: 1. Household energy (including heating and cooling), 2. Transport (including car, train, bus and subway displacements), 3. Food (+drinks), 4.

Clothing (+shoes), and 5. Others (including tobacco, electronic devices and pets: cats and dogs). The CF calculator was based on emission ratios computed from peer-reviewed papers and national agencies. The CF estimations were based on quantitative estimations of respondents' consumption in the five previously indicated categories. To improve the accuracy of the estimations, the interviewed citizens were previously informed that they would need to have detailed data related to their transport journeys or household energy consumption (monthly bills) on hand. For instance, to estimate their car emissions, the questionnaire asked about the size of their car, the total number of km driven during the previous year, fuel type (gasoline, gasoil, natural gas, electric), and average consumption (l/100 km or kW/100 km). The questionnaire asked the respondents to base the estimations on what they did in 2019, to avoid the potential bias introduced by the COVID-19 confinements' impact on their ordinary habits.

3.3.3 Selection of Variables

Since we aimed to explain the drivers of CF, the target variable was the estimation of total CF and their five components (household energy, transport, food, clothing and others). The explanatory variables included external and internal factors (**Table 3.1**). The former comprised sex, age group, level of studies, type of work, monthly income, town size and political orientation, while the latter involved the knowledge, perception and action of respondents regarding CC. These three aspects were related to the main hypothesis of our analysis, while the former aspects were mediators of those internal factors. More specifically, the following internal variables related to CC were considered:

Knowledge. This item aimed to classify respondents based on their understanding of the scientific basis of CC. To do this, two questions were included in the survey. In the first one, respondents were asked to select the main cause of CC from five choices: deterioration of the ozone layer, variations of solar radiation, aerosols, greenhouse gases (GHG) and "Don't know". In the second, the respondents were asked to rank the importance of natural factors to CC between 1 (very low) and 5 (very high). From these answers, a synthetic variable was created, named Knowledge. It was binary coded, assigning a code of 1 to those answers that correctly indicated the main cause of CC, while simultaneously considering the importance of natural factors as very low or low, and a code of 2 otherwise;

Perception. This included several questions related to the respondents' self-perception of their CC actions, using a Likert scale of five intervals. The questions aimed to estimate their perception of their self-commitment (from very high to very low) and the relationship

between their CF and the social norm (from much higher to much lower than national average). Other questions included perception of the responsibility of different agents to mitigate CC, including companies, governments, other countries and each one of us, and the main obstacles they perceived in reducing their CF, including economic, legal, social, and personal aspects. These four questions were summarized into two variables:

a) Perceived commitment, aimed to link self-reported responsibility and personal CF values. This variable was coded in three categories: 1. highly committed and below average emissions (that is, self-perceived as having a low CF); 2. highly committed and above average (self-perceived as having a medium-high CF); 3. otherwise (no particular commitment to CC);
b) Perceived intractability. This variable tried to relate CF with the self-perceived efficacy of personal actions to mitigate CC [30], assuming those who were confident in the relevance of personal actions would have a lower CF. This variable was coded as 1 when the respondent indicated that the importance of our personal actions in CC mitigation was high or very high, and 2 (otherwise).

Frequency of Action. The respondents were asked to rate, in a Likert scale from 1 (never) to 7 (very frequently), the frequency with which they participated in CC mitigation actions, including actions to reduce transport or consumption, changes in food habits, or being involved in CC-related activities. This question was also adapted from Xiang et al. [31].

Table 3.1. External and internal variables included in the questionnaire to explain personal CF

Name	Type	Categories	Description
		External variables	
Sex	Binary	2	Male, female
Age Group	Ordinal	4	0-17, 18-30, 31-65, >65
Level of Studies	Ordinal	3	No studies or primary, secondary school, university studies
Type of Work	Nominal	9	Student, agriculture, industry, administration, education, catering, other services, management, homemakers
Monthly Income	Ordinal	3	< 1500 €, 1500 a 3000 € and > 3000 €
Population	Ordinal	4	<10.000, 10.000-50.000, 50.000-500.000, or > 500.000
Political orientation	Ordinal	3	From the original 9 Likert scale, we grouped in 3 classes: left (<4), Centre (4-6) and right mind (>6)
		Internal variables	
Knowledge	Binary	2	1 = Identify GHG as main cause and consider natural factors as having low o very low importance; 2 = otherwise
Perceived commitment	Nominal	3	1 = highly committed and below average emissions; 2 = highly committed and above average; 3 = otherwise
Perceived intractability	Binary	2	1 = importance of personal actions high or very high; 2 = otherwise
Frequency of Action	Ordinal	7	Likert scale from 1 (never) to 7 (very frequently)

3.4 Analysis

3.4.1 Carbon Footprint and Its Components

Relationships between total CF and its components were explored using correlation and dispersion plots. Of the five components of CF, we focused mainly on transport and food values, as they were the most important factors in our data, and have been identified as the most clearly linked to daily habits and personal decisions [23,36]. In addition, the result of the clustering algorithm was used as the response variable, as it indicated a classification of personal CF values, which was related to different patterns of personal consumption.

3.4.2 Effect of External and Internal Factors

Descriptive statistics were computed to obtain mean and dispersion values of the different response variables (i.e., total CF and its components) and explanatory variables.

The main hypothesis required the computation of different confidence tests to verify whether differences in CF values were significant or not. As most of the explanation variables were measured in a nominal or ordinal scale, we selected the Kruskal–Wallis (KW) non-parametric test for most of the comparison tests. The KW metric is defined as:

$$\mathrm{H} = \frac{12}{N(N+1)} \sum_{i=1}^{m} \frac{R_i^2}{n_i} - 3\,(N+1) \qquad (1)$$

Where m is the number of groups, ni the number of cases for group i, Ri the ranking values for group i, and N the total sample size. We select a confidence level of 0.99 to identify significant differences ($p<0.01$).

3.4.3 Relevance of Explanatory Variables

We used two complementary approaches to determine the relative importance of the explanatory variables for CF. The first one aimed to explain the full range of CF variation, using the actual values of CF (total) and its main components (food and transport) as a target variable. The second one was based on the classification of CF groups obtained by the k-means algorithm, which provided a summary of different types of personal CF values and, to some extent, particular lifestyles.

Having two different sets of response variables implies the application of two different set of methods, one directed at continuous variables (CF values) and the other one at categorical variables (CF groups). In both cases, the final goal was to identify the main variables that explained the variation in CF values (first case) or the assignment to CF categories (second case). Since the explanatory variables were measured in categorical and ordinal scales, and most did not comply with normality assumptions, we opted to use the Random Forest (RF) algorithm in both models, which is a non-parametric model widely used in multiple fields [37–39]. RF is a recursive partitioning method that creates a collection of decision trees from a random selection of cases. Each tree is built from the training data, choosing a set of input variables by maximizing the interclass divergence of the selected cases. A collection of individual trees forms a “forest” that is trained from a percentage of the input data. The algorithm assigns an unknown case to the most repeated class in the trees’ outputs. The accuracy of the algorithm is computed

from cases not used to build the RF model (named “out of bag” (OOB)). In this way, the estimation of error is more accurate.

RF provides descriptive measures that reflect the impact of each variable in terms of both the main effects and interactions [40] and unbalanced size classes in factors [41]. The optimal number of attributes was randomly selected and the optimal node size at each split was adjusted following the specialized literature [42], before being determined for each response variable. For the original CF values, we used the RF regression mode. For the clusters of CF categories, we used the RF classification mode. In both cases, the indicator of variable importance was the mean decrease in accuracy that represents how much the OOB error decreases when each variable is removed [43].

$$OOB_MSE = \frac{1}{n}\sum_{i=1}^{n}(yi - \overline{yi}_{OOB})^2 \quad (2)$$

where ¯yi_OOB is the average prediction for the ith observation from all trees for which this observation has been OOB.

3.5 Results

3.5.1 Average CF Values and Clusters

The mean personal CF of our sample was 5010 kg of CO2e/year. This value was found to be lower than the per capita emission rate of Spain (6861.21 kgCO2e/year in 2019): (https://www.ine.es/jaxi/Datos.htm?path=/t26/p084/base_2010/serie/&file=01004.px, last accessed on 2 March 2021)). It should be noted that our estimation only included consumption emissions (emissions linked to construction or export goods, for instance, were not considered) and population older than 16 years. The main contributor to the meanpersonal emissions value was the transport section, which implied 45% of total emissions (2164 kg). The second one was food, with 33% (1509 kg), which was far greater than household energy consumption (9.25%), clothing (7.35%) or others (11%), with the latter mainly related to emissions from electronic tools and pets (see **Table B1**, Appendix B). The highest correlations between total CF and its components were found for transport (Spearman rs = 0.726) and food (rs = 0.448), with both being highly significant (**Table 3.2**). Lower values were observed for household energy, clothing and others, although they were still significant (rs < 0.35). Relationships between the CF components were observed in the case of household energy and transport, and food and clothing, which were significant in both cases, but with low values (rs < 0.158).

Table 3.2. Spearman correlation values between the different components of the carbon footprint

	Energy	Transport	Food	Clothing	Others	Total
Energy	1					
Transport	0.158*	1				
Food	-0.071	0.019	1			
Clothing	-0.054	0.026	0.156**	1		
Others	-0.007	0.055	0.039	0.158*	1	
Total	0.325**	0.726**	0.448**	0.204**	0.321**	1

p-values lower than 0.001 are marked as ** and lower than 0.01 as *

Table 3.3 shows the average CF values for the different groups obtained by automatic clustering (see also Figure A1). They can be described by their main CF component:

- Group 1 indicated high food emissions, medium to high transport emissions and low emissions from the three remaining CF sectors;
- Group 2 had particularly high CF values of others and medium to high values for transport and food. This was the less frequent group (6% of cases);
- Group 3 was characterized by high transport emissions, medium food emissions and low emissions from the remaining sectors;
- Group 4 indicated mean emission levels for all categories. This was the most populated cluster, with 425 respondents (50.3%);
- Group 5 included high values for household energy and mean of CF transport and food, while low values for the two remaining sectors.

Table 3.3. Average CF values for the different clusters (kg CO2e)

	1	2	3	4	5	Average values
Energy	385.05	525.61	447.37	261.26	1773.89	477.58
Transport	1612.28	1882.69	4265.49	1337.96	2054.99	2163.66
Food	3663.79	1339.45	1405.25	1151.2	1410.15	1509.17
Clothing	445.11	372.32	306.11	291.75	301.69	316.94
Others	471.24	2989.26	443.53	342.2	374.61	542.57
Number of cases	88	51	201	425	80	845

3.5.2 External Explanatory Factors

The influence of external factors on CF values was measured by the Kruskall–Wallis rank differences. KW test values determined which external factors were more closely related to the distribution of CF values (**Table 3.4** and **Table B1**, Appendix B).

Sex groups had significantly different emissions in terms of household energy, transport, clothing and others. However, a remarkably similar distribution in terms food emissions between sexes was found, with only minor differences in total emissions. The males in our sample consumed more in terms of household energy and transport (**Figure A1** and **Table B1,** Appendix B), but they had significantly lower emissions regarding clothing and others than females.

Table 3.4. Kruskall–Wallis values of CF differences for the explanatory variables (external and internal factors)

	Food	**Transport**	**Energy**	**Clothing**	**Others**	**Total**
Sex	0.05	**26.56***	**11.12***	**168.35***	**6.91***	2.97
Age group	8.30	**29.43***	9.41	**74.31***	**25.70***	**15.96***
Leve lof studies	4.10	**14.03***	3.24	5.67	**12.77***	8.53
Monthly income	2.72	**53.65***	2.28	2.44	2.16	**31.73***
Type of work	**20.47***	**42.70***	12.63	**51.69***	**36.83***	**21.57***
Population	4.94	3.63	**14.73***	4.41	**16.98***	8.26
Political orientation	3.57	0.73	1.18	1.62	5.93	2.72
Knowledge	6.16	5.56	3.97	**9.43***	1.86	0.10
Commitment	**10.82***	3.68	0.97	6.18	3.26	6.74
Intractability	0.70	1.56	**7.60***	0.23	3.88	0.11
Frecuency of Action	3.02	7.58	8.06	2.27	5.92	4.62

Values marked with * indicate $p < 0.01$

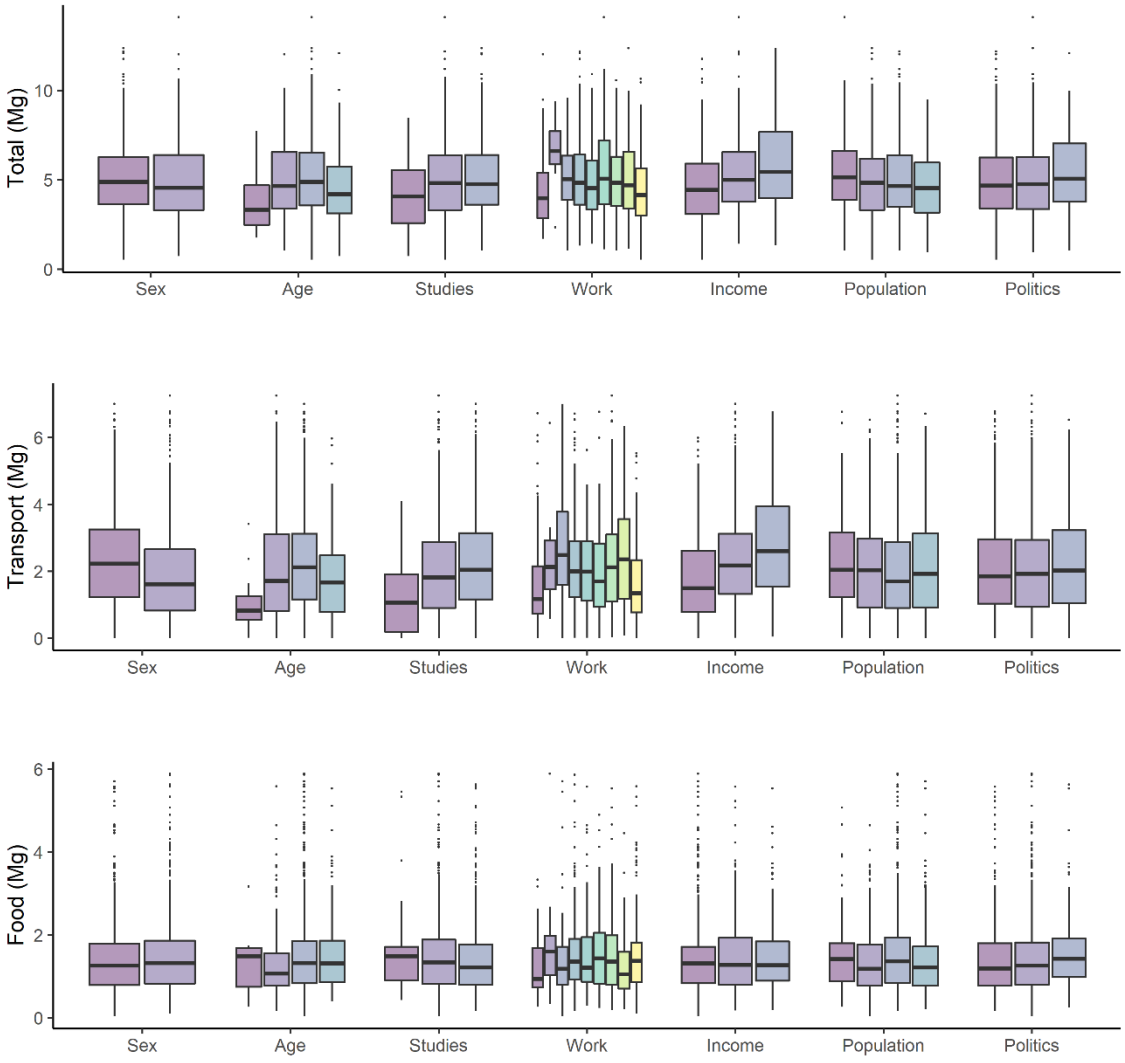

Figure 3.1. Boxplots of total, transport and food carbon footprint values (kg CO2e), depending on external drivers. Box categories are included in the same order as in Table 3.2

Age implied significant differences in total CF, transport, clothing and others. Transport CF was found to be higher for the intermediate groups, and lower for teenagers (16–17 years) and people above 65 years. However, clothing had higher values for the two younger groups (<30 years), with significantly lower values for those >65 years. Food emissions had fewer significant differences among age groups.

Income was observed to only be directly related to transport CF, with higher values related to higher income, while, for the other components, the relations were not clear, with intermediate values for higher incomes. Education level had a significant association with transport and household energy, with higher values for persons with university degrees.

