



**UNIVERSIDAD
DE SEVILLA**

**CIRCULAR BUSINESS
MODELS
ACTIVE CONSUMER
PARTICIPATION**

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To the most important people in my life - Nuno, Tomás, and Diogo.
With all my love and gratitude.
Dedicated to my dear Mom.

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Abstract

This Doctoral Thesis consists of a compendium of three research articles published in scientific impact journals, included in the Journal Citation Reports (JCR) of the Web of Science (WOS). It aims to provide an exploratory analysis of consumer active participation in companies' circular business models.

In recent years, the circular economy has gained relevance as a response to contemporary environmental challenges, including climate change, resource scarcity, pollution, and biodiversity loss. Although the role of businesses and governments has been widely emphasized in the transition to circular models, consumers' contributions have been less valued. Aiming to bridge this gap, this doctoral thesis compiles three studies that explore different determinants of consumer participation in circular business models. In this way, the evolution of this thesis reflects the complexity of this topic, which has recently been the subject of increasing research.

The first study explored the influence of consumer personality traits, based on the Big Five model, on their engagement with the circular economy and their willingness to participate in circular business models. The results indicate that personality traits directly influence engagement with the circular economy, but only through this engagement can the willingness to participate in circular business models be explained. It was also found that this relationship is stronger among younger and female consumers. The study contributes to extending the 3M theoretical model (Meta-Theoretic Model of Motivation and Personality) to circular consumer behavior and a deeper understanding of the multidimensionality of consumer engagement.

The second study assessed the influence of environmental concerns and the search for pro-sustainable information by Portuguese consumers on their circular habits (such as water and energy saving, waste management, and plastic reduction) and their respective circular consumption decisions. The results reveal that both environmental concerns and the search for information positively influence circular habits and, mediated by these, consumption decisions. Based on the data obtained, a model of consumer participation in the circular economy was proposed, reinforcing the consumer's role as an active agent in transforming traditional business models into circular ones.

The third study focused specifically on Portuguese Generation Z, with the aim of exploring how their circular habits and the perceived functional value of circular products (in terms of price and quality) influence their willingness to participate in the

circular economy. The results show that circular habits alone do not directly affect this willingness, but that the perceived functional value has a significant mediating effect. This study contributes to the literature by demonstrating that Generation Z's participation can be signaled through the perception of value in circular products, supported by signaling theory, and is pioneering in the simultaneous analysis of five circular habits.

The three studies adopted a quantitative methodology, with the collection of primary data through questionnaire surveys, and the application of the Partial Least Squares method. Data were collected from Portuguese consumers. The integrated results of the studies reveal that consumer participation in the circular economy is a complex phenomenon, influenced by environmental, behavioral, and psychological factors. This multidimensional approach offers important theoretical and practical implications for researchers, businesses, and policymakers promoting more sustainable consumption and production models.

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CHAPTER 1. Introduction and Objectives

1. Introduction

By embracing the transition to a circular economy, the world embarks on a journey of immense potential. This provides an opportunity to achieve remarkable economic growth and enables us to make a lasting impact at both environmental and social levels. In this way, the aim is to create a future where prosperity and sustainability are allies, inspiring future generations. However, this implies a transformational change in consumption and production (Ferreira et al., 2023; Meis-Harris et al., 2021). The essence of this transformation is minimizing waste. Waste minimization requires a longer lifespan for resources and products (OECD, 2020). Extending the lifecycle of products and materials means they must be reused, recycled, remanufactured, and discarded for repurposing (Korhonen et al., 2018).

Transitioning to a circular economy is one of Europe's main priorities in fulfilling its commitment to the United Nations 2030 Agenda for Sustainable Development and the Paris Agreement (Fetting, 2020). According to the Circularity Gap Report 2023, the global economy has a circularity level of only 7.2% (Circle Economy, 2023). This rate has been affected by the growing volume of natural resource extraction, which caused global circularity to drop from 9.1% in 2018 to 8.6% in 2020, and to 7.2% in 2023. This situation leaves a huge circularity gap, as the world still depends almost exclusively on virgin materials. As a result, over 90% of materials are wasted, lost, or unavailable for reuse for years, as they are incorporated into long-life buildings and machines (Circle Economy, 2023). The increasing consumption of materials threatens the continuity of future generations, as it tends to damage the natural systems we depend on for survival. The waste-based economy consumes natural resources, threatens

species survival, pollutes soil and water with toxins, and dangerously contributes to global warming (Circle Economy, 2023).

On the other hand, the Ellen MacArthur Foundation (2021) estimates that a transition to a circular economy could reduce global greenhouse gas emissions by 39% by 2050. Furthermore, if current trends continue, the world's oceans could contain more plastic than fish by weight by 2050.

However, if circular economy principles can be implemented, according to Schulze (2016), it would be possible to generate global economic benefits of \$2.2 trillion by 2030. Moreover, by 2030, resource productivity in Europe could be increased by 3%, resulting in annual cost savings of €600 billion and additional economic benefits valued at €1.8 trillion (Schulze, 2016). According to data from the Ellen MacArthur Foundation (2021), adopting circular economy principles could lead to a \$4.5 trillion increase in economic output by 2030 and create 18 million new jobs. These statistics demonstrate the potential benefits of the transition to a circular economy, including economic growth, job creation, reduction of greenhouse gas emissions, and achieving sustainability goals.

In this context, in recent years, the circular economy has grown in both academic interest and practical relevance for various societal stakeholders, notably businesses and policymakers (Ghisellini et al., 2016). The circular economy emerges as an alternative to the conventional linear economy, as it is more environmentally sustainable and enhances the performance of economic processes (Ghisellini et al., 2016). The circular economy is not just an individual process of converting business models; it also involves consumption. Therefore, it implies changes at the business level, as well as changes in consumer behaviors, attitudes, and values (Chizaryfard et al., 2021).

Although businesses progressively understand the value of a circular economy and are more aware of the opportunities it may offer, practical changes and the implementation of circular business models are still in their infancy (Geissdoerfer et al., 2017). However, the responsibility of implementing a circular economy should not fall solely on businesses but should be extended to consumers. According to Meis-Harris et al. (2021), the success of implementing a circular economy heavily depends on consumers' involvement in informed circular consumption behaviors. Consumers' circular purchasing choices can be an important trigger for companies to shift from traditional production systems to pro-environmental production systems and adopt circular business models. We may even ask: what role does civil society play in transforming consumption-based business models into circular economy models?

To contextualize, consumers are agents in circular economy processes, but they need to be aware and motivated to participate in this process actively. In some studies, as mentioned by Camacho-Otero et al. (2018), the approach to the role of consumers in the circular economy focuses on their circular purchase intentions or on expanding the meaning of the circular economy concept on the demand side. However, studies focusing on the relationship between the circular economy and the consumer are still scarce, especially those that consider the active role of consumers in the circular economy and explore their willingness to participate in this process. To that end, it is necessary to better understand consumer behavior in the circular economy—their attitudes, decision-making processes, and circular habits—which can provide important insights for business models and managerial and policy decision-making in the context of the circular economy (Stankevich, 2017). Deepening knowledge about the consumer is vital, since greater consumer engagement in the circular economy may entail behaviors that alter their daily routines and even their lifestyle. Consumer

engagement with the circular economy will be a prerequisite for active participation in circular business models. This field of scientific study is vast and underexplored and justifies the development of this doctoral thesis.

2. Methodological process

The present doctoral thesis was designed to gain an in-depth understanding of the consumer's role in the circular economy and their willingness to participate in circular business models and integrate environmental, behavioral, and psychological contributions. The adopted approach was based on an empirical, quantitative methodology, with the collection of primary data through questionnaire surveys, applied in three distinct yet complementary studies. Each study focuses on a specific set of variables, allowing an integrated and progressive analysis of consumer participation in the circular economy; the methodological process can, therefore be divided into three phases:

Phase 1 – Study of the influence of personality traits on engagement with the circular economy and on willingness to participate in circular business models.

The first phase aimed to explore the influence of personality traits, according to the Big Five model, on engagement with the circular economy and on willingness to participate in circular business models. To this end, a non-probabilistic sample of 489 Portuguese consumers was collected, and a questionnaire was used as the data-collection instrument. Statistical analysis was carried out using the partial least squares structural equation model. The results showed that personality traits directly influence engagement, but that their influence on participation in CBM depends on the mediation of that engagement. A moderating effect of gender and age was also observed, with the stronger association among women and young people.

Phase 2 – Exploration of environmental and informational determinants of circular behavior

In the second phase, the influence of environmental concerns and the search for pro-sustainable information on Portuguese consumers' circular habits and their circular consumption decisions was analyzed. For this purpose, an online questionnaire was administered to a non-probabilistic sample of 826 Portuguese consumers over 18 years old. The research model was also tested using the partial least squares structural equation modeling technique (PLS-SEM). The results validated a model of consumer participation in the circular economy, highlighting the mediating role of circular habits between environmental factors and circular consumption decisions.

Phase 3 – Analysis of perceived functional value as a mediator between habits and participation in the circular economy

In the third phase, the focus was directed toward Portuguese Generation Z, to assess the impact of circular habits on the perceived functional value (price and quality) of circular products, and the influence of this value on willingness to participate in the circular economy. A sample of 578 Portuguese youths belonging to Generation Z—also obtained through non-probabilistic sampling—was used. The data-collection instrument was likewise an online questionnaire. The data were again processed with the PLS-SEM method. The results showed that circular habits positively influence the perceived value of circular products and that this perception functions as a necessary mediator to generate participation intention. This study contributes to applying signaling theory to the context of circular consumption.

From a methodological synthesis standpoint, it is noted that the studies compiled in this doctoral thesis followed a coherent methodological strategy,

based on empirical quantitative research, with the collection of primary data by questionnaire, applying the PLS-SEM method for statistical modeling and analysis. This approach made it possible to test causal relationships between latent variables, modeled based on composites, and to identify direct, mediating, and moderating effects. The complementarity of the studies allows for a comprehensive reading of the complexity of consumer behavior in the context of the circular economy and of their willingness to participate in circular business models, exploring environmental, behavioral, and psychological dimensions.

3. Objectives

The main objectives addressed by this doctoral thesis will be presented in a very concise manner. The general objective is to analyze the environmental, behavioral, and psychological factors influencing consumer engagement with the circular economy and their participation in circular business models.

To achieve the general objective, the following specific objectives were defined:

To assess the influence of environmental concerns and the search for pro-sustainable information on circular habits and circular consumption decisions of Portuguese consumers.

To investigate how circular habits influence the perceived functional value of circular products (in terms of quality and price) and, consequently, the willingness to participate in circular business models.

To explore the influence of consumers' personality traits, based on the Big Five model, on engagement with the circular economy and the willingness to participate in circular business models, also considering the moderating effect of gender and age.

4. Thesis structure

This doctoral thesis was prepared by compilation as established in articles 62, 63, and 64 of the doctoral studies regulations of the University of Seville. It is structured in 5 chapters, with the first chapter showing the suitability of the topic to be addressed through theoretical-academic and practical justification, as well as the proposed objectives. The following three chapters show the articles published in journals of the Social Sciences Citation Index (SSCI)¹ collection, which have a JCR quality index with an impact factor (JIF) that is found in the first quarter (Q1). The fifth chapter summarizes the main results in the compilation of articles published in the main WOS collection, as well as their discussion and the main conclusions, contributions, and limitations of the universe of the study carried out with its methodological procedures.

¹ Business Strategy and Environment. Wiley (JIF 2023:12.5; JIF Rank Business: 5/304; JIF Quartile: Q1).

Journal of Cleaner Production. Elsevier (JIF 2023: 9.8; JIF Rank Environmental Sciences: 24/358; JIF Quartile: Q1)

CHAPTER 2. Personality Traits and Circular Business Models: Fostering Consumer Engagement with Circular Economy

Reference

Gomes, S. (2024). Personality traits and circular business models: Fostering consumer engagement with circular economy. *Business Strategy and the Environment*, 1–16. <https://doi.org/10.1002/bse.4057>

CHAPTER 2. PERSONALITY TRAITS AND CIRCULAR BUSINESS MODELS: FOSTERING CONSUMER ENGAGEMENT WITH CIRCULAR ECONOMY

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Purpose: Despite the growth of the circular economy in the last decade, consumer participation, particularly in circular business models, has still been little explored. Engaging consumers in the circular economy requires not only awareness but also a shift in behavior and mindset toward circularity. Based on the Meta-Theoretic Model of Motivation and Personality (3M Model), we explore the role of the big five personality traits as drivers of consumer engagement in a circular economy and their willingness to participate in the circular business model.