However, this group had a lower CF for food and others. Working activity implied different levels of personal emissions in terms of both the total CF and its components, with the exception of household energy (**Table 3.4**). It was observed that students and homemakers had significantly lower transport and food emissions, while for industrial workers and entrepreneurs, CF values were significantly higher (**Figure 3.1** and **Table 3.2**). Total CF was higher for agricultural workers and catering services and lower for students and homemakers (**Figure 3.1**).

Regarding the size of the town where respondents live, the only significant differences were found in terms of household energy and others, with higher emissions for smaller towns. Transport and food emissions were more equilibrated among town groups. Finally, political orientation was not found to be significantly associated with CF, either in total values or any of the CF components.

3.5.3 Internal Explanatory Factors

Regarding the internal factors, the KW test provided insights into the driving factors of personal CF. Knowledge about the causes of CC only implied significant differences in clothing CF, but not in total CF values, neither in their main components (**Table 3.4**). Although not highly significant, it was observed that respondents with higher knowledge about CC had less emissions in food and clothing than the others, but higher in transport and household energy (**Figure 3.2**).

The different levels of perceived personal commitment were found to be significantly related to food CF, while in other CF sections, they showed lower differences (**Table 3.4**). The CF values of those self-perceived to be highly committed and with below-average emissions, in fact, had the lowest total CF values, as well as lowest emissions in terms of transport, food and clothing, and the second lowest in terms of household energy (**Figure 3.2** and **Table B2**, Appendix B). Those self-perceived as having low commitment in fact had the highest emissions for total, transport, household energy, clothing and others, while those self-perceived as with high commitment and with higher than average total emissions had the highest values for food.

Perceived intractability, as indicated by the self-perceived relevance of personal responsibility for CC mitigation, only showed significant differences in energy CF (**Table 3.4**). Here, our initial assumptions were confirmed, as emissions from household energy use were lower for those that emphasized the importance of personal actions in CC mitigation. However, in other CF sections, the values were very similar, or even slightly

higher, for those who were less concerned about personal responsibility, particularly for food and others.

Finally, the frequency of climate action did not imply significant differences in CF in any of the CF sectors (**Table 3.4** and **Figure 3.2**). Considering the trends in this variable, higher emissions were not related to a lower frequency of CC actions, as was expected. In fact, similar emissions regarding transport and food were found for people in both extremes of the action scale: those never participating in any action and those with a high frequency of participation. The lowest values in both CF sections were observed for categories with a medium frequency of CC action (from 3 to 4 in the original Likert scale), indicating a low impact of CC activism on personal lifestyle.

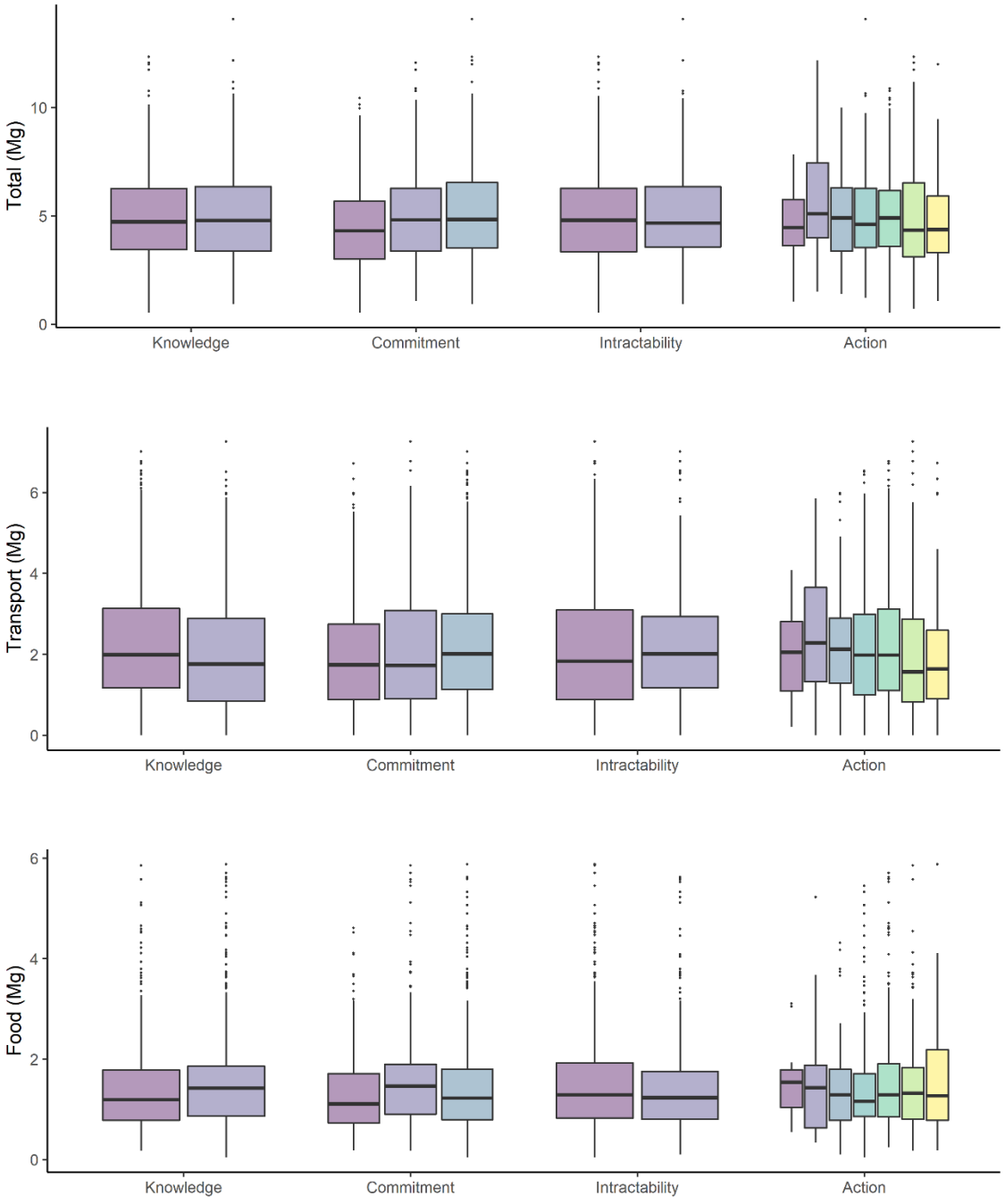

Figure 3.2. Boxplots of total carbon footprint and its components (Mg of equivalent CO2) depending on climate change knowledge, perception and action

Perceived intractability as indicated by the self-perceived relevance of personal responsibility in CC mitigation only showed significant differences in energy CF (**Table B1**, Appendix B). Here our initial assumptions were confirmed, as emissions from energy use were lower for those that emphasized the importance of personal actions for CC mitigation. However, in other CF sections the values were very similar or even slightly

higher for those less concerned about personal responsibility, particularly in food and others.

Finally, frequency of climate action did not imply significant differences in CF in any of the CF sectors (**Table B3**, Appendix B and **Figure 3.2**). Considering trends in this variable, the higher emissions were not related to lower frequency of CC actions, as it was expected. In fact, similar emissions were found for people in both extremes of the action scale, those never participating in any action and those with high frequency of participation, particularly in transport and food. Lowest values in both CF sections were observed for categories with medium frequency of CC action (from 3 to 4 in the original Likert scale), indicating low impact of CC activism on personal lifestyle.

3.5.4 Factors driving CF clusters

Clusters generated from automatic classification of CF sections were cross-tabulated with the different external and internal factors to compute significance trends and strength of association. The only factors significantly ($p<0.01$) associated to CF clusters were external factors: sex, work, income and population (**Table B3**, Appendix B).

Regarding the main associations of the CF groups, male and higher income respondents had higher proportions than expected in group 3 (high CF transport, medium CF food and low of the remaining); university degrees and people living in small towns (<10K) had a higher proportion than expected in group 2 (high CF of Others, medium to high transport and food), and homeworkers and citizens of medium size towns (50 – 500K) were more represented than expected in group 1 (high food CF). However, in most cases, the distribution of the cases among groups was very diverse, with no clear evidence of bias towards specific categories of explanatory variables.

3.5.5 Global random forest models

We included in the RF all external and internal factors, with the exception of income that had a large number of unfilled answers (172). Since this variable was correlated to level of studies ($rs= 0.34$, $p<0.001$), we used the latter variable as explanatory factor to keep the total number of cases. We intended to use RF models to identify the most explanatory variables of personal CF values. However, neither the regression nor the categorical RF models provided satisfactory results, with low explanation metrics for both the CF values and the CF clusters, respectively.

We developed RF regression models for the total CF values and the different CF sectors. In all cases, we found only a marginal explanation of the observed CF: 0.87% for total CF, 3.74% for transport CF and 0.18% for food CF. These values were very low, implying that neither the external nor internal factors provided a good estimation of personal emissions. Among the external factors, the accuracy metric for the total CF provided higher values for type of work, age group, level of studies and political orientation, while for internal factors, frequency of action showed the highest explanation power (**Figure 3.3**). For the model to explain transport CF, the main variables were type of work, sex, political orientation and age group, while for the model of food CF, level of studies, age group and commitment showed the greatest explanatory power.

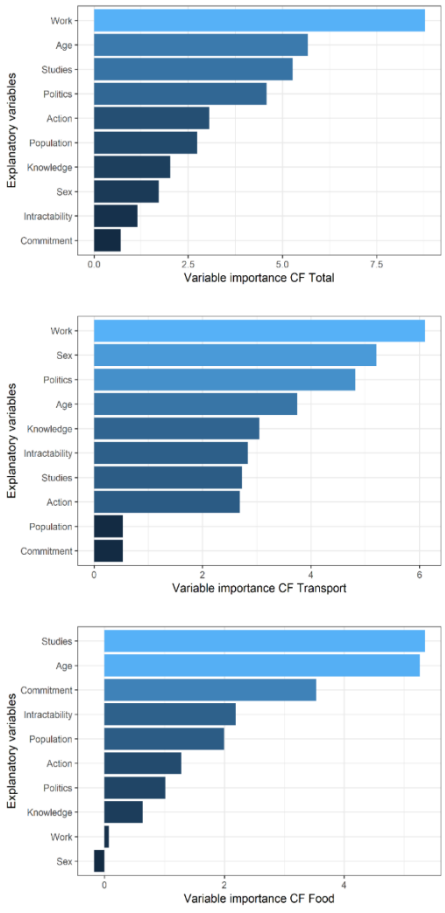

Figure 3.3. Variable importance for total, transport and food Carbon Footprint from regression CF models

The RF classification mode also provided a poor explanation of the CF clusters. The OOB classification error was 0.58 using ten variables and 0.5 using only the two most explicative variables (Frequency of action and Type of work). Besides these two variables, the first model included population, age group, perceived intractability,

commitment, sex, level of studies, knowledge and political orientation. The less explicative variables in the model (the last eight) were rejected in the second model. However, these rejections should be taken with care, considering the low explanation capacity of the model.

3.6 Discussion

3.6.1 Main findings

This study has analysed factors affecting personal carbon emissions through a quantitative measurement of personal CF for the main consumption sectors (household energy, transport, food, clothing, others). Although the previous literature has identified potential drivers of consumption impacting CF, only a few have used numerical estimations of personal CF based on detailed emission factors. As explained earlier, different studies have shown the discrepancies between concern and commitment, and even between commitment and personal behaviour [19,44]. Our approach makes it possible to verify whether external and internal factors, such as CC knowledge, perception and action, are really linked to low-carbon lifestyles.

We found that the personal CF of Spanish consumers accounted for an important share of the country's per capita emissions. With data from 2019, our estimations indicate that 73% of the total GHG emissions were derived from personal consumption. This value was similar to what was estimated by other authors based on census data (72% in the UK, found by [10], and >60% in a sample of 43 countries, found by [9]), although in our case we should consider that only the population older than 16 years participated in the questionnaire.

Regarding the distribution of sectors, personal CF was mainly related to transport and food, which form 78% of total personal emissions. Household energy, clothing and others accounted only for 10% each, approximately. Automatic classification of CF "profiles" included a very large group (covering 50% of cases) with lower-than-average values for all CF sectors, followed by a cluster 3 (with 24% of cases), with high transport CF and average results for the other CF sectors, and two smaller groups (80 cases each) with a high food (group 1) and energy CF (group 5). Finally, a marginal group (with 51 cases) was composed of those respondents with a high CF from others (tobacco, computers, and pets).

In the search for global models that would provide an insight into the most explanatory variables, we have not found any variable that explained overall CF trends, including

both quantitative CF values and classified CF groups. The inability to find correlations between personal variables and CF suggests that structural factors rather than personal factors may explain overall emissions. Future work should explore this possibility.

The explanatory variables had generally low correlations between them. The exceptions were income and level of education; this was also observed by other authors analysing CF [10,23]. In terms of single relations between CF values and explanatory factors, the Kruskal–Wallis test highlighted the higher importance of external over internal factors, as was also observed in other studies [20]. This further reinforces the idea that CF may be more explained by structural factors than by personal traits of individuals. Total CF was mainly related to age, income and work, with higher emissions for intermediate ages (30–65 years), greater incomes (>3000), and agricultural and catering employments, while lower emissions were observed for younger (16–17 years) and older ages (>65 years), lower income (<1500), and students and homemakers. This is in line with previous studies, particularly those relating income and CF [10,22]. Age and work have been less frequently tested, as most CF studies were based on census data, rather than on personal questionnaires [10].

The explanatory variables of different CF sectors were quite diverse. Food CF was significantly related to the type of work, with higher emissions for agriculture, home, catering and administration workers, and low for students and entrepreneurs. Commitment was also significantly associated with the food CF, following expected trends, with lower values for those self-perceived to be highly committed. However, those that were self-declared to be highly committed but with perceived higher emissions in fact had higher values than those declared to have low commitment. Perceived CF, in this case, correlates with actual values of CF.

Transport CF was related exclusively to external factors, including income, work, age, sex and education, in that order. Following expected trends, lower transport CF values were found for lower incomes and for the two extremes of the age cohorts: young and old respondents. Lower values were also observed for catering and homeworkers, females and students. The size of the residence town only implied significant differences in household energy and others, but not in transport, as was expected, as location is related to accessibility to work and food. Political orientation was not related to any of the CF sectors.

It was observed that the CF sectors more linked to personal decisions, such as food and clothing, were the most closely related to internal factors, although only a few were

significant. For instance, CC knowledge only significantly impacted the CF of clothing, probably because clothing is a consumption domain under greater agency of consumers compared to energy or transportation, with higher values for those ignoring the basis of CC. Similarly, knowledge also impacted food CF, although not significantly, with lower emissions for those who were more informed about CC.

Self-perceived commitment was also associated with food and clothing CF, with significantly lower values for those who were more committed. Other authors have found controversial results regarding the relationship between internal factors and climate behaviour [45], with some showing positive trends and some negative ones.

The self-perception of personal responsibility and impact of personal decisions to solve the problem (perceived intractability) was only found significantly related to household energy, but with low significance, and not with other sectors more related with personal decisions. This finding contradicts previous studies [31], that found significant differences between perceived intractability and climate action, although in that case, the study did not test actual CF indicators.

The frequency of CC actions was not significantly associated with any CF sector. This was particularly surprising, since it was the only variable that indicated actual behaviour, not just concern. However, apparently, the impact of this activity on personal lifestyles is not evident, with very similar values in the CF regarding food or clothing for those with a low and high frequency of activism. A recent study on climate protesters during the 2019 youth rallies showed that climate action does not necessarily affect personal behaviours [18].

The inconsistent relationship between internal factors and CF values confirms other studies that observed uneven relationships between concerns and personal habits, observed in several environmental topics [46], and particularly in terms of CC mitigation [47]. Certainly, concern relies on self-reporting of a value that is widely accepted by society, while actual reduction require changes that are much more complex to undertake; therefore, they are not necessarily highly related to objective indicators [48]. This also affects knowledge of CC (and other environmental issues), which is not necessarily related to personal commitment and environmentally friendly lifestyles [49]. In our results, some of the CF sectors may have, in fact, depend little on personal choices, as they are mediated by family or working activities, as is the case for the CF of household energy and transport. However, personal choices are more evident for food and clothing, which form a significant part of the total CF (>40%).

3.6.2 Limitations

When interpreting our results, it should be noted that CF values were computed from a CF personal calculator, with all the strengths and limitations that this approach includes.

On the positive side, the emission coefficients were estimated from updated scientific references and adapted to Spanish conditions [35]. On the negative side, quantitative estimations of CF require accurate inputs (energy bills, food amounts, transport distances), which are difficult to calculate and rely on respondent's provision of accurate data.

Although all respondents were warned about this before starting the interview, we had to remove some responses, as they included very unlikely CF values, using visual and automatic classification methods. The final values included in our analysis seem reasonable, but it was not possible to test their actual accuracy, as the analysis was based on the "bona fide" answers of the respondent. On the other hand, the sample was selected using a statistically designed sample, and included an unbiased representation of the Spanish population above 17 years. Consequently, we are confident the conclusions drawn from our work, which mostly align with previous research, but further studies based on actual CF measurements are necessary to verify some of the results.

Another limitation refers to the date on which the survey was conducted (May 2020). At that time, Spain was confined because of the COVID-19 pandemic; therefore, the consumption habits of the population were very different from ordinary. For this reason, we asked the respondents to base their estimations on data from 2019. In spite of this, some respondents may have been affected by the situation at the time of filling in the questionnaires. It is difficult to assess the impact of this, as no previous studies have dealt with personal CF values of the Spanish population.

3.7 Conclusions

In spite of these limitations, this study has shown the importance of better understanding the factors affecting citizen's consumption links to CC mitigation policies. Moving from declared concern or commitment to actual consumption habits requires quantitative assessment of CF values; this is complex and includes uncertainties, but still reveals interesting outcomes that go beyond declared concern and are obviously more important than this in quantifying CC mitigation efforts.

Reducing overall emissions should imply decreasing and reshaping consumption. Our initial hypothesis assumed that people with better knowledge about CC science, those who value the impact of their personal responsibility on the problem and those who have participated in CC-related activities would have a lower CF. From our results, none of these internal factors were found to be significantly related to total CF, but knowledge and concern about CC were found to be linked to food and clothing emissions, which account for 40% of average CF. External factors were more relevant than internal ones to explain differences in terms of transport, household energy and total CF, with income, level of studies, age group and type of work as the most important drivers.

Author Contributions

Conceptualization, E.C. and M.B.-B.; methodology, P.R.-B. and A.O.; software, P.R.-B., A.O. and G.O.; validation, P.R.-B., A.O. and G.O.; formal analysis, P.R.-B. and A.O.; investigation, E.C., M.B.-B., A.O., G.O., P.R.-B.; data curation, M.B.-B. and P.R.-B.; writing—original draft preparation, E.C.; writing—review and editing, E.C., M.B.-B., A.O., G.O., P.R.-B.; project administration, E.C. All authors have read and agreed to the published version of the manuscript.

Funding

This paper is based on research performed by the Environmental Ethics Chair, which is funded by the “Tatiana Pérez de Guzmán el Bueno Foundation”.

Institutional Review Board Statement

At the time of this study, our centre did not request approval by an ethics committee. However, the survey company followed all data protection protocols and those related to the integrity of human research.

Informed Consent Statement

Informed consent was not requested because the survey company followed an irreversible anonymization process, which means that the respondent cannot be identified.

Data Availability Statement

Not applicable.

Acknowledgments

The authors want to offer thanks for the financial support of the “Fundación Tatiana Pérez de Guzmán el Bueno” to the Environmental Ethics Chair at the University of Alcalá. We thank to Julián Tijerin, Rubén Ramo and Mariano García for discussion with the random forest methods. PRB is supported by the Community of Madrid Region under the framework of the multi-year Agreement with the University of Alcalá (Stimulus to Excellence for Permanent University Professors, EPU-INV/2020/010).

Conflicts of Interest

The authors declare no conflict of interest.

3.8 Appendix A. Survey Description

The opinion poll used to obtain the data for this paper was performed by a social studies company (Netquest) specializing in internet surveys, which follows the ISO 20252 for panellist selection. The sample was extracted from their population database, who were willing to respond to questionnaires. Three strata were defined to select a representative sample of the Spanish population: sex (50%), age (16–17 years: 4.44%; 18–30 18.16%; 30–65: 64.36% and >65: 13.03%), and geographical regions (also in proportion to their population size). The survey company invited 1584 respondents, finally obtaining 1016 answers. Each invited panellist was sent up to three reminders to complete the questionnaire. In case they did not respond or finish the questionnaire, the invitation was transferred to another person, considering the expected quotas for sex, age and geographical regions that mimic the overall Spanish population characteristics. In all cases, the representative size of each strata was met by the final sample. Each respondent was encouraged to fill out the questionnaire using a bonus point system given by the survey company. The reward was proportional to the time dedicated to completing the survey. The target sample size was 1000 people.

The questionnaire included some internal checks to avoid wrong answers. For instance, questions related to the CF included a range of minimum and maximum expected values (kg of food/person or litters of gasoline/100 km). The company also included some verification measures to ensure that respondents understood the questions and were properly answering them. However, some answers were still found to be unreliable, either because they had quite unrealistic accumulated values (food or transport) or because they were very unusual. For this reason, we applied additional post-survey filters, first by removing those records with obvious errors, and then by applying an automatic cluster analysis, as explained in the main text. The final size of the sample

was 845 persons, which were still distributed according to the initial quotas defined in the initial survey.

3.9 Appendix B. Additional Tables

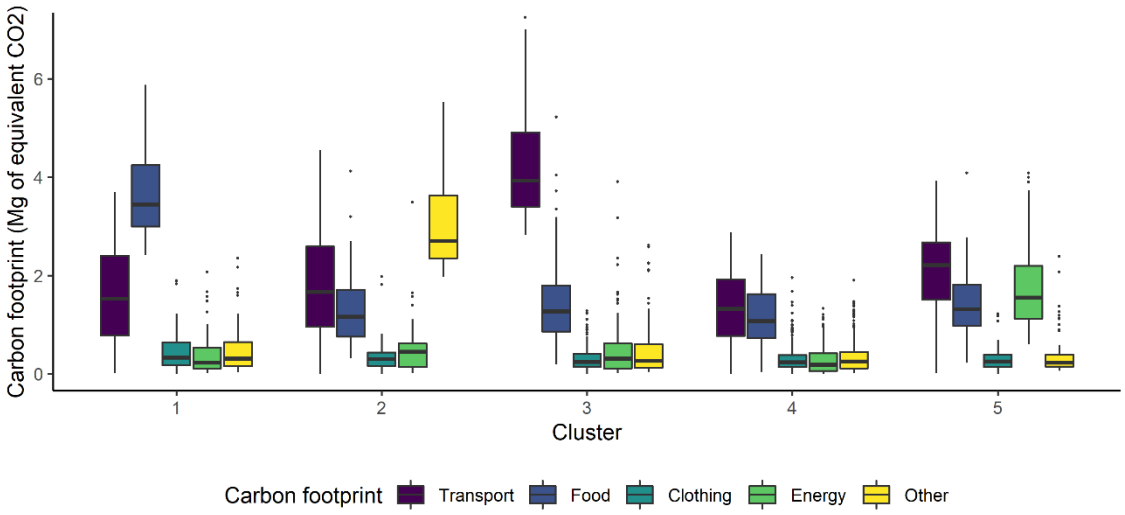

Figure A1. Boxplots of carbon footprint values for the different clusters

Table B1. Average CF values for the different groups of external factors

Variable	Categories	#Cases	Energy	Transp.	Food	Clothing	Other	Total
All		845	477.58	2163.66	1509.17	316.94	542.57	5009.93
Sex	Male	436	518.11	2391.12	1488.61	214.84	495.03	5107.71
	Female	409	434.38	1921.19	1531.10	425.78	593.25	4905.70
Age Group (years)	< 18	21	318.03	1012.37	1266.15	428.98	861.77	3887.29
	18-30	142	438.69	2203.51	1346.81	439.78	676.37	5105.16
	30-65	558	469.86	2288.25	1545.57	311.30	531.00	5145.99
	> 65	124	583.88	1752.36	1572.47	182.68	387.35	4478.75
Level of Studies	Primary	34	314.30	1306.91	1638.97	224.68	527.99	4012.84
	Secondary	375	462.12	2046.81	1548.46	322.54	626.36	5006.30
	University	436	503.62	2330.98	1465.26	319.31	471.65	5090.81
Monthly Income (€)	< 1500	305	457.18	1760.29	1541.08	317.98	564.96	4641.50
	1500-3000	245	532.17	2442.87	1495.27	331.97	519.94	5322.23
	> 3000	123	473.79	2889.08	1559.99	305.51	553.14	5781.52
Town size (inhab.)	< 10000	128	596.37	2280.57	1491.48	329.95	693.39	5391.76
	10000-50000	230	443.47	2186.77	1369.15	305.15	647.20	4951.74
	50000 - 500000	330	490.06	2093.03	1637.43	325.75	509.29	5055.55
	> 500000	157	404.49	2182.97	1459.15	305.07	336.30	4687.99
Political orientation	Left	312	490.28	2156.84	1445.03	302.71	584.39	4979.25
	Centre	429	471.79	2142.88	1521.83	314.90	511.64	4963.06
	Right	104	463.37	2269.84	1649.39	368.03	544.70	5295.33
Type of Work	Student	65	369.53	1664.28	1162.35	394.60	897.92	4488.67
	Agriculture	9	378.71	2466.19	1867.70	571.29	1324.99	6608.89
	Industry	98	526.91	2636.96	1343.10	224.25	392.41	5123.63
	Administration	191	438.42	2264.96	1601.29	333.94	526.94	5165.55
	Education	64	552.22	2097.16	1572.14	346.59	456.59	5024.70
	Catering	66	576.51	1985.71	1609.15	444.35	766.23	5381.96
	Health, Military	178	420.40	2254.64	1560.84	302.61	527.18	5065.67
	Management	57	691.32	2549.19	1244.68	207.40	391.28	5083.88
	Homemakers	117	454.09	1666.56	1622.41	291.16	454.26	4488.48

Table B2. Average CF values for the different groups of internal factors

		#cases	Energy	Transport	Food	Clothing	Others	Total
Knowledge on CC	Yes	438	501.04	2280.76	1420.19	278.69	517.08	4997.76
	No	407	452.34	2037.65	1604.93	358.10	570.01	5023.04
Commitment	> committed and <emissions	152	480.09	1988.08	1360.70	266.54	484.39	4579.80
	> committed and >emissions	234	445.69	2157.12	1643.47	312.36	535.21	5093.84
	< committed	459	493.01	2225.14	1489.87	335.96	565.60	5109.59
Intractability (self-efficacy)	High	523	433.24	2138.23	1532.45	318.76	563.11	4985.79
	Low	322	549.60	2204.98	1471.36	313.98	509.22	5049.14
Frecuency of CC Action	1	14	410.89	2008.92	1558.62	312.73	312.31	4603.47
	2	29	539.29	2349.42	1581.10	347.27	745.79	5562.87
	3	87	582.77	2243.03	1428.35	313.74	518.65	5086.53
	4	222	485.46	2176.32	1432.83	315.74	526.66	4937.02
	5	274	478.09	2236.96	1576.74	312.93	485.80	5090.52
	6	150	471.46	1999.14	1528.38	310.55	618.62	4928.15
	7	69	318.48	2042.78	1506.38	342.75	645.37	4855.76

Table B3 Contingency coefficient and Chi-square significance values for cross comparison of CF clusters and the different explanation factors

	chi-square	p
Sex	0.156	0.00
Age Group	0.156	0.05
Leve lof Studies	0.155	0.007
Type of work	0.268	0.00
Monthy Income	0.225	0.00
Population	0.192	0.001
Political orientation	0.069	0.853
Knowledge	0.101	0.071
Commitment	0.088	0.575
Intractability	0.069	0.407
Frecuency of CC Action	0.18	0.251

3.10 References

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4 EXAMINING THE RELATIONSHIPS BETWEEN RELIGIOUS AFFILIATION, EXTERNAL AND INTERNAL BEHAVIOURAL FACTORS, AND PERSONAL CARBON FOOTPRINT

Este capítulo explora la relación entre afiliación religiosa y huella de carbono personal, siguiendo el modelo sociopsicológico que considera al comportamiento influido por factores externos o situacionales, e internos o intrínsecos, sobre la misma muestra representativa de la población española utilizada previamente. Esto permitió situar el estudio del vínculo entre afiliación religiosa y huella de carbono personal en interacción con otros antecedentes del comportamiento, conocer diferencias entre los grupos religiosos y también, dentro de cada uno de ellos. Las conclusiones sugieren, por un lado, la importancia de examinar el vínculo religión-mitigación en un marco socio-psicológico y, por otro, la necesidad de seguir estudiando al interior de cada grupo para promover respuestas efectivas de mitigación.

Este capítulo está basado en el artículo:

Orellano, A.; Chuvieco, E. Examining the relationships between religious affiliation, external and internal behavioural factors, and personal Carbon Footprint. Religions, 2022, 13(5), 416. https://doi.org/10.3390/rel13050416

4.1 Abstract

Different studies have shown that daily consumption is responsible for a large portion of greenhouse gas emissions. Since consumption is closely linked to individuals' preferences, motivations, and beliefs, the personal carbon footprint should be a good indicator of actual consumers' commitments towards climate change mitigation. Previous research has shown the importance of considering individual-level religion as an antecedent of mitigation outcomes, although the evidence is inconclusive in this regard. This study examines the relationship between religious affiliation and personal carbon footprint, following socio-psychological models that consider behaviour to depend on external or situational factors, and internal or intrinsic ones. A questionnaire was administered to a random sample of the Spanish population (n = 845) to determine the main drivers of carbon footprint for different religious groups. External factors (i.e., socioeconomic) and internal ones related to climate change knowledge, commitment, and intractability, on the one hand, and value orientation, nature-relatedness, and the main motivation to conserve nature on the other hand, were analysed. Intergroup differences in the personal carbon footprint were found, especially based on sex, age group, and type of work among external factors and value orientation, the main motivation for conserving nature and climate change perceived commitment within the internals. Intragroup differences for food carbon footprint were also observed, as follows: the main motivation to conserve nature and the level of commitment implied differences among Catholic believers, whereas value orientation and the level of commitment implied differences among non-believers. Our conclusions suggest, on the one hand, the importance of examining the religion-mitigation link in a socio-psychological framework and, on the other, the need for further study within groups to promote better behavioural responses to climate change.

Keywords: *climate change; carbon footprint; religion; religious affiliation; behaviour*

4.2 Introduction

Although climate change (CC) is one of the greatest problems we face as a society (IPCC 2021), current emission reduction and mitigation policies are far from meeting the goals indicated by the scientific community to avoid dangerous warming levels, particularly those included in the Paris Agreement (Victor et al. 2017). Limiting human-induced global warming implies cutting down greenhouse gas (GHG) emissions, not only at the

institutional and organizational levels but also at societal and individual ones (O'Neill et al. 2014; Schultz and Kaiser 2012). Indeed, the literature reports that a large part of the total GHG emissions (between 60 and 70%) is related to personal consumption habits, so modifying emission trends requires a significant change in current lifestyles, particularly in Western societies (Franzen and Mader 2018; Ivanova and Büchs 2020; Richardsen Moberg et al. 2019).

Therefore, a better understanding of factors affecting individual behaviour, which would encourage people to reduce their emissions, is crucial to promote more efficient mitigation policies. Religious beliefs are one such factor that have received increasing attention in the last few years, and such beliefs have been shown to be related to environmental motivations (Chuvieco and Burgui 2016), sustainable consumption (Minton et al. 2015), and CC perceptions and attitudes (Jenkins et al. 2018). Considering the large global influence of religions, with a high level of affiliation (it is estimated that 84% of the world's population identify themselves with a religious denomination (Pew Research Centre 2017)), their influence in world education (Palmer and Finaly 2002), their importance in the conservation of natural areas (Mallarach et al. 2016), and their impact on personal worldviews and ethical guidance (Sherkat and Ellison 2007), religious beliefs are indeed an important factor in understanding CC commitment, both at the societal (Rolston III 2009; Tatay-Nieto 2020) and individual levels (Cohen and Rozin 2001; Lakhan 2018).

Although religion has been foregrounded as an antecedent of different environmental outcomes (Gifford and Nilsson 2014), the empirical evidence is mixed on whether religious affiliation promotes or constrains CC mitigation. Considering religious denomination, the evidence seems to suggest that conservative Christians are less concerned about CC, because of an association with political conservatism (Arbuckle 2017; Smith and Leiserowitz 2013), although some researchers point out that this evidence is restricted to the North American context (Morrison et al. 2015). In the case of Catholic believers, reporting positive (vs. negative) attitudes towards CC are associated with religious views of stewardship or human responsibility (vs. dominance) over nature (Agliardo 2013; Eom et al. 2021). In a broad sense, it seems that Catholics express higher levels of concern about CC than those belonging to other Christian churches, but believers, in general, are less concerned than people with no religious affiliation (atheists, agnostics) (Pew Research Centre 2015).