Methodology: To this end, we collected a sample of 489 Portuguese consumers, and the Partial Least Square method was applied to the formulated research model.

Findings: The results demonstrate that personality traits directly affect consumer engagement with the circular economy but not willingness to participate in the circular business model. Engaging with the circular economy in advance is necessary for consumers' personality traits to influence their willingness to participate in the circular business model. Furthermore, this association is stronger if consumers are women and young people.

Originality: This study contributes to the extension of the 3M Model to circular consumer behavior and the multidimensionality of the concept of consumer engagement. Furthermore, the results demonstrate that consumers' greater willingness to participate in a circular business model depends on their personality and engagement with the circular economy, allowing companies and policy-makers to adopt measures to promote the active role of the consumer in the circular economy.

Keywords: Big Five personality traits; consumer engagement; circular business model; circular economy; 3M Model.

1. Introduction

Climate change, the scarcity of natural resources, the compromise of future generations due to environmental damage, excessive consumption, and social and economic instability have changed how companies operate and led to reforming of their business models (Geissdoerfer et al., 2023). The transition from linear business models to environmentally friendly ones require changes in production and consumption systems, giving rise to circular business models (CBM) (Dey et al., 2022). According to data from the (Ellen Macarthur Foundation, 2021) adopting circular economy principles could increase 4.5 billion dollars in economic production by 2030 and create 18 million new jobs. These statistics demonstrate the potential benefits of transitioning to a circular economy, including economic growth, job creation, reduced greenhouse gas emissions, and achieving sustainability objectives.

Traditionally, studies on CBM focus on the behaviors of participants on the supply side (e.g. companies and institutions), neglecting the role of consumers (Gomes & Lopes, 2024; Lopes et al., 2023; Vidal-Ayuso et al., 2023). CBMs involve capturing, creating and delivering value in the circular economy (CE) (Elzinga et al., 2020). As such, we are concerned with the rational and efficient use of natural resources and the circularization of products, materials, and waste to avoid devastation and preserve and capture the greatest value (Reike et al., 2018). The growing concern about consumer behavior and its impact on the environment questions the need for their participation in CBM (Vidal-Ayuso et al., 2023b). Consumer participation must be transversal in CBM, involving themselves in all phases from “making”, “reducing”, “reusing”, “recycling” and “buying”.

To achieve this, consumers must participate in CBM because they feel that their attitudes can positively impact the environment and society in general (Patwa et al., 2021). Consequently, register sacrifices transferred with your environmental concerns and anticipate positive emotions from participation (Peronard & Ballantyne, 2019).

Another important perspective to understand the role of the consumer in the circular economy (CE), although still incipiently considered, is personality traits (Kutaula et al., 2022). Personality is a primary psychological mechanism that coordinates actions at the cognitive level, as well as emotional and behavioral aspects of humans (Halder et al., 2010). In recent years, multiple perspectives and relationships based on individuals' personalities have emerged (Khatri et al., 2022). More recent studies have related the personality traits measured by the big-five model to ecological issues, namely environmental concerns (Tran & Paparoidamis, 2021) and green attitudes and intentions (Dalvi-Esfahani et al., 2020).

In this context, we can identify some gaps in the existing research that motivated our study, which were systematized. First, the responsibility for implementing the circular economy does not lie solely with companies. As such, the focus must involve consumers, their role being minimized when most studies only address factors related to their circular consumption behavior (Gomes & Lopes, 2024; Lopes et al., 2023; Vidal-Ayuso et al., 2023). Second, CBMs must be built based on inputs from various stakeholders (and not just on the decision made by the management of companies to transform linear business models), and consumers are one of the most important agents in these processes, given their importance to the business. Third, knowledge of consumer behavior is vital since greater consumer engagement with the circular economy may involve behaviors that

change their daily routines and lifestyles. Consumer engagement with the circular economy will be a prerequisite for active CBM participation. Still, until now this behavior has mainly been studied in terms of motivations for circular purchasing intention, which is very reductive (Camacho-Otero et al., 2018). Fourth, consumers are agents of circular economy processes but must be aware and motivated to participate actively. Few studies still explore the influence of consumers' personality traits on circular behaviors and seek to understand the compelling motivation of these consumers (Kutaula et al., 2022). Existing studies do not explicitly address how consumer behavior in the circular economy is influenced by their personality, which translates into behavioral and emotional aspects.

To address these gaps identified in the literature, this study explores the factors influencing consumer participation in CBM. Specifically, the role of the big five personality traits as drivers of consumer engagement with the CE and their willingness to participate in CBM was explored. To this end, the association between consumers' personality traits, engagement with the CE, willingness to participate in CBM, and demographic factors was explored. Thus, three research questions were formulated: i) How does each Big Five personality trait affects consumer engagement with the CE? ii) How does consumer engagement with the CE influence their willingness to participate in CBM? iii) What is the moderating role of the demographic characteristics of gender and age in the association between consumer engagement with the CE and their participation in CBM?

This study makes several contributions. First, it approached CE and CBM from the demand side, that is, from consumers, unlike most studies (Mostaghel & Chirumalla, 2021). Secondly, under the theoretical framework Metatheoretical

Model of Motivation and Personality (3M Model), personality traits were directly associated, in a hierarchical way, with consumer behavior in CE and their availability to participate in CBM. This result extended the 3M Model to CE, which had never been applied to CE in this context. Specifically, the personality traits that most motivated consumer involvement with CE and their participation in CBM were identified, allowing us to demonstrate that in circular behavior, there is a hierarchical organization of personality traits that distinctly influence consumers' actions. We also demonstrated that personality traits had a latent effect on consumer behavior in the CE. Studies that have considered personality traits in the context of sustainability and circularity focus on their indirect impact on consumer behavior (e.g., purchase intention) and not as explanations of their effective participation in CE. Third, we contribute to conceptualizing consumer engagement, a multidimensional concept intrinsically associated with consumer behavior, particularly consumer attitudes and actions. However, very little has been used in CE (Camacho-Otero et al., 2020). The results of this study showed that consumer participation in CBM requires consumer involvement with CE, expanding the application of this concept and its measurement method. Fourth, the use of demographic factors as moderators of the association between consumer involvement with CE and willingness to participate in CBM demonstrated that women and younger consumers are those with greater involvement with CE and, as such, are more willing to participate in CBM. Therefore, companies have an important role in raising awareness about CE among this group of consumers. Fifth, the results demonstrated that consumers' greater willingness to participate in a circular business model depends on their personality traits and involvement with the circular economy. This allows companies and policymakers to adopt specific measures to give consumers an active role in the circular economy.

2. Theoretical framework

As the objective of the study and to answer the research questions, the Meta-Theoretic Model of Motivation and Personality (3M Model) was considered a theoretical framework to understand how personality traits affect behaviors (Mowen, 2000) of consumers in terms of engagement with the CE and willingness to participate in the CBM.

The 3M Model “integrates diverse psychological theories and consumer behavior constructs into a coherent general theory of motivation and personality that more parsimoniously explains a broad set of phenomena” (Mowen, 2000, p.6). This way, it provides a framework of personality traits for guiding consumer actions and behaviors (Mowen, 2000). This model comprises four theoretical approaches: i) control theory; ii) evolutionary psychology; iii) hierarchical models of personality, and iv) trait theories of personality. Hierarchical personality models assume that personality traits diverge but that, through control theory, these traits are structured in such a way that they result in goals, emotions, and behaviors (Schneider & Vogt, 2012).

This theoretical framework presupposes a hierarchical organization of personality traits at four levels (in ascending order: elementary, compound, situational, and superficial), with the lowest level containing personality traits that predict behaviors similar to personality traits, which are higher levels in this hierarchical organization (Mowen, 2000). Thus, at the lowest level, we have the personality traits of agreeableness and conscientiousness, considered genetic and learned very early. These traits can be a reference for our study for consumers to engage more with CE because they are more “warm” and “aware”. Composite traits involve task or activity orientation, combining several personality traits from the previous level, and resulting from learning and

cultural context (Mowen, 2000). These traits can lead the individual, for example, to adopt habits of circularity in their daily lives for a prolonged period and even enjoy some boredom from these habits. At the third level, we have situational traits triggered by individuals' context, namely value consciousness (Mowen, 2000). Circular consumption may imply that individuals are willing to pay more for products if there is a good cost-benefit ratio, which may be environmental. Finally, at the fourth level, superficial traits are the most tangible and result from interaction with traits from other levels. For example, greater engagement with CE could be triggered by greater awareness of climate change, resulting in the composite personality trait of recognition, boosting the composite trait of environmental value recognition and encouraging consumers to engage more with CE practices and CBMs. Despite the complexity of this theory, the fact that personality traits are not all at the same level to explain consumer behavior is based on the assumptions of the 3 M Model.

Thus, in the context of the association between personality traits and CE, the value of the 3M Model focuses on identifying personality traits as sources of motivation for consumer engagement with CE and participation in CBM. This process focuses on considering that these consumer behaviors result from an expression of personality and, as such, personality traits have a latent power of action manifested through attitudes and behaviors, not linearly, but hierarchically. This process is relevant to the study since we assume that consumer engagement behavior and participation in the CE are variable, reflecting different personality traits and behaviors.

3. Literature review

3.1. Big Five personality traits as a driver to consumer engagement with CE and the willingness to participate in the CBM

In the 80s, Goldberg (1981) proposed the five-factor structure called the Big Five, which encompasses individuals' most significant personality traits: conscientiousness, extraversion, agreeableness, neuroticism and openness to experience. Personality traits are personal characteristics that differentiate individuals from each other and are commonly used to explain their behavior and decision-making (Poškus & Žukauskienė, 2017). As personality traits involve feelings, thoughts, attitudes, and behaviors, they can also be used to explain consumer behavior (Barrera & Ponce, 2021; Khatri et al., 2022), particularly in CE. However, only a few more recent studies have addressed the relationship between the Big Five and sustainable consumer behavior (e.g., Duong, 2022; Gustavsen & Hegnes, 2020; Lu et al., 2015; Sun et al., 2018) and there are even fewer studies that relate personality traits and consumer behavior in CE (Kutaula et al., 2022).

Consumer behavior studies have evolved over time, particularly at the CE level (Shevchenko et al., 2023; Islam et al., 2021; Santos-Corrada et al., 2024). However, consumer engagement with CBM is still not addressed, as consumer behavior patterns result from different attitudes in which individuals engage (Camacho-Otero et al., 2020). Although there is not yet a consensual definition for consumer engagement given its multidimensionality, it can be argued that it is a motivational and relational state since it encompasses cognitive, emotional activities and behavioral attitudes that can occur between two agents, one of which is the consumer and another agent (e.g., system, model, company or brand) (Bilro & Loureiro, 2020). In our study, the consumer engagement with the

CE construct was measured by the positive anticipated emotion of participating in the CE, the willingness to sacrifice for the environment and the consumer's attitude towards the CE. Positive anticipated emotion is a positive anticipation of a specific behavior that can trigger a decision or other behaviors (Kotabe et al., 2019). Previous studies have considered positive anticipated emotions to explain consumer engagement with environmental issues (Odou & Schill, 2020; Schneider et al., 2021; Kim et al., 2016). Thus, individual choices to participate in CE are made based on utility, subjective happiness, and the expectation of experiencing positive feelings. Positive emotions affect the choices of participation in the CE, increasing consumer engagement to benefit the environment and generate positive expectations (Hao et al., 2020). The willingness to sacrifice for the environment refers to the intensity by which consumers are willing to sacrifice themselves in favor of the environment (Agag, 2019). The intention to change conventional individual behavior to circular behavior depends on consumers' willingness to sacrifice themselves in favor of the environment (Haring, 2013), influencing their engagement and willingness to participate in CBM (Hao et al. 2020). Finally, consumers' attitudes toward CE can be defined as the behavioral intentions and individual beliefs about circularity issues (Vidal-Ayuso et al., 2023). Personal attitude determines consumers' behavioral intention to participate in CE (Hao et al., 2020; Henao-Hincapié et al., 2024).

3.2. Main hypothesized paths

Extraversion describes the extroverted personality of individuals and manifests itself in their assertiveness, dominance, energy, enthusiasm, and socialization (Zhao & Seibert, 2006). Extroverted individuals are more likely to be active actors as they are more likely to express their opinions when they observe

errant behavior (Moisuc et al., 2018). According to Itani et al. (2020), the more extroverted consumers are, the more they are likely to engage with service firms. Previous studies have demonstrated a positive influence of extroverted individuals on societal concerns, specifically being more ecological consumers, and adopting sustainable attitudes and behaviors, which are important in CE contexts (Kim & Han, 2018; Soutter et al., 2020). Furthermore, extraversion is positively associated with environmental engagement, manifesting through self-expression, personal environmental sacrifice, and subjective well-being (Hopwood et al., 2022; Milfont & Sibley, 2012). Greater concern for the environment and more pro-ecological attitudes drives participation in CBM (Bäro et al., 2022; Wang et al., 2021). Therefore, from the positive association between higher levels of extraversion and environmental engagement, we can deduce that the behavior will be similar to CE practices. As such, more extroverted, energetic, enthusiastic, and friendly consumers will tend to exhibit greater engagement with CE and, as such, greater willingness to participate in CBM.