However, there is cross-national evidence supporting the contrary (Kvaløy et al. 2012). Several scholars point out that inconclusive findings may be related to a

conceptualization problem, generally focused on the analysis of isolated antecedents, such as political orientation or a dominion's views (Clements et al. 2014; Peifer et al. 2016). A step forward would be to consider religion as influencing environmental outcomes in complex ways and through interactions with other socio-psychological antecedents of behaviour (Michaels et al. 2021). The types of models that consider two main groups of behavioural factors are as follows (Gifford and Nilsson 2014; Clayton and Myers 2015): the external or situational ones, related to the environment and socioeconomic conditions (Corral-Verdugo et al. 2020), and the internal or intrinsic, related to individuals' knowledge, motivations, and beliefs (Schultz and Kaiser 2012; Steg et al. 2015; Steg et al. 2016). Based on these, we argue that religion at the individual level could be a sound basis for the adoption of low-carbon lifestyles by underlying or interacting with these sets of behavioural antecedents (Orellano et al. 2020).

Therefore, we focus our research specifically on understanding the relationships between religious affiliation, external and internal antecedents of behaviour, and personal carbon footprint (CF), as an indicator of consumption-related emissions. Using this observed measure instead of self-reports should provide a more rigorous assessment of the personal impact on CC mitigation, as previous research has shown that self-assessments are not necessarily linked to actual behaviour (Kormos and Gifford 2014; Moser and Kleinhückelkotten 2018; Steg and de Groot 2019). Regarding external factors affecting the relationships previously mentioned, there are well-established links between socioeconomic indicators and CF; past research has shown the positive influence of income on CF (with higher incomes resulting in higher CF), the non-linearity of age (with lower CF for younger and older citizens), and the impact of the type of work (with lower CF for students and homemakers), among others (Chuvieco et al. 2021; Büchs and Schnepf 2013; Bhoyar et al. 2014; Brand and Preston 2010).

Internal factors have been widely recognized as having a long-term effect on consumption habits, particularly those related to curtailing behaviours (Gifford and Chen 2017). We have selected value orientation, motives to conserve nature, and nature-relatedness in our analysis, as they have proven relevant correlates of pro-environmental behaviour (Pearson 2016; Steg et al. 2015; Whitburn et al. 2019; Nisbett et al. 2009), although their role in consumption-related emissions has not been previously researched. Value orientation was directly related to CC attitudes and self-report mitigation behaviour (Bouman et al. 2018; Steg 2018), while peoples' motives for conserving nature, its appreciation, and sense of connectedness (i.e., nature-relatedness) are suggested in the literature as significant for understanding

environmental views and beliefs that are antecedent of attitudes and behaviour (Pearson 2016; Mace 2014; Nisbett et al. 2009). Additionally, research has shown that CC knowledge, perceived intractability, and the level of commitment are relevant to understanding mitigation outcomes, as they undergird many of consumers' decisions (Pickering et al. 2021; van Valkengoed and Steg 2019; Poortinga et al. 2019; Corner et al. 2014).

To summarize, we aim to better understand the role of religious affiliation in explaining personal CF, and more specifically, to (1) examine intergroup differences, i.e., whether religious affiliation implies differences in personal CF, (2) analyse intragroup differences and whether external and internal factors mediate these differences, and (3) test how these interactions affect personal CF values, particularly for food and transport, the most important sectors of personal emissions (Büchs and Schnepf 2013; Druckman and Jackson 2016).

4.3 Materials and methods

4.3.1 Participants and procedures

An internet survey was conducted by a social studies company, specialized in online surveys (Netquest Soluciones de investigación S.L). The company follows the ISO 20,252 standard for the selection of panelists; it also complies with the European General Data Protection Regulation (GDPR) and the Organic Law on Data Protection and Guarantee of Digital Rights (LOPDGDD) applied in Spain. The research company requests the consent of its panelists and informs them about the protection and the irreversible anonymization of their data, assuring that the respondent cannot be identified. Additionally, the survey included a brief introduction guaranteeing the anonymity and confidentiality of all participants, its voluntary nature, and that it could be abandoned at any time.

The sample was addressed to 1000 people following a stratified protocol to represent the geographical variety of the Spanish population. The survey included internal checks to filter potentially incorrect answers from the CF-related section, where we asked participants to introduce an estimate of their consumption, setting up a range of reasonable minimum and maximum values for each item. However, some answers were still found to be unreliable, so we first filtered the questionnaire manually, rejecting unrealistic responses.

Then, we searched for anomalous cases using an automatic classification system. We grouped the CF values into five categories using the k-means algorithm (Likas et al. 2003) and reject those records assigned to groups with very few assigned cases (<30 people). The process was repeated 4 times until there were no marginal clusters (all groups had at least 50 cases). Following this process 845 cases were retained (84% of the original sample), which were used for further analysis.

The socio-demographic data of the final sample was as follows: 48% of the participants were female. In terms of age, 3% of the participants were between 16–17 years old; 16% were between 18–30 years old; 66% were between 31–65; 15% were 66 years old or above. In terms of religious affiliation, the outputs of our survey showed that 60.0% of the informants described themselves as religious. From this group, the majority were Christian Catholics (46.6%), followed by other Christians (2.9%), Buddhists (1.8%), Hindus (0.4%), Muslims (0.5%), and other confessions (7.8%). Since the number of believers of confessions other than Catholic was very small in the sample, we grouped them into the following groups: Catholic believers (46.6%), other-believers (13.4%), and non-believers (40.0%). Descriptive statistics and correlations are depicted in Tables A2 and A3, Appendix A.

4.3.2 Measures

Carbon footprint. We asked participants to introduce a quantitative estimation of their consumption for different categories (transport, food, household energy, clothes, and others), and then we calculate their emissions in kgCO2eq following the specifications of the Carbon Footprint Observatory's "CO2 web" (https://www.huellaco2.org/; last access on 16 September 2021). See Burgui-Burgui and Chuvieco (2020) for a full description of the calculator.

Religious affiliation. We used one single item to assess participants' religious affiliation (Pew Research Centre 2017). The options were Christian Catholic, Other Christian Churches, Buddhist, Hindu, Muslim, and Agnostic or Atheist.

Internal factors: We considered two groups of internal factors, those related to general environmental concern and those particularly associated with CC. Among the former, the following were included in the questionnaire: (a) *Motives to conserve nature*. In line with previous research, we assessed respondents' main motivation for conserving nature by giving them several options to choose from (human responsibility, religious reasons, the intrinsic value of nature, economic motives, health, or well-being). These were adapted

from Chuvieco and Burgui (2016) and Pearson (2016). (b) *Value orientation*. We assessed participants value orientation using a 4-item scale rating (from 1 = totally disagree to 5 = totally agree) their level of agreement with a serie of statements about altruism, vulnerability, resilience and egoism orientation (e.g., “I think that everyone should deal with their own problems”). This measure was adapted from Steg et al. (2016) and Steg (2016), Cronbach's alpha= 0.61); and the sum of the items was retained for further analysis. (c) Nature-relatedness. We measured this antecedent using the short 6-itemed version of the nature-relatedness scale from Nisbet and Zelenski (2013), which includes a series of statements rating (from 1 = totally disagree to 5 = totally agree) participants’ connection to nature (e.g., “my relationship with nature is an important part of who I am”) (Cronbach's alpha= 0.86); and the sum of the items was retained for further analysis.

Within the group of CC-related factors, we included the following: (a) Climate Change Knowledge. We asked participants about their knowledge of CC causes and the implications of human action (e.g., “Climate Change is mainly due to human action”). This measure was extracted from (Chuvieco et al. 2021). (b) Level of commitment. We asked participants their perception of personal commitment and if they perceived their emissions to be above or below the national average, as extracted from (Chuvieco et al. 2021). This measure was recoded in three categories: 1. highly committed and below-average emissions (self-perceived as having a low CF); 2. highly committed and above average (self-perceived as having a medium-high CF); 3. otherwise (no clear commitment to CC). (c) Perceived intractability. We asked participants about their perception of personal intractability (i.e., the importance of individual action to fight against CC). This was adapted from Xiang et al. (2019). This variable was recoded as 1. the importance of personal actions in CC mitigation was high or very high, and 2. otherwise.

External factors. As external variables we used sex, age group, level of studies, monthly income, type of work, and political orientation, as these were found to be related to CF in previous studies (Gifford and Nilsson 2014). All measures and details in terms of descriptive statistics are in **Tables A1** and **Table A2** of Appendix A.

4.3.3 Analytical strategy

Out of the five components of CF, we focused mainly on the transport and food sectors, as they account for 43% and 30% of total CF in our results, respectively, while they have also been identified as the most clearly linked to daily habits and personal decisions

(Büchs and Schnepf 2013; Druckman and Jackson 2016). Relationships between CF and its components were explored using correlation and dispersion plots. Association metrics for categorical variables were based on the Chi-square test and differences between sample groups with the Kruskal–Wallis (KW) non-parametric test, identifying which groups differed from others through post-hoc comparisons.

To determine the relative importance of the explanatory variables on relevant CF components, we chose a data-driven (i.e., automatic) method to run a non-parametric kernel regression (Racine 2019). The classical parametric approach to estimating these relationships requires specifying the functional form for the continuous variables and the nature of any interactions among all quantitative and qualitative regressors. If any of these assumptions are incorrect, the estimated model will be biased. Indeed, we first ran a test to verify the null hypothesis that a parametric model fits the data. We used a consistent model specification test (Hsiao et al. 2007) but the model was not shown to be significant (p = 0.185). Next, we proceeded with non-parametric methods, as they are less deterministic, to select the appropriate model (Racine 2008). The final model was based on a locally weighted least squares estimator, which is also known as local linear kernel regression (Li and Racine 2004). This model combines a simple regression model with a local weight function called a kernel function denoted as follows:

$$K\ (\mathrm{Z_i}) = \frac{\mathrm{K(x - X_i)}}{h}\ (1)$$

where x and i are vectors of regressors and h is a smoothing parameter called bandwidth.

The direct counterpart of model selection for parametric approaches is bandwidth selection, a key aspect of non-parametric kernel methods. Non-parametric regression computes a bandwidth object for a p-variate kernel regression estimator defined over mixed continuous and discrete (unordered, ordered) data using least-squares cross-validation (Li and Racine 2004). To evaluate the goodness of fit the model returns an r-squared, denoted as follows:

$$R^2 = \frac{[\sum_{i=1}^{\mathrm{n}}(\gamma i - \hat{}\gamma i)(\hat{}\gamma i - \gamma i)2}{\sum_{i=1}^{\mathrm{n}}(\gamma i - \hat{}\gamma i)2 \sum_{i=1}^{\mathrm{n}}(\hat{}\gamma i - \gamma i)2}\ (2)$$

where i is the outcome and ˆi the fitted value for observation i, and R2 will always lie in the range [0, 1] where 1 denotes a perfect fit to the sample data and 0 denotes no predictive power. Finally, to find relevant predictors, we first established the null that a predictor was irrelevant (the same as when doing a t-test of significance), and then we

calculated the p-values. For those p-values less than 0.05, we rejected the null at the 5% level and concluded that the predictors were relevant.

These analyses were processed in R software, version 4.1.0 with np package (Racine and Hayfield 2020). The function npreg() in this package automates the procedure explained above and allowed us to do a non-parametric regression, and to automatically choose the appropriate bandwidth using least-squares cross-validation (Hayfield and Racine 2008).

4.4 Results

4.4.1 Interactions between religious affiliation and external and internal factors

First, we examined the relationships between religious affiliations and external factors to test whether the potential explanation for differences in CF between religious groups might be related to cross-relationships with other variables. **Table A3** of Appendix A provides descriptive statistics for each religious affiliation. **Table 4.1** shows that only level of studies and political orientation among the external factors introduce differences between religious groups. Post-hoc comparisons show that other-believers had a low level of education than their alternative groups, while for political orientation, Catholics were closer to right and non-believers closer to left orientation ($p<0.05$). Of the internal factors, the main motivation to conserve nature, nature-relatedness, CC knowledge, and perceived commitment were found to differ across religious affiliations. The other internal variables did not show significant differences among religious groups. This is further explained next.

Table 4.1. Differences between external and internal variables and religious affiliation

External and Internal Factors	Statistic	*p*-value
Sex	3.530	0.169
Age group	10.238	0.235
Level of studies	13.044	**0.001**
Monthly income	7.565	0.560
Type of work	1.258	0.262
Political orientation	91.011	**<0.001**
Main motivation to conserve nature	48.261	**<0.001**
Nature-relatedness	12.640	**0.009**
Value orientation: egoistic	5.072	0.079
Value orientation: vulnerability	2.383	0.304
Value orientation: altruistic	3.155	0.207
Value orientation: resilience	0.013	0.940
CC Knowledge	14.784	**0.001**
CC Perceived commitment	13.348	**0.009**
CC Perceived intractability	0.087	0.957

p-values in bold are significant

From the significant differences, we observed that Catholic believers tended to prioritize human responsibility, and health and well-being, over other motivations for preserving nature, while for other-believers and non-believers, the main reason was the intrinsic value of nature, also followed by health and well-being (**Table A4**, Appendix A). All groups claimed to have a high connection to nature, although other-believers showed higher values than other groups (**Table A5**, Appendix A). As for CC knowledge, non-believers reported more knowledge about the anthropogenic cause of CC (with low importance of natural factors: **Table A6**, Appendix A), while Catholics reported the lowest knowledge. Related to the association between religious affiliation and CC perceived commitment (**Table A7**, Appendix A), non-believers showed the highest degree of perceived commitment, with the lowest of both among Catholics, although all religious groups had a majority of respondents identified with the "no particular commitment" category. Finally, CC intractability did not show any significant differences across affiliations (**Table A8**, Appendix A).

4.4.2 Differences in personal Carbon Footprint across religious groups based on external factors

The mean personal CF of our sample was 5010 kg of CO2eq, which was lower than the per capita emission rate of Spain for the same year, 2019 (6861.21 kgCO2eq/year: https://www.ine.es/jaxi/Tabla.htm?path=/t26/p084/base_2010/serie/&file=01004.px , last accessed on 24 February 2022). It should be noted that our estimation did not include emissions linked to construction or export goods, nor touristic lodgings. Out of total emissions, 73% were produced by transport (43%) and food (30%), far more than from other CF components, such as household energy consumption (10%), clothing (6%), and others (11%). As such, we focused the analysis on the following three CF components: total, transport, and food.

As observed in **Table 4.2**, age group and type of work introduced significant differences in all CF sectors for the overall sample. Young people, students, and homemakers had significantly lower total and transport CF than their alternative groups, while homemakers had higher food CF. Focusing on the level of studies and monthly income, we observed that those who had the highest level of education (university degree and higher) and higher income were also those who had the highest total and transport CF. Sex only implied differences for the transport sector, with women having the lowest CF. Finally, political orientation was not significantly associated with CF, neither in the total CF nor in any of its components.

Table 4.2. Kruskal–Wallis values from testing CF differences between external factors

External	Total		Food		Transport	
Factors	**Statistic**	***p*-value**	**Statistic**	***p*-value**	**Statistic**	***p*-value**
Sex	2.97	0.085	0.05	0.823	26.56	**<0.001**
Age group	15.96	**0.001**	8.30	**0.040**	29.43	**<0.001**
Level of studies	6.65	**0.036**	1.82	0.402	18.62	**<0.001**
Monthly Income	31.73	**<0.001**	2.72	0.256	53.65	**<0.001**
Type of work	21.57	**0.006**	20.47	**0.009**	42.70	**<0.001**
Political orientation	2.59	0.274	5.28	0.072	0.650	0.722
Religious affiliation	3.936	0.140	12.034	**0.002**	0.781	0.677

p-values in bold are significant

Religious affiliation was not found to be significantly related to the total and transport CF components, but it was for the food CF. Within religious groups, Catholics showed significantly higher food CF than non-believers.

Table 4.3 presents intergroup differences in CF, considering external factors. In this case, most relations are not significant, meaning that all religious groups have similar CF within the different categories of external factors. Only within food CF were differences found for women, adult population (30–65), and administration and homemakers. Non-believing women, those belonging to the adult population (30–65 years old), and those working in the administration sector had a lower CF than Catholic believers of those categories. In addition, homemakers of other believers had lower CF values than Catholics.

Table 4.3. Differences in personal CF across religious groups for each external factor

External Factors		Total		Food		Transport	
	Categories	**Statistic**	***p*-value**	**Statistic**	***p*-value**	**Statistic**	***p*-value**
Sex	Male	1.634	0.442	1.324	0.516	6.201	0.050
	Female	3.291	0.193	14.290	**0.001**	0.008	0.996
Age group (years)	< 18	3.613	0.164	3.439	0.179	0.237	0.888
	18–30	0.621	0.733	0.318	0.853	0.632	0.729
	30–65	0.890	0.641	12.158	**0.002**	0.978	0.613
	> 65	0.483	0.786	0.417	0.812	1.155	0.561
Level of studies	Primary	1.354	0.508	1.190	0.551	4.477	0.107
	Secondary	0.599	0.741	6.155	0.051	0.499	0.779
	University	0.808	0.668	5.524	0.063	1.202	0.548
Monthly Income (€)	< 1500	5.247	0.073	2.414	0.299	6.265	0.051
	1500–3000	0.799	0.671	2.803	0.246	0.313	0.855
	> 3000	2.118	0.347	2.597	0.273	0.028	0.986
Political Orientation	Left	0.055	0.973	7.040	0.051	2.640	0.267
	Centre	0.904	0.636	5.831	0.054	3.998	0.135
	Right	0.111	0.946	0.230	0.988	1.385	0.500
Type of work	Student	0.265	0.876	4.361	0.113	2.815	0.245
	Agriculture	4.200	0.122	0.611	0.737	2.800	0.247
	Industry	0.930	0.628	1.812	0.404	0.126	0.939
	Administration	1.144	0.564	10.636	**0.005**	0.256	0.880
	Education	2.087	0.352	1.871	0.392	1.926	0.382
	Catering	1.418	0.492	2.792	0.248	0.730	0.694
	Health, Military	0.943	0.624	1.276	0.528	3.019	0.221
	Management	0.245	0.882	0.534	0.766	0.725	0.696
	Homemakers	5.503	0.064	16.509	**<0.001**	2.902	0.234

p-values in bold are significant

Table 4.4 shows results for CF differences within religious groups, related to external factors. In the case of Catholic believers, the largest differences were found in the transport sector. Women and those older people (>65 years) had the lowest CF value, while adults (30–65 years) had the highest. Level of studies, monthly income, and type of work also implied differences among Catholics, with the lowest level of education and income having the lowest CF values. Regarding the type of work, students and homemakers had the lowest transport CF, and workers in the industry the highest. Age group and monthly income also imply differences among this group, being the lowest CF of those with the lowest income; older people (>65 years) had also the lowest CF value among age groups, while adults (30–65 years) had the highest. In the case of other-believers, those with the lowest level of education and income were those with the lowest transport CF. Relative to non-believers, women had lower total and transport CF than men; younger people have the lowest total and transport CF, and adults (30–65) have the highest; those with lower incomes were also those with a lower transport CF. Finally, homemakers had the highest food CF, while students had the lowest.

Table 4.4. Differences in personal CF across external factors for each religious group

External Factors	Catholics Believers					
	Total		**Food**		**Transport**	
	Statistic	***p*-value**	**Statistic**	***p*-value**	**Statistic**	***p*-value**
Sex	3.055	0.890	0.070	0.125	26.56	**0.005**
Age group	8884	**0.031**	6.850	0.077	12.99	**0.005**
Level of studies	4.701	0.095	1.073	0.585	7.311	**0.026**
Monthly Income	29.572	**<0.001**	2.995	0.224	27.799	**<0.001**
Type of work	12.761	0.120	13.624	0.092	25.167	**0.001**
Political orientation	1.529	0.466	0.341	0.843	1.669	0.434
	Other-Believers					
Sex	2.25	0.786	0.060	0.412	27.56	0.479
Age group	0.805	0.848	1.141	0.767	6.564	0.087
Level of studies	3.413	0.181	0.225	0.894	7.786	**0.020**
Monthly Income	5.323	0.070	3.617	0.164	12.796	**0.002**
Type of work	14.533	0.069	14.562	0.068	16.862	0.056
Political orientation	1.050	0.592	2.546	0.280	1.397	0.497
	Non-Believers					
Sex	3.56	**0.004**	0.060	0.302	21.89	**<0.001**
Age group	9.732	**0.021**	5.540	0.136	0.046	**0.046**
Level of studies	0.375	0.829	1.568	0.457	4.439	**0.109**
Monthly Income	2.105	0.349	0.201	0.904	13.152	**0.001**
Type of work	6.608	0.579	21.281	**0.006**	10.598	0.226
Political orientation	0.343	0.842	3.558	0.169	1.384	0.501

p-values in bold are significant

4.4.3 Differences in personal Carbon Footprint across religious groups based on internal factors

Table 4.5 presents the results of CF differences across religious groups for the internal factors. None of them introduced significant differences between religious groups concerning total CF. For food CF, resilience value, CC knowledge, CC perceived commitment and CC intractability explained significant differences between religious groups, while for transport CF, only the main motivation to conserve nature explained differences. Among those indicating the role of human responsibility as a strong motivation of nature conservation, Catholics had lower transport CF than non-believers. Finally, those non-believers having higher levels of resilience value orientation, CC knowledge, CC perceived commitment and CC intractability were found to have significantly lower food CF than Catholics, having no significant differences with the other-believers group.

Table 4.5. Differences in CF across religious groups for each internal factor

Internal Factors		Total		Food		Transport	
	Categories	**Statistic**	**p-value**	**Statistic**	**p-value**	**Statistic**	**p-value**
The main motivation for conservation	Human responsability	2.078	0.354	1.100	0.577	6.145	**0.046**
	Religious reasons	1.125	0.724	1.125	0.289	0.125	0.724
	Intrinsic value	3.354	0.187	2.658	0.265	0.137	0.504
	Economic motives	2.879	0.237	3.480	0.176	0.757	0.685
	Health or well-being	0.264	0.876	4.678	0.096	1.564	0.457
Value Orientation	Egoism	2.794	0.247	4.919	0.085	1.632	0.442
	Vulnerability	0.194	0.907	1.799	0.407	3.369	0.186
	Altruism	0.876	0.645	5.888	0.053	4.175	0.124
	Resilience	2.716	0.257	10.636	**0.050**	0.235	0.889
Nature relatedness		4.649	0.098	4.292	0.117	0.614	0.360
CC Knowledge	GHG main cause	3.385	0.184	11.986	**0.002**	2.362	0.307
	Otherwise	0.384	0.825	1.666	0.435	0.985	0.611
CC Perceived commitment	Highly committed, below-average emissions	0.530	0.767	4.140	0.126	2.738	0.254
	Highly committed, above-average emissions	0.183	0.913	7.755	**0.021**	3.339	0.188
	Otherwise	0.214	0.899	2.994	0.224	0.359	0.836
CC Intractability	Importance of personal actions high or very high	1.671	0.434	10.907	**0.004**	2.241	0.326
	Otherwise	1.067	.587	2.988	0.224	2.058	0.357

p-values in bold are significant

Table 4.6 shows CF differences within religious groups related to internal factors. Only CC perceived commitment was found to introduce significant differences among Catholics in food CF, showing the lowest CF values for people with a high level of commitment. For other-believers, none of the internal factors implied significant differences in any of the CF dimensions, while for non-believers, value orientation was found to be relevant for total and transport CF. In this case, those having higher levels of resilience values had lower transport CF, while those having lower levels of egoistic values had lower total and food CF.

Table 4.6. Differences in personal CF across internal factors for each religious group

Internal variables	Catholics believers					
	Total		Food		Transport	
	Statistic	p-value	Statistic	p-value	Statistic	p-value
The main motive for conservation	4.829	0.305	6.864	0.143	1.451	0.835
Value Orientation: egoism	6.177	0.186	1.279	0.865	4.151	0.386
Value Orientation: vulnerability	1.811	0.771	0.986	0.912	2.759	0.599
Value Orientation: altruism	2.873	0.579	2.020	0.732	0.502	0.973
Value Orientation: resilience	3.515	0.476	1.430	0.839	0.992	0.911
Nature relatedness	0.806	0.651	2.059	0.357	2.075	0.354
CC Knowledge	18.755	0.595	19.701	0.759	17.381	0.080
CC Perceived commitment	3.482	0.175	6.003	0.045	3.928	0.140
CC Intractability	18.575	0.868	16.882	0.170	19.603	0.271
	Other-believers					
The main motive for conservation	2.205	0.698	1.234	0.872	2.275	0.685
Value Orientation: egoism	5.362	0.252	7.332	0.119	.975	0.914
Value Orientation: vulnerability	3.290	0.511	1.588	0.811	5.650	0.227
Value Orientation: altruism	3.122	0.538	2.175	0.704	4.101	0.393
Value Orientation: resilience	2.039	0.729	1.169	0.805	1.109	0.893
Nature relatedness	2.193	0.334	3.780	0.151	.017	0.991
CC Knowledge	1.824	0.138	1.902	0.530	1.53	0.975
CC Perceived commitment	1.350	0.509	4.531	0.104	1.327	0.515
CC Intractability	1.698	0.219	1.662	0.308	1.508	0.920
	Non-believers					
The main motive for conservation	5.409	0.144	2.473	0.480	5.950	0.114
Value Orientation: egoism	15.480	**0.040**	9.815	**0.044**	3.640	0.457
Value Orientation: vulnerability	3.226	0.521	2.931	0.569	2.311	0.679
Value Orientation: altruism	7.694	0.103	6.835	0.145	7.012	0.135
Value Orientation: resilience	4.541	0.338	2.890	0.576	13.249	**0.010**
Nature relatedness	0.082	0.960	3.224	0.220	.123	0.940
CC Knowledge	13.807	0.936	15.462	0.050	12.493	0.158
CC Perceived commitment	1.712	0.425	3.225	0.199	.569	0.752
CC Intractability	12.997	0.611	12.983	0.600	14.061	0.476

p-values in bold are significant

4.4.4 Regression models

In this section, we focused on food CF to deepen the study of the effect of religious affiliation, since this sector showed most of the significant differences among religious groups. In addition, it was identified by different studies as one of the most clearly linked to daily habits and personal decisions (Büchs and Schnepf 2013; Druckman and Jackson 2016).

Before running the regression model, we checked for collinearity between factors. Except for monthly income and the level of studies (rs= 0.4, p = 0.001), collinearity was low between them (**Table A2**, Appendix A). Therefore, we included all factors in the regression model, except for monthly income, as this variable had unfilled responses and was highly correlated with the level of studies. Two regression

models were run, for Catholic and nonbelievers. Other-believers were not considered in this analysis, as no significant relations were found in food CF in any of the external or internal factors. **Table 4.7** presents the results of regression models. The models explain food CF for non-believers (R2 Food CF =0.38), with the age group of the external factors and value orientation for the internal factors resulting significant. For Catholic believers (R2 Food CF = 0.35), age group, main motivation to conserve nature, and the level of CC perceived commitment were found to be significantly associated with food CF.

Table 4.7. Non-parametric regression model with internal and external factors for Food CF

	Food Carbon Footprint	
	Catholics believers	**Non-believers**
Sex	0.133	0.870
Age group	0.007**	0.000***
Level of studies	0.687	0.051
Type of work	0.083	0.067
Political orientation	0.073	0.406
Main motivation to conserve N	0.030*	0.058
Value orientation: egoism	0.198	**0.023***
Value orientation: vulnerability	0.461	0.233
Value orientation: altruism	0.338	0.298
Value orientation: resilience	0.172	0.118
Nature relatedness	0.719	0.118
CC Knowledge	0.687	0.080
CC Perceived Commitment	**0.018***	**0.002***
N	394	338
R-squared	0.35	0.38
Residual standard error:	0.508	0.520

p-values are significant at * p < 0.05, ** p < 0.01, *** p < 0.001. CC intractability variable had to be removed from the models as it destabilized them

4.5 Discussion

This study has shown the value in considering religious affiliation in order to better understand how consumption habits impact CC mitigation. We have shown the variability in GHG emissions for different religious groups, namely Catholic believers, other-believers, and non-believers. Even though past studies analysed the link between religious affiliation, consumption, and CC actions (Leonard and Pepper 2015), they were based on self-perception measures rather than actual behaviour, and it is well established in literature that self-perceived measures are not necessarily linked to actual commitment (Gifford and Chen 2017; Kormos and Gifford 2014). In addition, previous research mainly focused on the analysis of isolated antecedents related to religion at the individual level and mitigation outcomes but given the influence of several factors

affecting CC mitigation behaviour, we examined this link within a social-psychological model that considers behaviour to depend on external and internal determinants (Clayton and Myers 2015; Gifford and Nilsson 2014). Thus, preliminary findings are not intended to resolve the inconsistencies of previous research, but to provide insights from this perspective.

4.5.1 Main findings

Consistent with previous findings (Chuvieco et al. 2021), our results showed that several external factors were significantly associated with CF values, considering all religious affiliations together. In addition, we observed interesting inter- and intra-group differences in personal CF based on external and internal factors affecting consumers' behaviour. Clearly, the CF for the food sector is the most closely related to the interactions between religious affiliation and those factors. Deepening these intergroup comparisons, non-believers were found to have a lower CF than Catholics. Additionally, these groups differ on external factors, as non-believing women, those belonging to the adult population (30–65), those working in administration, and homeworkers had a lower CF than Catholics of the corresponding subgroups.

It is important to know what internally motivates individuals to support and effectively mitigate CC. Regarding the internal factors, our findings showed that the motivation to conserve nature is an important driver of CF. Human responsibility was more frequently selected among Catholic believers, while the intrinsic value of nature was more valued by non-believers, coincident with previous findings (Chuvieco and Burgui 2016). Intergroup comparisons for internal factors showed that the lowest transport CF was estimated for those Catholics who selected human responsibility as the main motivation to conserve nature, as compared to non-believers. In contrast, those non-believers who had higher levels of resilience value orientation, CC knowledge, CC perceived commitment, and CC intractability were found to have a significantly lower CF than Catholics of the corresponding subgroups.

In addition, intragroup differences revealed the importance of CC perceived commitment among Catholics, showing the lowest food CF values for those with high level of commitment. For non-believers, value orientation was found to be significantly associated with CF, showing that having higher levels of resilience values and lower levels of egoistic values led to lower CF. Finally, the regression model showed that the main factors controlling food CF for Catholics were age group, and the main motivations

to conserve nature and CC perceived commitment. The age group was also relevant for food CF of non-believers, as was egoistic value orientation.

4.5.2 Implications

Although these findings should be considered as a first approximation to the implications of religious affiliation in personal consumption linked to the CF indicator, there are some potential implications that may derive from our findings. First, our findings reject the notion that individuals with the same religious affiliation have similar emissions. Rather, our findings allow identifying intragroup differences across these affiliations. Thus, to promote effective ways of CC engagement and action, efforts should focus on addressing the potentials and misperceptions of each group. For example, our findings support previous evidence that non-believers have higher agreements about the anthropogenic cause of CC (Morrison et al. 2015; Zaleha and Szasz 2015; Uzarevic and Coleman 2021), in contrast to believers (Barker and Bearce 2012; Ecklund et al. 2016; Zaleha and Szasz 2015); this is useful for designing mitigation policies, but at the same time, they express difficulties in handling CC anxiety (Hope and Jones 2014), which should also be considered. The same occurs in the case of believers. Even though they have the least CC knowledge and higher CF values, our findings suggest that these outcomes vary depending on the interaction with other factors, such as the main motivation for nature conservation and the level of CC commitment. This is coincident with the literature that considers religions' influence as multifaceted and dependent on other determinants such as political ideology, fundamentalism, the level of education, and the geographical context (Arbuckle 2017; Kilburn 2014; Lewis et al. 2018; Morrison et al. 2015). However, in linking our results with previous studies, we should consider that they have mostly been conducted in the USA, and mainly focused on differences among Christian denominations. For instance, the relevance of literal versus non-literal interpretation of the Bible was found significantly related to environmental concern (McCammack 2007; Guth et al. 1995). However, in Spain this distinction is not relevant, as evangelical groups linked to a literal interpretation of the Bible have much less social influence than in the USA.

A second implication of our study relates to the attitude of believers towards CC. A more detailed study should focus on factors affecting some believers' perception of CC that leads them to have opposing opinions on CC (Dickinson et al. 2016), in spite of the general calls of religious authorities to support CC action. A theological framework adapted to different religious affiliations still needs to be developed in order to find solid grounds for general acceptance of religious principles that would directly link to

environmental commitment, similarly to the generalized agreement on other issues, such as concerns for the poor (Pew Research Centre 2015). It is suggested in the literature that religion at the individual level could both diminish concerns through stronger views of dominance and indifference towards nature, and promote it through values of sacredness, spirituality, and stewardship (Preston and Baimel 2021). Religious denominations could provide resources from their traditions to approach issues such as CC, consumption habits, and lifestyles, because of their ability to construct frameworks that can guide those who follow them (Tucker 2003).

In relation to this, it is important to emphasize the role of prominent religious leaders in promoting lifestyle changes and encouraging a more rigorous commitment to CC actions. Among many examples of these, we can emphasize the interfaith declarations addressed to the different UN Climate Summits https://interfaithclimate.org/the-statement ; last accessed on 16 February 2022), the common declaration of Pope John Paul II and Patriarch Bartholomew on environmental responsibility (Common Declaration on Environmental Ethics. Common Declaration of John Paul II and the Ecumenical Patriarch Bartholomew I 2002) or the encyclical letter Laudato Si of Pope Francis (2015). The impact of these initiatives has been wide, but still requires further implementation at the local and individual level (Tsimpo and Wodon 2016; Hanchin and Hearlson 2020; Savino 2019).