H1a: Consumers characterized by high extroversion levels are likelier to exhibit high engagement levels with CE.

H2a: Consumers characterized by high levels of extroversion are more likely to exhibit high levels of willingness to participate in CBM.

H3a: Consumers characterized by high levels of extroversion are more likely to exhibit high levels of willingness to participate in CBM when mediated by their engagement with the CE.

Conscientiousness describes a personality prone to self-discipline, determination, organization, obligations, attention to detail and responsibility (McCrae & Costa, 1985). Higher levels of conscientiousness lead individuals to think more

frequently about their future (Kvasova, 2015) and to find it easier to detect severe environmental problems because they have more ecological interests and are more concerned about the consequences of their actions on society and the environment (Kutaula et al., 2022; Sun et al., 2018). They believe climate change is real (Hopwood et al., 2022). In this way, they act to correct problems in favor of a more sustainable environment, as they tend to have higher moral standards and behave more honestly (Van Scotter & Roglio, 2020). Previous studies have shown that individuals with higher levels of conscientiousness have greater environmental engagement (Kvasova, 2015; Milfont & Sibley, 2012). Song and Kim (2018) also found a positive relationship between conscientiousness and circular behaviors, particularly regarding reducing socially responsible purchases and product disposal. According to Kutaula et al. (2022), conscientious consumers tend to value recyclable and ecological packaging and reduce unnecessary packaging and single-use plastic (e.g., beauty products). Soutter et al. (2020) demonstrated that more conscious individuals have a positive and consistent relationship with sustainable attitudes and behaviors. Therefore, they are more willing to make personal environmental sacrifices such as greater recycling efforts and preferring public transport to private transport, demonstrating, as such, greater engagement with the CE (Hopwood et al., 2022).

This author also concluded that conscientiousness is the greatest predictor of sustainable attitudes and behaviors. In this way, individuals with higher conscientiousness tend to be more aware of environmental problems and climate change and to act to correct these problems, such as valuing circular economy practices (recycling, reducing plastic, reducing purchases, and sustainable mobility, among others). Furthermore, conscientiousness is one of the main personality traits (in addition to Agreeableness and Openness) related to environmental engagement (Milfont & Sibley, 2012). Therefore, based on this

knowledge, we can conclude that more conscientious individuals will tend to exhibit greater engagement with CE and greater willingness to participate in CBM.

H1b: Consumers characterized by high conscientiousness levels are likelier to exhibit high engagement levels with CE.

H2b: Consumers characterized by high levels of conscientiousness are more likely to exhibit high levels of willingness to participate in CBM.

H3b: Consumers characterized by high levels of conscientiousness are more likely to exhibit a high willingness to participate in CBM when mediated by their engagement with CE.

Agreeableness is the personality trait that describes individuals who are motivated, generous, empathetic, confident, in social harmony, with compassion for others and attentive to general well-being (Dalvi-Esfahani et al., 2020; McCrae & Costa, 1985). They like helping others and being cooperative, relaxed, supportive and kind (Duong, 2021). Concern for others motivates the desire to benefit society through individual actions, particularly environmental ones (Wang et al., 2021). Being considered correct citizens, they are likelier to engage in favorable environmental behaviors (Sun et al., 2018). Previous studies have demonstrated a positive relationship between agreeableness and pro-environmental behaviors, namely attitudes toward green products (Sun et al., 2021; Wang et al., 2021). Thus, individuals with more agreeableness care more about others, are more aware of climate change (Hopwood et al., 2022), and are motivated toward more pro-environmental behaviors and attitudes (Stieger et al., 2018). In this way, they are more willing to make personal sacrifices for the environment (Ferguson et al., 2019). The study by Zhao (2023) also demonstrated that individuals with higher agreeableness tend to highlight more

individual waste-sorting behavior, and the study by Duong (2022) showed a positive relationship between agreeableness and pro-sustainable consumption. Agreeableness is one of the main personality traits associated with environmental engagement (Milfont & Sibley, 2012). In this way, individuals with higher levels of agreeableness are more concerned about the environment and climate change and, therefore, tend to act individually in favor of the well-being of society, being available to make sacrifices in favor of the environment. This behavior tends to be socially promoted, encouraged and appreciated and can be conducive to agreeableness others. Being agreeable to others is an assumption rooted in an agreeableness personality. Therefore, based on the characterization of individuals with higher levels of agreeableness and the literature that links this personality trait to environmental engagement, we suggest that agreeableness increases consumers' engagement with the CE and greater willingness to participate in CBM.

H1c: Consumers characterized by high levels of agreeableness are likelier to exhibit high engagement levels with CE.

H2c: Consumers characterized by high levels of agreeableness are likelier to exhibit high willingness to participate in CBM.

H3c: Consumers characterized by high levels of agreeableness are more likely to exhibit high levels of willingness to participate in CBM, when mediated by their engagement with CE.

Openness to experience is the personality trait held by imaginative, open-minded, curious, intelligent and change-prone individuals (McCrae & Costa, 1985). Individuals with higher levels of openness tend to be more tolerant and universalistic, open to diverse and different experiences (Kvasova, 2015). Tolerance and universality lead to greater concern for the well-being of others to

the detriment of oneself. This concern extends to the environment (Hopwood et al., 2022). Previous studies have demonstrated that openness positively influenced pro-environmental behaviors (Hopwood et al., 2022; Sun et al., 2018) and attitudes and intentions towards environmentally friendly behaviors (Markowitz et al., 2012). Thus, individuals with openness to experience tend to adhere to pro-environmental initiatives involving green consumption behaviors (Duong, 2022). Song and Kim (2018) identified a positive relationship between openness and CE practices such as socially responsible purchasing and disposal. As open individuals are more likely to accept new things and make changes, they are more willing to make positive changes to their recycling habits and save energy (Sijtsema et al., 2020), positively affecting consumers' e-waste recycling intention (Bhutto et al., 2023), linking openness to experience to CE. In this way, individuals with greater openness to experience, tend to be more available to participate in CE, given their concern about climate change (Hopwood et al., 2022) and their propensity to have pro-environmental behaviors and attitudes. The empirical study by Milfont and Sibley (2012) demonstrated that openness (in addition to agreeableness and conscientiousness) is one of the main personality traits associated with environmental engagement. In this way, individuals with higher levels of openness to experience tend to adopt environmentally responsible behaviors and CE practices such as responsible purchasing, recycling and disposal. This behavior tends to be socially valued and encouraged to contribute to the well-being of society to the detriment of individual well-being, which is characteristic of individuals with higher levels of openness. Thus, considering the behaviors of individuals with higher levels of openness and the studies mentioned, we suggest that consumers with higher levels of transparency will tend to exhibit greater engagement with the CE and, as such, greater willingness to participate in CBM.

H1d: Consumers characterized by high levels of openness to experience are likelier to exhibit high engagement levels with CE.

H2d: Consumers characterized by high levels of openness to experience are likelier to exhibit a high willingness to participate in CBM.

H3d: Consumers characterized by high levels of openness to experience are more likely to exhibit high willingness to participate in CBM, when mediated by their engagement with CE.

Neuroticism reflects the personality of individuals who experience emotional instability and negative feelings such as anxiety, depression, anxiety, suffering, worry, boredom, and fear (McCrae & Costa, 1985). As they show unstable and inconsistent behavior, neurotic consumers tend to avoid ethical standards and not be concerned about the well-being of society (Kutaula et al., 2022). Unlike individuals with higher levels of extraversion, neuroticists are passive agents due to a lack of self-esteem and low assertiveness. As such, they tend to be less concerned about climate change and value the environment less (Hopwood et al., 2022). Recent studies have demonstrated a negative relationship between neuroticism and pro-environmental behavior (Akhtar, 2022) and environmental concern (Wang et al., 2021). Due to high levels of vulnerability, anger and anxiety, neurotic individuals show less environmental engagement (Milfont & Sibley, 2012). According to Bhutto et al. (2023) emotionally unstable consumers who are worried and easily upset may be reluctant to adopt CE practices such as e-waste recycling. Considering the literature above, consumers with high levels of neuroticism tend to be more concerned about their well-being, distancing themselves from society. As such, they focus less on the negative consequences of their behavior and tend to express less environmental suffering resulting from ecological damage. Given their personality characteristics, individuals with higher

levels of neuroticism tend to show less engagement with CE and less willingness to participate in CBM.

H1e: Consumers characterized by high levels of neuroticism are less likely to exhibit high levels of engagement with CE.

H2e: Consumers characterized by high levels of neuroticism are less likely to exhibit a high willingness to participate in CBM.

H3e: Consumers characterized by high levels of neuroticism are less likely to exhibit a high willingness to participate in CBM when mediated by their engagement with CE.

Consumer engagement is a comprehensive concept as it involves a mental process (e.g. cognitive aspects) but also an emotional one (e.g., satisfaction, empathy), leading to a significant association with a product, service, brand, or idea (Giakoumaki & Krepapa, 2020). Consumer engagement has been widely studied in the marketing area, particularly about online brand communities, seeking to explore antecedents and consequences of online customer engagement and its impact on purchase intention (Hollebeek & Solem, 2017; Islam et al., 2017a; Rasool et al., 2020), namely the influence of personality traits on consumer engagement to motivate purchasing behavior (Islam et al., 2017b; Itani et al., 2020), in impact on loyalty and revisit intention to a brand or company (Rasool et al., 2023) on consumer behaviors in individualistic and collectivist markets (Roy et al., 2018), among others. However, consumer involvement with the circular economy is still very little addressed and, as far as we know, there is no literature on CBMs (Camacho-Otero et al., 2020).

The mentality of consumers will influence their participation in CBM (Gomes et al., 2022), leading them to prefer purchasing circular products (Calvo-Porrall & Lévy-Mangin, 2020), valuing the recirculation of materials (Zeeuw van der Laan &

Auricchio, 2019) resisting disposal (Haines-Gadd et al., 2018) and appreciating products with multiple functionalities (Kasulaitis et al., 2021). The association of consumer engagement with CE and CBM can also be manifested in some behaviors, such as the purchase of recycled, reconditioned and remanufactured products (Baier et al., 2020), leading to consumer participation in different phases of the circularization system. from pre-acquisition with reduced consumption to post-use with reuse of the product (Gomes et al., 2022).

H4: Consumers characterized by high levels of engagement with CE are more likely to exhibit high levels of willingness to participate in CBM.

3.3. Moderating hypotheses

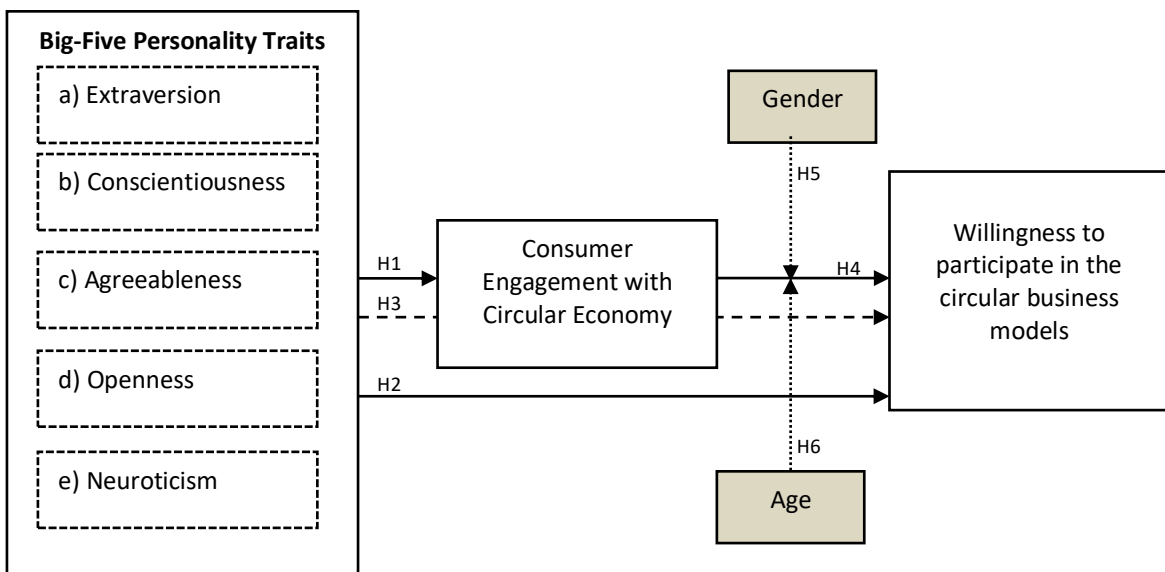
The role of gender in consumer behavior in the CE has been addressed in several studies (e.g. Kutaula et al., 2022; Enciso-Alfaro & García-Sánchez, 2024). Understanding environmental threats and implementing strategic environmental changes has revealed that women are more concerned about climate change than men (Ali et al., 2022). Women are associated with greater environmental concerns and circular behaviors and habits due to their central role in managing family life. As such, women play a more active and empathetic role than men in climate issues, being aware of the consequences that their behaviors can lead to (Shang & Pelozo, 2016). Gender, as a moderator of the relationship between environmental beliefs and the adoption of CE, demonstrated that this relationship is more intense in the case of women (Ali et al., 2022). Women's personality traits, environmental sensitivity and permeability when adopting CE practices (Nadeem et al., 2020) can lead to greater engagement with CE and willingness to participate in CBM.