4.5.3 Limitations and future research lines

Although the richness of this study is based on numerical estimations of personal CF based on detailed emission factors, which goes beyond self-perceptions of estimations, certain limitations should be considered. Quantitative estimations of CF require accurate inputs (energy bills, food amounts, transport distances), which are difficult to acquire. Even though all respondents were warned about this before starting the survey, we had to remove questionnaires for including very unlikely CF values, using visual and automatic classification methods. The final values included in our analysis seemed reasonable, but it is not possible to test their actual accuracy.

Limitations also include the generalizability of the results to another cultural or geographical contexts, considering that individuals with the same religious affiliation may behave differently based on other cultural factors. More research outside of North America and European countries is needed to expand our understanding about the relationship between religious beliefs and different measures of consumption, such as the personal CF indicator, to address the north-western bias in existing studies.

Finally, this study only includes the measure of religious affiliation, which leaves aside the possibility of analysing and interpreting, for example, differences based on the degree of individual religiosity, or the frequency of participation in religious services, or considering intrinsic or extrinsic measures of religiosity. There are a wide variety of religious commitments and practices, even within the same religious tradition and affiliation. Future research should focus on more precise measurements of religiosity, which should provide further nuances in the links established in our study. In this regard, our analysis may serve as a starting point for better understanding the role of religious beliefs in CC mitigation.

4.6 Conclusions

Climate change mitigation at the individual level requires understanding and promoting behavioural change by analysing its underlying factors. Previous studies on the relationship between religion and CC mitigation outcomes present inconclusive findings. Therefore, we examine an explanation that considers individual-level religion as interacting in complex ways with other socio-psychological antecedents of behaviour. Examining these relationships within this framework allows more robust conclusions to be drawn than the study of isolated factors.

Thus, this study shows that religious affiliation is associated with consumption-related emissions, measuring by the personal carbon footprint indicator, and relevant external and internal antecedents of behaviour. Intergroup differences in the personal carbon footprint were found, especially based on sex, age group, and type of work among external factors, and value orientation, the main motivation for conserving nature, and CC perceived commitment within the internals. Intragroup differences for food carbon footprint were also observed, as follows: the main motivation to conserve nature and the level of CC commitment implied differences among Catholic believers, whereas value orientation and also the level of CC commitment implied differences among non-believers. These preliminary conclusions are not intended to resolve inconclusive findings, but to provide insights for considering the relationship between religion and CC mitigation outcomes in complex ways. From this perspective, we aim to go beyond the debate that focuses only on differences between religious groups, toward an understanding of these complex interactions, so that addressing the misperceptions and potentials of each group will foster better behavioural responses to climate change.

Author Contributions

Conceptualization, A.O. and E.C.; methodology, A.O. and E.C.; software, A.O.; validation, E.C.; formal analysis, A.O.; investigation, A.O.; resources, A.O.; data curation, A.O.; writing—original draft preparation, A.O.; writing—review and editing, E.C.; supervision, E.C. All authors have read and agreed to the published version of the manuscript.

Funding

This research was funded by a pre-doctoral fellowship of “Fundación Tatiana Perez de Guzmán el Bueno”.

Data Availability Statement

The data presented in this study are available on request from the corresponding author.

Conflicts of Interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

4.7 Appendix A

Table A1. List of variables included in the study

	Type	Categories	Description
Target Variables			
Carbon footprint	Quantitative	Interval scale	Total, Transport, Food, Clothes, Household energy (kgCO2eq)
Religious affiliation	Nominal	3	Catholic believers, other believers, and non-believers.
Internal variables			
The main motivation for conservation	Nominal	5	Human responsibility, religious reasons, the intrinsic value of nature, economic motives, health or well-being.
Value Orientation	Ordinal	4	Egoism, vulnerability, altruism, resilience, Likert scale from 1 (strongly disagree) to 5 (strongly agree)
Nature relatedness	Ordinal	6	Likert scale from 1 (strongly disagree) to 5 (strongly agree)
CC knowledge	Binary	2	1 = Identify GHG as the main cause and consider natural factors as having low o very low importance; 2 = otherwise
CC Perceived commitment	Nominal	3	1 = highly committed and below-average emissions; 2 = highly committed and above average; 3 = otherwise
CC Perceived Intractability	Binary	2	1 = importance of personal actions high or very high; 2 = otherwise
External variables			
Sex	Binary	2	Male 1, female 2
Age group	Ordinal	4	16-17, 18-30, 31-65, >65
Level of studies	Ordinal	3	No studies or primary, secondary school, university studies
Monthly Income	Ordinal	3	< 1500 €, 1500 a 3000 € and > 3000 €
Type of work	Nominal	9	Student, agriculture, industry, administration, education, catering, other services, management, homemaker.
Political orientation	Ordinal	3	From the original 10 Likert scale, we grouped in 3 classes: left (<4), Centre (4-7) and right (>8)

Table A2. Spearman correlation coefficients. P-values lower than 0.001 are marked as ** and lower than 0.01 as *

	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Transport CF	1															
2	Food CF	0.02	1														
3	Total CF	0.73**	0.45**	1													
4	Sex	0.16*	0.02	-0.1	1												
5	Age group	-0.01	0.08*	-0.03	-0.31*	1											
6	Level of studies	0.15*	-0.04	0.08*	0.01	-0.08*	1										
7	Monthly income	0.3**	0.02	0.2	0.16	0.09	0,40**	1									
8	Political orientation	0.03	0.04	0.05	-0.03*	0.04	-0.02	0.00	1								
9	CC knowledge	-0.08	0.09*	0.00	0.06	-0.09*	-0.15*	0.18	0.17*	1							
10	Commitment	0.06	0.02	0.07*	0.06	-0.07*	-0.05	-0.01	0.15*	0.21*	1						
11	Intractability	0.02	-0.03	0.01	-0.09*	0.08*	-0.07	-0.02	0.07*	0.10*	0.23*	1					
12	Nature relatedness	-0.02	0.02	-0.03	-0.02	0.01*	0.02	-0.01	0.13*	0.12*	0.34**	0.22**	1				
13	Value orientation: egoism	0.04	0.04	0.04	0.04	0.11**	-0.02	-0.06	0.11**	0.11*	0.04**	0.01	0.05	1			
14	Value orientation: vulnerability	0.04	0.04	0.04	-0.04	0.13**	-0.01	0.04	-0.01*	-0.02*	0.16**	-0.08*	0.18**	-0.17*	1		
15	Value orientation: altruism	0.01	0.02	0.02	-0.03	0.01*	0.09*	0.02	0.12**	0.12**	0.25**	0.14**	0.30**	-0.20*	0.35**	1	
16	Value orientation: resilience	0.01	-0.01	0.01	-0.00	0.01	0.01	0.03	-0.01	-0.07*	0.11*	0.1	0.19**	0.01*	0.28*	0.35**	1

Table A3. Descriptive statistics for the overall sample and each religious group

	Overall sample		Catholics believers		Other believers		Non-believers	
Variables	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Transport CF	2163.66	1512.83	2120.14	1506.22	2079.78	1677.80	2242.44	1462.79
Food CF	1509.17	1001.23	1637.51	1064.99	1407.07	914.25	1393.70	934.88
Total CF	5009.93	2167.63	5084.23	2205.09	4931.80	2346.53	4949.44	2062.75
Sex	1.48	0.50	1.49	0.50	1.56	0.50	1.46	0.50
Age group	2.93	0.64	3.08	0.59	2.65	0.74	2.84	0.61
Level of Studies	2.48	0.64	2.45	0.61	2.34	0.56	2.55	0.53
Monthly income	2.01	0.75	2.00	0.77	1.86	0.70	2.07	0.74
Political orientation	1.75	0.66	1.96	0.65	1.76	0.60	1.51	0.60
CC knowledge	1.48	0.50	1.53	0.50	1.57	0.50	1.40	0.49
CC Commitment	2.36	0.77	2.45	0.72	2.28	0.77	2.28	0.81
CC Intractability	1.38	0.49	1.39	0.49	1.37	0.49	1.38	0.49
Nature relatedness	3.51	0.77	3.45	0.79	3.73	0.77	3.52	0.74
Value orientation: egoism	2.73	1.12	2.69	1.10	2.96	1.16	2.70	1.12
Value orientation: vulnerability	3.93	0.95	3.97	0.96	3.84	0.99	3.91	0.94
Value orientation: altruism	3.96	0.86	3.91	0.86	4.00	0.92	4.01	0.84
Value orientation: resilience	4.12	0.88	4.12	0.91	4.14	0.90	4.15	0.84

Table A4. Cross-table religious groups and main motivation to conserve nature

Reasons	Human Responsibility N, Col%, Row%	Spiritual/ religious N, Col%, Row%	Intrinsic value N, Col%, Row%	Economic N, Col%, Row%	Health and wellbeing N, Col%, Row%	Total N, Col%, Row%
Catholic Believers	132, 57.64, 33.50	3, 42.86, 0.76	107, 34.74, 27.16	21, 65.62, 5.33	131, 48.70, 33.25	394, 46.63, 100
Other Believers	27, 11.79, 23.89	4, 57.14, 3.54	44, 14.29, 38.94	3, 9.38, 2.65	35, 13.01, 30.97	113, 13.37, 100
Non-believers	70, 30.57, 20.71	0, 0.00, 0.00	157, 51.97, 46.45	8, 25.00, 2.37	103, 38.29, 30.47	338, 40.00, 100
Total	229, 100, 27.10	7, 100, 0.83	308, 100, 36.45	32, 100, 3.79	269, 100, 31.83	845, 100, 100

Table A5. Cross-table religious groups and nature relatedness

Nature relatedness	Low N, Col%, Row%	Medium N, Col%, Row%	High N, Col%, Row%	Total N, Col%, Row%
Catholic Believers	38, 46.91, 9.64	131, 55.74, 33.25	225, 42.53, 57.11	394, 46.63, 100
Other believers	9, 11.11, 7.96	23, 9.79, 20.35	81, 15.31, 71.68	113, 13.37, 100
Non-believers	34, 42.98, 10.06	81, 34.47, 23.96	223, 42.16, 65.98	338, 40.0, 100
Total	81, 100, 9.57	235, 100, 27.81	529, 100, 62.60	845, 100, 100

Table A6. Cross-table religious groups and CC knowledge

Climate Change Knowledge	GHG main cause and natural factors low importance N, Col%, Row%	Otherwise N, Col%, Row%	Total N, Col%, Row%
Catholic Believers	187, 42.67,47.5	207, 50.86, 52.54	394, 46.63,100
Other-believers	49, 11.19, 43.36	64, 15.72, 56.64	113, 13.37, 100
Non-believers	202, 46.12, 59.76	136, 33.42, 40.24	338, 40.00,100
Total	438, 100, 51.83	407, 100, 48.17	845, 100, 100

Table A7. Cross-table religious groups and perceived commitment

Perceived Commitment	Highly committed, below-average emissions N, Col%, Row%	Highly committed, above-average N, Col%, Row%	Otherwise (no particular commitment) N, Col%, Row%	Total N, Col%, Row%
Catholic Believers	53, 34.87, 13.45	109, 46.58, 27.66	232, 50.54, 58.88	394, 46.63, 100
Other-believers	22, 14.47, 19.47	37, 15.81, 32.74	54, 11.76, 47.79	113, 13.37, 100
Non-believers	77, 50.66, 22.78	88, 37.61, 26.04	173, 37.69, 51.18	338, 40.00, 100
Total	152, 100, 17.99	234, 100, 27.69	459, 100, 54.32	845, 100, 100

Table A8. Cross-table religious groups and perceived intractability

Perceived Intractability	High or very high N, Col%, Row%	Low or very low N, Col%, Row%	Total N, Col%, Row%
Catholic Believers	242, 46.27, 61.42	152, 47.20, 38.58	394, 46.63, 100
Other-believers	71, 13.58, 62.83	42, 13.04, 37.17	113, 13.37, 100
Non-believers	210, 40.15, 62.13	128, 39.75, 15.15	338, 40.00, 100
Total	523, 100, 62.89	322, 100, 38.1 1	845, 100, 100

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5 THE DIMENSIONS OF INDIVIDUAL RELIGIOSITY AND ITS INFLUENCE ON PERSONAL CARBON FOOTPRINT: AN EXPLANATORY STUDY

Este capítulo presenta una primera aproximación de los efectos de las diferentes dimensiones de la religiosidad sobre el comportamiento de mitigación del cambio climático medido como huella de carbono personal. Se examina la religiosidad como un constructo multidimensional y se propone que sus cuatro dimensiones (cognitiva, emocional, moral y social) pueden afectar de forma diferente a la huella de carbono personal. Se presentan los resultados obtenidos en un estudio mediante encuesta representativa de la población argentina. Los resultados muestran que hay diferencias en la huella de carbono para el sector de la alimentación según la afiliación religiosa y que son distintas las dimensiones de la religiosidad que impactan en la huella de carbono personal, dependiendo del grupo religioso analizado. La religiosidad moral resultó ser relevante para la submuestra de católicos, mientras que las dimensiones cognitiva, emocional y social fueron significativas para el grupo de otros creyentes. Las conclusiones sugieren que tratar la religiosidad como un constructo multifacético puede contribuir a una mejor comprensión de sus efectos en el comportamiento de mitigación del cambio climático.

5.1 Abstract

Research on factors affecting individual Climate Change mitigation behaviour shows the relevance of considering religious affiliation and religiosity, although previous studies have not provided conclusive evidence. This study explores the association between religious affiliation, the four dimensions of religious construct (cognitive, emotional, moral and social) and Personal Carbon Footprint as a measure of CC mitigation behaviour in a representative sample of the Argentinian population (n=1101). The findings shows that religious affiliation introduces differences on the Food subsector of the personal Carbon Footprint. Also, the different dimensions of religiosity lead to differences on Food Carbon Footprint, depending on the religious group involved. Moral religiosity were found to be relevant for the Catholics subsample whereas cognitive, emotional and social results significant for other-believers group. Our preliminary findings suggest that treating religiosity as a multifaceted construct may contribute to a better understanding of its effects on Climate Change mitigation behaviour.

Keywords: *Climate Change; Carbon Footprint; religiosity; religious dimensions*.

5.2 Introduction

Climate Change (CC) mitigation solutions consistent with 1.5°C pathways require multiple strategies, thereby allowing to achieve the goals of Paris Agreement and Sustainable Development Goals 12 (#Sustainable production and consumption) and 13 (#Climate Action) (Haigh et al., 2021). These necessary demands stakeholder involvement and citizens participation (IPCC, 2021), notably from consumers (Mies & Gold, 2021; van Langen et al., 2021). Understanding what drives adoption of low-carbon lifestyles at the individual level has attracted much attention insofar as consumers' opinions, attitudes and behaviours towards CC and are critical to reach mitigation outcomes (Nielsen et al., 2021).

The relevance of including religion as one of such drivers for the adoption of low-carbon lifestyles has been recently emphasised in the literature, specifically as an antecedent of CC mitigation behaviour (Haluza-DeLay, 2014; Nche, 2020; Globus Veldman et al., 2013). However, empirical evidence is mixed about its influence, showing that religion at the individual level could both enhance or constrain these outcomes (Preston & Baimel, 2021). There are many reasons why the evidence is inconclusive; one of them regards

the methodology: most of the empirical studies conducted so far have only considered religious affiliation or have used partial measures of the religiosity construct that seem unable to capture the religious complexity, such as the importance of religion in life or the frequency of participation in religious services (see Hill (2013) for a full description of existing scales of measurement). To contribute to the debate and in agreement with the literature arguing that a better treatment of the religiosity construct could bring clarity to this issue (Mathras et al., 2015; Minton et al., 2015; Mokhlis, 2009), we selected a measure of religiosity developed in the field of psychology of religion, which operationalized this construct in a more complex way (Saroglou et al., 2020).

This scale of measurement is based on the notion that religiosity comprises four dimensions that capture the cognitive, emotional, moral and social functions that religion provides to an individual (Saroglou, 2011; Saroglou et al., 2020): (1) the cognitive dimension refers not to specific beliefs (such as dominion or stewardship), but to religion as meaning-making and as connection with transcendence; (2) the emotional dimension intends to capture the emotions arising from rituals and devotional practices and not, for example, the frequency of participation in religious services; (3) the moral dimension refers to religion as a frame of reference to guide behaviour; and (4) the social dimension is understand more from the sense of belonging to a religious tradition, rather than a simple measure of affiliation. This integrative measure of religiosity was found to be consistent across countries, cultures and religious groups (Aditya et al., 2021; Bender et al., 2022; Remizova et al., 2022).

Recently, the link between religion at the individual level and CC mitigation outcomes has begun to attract researchers' attention; in particular, its influence on CC perceptions, attitudes toward mitigation policies and the willingness to change consumption habits and current lifestyle (Lee et al., 2021; Morrison et al., 2015; Urbatsch & Wang, 2021). However, this evidence is based on intention to behave-oriented measures and its effects on consumption in terms of its associated emissions in the context of CC reminds to be investigated. We proposed that the distinct dimensions of religiosity have an impact on CC mitigation behaviour measures as Carbon Footprint, as explained next.

Cognitive dimension. It is generally accepted as a primary function of religion to guide on the search of meaning that allows an individual: to organize her/his life on the basis of goals (Emmons & Paloutzian, 2003), to situate him/her in a broad time horizon, to reduce uncertainty and to bring stability to her/his personality (Paloutzian & Park, 2005), and to organize, process and evaluate incoming information (Seitz & Angel, 2015). Specific belief derived from religious confessions such as dominion/stewardship were

found to be antecedents of CC perceptions (Ecklund et al., 2016; Morrison et al., 2015; Sachdeva, 2016). Thus, the cognitive dimension could be related to CC mitigation behaviour.

Emotional dimension. The emotional aspects involved in the link with the transcendent, occurs primarily through religious rituals (e.g., meditation and prayer) (Saroglou et al., 2020) that generate positive emotions such as gratitude, calm and awe, which in turn have positive consequences on an individual emotional regulation and subjective well-being (Emmons, 2005). Emotions in general are beginning to be examined as antecedents of CC risk perception, policy support and acceptance of technology (Brosch (Brosch, 2021; Schneider et al., 2021; Wang et al., 2018). Thus, it is plausible to think that specific emotions derived from religiosity may have an effect on CC mitigation behaviour.

Moral dimension. It has been found that morality is one of the bases on which an individual decides what is right (Cohen, 2015; Cohen & Rozin, 2001). Moral constructs are studied in relation to consumption (Arli & Pekerti, 2017; Davari et al., 2017; Doran, 2009; Vitell, 2009; Vitell et al., 2016). The moral dimension of religiosity may influence CC mitigation behaviour through the perception of moral obligation toward future generations (Markowitz & Shariff, 2012), which increases the perception of responsibility toward them, and it was found to explains environmental concern (Syropoulos & Markowitz, 2021). Thus, it plausible to link the moral dimension of religiosity with CC mitigation behaviour.

Social dimension. This dimension refers to the social aspects of religion, being part of a community, a continuity with a tradition, and the search for collective identity and social self-esteem by belonging to a group (Saroglou et al., 2020). Particularly, belonging to a religious community may increase the acceptance of subjective or social norms and favourably drive intention-oriented behaviours such as household energy reduction or the adoption of green consumption (Goldstein et al., 2008; Sachdeva, 2016). Although its link to CC mitigation behaviour remains to be examined.

In sum, in view of this evidence, it is plausible to defend that each dimension of religiosity is associated with CC mitigation behaviour. This research aims to provide an assessment of individual behaviour, measuring consumption-related emissions thought the personal Carbon Footprint. Therefore, our research aims to answer the following question:

RQ: is there an association between the different dimensions of religiosity and CC mitigation behaviour measured as Carbon Footprint? Do the distinct dimensions of

religiosity have a different impact on Carbon Footprint depending on the religious affiliation?

Due to the limited evidence provide in literature regarding this link, the nature of this research is exploratory, so it does not attempt to test specific hypotheses but to provide a starting point for the analysis of the proposed relationships. More specifically, we aim to explore: (1) the associations between religious affiliation and Carbon Footprint; (2) the relationships between the different dimensions of religiosity and Carbon Footprint.

5.3 Methods

5.3.1 Participants and procedures

Data were collected through an online survey distributed by a social studies company specialized in internet-surveys. To obtain a representative sample of the Argentinean population, cross quotas for age, sex, education and region of residence were set in similar proportion to the overall population. Respondents received points in exchange for their participation, that can be redeemed for gifts. A total of 1537 people accessed the survey, of which 99 were eliminated for not complying with ISO quality requirements followed by the company, 12 for failing an attention check question and 223 for being incomplete. With the aim to reduce common-method bias, and following Osborne (2013) and Aguinis (2021), during the data preparation, 24 questionnaires whose response time was less than 5 minutes and greater than 50 minutes were eliminated; 10 for inconsistent or unrealistic responses in the estimation of emissions and 68 multivariate outliers were eliminated by applying Mahalanobis test ($p<0.001$). Thus, the final sample comprised 1101 individuals.

51% of the participants are females. In terms of age, 21% of the participants are between 18 and 24 years old; 19% are between 25 and 34 years old; 18% are between 35 and 44; 14% are between 45 and 54 years old; 14% are between 55 and 64 years old, 9% are between 65 and 74 years old and 6% are 75 years old or above.

The outputs of our survey showed that 68.7% of the informants described themselves as having a religious affiliation. From this group, the majority were Christians Catholics (59.5%), followed by other Christians (5%), Jewish (3.3%), Buddhist (0.7%), Hindus (0%), Muslims (0.2%), agnostic (11.7%), atheist (12.8%), and other (6.8%). Since the number of believers of confessions other than Catholic was very small in the sample, we grouped them into the following religious groups: Catholic believers, other believers (9.2%) and non-believers (24.5%).

5.3.2 Measures

Carbon footprint of transport and food. Participants were asked to introduce a quantitative estimation of their consumptions for transport and food, and then we calculate their emissions following the specifications of the Carbon footprint Observatory "CO2 web" (https://www.huellaco2.org/ ; last access on 16 April 2022). The individual carbon footprint was calculated for transport and food, because these sectors are the main contributors of individual consumption to CF and at the same time are those with the greatest reduction potential (see Burgui-Burgui & Chuvieco, 2020 for a full description of the method).

Religious affiliation. One single item was used to assess participants' religious denomination (Pew Research Centre, 2017).

The Four Basic Dimensions of Religiosity Scale. This measure has 12-item scale rating (from 1 = totally disagree to 7 = totally agree) respondent's interest on/ attachment to/ valuing (1) the cognitive dimension (e.g., existential quest, meaning) of religiosity construct, (2) the emotional dimension refers to emotions related to religious rituals and ceremonies, (3) the moral dimension, implying norms and moral rules, values and virtue (4) the social dimension refers to religious community and tradition. This measure was extracted from Saroglou et al. (2020) and the Spanish translation was facilitated by Antonio Muñoz-García. The sum of the items for each dimension was retained for further analysis. Items scale and reliability are presented in **Table A2** of Appendix A.

Sociodemographic controls included sex, age group, level of studies, monthly income, and political orientation, following previous studies (Gifford & Nilsson, 2014).

5.3.3 Analytical strategy

We used Spearman correlations to examine the relationship between variables. Differences between sample groups were tested by the Kruskal-Wallis and post hoc comparisons. We choose non-parametic regression methods (i.e., the local linear kernel regression) to know the importance of external and internal factors on CF, due to the nature of the dependent variable (Racine, 2019). See Li & Racine (2004) for a full description of the method.

To determine relevant predictors, we calculate the p-values and for those p-values less than 0.05, we reject the null at the 5% level and conclude that the predictors are relevant.

These analyses were process in R software, version 4.1.0 with npreg() function (Hayfield & Racine, 2008).

5.4 Results

5.4.1 Links between religious affiliation and personal carbon footprint

The mean personal CF of the sample for transport sector was 2,067 kgCO2e and 1,095 kgCO2e by the Food sector. The per capita emission rate of Argentina was 4,000 kgCO2eq/year in 2019 (Climate Watch, 2021). It should be noted that our estimation did not include emissions linked to other sectors such as household energy consumption, clothing or electronic devices. The relationship of socioeconomic antecedents with CF was measured by the Kruskall-Wallis rank differences (**Table 5.1**). Those factors showing higher differences between ranges should be those more closely influencing CC mitigation behaviour.

Table 5.1. Kruskal-Wallis test for socioeconomic antecedents

Variables	Food CF H-statistic	Transport CF H-statistic
Sex	**119.51****	**116.91****
Age group	8.90	**40.90****
Level of studies	5.57	**32.89****
Monthly Income	**19.52****	**65.82****
Political orientation	**8.01***	**9.57***
Religious affiliation	**9.17***	5.02

Values marked with * indicate $p < 0.01$ and ** $p < 0.001$

All socioeconomic antecedents introduced differences between groups for the Transport sector of personal CF. Post-hoc comparison showed that men, those of higher income and those who identified with right-wing political orientation had the highest transport CF. Conversely, women, those of left-wing political orientation and those with lower incomes had the lowest CF. Post-hoc comparison also revealed differences between age groups, with the youngest (18-24) having the lowest transport CF and adults (55-64 and 65-74 age groups) having the highest values. In terms of education, those with an intermediate level of studies were those with the lowest transport CF. Regarding the Food sector of personal CF, sex, monthly income and political orientation implied differences between

groups. Women, those with lower income and left-wing political orientation are those with the lowest Food CF. **Figure 5.1** visually depicts these results.

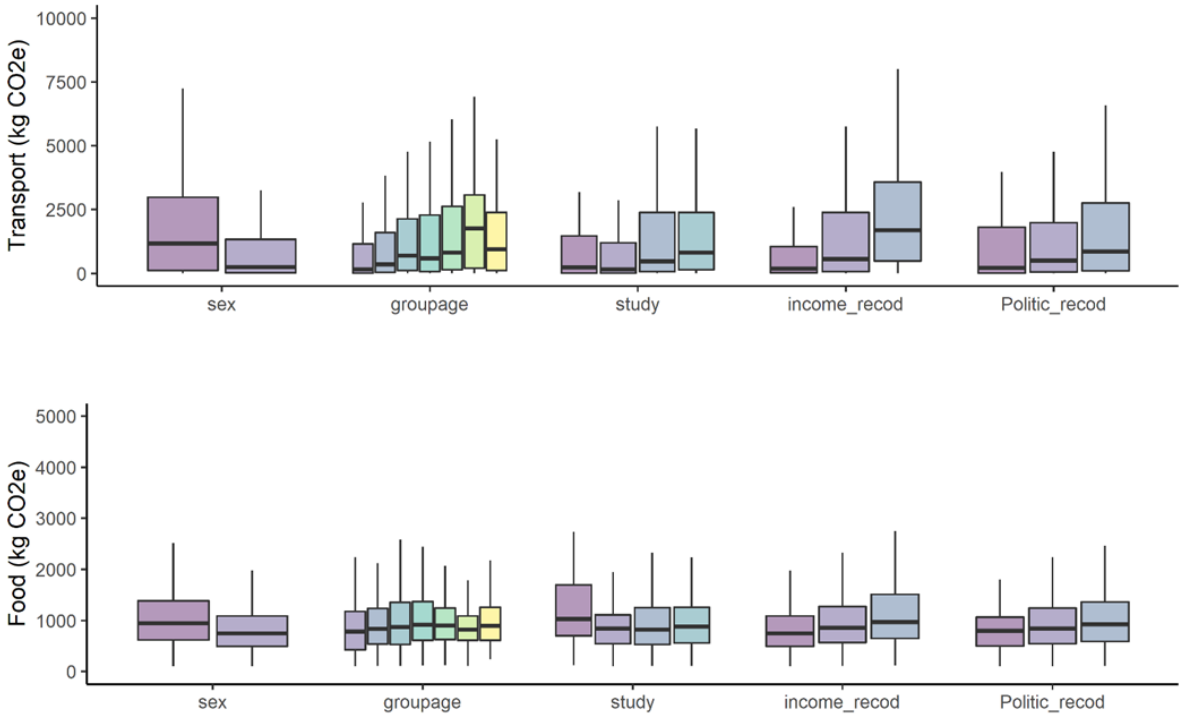

Figure 5.1: Boxplots of Food and Transport Carbon Footprint (kg CO2eq/year).

Considering religious affiliation, differences across them in terms of the individual Carbon Footprint on the Food sector were observed ($H=9.17$, $p<0.01$). Post hoc comparison showed differences between Catholic believers and other believers ($p=0.045$), with the lower CF for the latter group.

5.4.2 Religiosity dimensions and its influence on Food Carbon Footprint

Next, we focused on Food CF to deepen the effect of explanatory variables, since differences across religious affiliation were found only for this sector. Regression models were run for the overall sample considering first religious affiliation as independent variable (in addition to controls) and then, religiosity dimensions plus controls. Finally, regression models were run for each religious group.

Table 5.2 shows that neither religious affiliation nor any of religiosity dimension result significant for the overall sample. However, the explanatory power of the model considering the different dimensions is higher than when a measure of affiliation is

introduced. Of the socioeconomics antecedents, sex, monthly income and political orientation were found significant for the overall sample across models.

Table 5.2: Non-parametric regression model for Food Carbon Footprint for the overall sample

Variables	Model 1: religious affiliation plus controls	Model 2: religiosity dimensions plus controls
Religious affiliation	0.86297	
Religiosity dimensions		
Cognitive religiosity		0.23308
Emotional religiosity		0.22055
Moral religiosity		0.24310
Social religiosity		0.09774
Socioeconomic indicators		
Sex	**0.000 *** **	**0.000 *** **
Age group	0.09761	0.08270
Monthly income	**0.00673 ***	**0.01754 ***
Political orientation	**0.000 *** **	**0.00250 ** **
N	*1101*	*1101*
R-squared (s.e)	0.23(0.65)	0.27(0.78)

P-values in bold are significant. Due to its skewed distribution, Food CF was log-transformed.

Given these non-significant findings, we examine next whether affiliation moderates the influence of religiosity (and its separate dimensions) on CF. For this, we examine antecedents explaining food CF across religious groups. **Table 5.3** shows that moral religiosity was found to be significant for Catholics, while cognitive, emotional and social for other believers. As expected, no dimension of religiosity was found to be significant for non-believers. Relevant to note, of the socioeconomic predictors, sex and monthly income were the most explicative. Age group also relevant for Catholics and political orientation for other believers. The models explaining food CF for non-believers shows sex and monthly income as significant antecedents ($p<0.001$).

Table 5.3: Non-parametric regression model for Food Carbon Footprint across religious groups

variables	Catholics believers	Other-believers	Non-believers
Religiosity dimensions			
Cognitive religiosity	0.38345	**0.000 *** **	0.39348
Emotional religiosity	0.57393	**0.000 *** **	0.87969
Moral religiosity	**0.03508 ***	0.68671	0.75689
Social religiosity	0.42105	**0.00501 ** **	0.35087
Socioeconomic indicators			
Sex	**0.000 *** **	**0.000 *** **	**0.0025063 ** **
Age group	**0.00751 ** **	**0.00250** **	0.1278195
Monthly income	**0.03258 ***	**0.00751 ** **	**0.03258 ** **
Political orientation	0.0651629	**0.02506 ***	0.08521
N	*655*	*101*	*270*
R-squared (s.e)	0.32(0.60)	0.35(0.54)	0.20(0.70)

P-values in bold are significant. Due to its skewed distribution, Food CF was log-transformed

5.5 Discussion

5.5.1 Main findings, implications, and future research lines

This study has shown the value of considering individual level religion in terms of affiliation and religious dimensions to understand CC mitigation behaviour, measured as Carbon Footprint. Our initial assumption was that religiosity affects CF through four dimensions (cognitive, emotional, moral, social). The main findings are discussed next.

First, coincident with previous findings, religious affiliation introduces differences in Food Carbon Footprint; there is variability in GHG emissions by group of believers (Orellano & Chuvieco, 2022). Similarly, based on household-level consumer surveys, it was found that religious affiliation does not influence household CF except on the food category (Lee et al., 2021). Regarding the dimensions of religiosity, no one was relevant for the overall sample: however, when examining the relationship across religious groups, it was found that different dimensions of religiosity influenced the food CF of different religious groups. For the Catholic sample, moral religiosity was found to be significant, while for other believers the cognitive, emotional and social dimensions were significant.

Second, our study confirms the importance of socioeconomic over other antecedents on CF, in line with previous evidence (Baiocchi et al., 2010; Paterson & Stripple, 2010; Wilson et al., 2013). Particularly, sex and monthly income were found those antecedents

which more strongly influence CF, being higher income and men associated with higher CF for both the transport and food sector of CF.

Although this study presents a first approximation about the link between religiosity's dimensions and CF, the proposed relationships may serve to a starting point to new research questions about CC mitigation behaviour and religion. Further studies should analyze within each dimension the relationship with other relevant antecedents. For example, related to the moral dimension, a common theme for all religious denominations is frugality, which is desirable in relation to consumption, promoting its moderation and/or reduction (Culiberg et al., 2022; Goldsmith & Flynn, 2015; Witkowski, 2010). From a moral perspective, one of the ways in which religiosity may influence the reduction of consumption is by activating self-control (Baumeister & Exline, 2001; Marcus & McCullough, 2021; McCullough & Willoughby, 2009), which in turn promotes, for example, different forms of ethical consumption such as veganism (Raggiotto et al., 2018) or the reduction of compulsive behaviour in clothing purchases (Nielsen & Hofmann, 2021). Thus, more research is need on the link between moral religiosity, self-control and CC mitigation behaviour.