H5: The association between consumers' engagement with CE and their willingness to participate in CBM is stronger for female consumers.

Previous studies have shown that younger consumers tend to be more aware of environmental problems, reflected in their behavior, particularly in consumption (Casalegno et al., 2022; Ham et al., 2022). Age plays a fundamental role in the perception of environmental and social issues. The younger the consumers, the more likely they will buy more sustainable products. Furthermore, the greater propensity to adopt pro-environmental behaviors, namely circular habits, leads to consumers being more predisposed to participate and get involved with CE and, consequently, with the CBM (Testa et al., 2020).

H6: The association between consumers' engagement with CE and their willingness to participate in CBM is stronger for younger consumers.

The research model and formulated hypotheses are shown in Figure 1.



Note: Direct Effects (→) and mediating effects (→)

Figure 2.1: Search model

4. Methods

4.1. Sample and data measurement

The sample for this study was collected between October and December 2023 through an online questionnaire, the link to which was published on the authors' social and contact networks. The sample was obtained by convenience, being non-probabilistic. Informed consent was obtained from all participants, and the questionnaire was anonymous. The participation criterion was being over 18 years old and living in Portugal for over six months. A pre-test was carried out with 15 participants with different sociodemographic characteristics, demonstrating that the participants had no difficulties in understanding the questions, and the average response time was 5 minutes. We received a total of 489 valid responses.

Regarding the sociodemographic characterization of the participants, 52% were female, and 48% were male. The average age is 35.8 years old, with 36% aged between 18 and 30 years old, 26% between 30 and 35 years old, 14% between 35 and 45 years old and 24% over 45 years old. Regarding education, 19.6% have at most secondary education, and 80.4% have completed tertiary education.

The questionnaire consists of three groups of questions (Appendix A.1.). The first group relates to the Big Five Personality Traits, whose scale was adapted from Nunes et al. (2018). These authors tested the Portuguese Ten-Item Personality Inventory (TIPI), a reduced version of the personality trait scale developed by Gosling et al. (2003) The motivation for choosing this scale results from the fact that it only includes ten items (two items for each personality trait) and has been successfully tested on Portuguese adults, having demonstrated that it is a reliable and valid alternative, especially in a research context with limited time,

such as the questionnaire in this study. The second group is related to consumer engagement with the CE, which was measured by ten items grouped into three dimensions: i) positive emotions anticipated by the consumer's participation in the CE (three items) adapted from Hao et al. (2020); ii) consumer sacrifice in favor of the environment (three items) also adapted from Hao et al. (2020); and consumer attitude towards the CE (four items) adapted from Mostaghel and Chirumalla (2021). The third group of questions related to the willingness of consumers to participate in CBM was measured by six items adapted from Hao et al. (2020). All items were measured on a 5-point Likert agreement scale, with 1 – completely disagree and 5 – completely agree.

4.2. Data Analysis

Firstly, a statistical analysis of the items that measured the constructs presented in the research model was conducted using SPSS (V. 29) software. Afterward, a factor analysis was carried out, with an Exploratory Factor Analysis (EFA) being implemented to divide the items by factors and evaluate the accumulated and individual variance of the factors and a Confirmatory Factor Analysis (CFA) to evaluate the confirmatory factor loads of each item and the reflective nature of the model. Then, the Partial Least Square (PLS) method was applied to the research model using Smart PLS (V. 4.0). The PLS method combines factor analysis with linear regressions estimated by the Ordinary Least Square method. It is a deterministic analysis technique that seeks to observe the covariances of one or more independent variables on a dependent variable (Hair et al., 2022). This method has been commonly used in studies on consumer behavior in the CE (e.g., Chao & Yu, 2023; Gomes & Lopes, 2024). The model obtained was evaluated regarding reliability, convergence, and discriminant validity. To this end, the measures proposed by Hair et al. (2022): (i) Cronbach's Alpha ($C\alpha >$

0.70); (ii) Composite reliability (CR > 0.70); (iii) Average Variance Extracted (AVE > 0.5) and (iv) discriminant validity tested by the heterotrait-monotrait ratio of correlations (HTMT) criterion. The good fit of the model, the existence of collinearity problems, the predictive relevance of the model and the explanatory power of the constructs were also assessed. Finally, to test the relationships established in the research model, a bootstrapping analysis was carried out in Smart PLS (V. 4.0).

5. Results

5.1. Statistical description of items

Table 1 shows the mean and standard deviation of the items that measure the constructs. Regarding personality traits, neuroticism (M = 3.58) and extraversion (M = 3.32) were those that, on average, generated the greatest agreement. Participants agreed, on average, with the constructs that measured consumer engagement with the CE (M = 3.47), with consumer attitude being the construct that generated the greatest agreement (M = 3.65) and also with the items that measure willingness to participate in CBM (M = 3.38).

Table 2.1. Statistical description of the items that measure the constructs

	MEAN	STD. DEVIATION
Big Five Personality Traits		
Extraversion (EXT)	3,32	1,117
Ext1	3,51	1,059
Ext2	3,13	1,174
Conscientiousness (CONS)	3,18	0,992
CONS1	3,93	0,86
CONS2	2,43	1,124
Agreeableness (AGREE)	2,98	0,918
AGREE1	1,98	0,975
AGREE2	3,97	0,860

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Openness (OPEN)	3,29	0,959
OPEN1	4,01	0,828
OPEN2	2,56	1,09
Neuroticism (NEURO)	3,58	1,043
NEURO1	3,76	1,069
NEURO2	3,39	1,017
Consumer Engagement (CE)	3,47	0,952
Consumer Attitude	3,65	0,913
ATT1	3,65	0,888
ATT2	3,54	0,918
ATT3	3,57	0,882
ATT4	3,85	0,962
Positive Emotions Anticipated	3,43	0,954
EMO1	3,31	0,98
EMO2	3,50	0,956
EMO3	3,48	0,927
Consumer Sacrifice	3,34	0,988
SACR1	3,03	1,049
SACR2	3,65	0,955
SACR3	3,34	0,96
Willingness to participate CBM (WP)	3,38	0,896
WP1	3,19	0,96
WP2	3,09	0,999
WP3	3,08	0,947
WP4	3,57	0,817
WP5	3,76	0,774
WP6	3,57	0,878

5.2. Factor Analysis

The results EFA and CFA implementation are included in Appendix A.2. Regarding EFA, the items were divided into seven factors according to the constructs presented in the research model. All items have high commonalities (>0.70), and the accumulated variance of the factors is 71.61%. No individual factor presents

a variance greater than 50%. The results of the CFA implementation reveal that all items have high confirmatory factor loads (> 0.70), and the reflective nature of the research model was confirmed.

5.3. Assessment of the measurement model

The model obtained after applying the PLS algorithm to the research model was evaluated according to the criteria proposed by (Hair et al., 2022) as shown in Table 2. Thus, the model is convergent and realistic since the coefficients obtained for Cronbach's Alpha ($C\alpha > 0.70$), Composite reliability ($CR > 0.70$), and AVE ($AVE > 0.5$) are higher than those reference values presented by Hair et al. (2022). Furthermore, discriminant validity exists between two reflectively measured constructs tested by the HTMT criterion (< 0.90).

Table 2.2: Convergence, reliability and discriminant validity

	$C\alpha$	CR	AVE	EXT	CONS	AGREE	OPEN	NEURO	CE	WP
Extraversion (EXT)	0.792	0.724	0.582							
Conscientiousness (CONS)	0.786	0.762	0.530	0.420						
Agreeableness (AGREE)	0.706	0.776	0.539	0.562	0.474					
Openness (OPEN)	0.822	0.721	0.562	0.427	0.470	0.523				
Neuroticism (NEURO)	0.779	0.741	0.538	0.383	0.558	0.401	0.427			
Consumer Engagement (CE)	0.909	0.925	0.556	0.186	0.195	0.432	0.249	0.326		
Willingness to participate CBM (WP)	0.836	0.878	0.549	0.211	0.260	0.334	0.290	0.269	0.505	

The model fit was also evaluated according to the criteria reported by Hair et al. (2022). The model presents a good fit considering the values obtained for the Chi-Square ($p = 0.087$), Goodness-of-Fit (0.965), the Comparative Fit Index (0.843), and Standard Root Mean Square Residual (0.093). Table 3 also contains the results of the coefficient of determination (R^2) and predictive relevance

(Stone-Geisser - Q^2) based on the cross-validated redundancy approach. The dependent variables, consumer engagement and willingness to participate in CBM have a substantial effect according to Cohen's (1988) criterion. The model has predictive relevance since the Q^2 coefficients are greater than zero.

Table 2.3: Predictive relevance and coefficient of determination

	R ²	Q ²
Consumer Engagement (CE)	0.310	0.160
Willingness to participate CBM (WP)	0.699	0.370

5.4. Estimation of research model relationships

Tables 4 and 5 contain the results of the estimations of the relationships established between constructs in the research model after implementing the bootstrapping analysis.

Table 2.4: Direct and mediating effects between constructs

	β	T Statistics	P Values	Confidence Interval		Hypothesis Support
				2.5%	97.5%	
H1a: Extraversion → Consumer Engagement	0.144	2.905	0.004	0.043	0.237	Yes
H2a: Extraversion → Willingness to participate CBM	0.059	2.216	0.127	0.077	0.261	No
H3a: Extraversion → Consumer Engagement → Willingness to participate	0.118	2.948	0.003	0.036	0.192	Yes
H1b: Conscientiousness → Consumer Engagement	0.148	1.118	0.004	0.053	0.153	Yes
H2b: Conscientiousness → Willingness to participate CBM	0.015	0.471	0.638	-0.078	0.082	No
H3b: Conscientiousness → Consumer Engagement → Willingness to participate in CBM	0.139	1.116	0.001	0.042	0.142	Yes
H1c: Agreeableness → Consumer Engagement	0.106	1.737	0.003	-0.027	0.198	Yes
H2c: Agreeableness → Willingness to participate CBM	0.035	1.191	0.234	-0.056	0.130	No

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H3c: Agreeableness → Consumer Engagement → Willingness to participate CBM	0.086	1.733	0.004	-0.022	0.159	Yes
H1d: Openness → Consumer Engagement	0.150	2.942	0.003	0.049	0.248	Yes
H2d: Openness → Willingness to participate CBM	0.069	2.230	0.126	0.104	0.276	No
H3d: Openness → Consumer Engagement → Willingness to participate CBM	0.122	2.952	0.003	0.040	0.202	Yes
H1e: Neuroticism → Consumer Engagement	-0.110	2.128	0.034	-0.118	0.107	Yes
H2e: Neuroticism → Willingness to participate CBM	0.037	1.302	0.194	-0.025	0.163	No
H3e: Neuroticism → Consumer Engagement → Willingness to participate CBM	-0.090	2.122	0.034	-0.115	0.170	Yes
H4: Consumer Engagement → Willingness to participate CBM	0.816	42.371	0.000	0.775	0.850	Yes

The results reveal that the personality traits extraversion, conscientiousness, agreeableness, and openness to experience affect consumer engagement with CE. Still, they are not significant in directly influencing the willingness of consumers to participate in CBM. This way, hypotheses H1a to H1e are confirmed, and hypotheses H2a to H2e are rejected. Personality traits do not uniformly affect consumer engagement. Thus, consumers who show higher levels of engagement with the CE are those characterized by high levels of openness to experience ($\beta = 0.150$), followed by conscientiousness ($\beta = 0.148$), extraversion ($\beta = 0.144$) and agreeableness ($\beta = 0.106$), as well as lower levels of neuroticism ($\beta = -0.110$). However, personality traits affect consumers' willingness to participate in CBM when mediated by consumer engagement with the CE, confirming hypotheses H3a and H3e. Furthermore, consumer engagement with the circular economy positively and significantly affects consumers' willingness to participate in CBM ($\beta = 0.816$), confirming hypothesis H4.

Table 5 contains the results of the moderating effect of gender and age on the association between consumer engagement with CE and willingness to consumer participate in CBM. The results reveal that this relationship is stronger for female consumers ($\beta = 0.67$) and younger consumers ($\beta = 0.45$), confirming hypotheses H5 and H6.

Table 2.5: Moderating effects

Main effect	Hypothesized moderating effect	Female consumer	Male consumer
<i>Gender as moderator</i>			
Consumer Engagement → Willingness to participate in CBM	H5: The association between consumers engagement with circular economy and their willingness to participate in circular business models is stronger for female consumers.	$\beta = 0.67$ $t = 5.877$ $\rho = 0.002$	$\beta = 0.52$ $t = 4.236$ $\rho = 0.003$
<i>Age as moderator</i>			
Consumer Engagement → Willingness to participate in CBM	H6: The association between consumers engagement with circular economy and their willingness to participate in circular business models is stronger for younger consumers.	$\beta = 0.45$ $t = 3.112$ $\rho = 0.001$	$\beta = 0.38$ $t = 2.656$ $\rho = 0.001$

6. Discussion and Implications

The role of the consumer as an active agent in CE and CBM continues to be undervalued (Gomes & Lopes 2024; Lopes et al., 2023). A better understanding of consumers and engagement with the CE is essential to encourage their participation in CBM and their active cooperation. This study aims to evaluate the influence of big-five personality traits on consumer engagement with CE and

willingness to participate in CBM.

The results reveal new contributions. First, four personality traits (openness to experience, conscientiousness, extraversion, and agreeableness) positively affect consumer engagement with CE, and the neuroticism personality trait negatively affects it, thus answering the first research question and confirming all the hypotheses H1. To our knowledge, this is the first study to obtain empirical results on the influence of big-five personality traits on consumer engagement with the CE. In this way, the results demonstrate that the fact that personality traits involve feelings, thoughts, and attitudes can be explanatory of consumer behaviors, particularly in CE (Barrera & Ponce, 2021), theoretically substantiating the 3M Model framework in this study. According to the assumptions of the 3M model, personality traits are distributed across four hierarchical levels, from elementary to superficial, with personality traits at the highest levels of the hierarchy resulting from interaction with personality traits in lower hierarchical levels. As the results demonstrated, consumer personality traits differed, resulting in different personality combinations and influencing consumer engagement with CE and their willingness to participate in CBM. Thus, consumers with an extroverted personality tend to show greater environmental engagement due to the propensity for environmental sacrifice and the appreciation of subjective well-being (Hopwood et al., 2022). Conscientious consumers prone to self-discipline and concerned about the environmental consequences of their actions (Van Scotter & Roglio, 2020) tend to value CE practices such as recycling, reducing and minimizing plastic (Kutaula et al., 2022). Consumers with higher levels of agreeableness and openness to experience tend to be motivated, confident and open to change, valuing pro-environmental behaviors (Wang et al., 2021) and being more aware of the consequences of climate change (Hopwood et al., 2022). On the other hand, consumers with high

levels of neuroticism are emotionally unstable and passive agents, valuing their actions on the environment less (Akhtar, 2022) and, as such, less involved with CE.

Second, the results demonstrated that personality traits were not statistically significant in directly affecting the willingness of consumers to participate in CBM, rejecting all hypotheses H2. However, when this relationship is mediated by consumer engagement with the circular economy, personality traits affect their willingness to participate in CBM, confirming all the hypotheses H3. In this way, we can conclude that consumers' personality as a primary psychological mechanism coordinates actions at an emotional and cognitive level (Halder et al., 2010), but individual choices to participate in CBM are made based on subjective happiness and expectations of well-being (Hao et al., 2020). Thus, they depend on the attitudes and willingness of consumers to sacrifice themselves in favor of the environment (Vidal-Ayuso et al., 2023) and consumers need to first experience engagement with the CE.

Third, the results demonstrated that consumer engagement with CE positively and significantly affects their willingness to participate in CBM, answering the second research question of this study and confirming all the hypotheses H4. The consumer was measured by the positive anticipated emotion of participating in the CE, the willingness to sacrifice for the environment and the consumer's attitude towards the CE. Previous studies have already used positive anticipated emotion to explain consumer engagement in environmental issues (Odou & Schill, 2020). The sacrifice in favor of the environment (Agag, 2019) influences the intensity of the adoption of circular behaviors (Hao et al., 2020) and the attitude of consumers is one of the determinants of their behavioral intention to participate in CE (Henao-Hincapié et al., 2024).

Fourth, it was found that the relationship between consumer engagement with the CE and their willingness to participate in CBM is more intense if consumers are women and young, answering the third research question and confirming hypotheses H5 and H6. It confirms that, women are more predisposed to participate in CE due to their more active and empathetic role in environmental problems, (Nadeem et al., 2020). Like younger consumers, who tend to become more involved in CE actions due to their greater propensity to adopt pro-environmental behaviors (Casalegno et al., 2022) and adopt circular habits (Testa et al., 2020).

6.1. Theoretical implications

The results of this study expand the existing theoretical knowledge about consumer participation in the CE, which is still considered incipient (Shevchenko et al., 2023). We demonstrate that it is possible to extend the theoretical assumptions of the 3M Model to consumer behavior in CE, with most existing research on this topic focusing on the theoretical framework of the Theory of Planning Behavior (TPB), not considering the important role of personality in consumer behavior. As the results demonstrated, consumers' personality traits diverge. Still, these personality characteristics can be structured (Schneider & Vogt, 2012) to increase consumer involvement with CE and motivate their participation in CBM. In this way, consumer involvement with the CE and their participation in the CBM can be a consequence of and driven by the expression of the consumer's personality, which manifests itself in latent actions through behaviors and attitudes in the CE. Consequently, from the 3M Model framework perspective, personality traits were directly and hierarchically associated with consumer behavior in the CE and their availability to participate in CBM. Thus, identifying the personality traits that most motivated consumer involvement

with the CE and their participation in CBM allowed us to demonstrate that consumers' circular behavior is inherent in a hierarchical organization of personality traits that, in turn, distinctly influence consumer actions.

In this way, the big-five model of personality traits by McCrae and Costa (1985) can be used to explain consumer behaviors in the CE, complementing and expanding the results of studies carried out at the level of sustainability for the CE (Tran & Paparoidamis, 2021).

By integrating these three constructs, our study provides an alternative solution to the conventional participation of consumers in the CE as passive agents and a better understanding of the dynamics of circular consumer behavior.

Previous studies that focus on CBM focus on the role of companies, without evaluating the role of the consumer (Gomes & Lopes 2024; Lopes et al., 2023; Vidal-Ayuso et al., 2023). Our study encompasses and demonstrates that consumers who have greater engagement with CE are more willing to participate in CBM. This demonstrates the need for researchers to expand their field of research consider consumers as active agents of CBM, and look for key factors of greater consumer engagement. Furthermore, it extended the concept of consumer engagement to the CE, contributing to the multidimensionality of this concept.

6.2. Practical implications

The results of our study allow us to assess several practical implications for companies, policymakers, and consumers. Changing attitudes, behaviors, and mentalities is necessary for the success of CE despite being difficult, arduous, and time-consuming. Therefore, companies must actively involve consumers and promote circular goods and services (Gomes et al., 2023) through marketing

actions and obtaining consumer contributions for the different stages of production.

Personality traits drive consumer engagement with CE, and as such, companies must understand this association and identify important motivational factors for each consumer profile, adapting products and marketing strategies to engage consumers strategically in their CBM. For example, consumers with higher levels of awareness and agreeableness are more sensitive to issues of climate change and disposal and recycling (Kutaula et al., 2022; Song & Kim, 2018), and as such, marketing campaigns they must support these personal convictions and values and companies must offer more durable and fully recyclable products. Extroverted consumers with high engagement with the CE can be used as charismatic opinion leaders by marketers in campaigns to publicize CE practices, allowing them to share their active experience with other consumers (Kutaula et al., 2022). As the association between consumer engagement with CE and their willingness to participate in CBM is more intense when consumers are women and young people, so should promotion campaigns. of the CE should be aimed at this target audience and define strategic practices to attract new consumers from other groups.

Furthermore, consumers' perceptions that companies adopt CBM must be built by companies through a sustainable positive image transmitted and publicizing the implementation of CE practices (Ting et al., 2023). In return, companies become more efficient, with cleaner production and more sustainable profits.

Political decision-makers can also support the reinforcement of consumer engagement and willingness to participate in CBM by disseminating institutional campaigns about the CE, advertising on social networks, and strengthening consumers' emotions about sacrifices in favor of environmental protection (Hao

et al., 2020). Popularizing relevant issues about consumer participation in the CE can improve the understanding of government policies in this context. Furthermore, policymakers must provide financial support, namely subsidies and tax benefits, for companies' transition to CBM and the production of circular products for daily use by consumers, particularly with regulations in this regard. The anticipated positive emotions that increase consumer engagement with the CE and boost their participation in CBM can be boosted by policymakers by disseminating the benefits and effects expected from participation in the CE, such as improving living conditions, protecting future generations and fewer harmful effects of climate action. Apprehending these benefits increases consumer awareness, incentives, and sacrifices to participate in the CE. Furthermore, consumers need to reduce the uncertainties surrounding their participation in the CE, which will only be possible when the level of perceived obstacles to their participation is reduced through more information and fewer costs. Finally, policymakers must invest in education for circularity. Introducing these themes into mandatory school curricula from childhood could awaken environmental awareness earlier, contribute to the adoption of CE habits and routines, and, as such, encourage consumers, from a young age, to begin engaging with CE, contributing to its active role in building CBM.

7. Conclusion

This study explores the influence of the big five personality traits on consumer engagement with CE and their willingness to participate in CBM. The results demonstrated that personality traits directly affect consumer engagement with CE but not willingness to participate in CBM, answering the first research question about how each Big Five personality trait affects consumer engagement with CE. However, for personality traits to affect the willingness of consumers to

participate in CBM, this relationship must be mediated by consumer engagement with the CE. A positive relationship between consumer engagement with CE and willingness to participate in CBM was also found, answering the second research question. Finally, and to answer the third research question, the moderating role of consumers' gender and age in the relationship between consumer engagement with the EC and willingness to participate in CBM was demonstrated. Thus, the results demonstrated that the association between consumer engagement and willingness to participate in CBM is stronger when consumers are women and young. This study has some limitations. The sample does not represent Portuguese consumers, it was collected using non-probabilistic techniques and for convenience. A representative sample of the Portuguese population could lead to different results since the sociocultural context of residence can influence personality traits. As age was used as a moderating variable of the relationship between consumer engagement and willingness to participate in CBM, it would be interesting to replicate the research model for different generations (X, Y and Z) and evaluate how generational cohorts affect consumer participation in the EC. Furthermore, although several studies highlight that consumers' association with CBM has received little attention, and our study is a pioneer in associating the exploration of consumers' personality, the relationship between consumer engagement with CE and CBM needs further investigation.

Further research is to assess the dynamics of consumer behavior in this context, namely exploring daily circular habits and acceptance by companies of active consumer participation. In this study, we used the Ten-item Big-Five personality traits scale. Using a scale with more subconstructs can describe and capture different forms of consumer attitudes and behaviors toward CE, which will be explored in future studies. Furthermore, the sample for this study was collected

through a questionnaire answered in a single moment and it would be interesting to re-apply the questionnaire and analyze the differences in behavior about CE.

In a future study, it would still be interesting to test the model or parts of it (e.g., examining the two most influential personality traits and their impact on the dependent variables) using proxies of real behaviors as DVs through an experimental design, allowing for further testing effectively the causal relationships between variables, as suggested by Nieto-García et al. (2024). Consumer attitudes and behaviors about the CE are changing due to massive information about climate change, personal experiences, and awareness-raising actions. Thus, a longitudinal study will make it possible to evaluate consumer engagement with the CE over time and its impact on the greater propensity to participate in CBM. Furthermore, it would be interesting to trace consumer engagement patterns and relate them to different levels of availability to participate in CBM, allowing companies and political decision-makers to take specific measures to increase the engagement of each group of consumers.