Understanding that consumption involves ethical/moral decision making, other line of study could be linking virtues and low carbon lifestyles. From virtue ethics and positive psychology, virtues are understood as dispositions of the individual that allow him/her to make an ethical evaluation and judgment of the actions he/she performs (Schnitker & Emmons, 2017). These virtues are present in all religious traditions (Peterson & Seligman, 2004) and their study shows that many of them have an impact on the decision-making process related to sustainable consumption (Corral-Verdugo et al., 2015; Valor et al., 2020) .Thus, reframing CC as an ethical issue in which virtues could play a key role is one avenue that could be empirically explored (Hulme, 2014; Jenkins, 2016; Markowitz & Shariff, 2012).

Regarding the social dimension, the evidence shows that social norms emanating from an individual's reference groups strongly influence her/his decision-making process (Lee, 2010; Salazar et al., 2013), so a way of inquiry could be analysing the effect of a reference religious group regarding CC on an individual to adopt low carbon lifestyles.

Finally, due to the important contribution of food CF to the total emissions, and considering the impact of food choices on CC, these may serve to inform mitigation policies (Veeramani et al., 2017) and religious leaders seeking to guide climate action of believers (Cohen, 2020). For example, the relevancy of the moral dimension for

Catholics supports the theoretical idea that reframing CC and consumption as a moral dilemma, where the religious individual in their decision-making process could refer to the norms, values and teachings of their religious tradition, could led better mitigation responses.

5.5.2 Limitations

Limitations of this study include, on the one hand, the impossibility of verifying the inputs that the panelists included in their responses to estimate their consumption. However, these responses were verified by taking into account maximum and minimum limits for each consumption category, and filtrating inconsistences responses. In addition, it should be noted that, although the sample is representative of the population, the survey company recruits panelists via internet, which may affect the representativeness of the sample, as it leaves aside the possibility of surveying those without internet access. Notwithstanding these limitations, this study provides the first detailed account of Argentinian's CF, its explanatory drivers, and how it is related to religious affiliation and its dimensions.

5.6 Conclusion

This study presents a first approximation of the effects of individual-level religion on Climate Change mitigation behaviour measure as Carbon Footprint, with the aim of inspiring future research on the proposed relationships. We examine religion as a multidimensional construct and propose that religiosity affects Carbon Footprint through four dimensions-cognitive, emotional, moral and social- that have a distinct impact on this outcome. Our results corroborate the significant contribution of the food sector to the total CF and its variability across affiliations. Indeed, it provides evidence to support that specifics facets of religiosity influence CF, which may help the design of specific interventions targeting or reinforcing these aspects separately.

Funding: This research was funded by a pre-doctoral fellowship of "Fundación Tatiana Perez de.Guzmán el Bueno". The questionnaire was funded by Cátedra de Etica Ambiental of Universidad de Alcalá.

Ethics: All participants were informed about the purposes of the study and gave their informed consent in accordance with the Declaration of Helsinki.

5.7 Appendix A

Table A1. Descriptive statistics and Spearman correlation coefficients for the overall sample.

	Variables	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12
1	Transport CF	2066,916	3785,463	1											
2	Food CF	1094,945	1065,447	**.136****	1										
3	Sex	1.510	.500	-.198	**-.183****	1									
4	Age group	4.294	1.847	**.176****	**.063***	**-.328****	1								
5	Level of studies	3.204	.843	**.160****	.005	**-.065***	**.228****	1							
6	Monthly Income	1.840	.622	**.238****	**.130****	**-.300****	**.447****	**.384****	1						
7	Political orientation	2.095	.596	**.091****	**.085****	**-.086****	**.086****	.036	**.066***	1					
8	Cognitive religiosity	3.582	2.017	-.047	.014	.020	**.092****	-.052	-.049	**.117****	1				
9	Emotional religiosity	3.253	1.854	-.029	.027	.055	.012	**-.089****	**-.072***	**.131****	**.750****	1			
10	Moral religiosity	3.208	2.099	-.015	.052	-.036	**.097****	-.046	-.035	**.150****	**.824****	**.785****	1		
11	Social religiosity	2.804	1.905	.005	.045	-.039	**.100****	-.024	.014	**.154****	**.735****	**.761****	**.836****	1	
12	Religiosity all	3.212	1.801	-.025	.036	.003	**.083****	-.058	-.040	**.148****	**.915****	**.898****	**.935****	**.895****	1

Table A2. Items scale and reliability.

Measures	**Cronbach Alpha**
Carbon Footprint (index)	**-**
Religiosity (from 1= strongly disagree to 7= strongly agree) *Source: Saroglou et al. (2020). Spanish traslation by Muñoz-García.*	**0,96**
Cognitive dimension (beliefs/meaning) I feel attached to religion because it helps me to have a purpose in my life It is important to believe in a Transcendence that provides meaning to human existence Religious beliefs have important implications for our understanding of human existence	**0,88**
Emotional dimension (rituals) I like religious ceremonies Religious rituals, activities or practices make me feel positive emotion Religion has many artistic, expressions, and symbols that I enjoy	**0.88**
Moral dimension (norms) I am attached to the religion for the values and ethics it endorses Religion helps me to try to live in a moral way When I've got a moral dilemma, religion helps me to make a decision	**0.95**
Social dimension (community/Identity) In religion, I enjoy belonging to a group/community Belonging to a religious tradition and identifying with it is important for me Referring to a religious tradition is important for my cultural/ethnic identity	**0.96**

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6 CONCLUSIONES

6.1 Hallazgos principales

Esta tesis partió de una pregunta fundamental: si la religión influye, y bajo qué supuestos, en el consumo sostenible, en el marco de uno de los mayores desafíos a los que asiste la vida en la tierra, como es el cambio climático. Responder efectivamente a esta problemática exige esfuerzos colectivos, pero también individuales que busquen revertir las tendencias que lo causan. Centrándose en el papel del individuo, sin ignorar su necesaria sinergia con los factores sociales e institucionales, esta investigación se preguntaba si el hecho de estar afiliado a una confesión religiosa y la vivencia de la religiosidad personal puede ser uno de los factores que motive el cambio hacia hábitos de consumo de bajo impacto en la huella de carbono personal y propicie la transición hacia estilos de vida sostenibles.

Durante el desarrollo de esta investigación, se advirtió que el estudio de la influencia de la religión en el consumo sostenible se encuentra dentro de un debate abierto y creciente en la literatura. La evidencia empírica seleccionada y analizada sistemáticamente fue organizada según esta influencia fuera realizada de forma directa o indirecta. Esto llevó a comprender que la religión puede influir en el comportamiento desde: (1) la esfera cognitiva de los individuos, al incidir en el proceso de razonamiento que lleva a cabo para tomar una decisión; siendo el sistema de creencias asociado a una visión de dominio utilitarista de la naturaleza o de custodia de la creación, los que marcan una gran diferencia en las actitudes negativas o positivas hacia el consumo sostenible; (2) los hábitos de consumo, a través de los valores, virtudes y las normas que se desprenden de una tradición religiosa e influyen en el la adquisición, mantenimiento y cambio de esos hábitos (3) su interacción con otros antecedentes que a su vez influyen en el comportamiento de consumo sostenible como la orientación política, las normas sociales, su percepción de eficacia en la resolución de un problema, etc.

Las investigaciones empíricas existentes hasta el momento también revelaron que no es clara la dirección de la influencia de la religión en el consumo sostenible, encontrándose evidencia no concluyente al respecto. Esto se debe a varias razones: (1) a focalizar el estudio seleccionando factores aislados que en su interacción con la religión influyen en el consumo sostenible; (2) debido a problemas metodológicos al operacionalizar los constructos bajo análisis y (3) al provenir la mayor parte de los estudios empíricos de un contexto geográfico y cultural específico como es el norteamericano.

Esta tesis pretendió contribuir a avanzar el estado del arte en el tema al (1) situar el estudio de la religiosidad y el consumo dentro del marco socio psicológico que entiende el comportamiento influido por factores externos e internos que en su interacción con la religión influyen en el consumo; (2) al operacionalizar los constructos tomando como variable independiente a la afiliación religiosa (estudio 2) pero también complejizando su análisis desde la religiosidad en sus cuatro dimensiones (cognitiva, emocional, moral y social) (estudio 3) y (3) al aportar evidencia empírica del objeto de estudio desde otras regiones geográficas-culturales (España y Argentina) (capítulos 3, 4 y 5).

Por otro lado, y en base a las evidencias existentes, se observa que los individuos, si bien declaran tener preocupación por las problemáticas ambientales en general y el cambio climático en particular, no logran asociar completamente sus propias opciones de consumo con su impacto en los sistemas ambientales y climáticos. Entre las múltiples causas que señala la literatura sobre esto, una línea sugiere que tomar como medida de consumo una que cuantifique sus emisiones asociadas, podría servir para visibilizar la problemática del cambio climático y aumentar la responsabilidad individual hacia el mismo. Siguiendo este razonamiento, para los estudios empíricos de esta investigación, se eligió a la huella de carbono personal como medida de la variable dependiente. Así, se cuantificaron las emisiones personales asociadas a los sectores del consumo considerados más relevantes en cuanto a su aporte al total para examinar su vínculo con la religión a nivel individual.

Los resultados de los estudios de esta tesis presentan evidencia para sostener que la religión en su esfera individual está relacionada con la huella de carbono personal, aunque no en todos sus sectores, sino en aquellos más cercanos a la agencia del individuo, es decir, sobre los que las personas ejercen un mayor control. De este modo, se encontró que la afiliación religiosa está relacionada con la huella de carbono de la alimentación, pero no con la del transporte (estudio 2 y 3). Además, la relación entre huella de carbono personal y afiliación religiosa debe entenderse considerando los otros factores que inciden en el comportamiento, como los factores socioeconómicos y situacionales y los internos o intrínsecos. Quedó clara la influencia de los factores estructurales en la huella de carbono personal, particularmente en la de transporte, y la menor influencia de los factores internos en esta medida.

En cuanto a los factores internos, los resultados mostraron que la motivación para conservar la naturaleza incide en la huella de carbono personal. De entre las motivaciones, la responsabilidad humana fue seleccionada con mayor frecuencia entre los creyentes católicos, mientras que el valor intrínseco de la naturaleza fue más

valorado por los no creyentes. Las comparaciones intergrupales para los factores internos mostraron que una menor huella de carbono de transporte se estimó para aquellos católicos que seleccionaron la responsabilidad humana como principal motivación para conservar la naturaleza, en comparación con los no creyentes. Por el contrario, se encontró que aquellos no creyentes que tenían niveles más altos de valores resilientes, un mayor conocimiento del CC, una mayor responsabilidad y eficacia reportaron valores de huella de carbono menores que los católicos de los subgrupos correspondientes. Estos resultados apuntan a una interrelación entre factores que debe ser explorada en futuros estudios, quizá enfocando el estudio con aproximaciones configuracionales.

Por otra parte, esta investigación ha confirmado que la religiosidad tiene el potencial de influir en la huella de carbono, atendiendo a sus distintas facetas, cognitiva, emocional, moral y social y que las mismas difieren según la afiliación religiosa. Para los católicos se encontró relevante la religiosidad moral y para los creyentes de otras confesiones, las otras facetas. Esto apunta a que diferentes afiliaciones podrían influir en el consumo por diferentes mecanismos.

Con la realización de estos estudios, esta tesis contribuye a la literatura de varias formas. A la literatura en religión, brindando evidencia empírica sobre su papel en la transición hacia estilos de vida sostenibles; a la literatura en consumo sostenible, aportando evidencia de que la religiosidad personal puede ser capaz de impulsar estilos de vida bajos en emisiones de carbono, y finalmente, a la reciente literatura sobre comportamiento de mitigación del cambio climático, a partir del análisis de los factores que junto a la religiosidad influyen en la huella de carbono personal, para promover el desarrollo de intervenciones eficaces y focalizadas para los distintos grupos religiosos.

6.2 Limitaciones

Si bien en cada estudio se mencionaron las limitaciones encontradas, en este apartado se remarcarán las más sobresalientes. En primer lugar, en la revisión sistemática de la literatura, cabe decir que los artículos seleccionados para su análisis se basaron en el vínculo entre religión y consumo sostenible. Sin embargo, la literatura sobre espiritualidad entendida por fuera de las confesiones religiosas no fue recogida, y esto podría servir para comparar su efecto en el consumo sostenible y ampliar el campo de estudio.

Respecto a los estudios empíricos, la medida de huella de carbono empleada se basa en el consumo personal que cada encuestado reporta, pero esas estimaciones no pueden verificarse de modo independiente. Esto implica que los resultados, aunque cuantitativos, tengan un margen de incertidumbre, que se asume bajo al contar con una muestra considerable. Por otra parte, los datos necesarios para calcular la huella de carbono no son fáciles de obtener. Por ejemplo, para el sector del transporte, se pide introducir la cantidad de kilómetros recorridos en cada tipo de vehículo (coche, tren, autobús, etc.), el combustible utilizado, entre otros, para luego realizar el cálculo de la huella de carbono. Esto requiere tiempo y esfuerzo por parte del encuestado para pensar en hábitos que se encuentran automatizados y puede dar lugar a errores. Sin embargo, al filtrar posteriormente las respuestas inconsistentes, los valores de huella de carbono calculados se encuentran dentro de lo esperado para cada sector de la huella y país analizado.

6.3 Futuras líneas de investigación

Si bien a lo largo de esta investigación, en cada apartado se han brindado sugerencias para abordar futuras líneas de investigación, se sistematizan en este apartado las consideradas más importantes.

En primer lugar, esta investigación sirve como punto de partida para complejizar el debate de la relación entre religión y consumo basado en sus emisiones asociadas. Es crucial avanzar la discusión que hasta ahora está situada en conocer qué grupo religioso es más o menos sostenible que otro, hacia el estudio focalizado para cada afiliación religiosa, ya que conocer más a fondo los factores explicativos relevantes abre nuevas vías para indagar cómo deben abordarse las potencialidades y debilidades específicas de cada grupo. Dado que la religión es un factor distal, es necesario centrar la investigación en los mecanismos que explican la relación entre afiliación y religiosidad y consumo sostenible.

En segundo lugar, esta investigación muestra que situar el estudio de la afiliación religiosa y religiosidad en interacción con otros factores que a su vez inciden en el comportamiento, es más consistente que el estudio de la influencia lineal y separada de cada variable. Sin embargo, desde el punto de vista metodológico, este estudio sólo analizó relaciones lineales entre las variables bajo análisis, y sería deseable probar métodos que asuman que otro tipo de relaciones entre variables es posible, como los métodos o aproximaciones configuracionales.

Además, el estudio de la religiosidad según sus facetas abre nuevos horizontes de investigación, ya que si una o varias dimensiones sobresalen más que otras para cada afiliación religiosa, reforzarlas o focalizar intervenciones desde ellas podría dar lugar a los resultados de mitigación esperados. Hacen falta más estudios de cada dimensión específica y los mecanismos que explican su relación con el consumo sostenible. Por ejemplo, la dimensión moral y el autocontrol, la eficacia auto percibida, o la percepción de responsabilidad hacia otros y su influencia en la huella de carbono personal u otras medidas de la variable dependiente. Una posible área de investigación son estudios experimentales o intervenciones en grupos religiosos que examinen qué tipo de faceta de la religiosidad genera mayor adopción de consumo sostenible en diferentes afiliaciones religiosas.

En tercer lugar, hace falta más investigación cualitativa, no solo para complementar la cuantitativa, sino para tratar constructos tan complejos, ricos y sensibles desde otro enfoque. Podrían utilizarse diversos métodos cualitativos además de la teoría fundamentada con los que se habían realizado los estudios cualitativos recogidos en la revisión sistemática, como, por ejemplo, etnografías y estudios de casos. Lo importante es que se ponga en diálogo, por ejemplo, la identidad religiosa con las prácticas de consumo, o el legado que la religión deja en una persona, aunque ésta en el presente se considere alejada de su confesión religiosa, o el hecho de entender tanto la vivencia de la religiosidad como el consumo sostenible y estilos de vida bajos en carbono no como un resultado acabado sino como un proceso aportaría claridad a la discusión. Todo esto permitiría estudiar cómo la religiosidad puede influir en un mayor compromiso ambiental, que lleve a generar hábitos sostenibles de consumo, fomentando la frugalidad y las opciones que supongan una menor huella de carbono.