Appendix

A.1. Questionnaire available at: https://drive.google.com/file/d/1ig8aHE-nPLz5dAbsDxQX9xc074AJlb2N/view?usp=drive_link

Circular Business Models: Active Consumer Participation

A.2. EFA and CFA results

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Confirmatory Factor Loads	Commonalities
Big Five Personality Traits									
Extraversion (EXT)									
Ext1	0.776							0.748	0.812
Ext2	0.816							0.779	0.750
Conscientiousness (CONS)									
CONS1		0.085						0.995	0.712
CONS2		0.774						0.864	0.752
Agreeableness (AGREE)									
AGREE1			0.072					0.876	0.728
AGREE2			0.753					0.968	0.811
Openness (OPEN)									
OPEN1				0.788				0.999	0.702
OPEN2				0.843				0.855	0.734
Neuroticism (NEURO)									
NEURO1					0.868			0.903	0.706
NEURO2					0.774			0.747	0.812
Consumer Engagement (CE)									
Consumer Attitude									
ATT1						0.800		0.735	0.799
ATT2						0.794		0.781	0.766
ATT3						0.803		0.800	0.731
ATT4						0.766		0.772	0.539
Positive Emotions Anticipated									
EMO1						0.771		0.773	0.760
EMO2						0.756		0.860	0.753
EMO3						0.751		0.863	0.764
Consumer Sacrifice									
SACR1						0.749		0.726	0.758
SACR2						0.708		0.778	0.744
SACR3						0.781		0.714	0.728
Willingness to participate in CBM (WP)									
WP1							0.776	0.850	0.722
WP2							0.871	0.812	0.822
WP3							0.812	0.825	0.728
WP4							0.785	0.793	0.701
WP5							0.803	0.724	0.762
WP6							0.745	0.701	0.723

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CHAPTER 3. Unlocking the potential of circular consumption: The influence of circular habits, environmental concerns and the search for pro-sustainable information on circular consumption

Reference

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CHAPTER 3. UNLOCKING THE POTENTIAL OF CIRCULAR CONSUMPTION: THE INFLUENCE OF CIRCULAR HABITS, ENVIRONMENTAL CONCERNS AND THE SEARCH FOR PRO-SUSTAINABLE INFORMATION ON CIRCULAR CONSUMPTION

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Abstract

In response to growing environmental and sustainability concerns, the circular economy and consumption have become significant themes in recent years. The transition to a circular economy is considered a critical move towards sustainable development as it addresses challenges such as climate change, waste, pollution and biodiversity loss. The present study evaluates the influence of environmental concerns and the search for pro-sustainable information by Portuguese consumers on their circular habits and their influence on their circular consumption choices. Furthermore, it assesses the influence of environmental concerns and Portuguese consumers' search for pro-sustainable information on their circular consumption when mediated by their circular habits. Through an online questionnaire, 826 valid responses were collected from Portuguese consumers over 18 years of age, using a non-probabilistic convenience sampling technique. The hypotheses established in the research model were tested using the Partial Least Squares method. Results indicate that environmental concerns and the search for pro-sustainable information positively impact circular habits, with more emphasis on energy and water saving, and zero plastic use. Additionally, environmental concerns and the search for pro-sustainable information directly correlate with circular consumption decisions, although this relationship is less intense when mediated by circular habits. Based on the results obtained in this study, a model of consumer participation in the circular

economy is proposed. Consumers' adherence to responsible circular consumption habits can transform traditional corporate business models into circular models, accelerating more efficient management of natural resources and ensuring global sustainability and future generations' survival.

Keywords: circular economy; circular habits; circular consumption; environmental concerns; pro-sustainable information.

1. Introduction

The circular economy and circular consumption have become increasingly important topics in recent years due to growing concerns about the environment and sustainability (Camacho-Otero *et al.*, 2018, Garcia *et al.*, 2021). As the world faces climate change, biodiversity loss, waste and pollution, transitioning to a circular economy is crucial for more sustainable development. The circular economy and circular consumption aim to reduce waste and pollution while promoting sustainability and economic growth (Korhonen *et al.*, 2018a, Lamba *et al.*, 2023, Camacho-Otero *et al.*, 2018). The idea involves using resources for as long as possible through recycling, reuse and repair. This approach can help combat climate change by reducing greenhouse gas emissions and promoting renewable energy sources (Yang *et al.*, 2023).

Resource depletion, pollution, and land use are some environmental issues the circular economy can tackle (Geissdoerfer *et al.*, 2017). This comprehensive solution involves transforming of production and consumption practices to detach waste generation and resource use from value creation (Camacho-Otero *et al.*, 2018). On the other hand, circular consumption involves maximizing value and reducing waste through product and service usage (Testa *et al.*, 2020). It is worth noting that while the circular economy involves several sectors of the

economy, circular consumption centers on consumer behavior as a consumption model. Therefore, the circular economy is a more extensive economic model than circular consumption. Both aim to reduce waste and environmental impact but address different aspects of the problem.

Industries and stakeholders face obstacles when trying to adopt circular consumption practices. (Abdelmeguid *et al.*, 2022) examined the challenges in implementing the circular economy in the fashion industry. Among the main obstacles were insufficient infrastructure and technology to support circular consumption practices, as well as the need for significant changes in business models, supply chains and consumer behavior (Barros *et al.*, 2021). Moving to circular consumption means abandoning traditional linear models, which prioritize end-of-life concepts, in favor of a more sustainable and circular model (Corvellec *et al.*, 2022). In this way, industries and stakeholders can reap the rewards of adopting circular consumption practices, despite the obstacles. When consumption of primary materials decreases, costs go down and environmental damage decreases as the circular economy comes to the fore. In addition, companies can discover new sources of income by offering circular services and developing circular supply chains (Oghazi and Mostaghel, 2018). Circular consumption practices have immense potential for companies to manage their sustainability impacts within an organization (Barros *et al.*, 2021). Adopting circular economy principles can lead to positive economic and environmental outcomes, benefiting both industries and stakeholders (Oghazi and Mostaghel, 2018, Korhonen *et al.*, 2018b).

According to the Circularity Gap Report 2023, the global economy has a circularity level of only 7.2% (Circle Economy, 2023). This rate has been affected by the increasing volume of material extraction, which has resulted in the global

circularity dropping from 9.1% in 2018 to 8.6% in 2020 and now to 7.2% in 2023. This situation leaves a huge circularity gap, as the world still relies almost exclusively on new, i.e. virgin, materials. As a result, over 90% of materials are wasted, lost or unavailable for reuse for years as they are incorporated into long-lived buildings and machines (Circle Economy, 2023). Increased consumption of materials only sometimes benefits people, as it can damage the natural systems we depend on for survival. The waste economy consumes natural resources, threatens species' survival, pollutes soil and water with toxins and contributes dangerously to global warming (Circle Economy, 2023).

On the other hand, the Ellen MacArthur Foundation (2021) estimates that a transition to a circular economy could reduce global greenhouse gas emissions by 39% by 2050. Stahel (2016) states that shifting to a circular economy would reduce each nation's greenhouse gas emissions by up to 70% (Stahel, 2016). The Ellen MacArthur Foundation (2021) report further estimates that by 2050, the world's oceans could contain more plastic than fish by weight if current trends continue.

However, if circular economy principles can be implemented, according to Schulze (2016), it will be possible to generate global economic benefits of up to \$2.2 trillion by 2030. Also, by 2030, resource productivity in Europe may be increased by 3%, resulting in cost savings of €600 billion per year and other economic benefits valued at €1.8 trillion (Schulze, 2016). Furthermore, the Ellen MacArthur Foundation (2021) indicates that adopting circular economy principles could result in a \$4.5 trillion increase in economic output by 2030 and create 18 million new jobs. These statistics demonstrate the potential benefits of transitioning to a circular economy, including economic growth, job creation, reducing greenhouse gas emissions, and achieving sustainability goals.

Despite the growing interest in the circular economy and circular consumption, statistics show that there is still a long way to go. For example, a study by Garcia *et al.* (2021) found that consumers are not yet fully aware of the benefits of circular economy practices. In addition, Lee (2022) found that while environmentally friendly packaging options exist, consumers still choose non-green options. These issues highlight the need for more research and education on circular consumption practices (Arruda *et al.*, 2021, Leipold *et al.*, 2023).

Environmental concerns have become increasingly prevalent in today's society, leading people to seek out pro-sustainable information (Pinho and Gomes, 2023). This increased awareness encourages individuals to adopt circular practices that prioritize resource conservation and waste reduction. Yue *et al.* (2020) have shown that environmental responsibility can promote environmental concern and increase ecological consumption. However, not enough attention has been paid to studying the shift towards pro-environmental behavior and the adoption of circular customs (Minelgaitė and Liobikienė, 2021).

These practices include energy saving; water saving; waste management; sustainable mobility; zero plastic (Linder *et al.*, 2022). Therefore, consumer understanding and adopting circular habits are fundamental for transitioning to a circular economy and pursuing sustainable development (Testa *et al.*, 2020). However, there are still gaps in the literature on environmental concerns and circular habits, particularly in identifying barriers to pro-environmental behavior and further studies are needed (Ratner *et al.*, 2021, Yue *et al.*, 2020, Yang *et al.*, 2022).

It is also important to highlight those environmental concerns and the search for pro-sustainable information have become increasingly relevant for consumers. Pro-sustainable information can play a significant role in influencing consumers

to adopt circular habits (D'Amato *et al.*, 2019). The availability of information about the environmental impact of products and services can help consumers make more informed decisions regarding their consumption habits (White *et al.*, 2019). For example, information on sustainable packaging can encourage consumers to choose products with less waste or packaging that is recyclable or compostable (Pinho and Gomes, 2023). In addition, information about the environmental benefits of circular habits, such as reuse and repair, can motivate consumers to adopt these practices (Lubowiecki-Vikuk *et al.*, 2021). A study by Lee (2022) found that news consumption positively affects environmental attitudes, subjective norms, perceived behavioral control and circular packaging. However, there are still gaps in the literature on the impact of environmental concerns and the search for pro-sustainable information on circular consumption and habits (Szilagyi *et al.*, 2022, Alcalde-Calonge *et al.*, 2022, Abad-Segura *et al.*, 2020).

That said, the mediating role of circular habits in influencing environmental concerns and the search for pro-sustainable information on circular consumption is an area that requires further exploration. Circular habits can be crucial in promoting pro-environmental behaviors and transitioning to a circular economy (Solano-Pinto *et al.*, 2020, Kevin van Langen *et al.*, 2021, Testa *et al.*, 2020). Circular habits can contribute to a more sustainable future by reducing waste and optimizing the use of resources (Castro Oliveira *et al.*, 2022). By incorporating circular habits, individuals can minimize their environmental impact and contribute to creating a more sustainable society (Lopes *et al.*, 2023a). In addition, circular habits can help reduce the consumption of non-renewable resources, which can contribute to mitigating climate change and other environmental issues. By adopting circular habits and making more sustainable choices, consumers can play a vital role in creating a more

sustainable future (Lopes *et al.*, 2023b). It is therefore crucial to continue promoting pro-sustainable information and encouraging the adoption of circular habits in order to achieve a more sustainable and environmentally conscious society (Yue *et al.*, 2020). This poses two important questions: 1) How do environmental concerns and consumers' search for pro-sustainable information affect their circular habits? 2) How do environmental concerns, pro-sustainable information search and consumers' circular habits determine their circular consumption choices?

That said, this study evaluates the influence of environmental concerns and the search for pro-sustainable information by consumers on their circular consumption when mediated by their circular habits. To this end, 826 responses from Portuguese consumers were collected through an online questionnaire (available in Supplementary Information). It is important to study the Portuguese context, as Portugal faces major challenges in implementing circular economy practices. In 2021 the country presented a low circular material utilisation rate of only 2.5%, far below the European Union average (11.7%) (Pordata, 2021).

The results demonstrate that more significant environmental concern and greater search for pro-sustainable information by Portuguese consumers positively influence the adoption of circular habits (water and energy savings, waste management, sustainable mobility and plastic reduction) and their circular consumption. Furthermore, these circular consumer habits positively influence their circular consumption. The results also reveal that environmental concerns and the search for pro-sustainable information positively influence circular consumption when mediated by circular habits. However, the intensity of this influence is lower when compared to a direct relationship between the constructs.

This study offers four important contributions. First, it extends signaling theory to include circular consumption decisions. This study is analysed from the perspective of signaling theory. This theory is a framework that explains how individuals use signals to convey information about themselves or their products to others (Chang *et al.*, 2021, Gomes *et al.*, 2023). Signaling theory can help explain why individuals engage in sustainable consumption practices in circular consumption. Consumer search for pro-sustainable information can reduce ambiguity and asymmetry, encouraging purchase intention. Environmentally concerned consumers seek signals in products and services to gain knowledge and make bold choices. Secondly, the study enriches the circular economy literature by addressing consumer participation. Despite growing research interest in recent years, the circular economy still lacks studies focused on the consumer perspective. Thirdly, the study demonstrates that environmental concerns, pro-sustainable information search and circular habits of consumers can influence circular consumption choices. Finally, the study proposes a model of consumer participation in the circular economy, highlighting the consumer's key role in transforming traditional business models into circular models.

2. Literature Review

2.1. Signaling Theory

The Signaling Theory has been applied over the past few years to explain consumer attitudes towards the circular economy (Wang *et al.*, 2020). According to Spence (1973), in the context of the Signaling Theory, it is assumed that when consumers do not know or have no access to accurate information about the products they intend to buy, they tend to use external information sources to judge the product. Thus, according to Signaling Theory, information asymmetry

challenges the relationship between buyers and sellers or producers since the product or service will be judged by the information or signal emitted by the buyer (Chang *et al.*, 2021, Skaggs and Snow, 2004). When consumers do not quickly uncover product characteristics, sellers provide external information about quality and attributes, encouraging consumers' purchasing behavior (Well *et al.*, 2011). Moreover, in sustainable purchasing decision-making, consumers' decisions are shrouded with environmental concerns (Trudel, 2019). Signaling in the form of knowledge of product features can decrease environmental concerns (Wang and Hazen, 2016), reduces uncertainty and promotes purchasing behavior. Therefore, according to this theory, consumers tend to trust external information that they seek to justify their purchase intention (Chang *et al.*, 2021). Thus, in the context of this study, Signaling Theory supports the need to research pro-sustainable information to influence your daily behavior, that is, your habits and circular purchasing intention.

2.2. Circular Consumption

The concepts of circular consumption and circular habits are often confused. However, their meanings are different. Circular habits refer to individual behaviors and practices that align with the principles of the circular economy (Abd'Razack *et al.*, 2017, Gonella *et al.*, 2023). These habits involve making conscious choices to reduce waste and promote sustainability, such as: 1) Repairing and reusing items instead of throwing them away; 2) Choosing products made from recycled materials; 3) Opting for reusable items, such as water bottles and shopping bags; 4) Supporting companies that prioritize sustainability and circular practices. Circular consumption is a concept that aims to decouple value creation from waste generation and resource use, transforming production and consumption systems (Arruda *et al.*, 2021). Circular

consumption is an essential approach to achieving a circular economy, in which resources are kept in use for as long as possible, waste is minimised, and environmental impact is reduced (Muranko *et al.*, 2018, Henry *et al.*, 2021). The circular economy has been recognised as a crucial step towards achieving sustainable development goals, and circular consumption plays a vital role in this transition (Camacho-Otero *et al.*, 2018). The main difference between circular consumption and circular habits is their scope and focus. Circular consumption is a broader concept that involves systemic changes in the economy and industry, while circular habits are individual actions that align with these principles. Circular consumption involves designing products and processes for longevity, reparability and recycling (Lopes *et al.*, 2023a, Lopes *et al.*, 2023b), while circular habits involve making conscious choices to reduce waste and promote sustainability in everyday life (Abd'Razack *et al.*, 2017, Gonella *et al.*, 2023). Both circular consumption and circular habits are essential for the transition to a circular economy, promoting a more sustainable future.

The study of circular consumption needs to be addressed more than related topics researched in literature, such as product-services systems, circular economy, sharing economy, and collaborative consumption (Bocken *et al.*, 2022, Arekrans *et al.*, 2022). Modifying consumer behavior and changing attitudes towards consumption are prominent obstacles to promoting circular consumption. Consumers typically seek convenience, novelty, and status, which can result in excess consumption and waste (McCarthy *et al.*, 2020). Encouraging sustainable consumption and offering cost-effective, accessible substitutes is necessary to educate consumers on the advantages of circular consumption (Garcia *et al.*, 2021, Coderoni and Perito, 2020). Szilagyi *et al.* (2022) and Lee (2022) have both suggested an association between pro-sustainable information, circular habits, environmental concerns, and climate change. This connection

highlights the significance of advocating for circular consumption to foster sustainable consumption patterns and resolve environmental concerns (Gutentag, 2021).

Manufacturing practices and consumer behavior would need significant changes for circular consumption to be widely adopted, according to Lazanyuk *et al.* (2021). But, companies are acknowledging innovation and circularity's importance in their operations as evidenced by Barros *et al.* (2021) and Walker *et al.* (2022). Also, studies reveal the advantages of circular business models such as better economic performance, reduced resource utilization, and increased resilience (Camacho-Otero *et al.*, 2018). Consequently, endorsing circular consumption can generate a sturdy, sustainable economy and a more favorable environment for future generations.

2.3. Development and formulation of hypotheses

2.3.1 Environmental Concerns

Environmental Concerns are crucial in promoting sustainable environmental practices. Environmental Concerns refer to an individual's awareness that the environment is threatened by pollution or overuse of resources (Saari *et al.*, 2021). Moreover, environmental concerns also encompass individuals' concerns and good information regarding environmental problems and their willingness to act (Cruz and Manata, 2020, Yue *et al.*, 2020). Environmental concerns are a multifaceted concept involving several dimensions, such as environmental knowledge, attitudes, values and behaviors (Cruz and Manata, 2020).

Environmental concerns have been recognised in the scientific community, and some studies have investigated the factors that influence individuals' environmental concerns. Groot and Steg (2008) found that knowledge about environmental issues was positively related to environmental concerns.

Moreover, individuals considering environmental problems serious and urgent were more likely to adopt pro-environmental behaviors. Kormos and Gifford (2014) suggested that values play a crucial role in shaping individuals' environmental concerns. Specifically, individuals who highly value nature and the environment are more likely to engage in pro-environmental behaviors. Cruz and Manata (2020) point out that environmental concerns positively influence circular habits (e.g., energy saving, water saving, waste management, sustainable mobility, and zero plastic). Therefore, the literature points to environmental concerns' in promoting circular economy practices (Arruda *et al.*, 2021, Alhawari *et al.*, 2021). A study by Szilagyi *et al.* (2022) found that environmental concerns positively impact circular purchasing behavior. Thus, individuals with high environmental concerns are more likely to engage in circular consumption practices.

By increasing knowledge, promoting values prioritising the environment and creating a sense of urgency around environmental issues, we can encourage people to act towards a more sustainable future (Zhanbayev *et al.*, 2023). Therefore, environmental concerns play a crucial role in promoting sustainable environmental practices (Yousaf, 2021, Hameed *et al.*, 2020, Nisar *et al.*, 2021). As such, efforts to promote environmental concerns and sustainable practices should continue to be a priority for individuals, organisations and governments (Shrivastava *et al.*, 2020, Dutra *et al.*, 2018). Based on the studies mentioned above, we formulate the following hypotheses:

H1: Environmental concerns positively influence circular habits: a) Energy Saving, b) Water Saving, c) Waste Management, d) Sustainable Mobility, e) Zero Plastic.

Some studies have shown a positive correlation between environmental concerns and circular consumption (Camacho-Otero *et al.*, 2018, Patwa *et al.*,

2021, Velenturf and Purnell, 2021, Yue *et al.*, 2020). As an example, Yue *et al.* (2020) found that those with a greater sense of environmental responsibility are more inclined to participate in circular consumption practices, thus exhibiting a positive correlation between environmental concern and responsibility. Rodríguez-Espíndola *et al.* (2022) concluded that a circular economy that promotes sustainability-oriented innovation has a positive impact on financial, environmental and social outcomes, suggesting that circular consumption can be beneficial for both individuals and society as a whole. Circular consumption practices can be linked to environmental concerns for various reasons (Camacho-Otero *et al.*, 2018, Alhawari *et al.*, 2021, Velenturf and Purnell, 2021). Awareness and motivation to reduce waste and conserve resources can be a factor. When people become more aware of how their actions can negatively affect the environment, they may be more inclined to adopt circular consumption habits in order to minimize waste and make better use of resources. In addition, public policies, legal frameworks and green initiatives can play a role in spreading environmental awareness and promoting circular consumption (Wang *et al.*, 2022). By providing the necessary tools, incentives and support, a culture of circular consumption can be established with the aim of encouraging sustainable practices while keeping environmental concerns at the forefront. That said, the following hypothesis was formulated:

H2: Environmental concerns positively influence circular consumption.

As previously verified, with the literature tending to suggest that environmental concerns positively influence circular consumption, as well as environmental concerns positively influence circular consumption, we can infer that environmental concerns positively influence circular consumption when mediated by circular habits. Lopes *et al.* (2023a), Szilagyi *et al.* (2022), and Testa

et al. (2020) studies suggest that circular habits play a crucial role in translating environmental concerns into sustainable behaviors. The development of circular habits aid in bridging the gap between intention and action, allowing individuals to transform their environmental concerns into tangible actions that facilitate circular consumption. Thus, the following hypotheses were formulated:

H3: Environmental concerns positively influence circular consumption when mediated by circular habits: a) Energy Saving, b) Water Saving, c) Waste Management, d) Sustainable Mobility, e) Zero Plastic.

2.3. 2 Pro-Sustainable Information

Pro-sustainable information is a form of information promoting sustainable practices and behaviors, such as waste reduction and resource conservation (Gomes and Lopes, 2023, Landon *et al.*, 2018, Tölkes and Butzmann, 2018). The availability and accessibility of accurate and reliable information on sustainable practices are crucial in promoting sustainable behaviors and practices, positively impacting the environment (Tian and Liu, 2022). Studying pro-sustainable information can help advance our understanding and implementation of sustainable practices. It should be undertaken to ensure that the information provided is accurate, reliable and effective in promoting sustainable behaviors (Lopes *et al.*, 2023a).

The reliability of environmental information sources has been shown to have an impact on pro-environmental actions, according to research by Díaz *et al.* (2020) and Xu *et al.* (2023), underscoring the need for accurate information that can instill confidence. Furthermore, Rosen and Kishawy (2012) highlight the role of pro-sustainable information in advancing sustainable manufacturing practices and fostering greater understanding. In rural territories, Yang *et al.* (2022) found that imparting ecological knowledge had an affirmative influence on pro-

environmental actions, boosting conservation efforts and aiding the administration in optimal resource usage. The discovery underscores the relevance of promoting pro-sustainable information, which can catalyze circular consumption and habits, thus helping to advance sustainable practices. Therefore, we formulate the following hypotheses:

H4: The search for pro-sustainable information by consumers positively influences circular habits: a) Energy Saving, b) Water Saving, c) Waste Management, d) Sustainable Mobility, e) Zero Plastic.

Calvo-Porrall and Lévy-Mangin (2020), Stangherlin *et al.* (2023) and Lopes *et al.* (2023b) studies have concluded that consumers who actively seek out information about sustainable products and practices are more likely to adopt circular consumption behaviors. These findings suggest that pro-sustainable information can be a powerful motivating factor for consumers to adopt more sustainable behaviors. Furthermore, Lee (2022) and Henriques *et al.* (2023) has shown a positive correlation between pro-sustainable information and circular consumption. For example, a study by Lee (2022) concluded that perceptions of eco-friendly packaging directly influence consumer propensity to purchase, highlighting the importance of providing pro-sustainable information to consumers. Additionally, Henriques *et al.* (2023) concluded that pro-sustainable information can play a crucial role in promoting circular consumption, particularly in the context of marketing and communication strategies. Potential mechanisms underlying the correlation between pro-sustainable information and circular consumption include increased awareness and motivation to adopt sustainable behaviors (Camacho-Otero *et al.*, 2018, Lopes *et al.*, 2023b). As an example, White *et al.* (2019) and Gomes *et al.* (2022) suggest that consumers are more inclined to engage in pro-environmental behaviors when they have a sense

of self-efficacy and perceive the behavior as socially normative. Similarly, Parajuly *et al.* (2020) and Zhang and Dong (2020) highlight the importance of behavioral theories in promoting sustainable consumption and pro-environmental behaviors. In particular, they note that providing pro-sustainable information can help increase consumers' knowledge and awareness of sustainable practices, leading to greater engagement in circular consumption behaviors (Parajuly *et al.*, 2020, Zhang and Dong, 2020). Taking the above into account, the following hypothesis was formulated:

H5: The search for pro-sustainable information by consumers positively influences circular consumption.

As noted above, the literature tends to suggest that consumers' search for pro-sustainable information positively influences circular habits and circular consumption, so we can infer that consumers' search for pro-sustainable information positively influences circular consumption when mediated by circular habits. The adoption of circular habits can act as a facilitating factor in the relationship between pro-sustainable information and circular consumption, as it reinforces the goal of reducing waste and promotes more sustainable consumption practices (Lopes *et al.*, 2023b, Stangherlin *et al.*, 2023). This highlights the importance of promoting both pro-sustainable information and circular habits in encouraging sustainable consumption practices. That said, the following hypotheses were formulated:

H6: The search for pro-sustainable information by consumers positively influences circular consumption when mediated by circular habits: a) Energy Saving, b) Water Saving, c) Waste Management, d) Sustainable Mobility, e) Zero Plastic.

2.3. 3 Circular habits

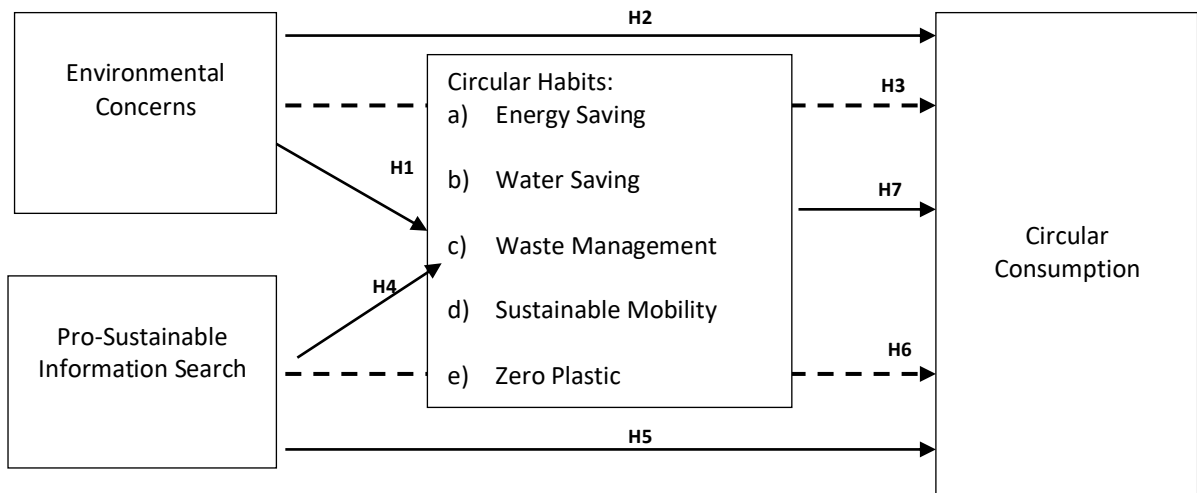
Circular habits are essential in promoting sustainable behavior. Circular habits refer to daily actions and behaviors that individuals can adopt to reduce their environmental impact and promote sustainability (Akram *et al.*, 2023, Lee, 2022). Examples of circular habits include energy-saving practices, water-saving habits, waste management, sustainable mobility and zero plastic use (Linder *et al.*, 2022). Individuals can promote a circular economy that maximises resource efficiency and reduces their carbon footprint by adopting certain habits that minimize waste.

Sustainability science literature has identified the importance of exploring how habits can induce transformations towards sustainable behavior, as noted by Linder *et al.* (2022). To design successful interventions promoting circular habits, it is essential to comprehend these habits' potential to promote sustainability. Additionally, previous research indicates that environmental beliefs and knowledge of sustainable development might play a role in adopting circular habits (Solano-Pinto *et al.*, 2020, Pinho and Gomes, 2023).

The circular habits literature suggests that these habits positively influence circular consumption (Akram *et al.*, 2023, Filho *et al.*, 2022) Akram *et al.* (2023) indicate that individuals who engage in circular habits are more likely to adopt circular consumption practices, such as recycling and upcycling, which contribute to reducing waste and resource depletion. Furthermore, Filho *et al.* (2022) indicate that circular habits can significantly reduce energy and water consumption and improve waste management. In this context, we formulate the following hypotheses:

H7: Circular habits: a) Energy Saving, b) Water Saving, c) Waste Management, d) Sustainable Mobility, e) Zero plastic positively influences circular consumption.

Figure 1 presents the research model. Hypotheses H1 and H4 formulate the direct relationships of environmental concerns and pro-sustainable search in circular habits and hypotheses H2 and H4 the direct relationships of these constructs in circular consumption. Hypotheses H3 and H6 formulate the indirect relationships between environmental concerns and pro-sustainable search in circular consumption when mediated by circular habits.



Note: → Direct Effect; - -► Indirect effect
 Figure 3.1: Research model and hypotheses

3. Methods

3.1. Sample

The sample for this study was collected through a questionnaire made available online through google forms and published on the authors' social networks and contacts between September and October 2022. This is a convenience sample. The target audience is Portuguese citizens over 18 years old. The Portuguese population over 18 years old (target audience) in 2022 amounts to around 8,566 thousand (Pordata, 2023). Considering a margin of error of 3%, we would need 1,067 valid responses for the sample to be representative. As the number of

responses was lower, the sample collected is not representative of the Portuguese population. The questionnaire is anonymous, and all respondents were informed of the purpose of the study. Informed consent was obtained from all respondents. A pre-test was conducted with 15 respondents with different sociodemographic characteristics to assess their understanding of the questions and response time. The pre-test results demonstrate that all respondents had no difficulty understanding the questions, and the average response time to the questionnaire was five minutes.

The collected sample had 864, and 826 responses were considered valid. Regarding the socio-demographic characterisation of the respondents, 69.9% were women, and 31.1% were men. The average age was 33.8 years, with a minimum age of 18 and a maximum of 78 years. Regarding education, 39.2% had at most secondary education, 47.7% were bachelors, 11.9% were masters, and 1.2% were doctors. Given their work situation, 46.4% were employees, 28.9% were students, and 10.2% were self-employed. Regarding net monthly income, 63.9% earned a maximum of 1,000 euros.

3.2. Measures of variables

The questionnaire consists of five groups of questions: i) environmental concerns with four questions; ii) pro-sustainable information search with three questions; iii) circular consumption with eight questions; iv) circular habits in terms of energy saving, water saving, waste management, zero plastic and sustainable mobility; v) socio-demographic characterisation of the respondents. The circular habit questions were adapted from Ratner et al. (2021) and were measured on a 5-point Likert scale: 1-never and 5-always/whenever I can. Questions relating to environmental concern, circular consumption and the search for pro-sustainable information were adapted from Testa *et al.* (2020). Environmental concern and

circular consumption were measured on a 5-point Likert scale: 1 – strongly disagree and 5 – strongly agree. The search for pro-sustainable information on a 7-point Likert scale: 1 – Totally disagree and 7 – Totally agree.

3.3. Methodological procedures

The methodology used in this study is quantitative. Initially, a statistical description of the variables and indicators contained in the research model in the SPSS software (v.25) was carried out. Afterwards, a factor analysis was implemented, and an exploratory factor analysis and a confirmatory factor analysis were performed in the SPSS (v.25) software. To test the relationships established in the structural model, the Partial Least Square (PLS) method was applied in Smart PLS 3.0. (Ringle *et al.*, 2020). The PLS method combines factorial analysis with simple linear regressions estimated by the Ordinary Least Squares method (Sarstedt *et al.*, 2022). It does not require data normality (confirmed by the kurtosis and skewness statistics that the data in this study do not have a normal distribution). The model obtained after applying the PLS method was validated through the measures suggested by Hair *et al.* (2019): (i) Cronbach's Alpha measurements ($C\alpha > 0.70$); (ii) composite reliability ($CR > 0.70$); (iii) Average Variance Extracted ($AVE > 0.50$) and (iv) discriminant validity tested by the Fornell-Larcker criterion. Finally, a bootstrap analysis was carried out in Smart PLS to test the relationships established in the structural model. This analysis was carried out in Smart PLS 3.0 software and consists of a non-parametric procedure that allows testing the statistical significance of several PLS results. In bootstrapping analysis, subsamples are created with observations randomly extracted (with replacement) from the original data set (Ringle *et al.*, 2023). To guarantee the stability of the results, the number of subsamples must be large, with 500 subsamples being used.

4. Results

4.1. Statistical description of variables and indicators

Table 1 contains the mean and standard deviation of the variables. The mean and standard deviation of the indicators that measure the variables are in Appendix A. In general terms, respondents reveal high environmental concerns (M = 4.62), worrying above all about issues related to the waste of resources and the protection of the natural environment. Regarding the pro-sustainable search (M = 5.34), the respondents essentially revealed that they would like access to more information about the environmental attributes of the products. As for circular consumption (M = 3.41), the items most valued by the respondents were purchasing products with a longer shelf life. In terms of circular habits, respondents do not reveal high practices in their daily lives, with the most frequent habits being energy saving (M = 3.19) and zero plastic (M = 3.06). The least regular circulation habit is sustainable mobility (M = 2.56), with little adherence to public transport, bicycles, and walking.

Table 3.1: Descriptive statistics

Variables	Mean (M)*	Std. Deviation*
Environmental Concerns	4.62	0.661
Pro-Sustainable Information Search	5.34	1.391
Circular Consumption	3.41	0.779
Energy Saving	3.19	0.785
Water Saving	2.98	0.836
Waste Management	2.86	0.939
Zero Plastic	3.06	0.777
Sustainable Mobility	2.56	0.924

Note: Mean and standard deviation of the items that measure the variables are found in appendix A. * Simple average of the items to which they correspond.

4.2. Factor Analysis

Appendix B contains the results of implementing the exploratory factor analysis and the confirmatory factor analysis. Regarding the exploratory factor analysis, the 45 initial items were divided into eight factors as foreseen in the research model: i) factor 1 related to the environmental concerns with four items; ii) factor 2 related to the pro-sustainable information search with three items; iii) factor 3 for the circular consumption with eight items; iv) factor 4 with 10 items related to energy saving; v) factor 5 with six items related to water saving; vi) factor 6 five items related to waste management; vii) factor 7 with three items related to zero plastic and viii) factor 8 with six items related to sustainable mobility. Considering that the sample was collected through a questionnaire, we performed a common method bias in PLS using the Harman unifactorial test to assess whether there was any consistency in the responses or any bias (Kock, 2020). The eight constructs have a cumulative variance of 60.32%. The largest factor explains only of the 25.70% variance. As, individually, no single factor explains a variation greater than 50%, it is unlikely that our data are affected by the common method bias (Kock, 2020). Appendix B also contains the confirmatory factor load from implementing the confirmatory factor analysis. All confirmatory factor loads are greater than 0.70, and as such, no items were excluded, and the reflective nature of the model is confirmed (Hair *et al.*, 2020).

4.3. Measurements of the research model after applying the PLS method

Table 2 shows the results of validating the research model after applying the PLS method. The model is reliable and presents good convergence, considering the results obtained regarding Cronbach's Alpha measurements ($C\alpha > 0.70$), composite reliability ($CR > 0.70$), and Average Variance Extracted ($AVE > 0.50$) are superior to the reference values. According to the Fornell-Larcker criterion, there

is discriminant validity since the square root of the average variance extracted from each construct must be greater than the correlation between the construct and any other construct, (in bold in table 2 (Fornell and Larcker, 1981). The model has an excellent fit (Henseler, 2017): i) the Goodness-of-Fit Index (0.965; reference value > 0.90); ii) Normative Fit Index (0.974; reference value > 0.90), and iii) the Root Mean Square Approximation Error (0.072; reference value < 0.08).

Table 3.2: Measures of reliability, convergence and validity

	Cα	CR	AVE	EC	PSIS	CC	ES	WS	WM	ZP	SM
Environmental Concerns (EC)	0.691	0.809	0.523	0.723							
Pro-Sustainable Information Search (PSIS)	0.869	0.919	0.792	0.403	0.890						
Circular Consumption (CC)	0.774	0.835	0.599	0.402	0.411	0.774					
Energy Saving (ES)	0.844	0.878	0.521	0.323	0.462	0.631	0.722				
Water Saving (WS)	0.743	0.824	0.552	0.317	0.290	0.603	0.619	0.743			
Waste Management (WM)	0.714	0.814	0.581	0.264	0.262	0.571	0.462	0.499	0.762		
Zero Plastic (ZP)	0.715	0.840	0.637	0.332	0.333	0.731	0.526	0.525	0.494	0.798	
Sustainable Mobility (SM)	0.727	0.803	0.517	0.198	0.236	0.562	0.443	0.447	0.390	0.441	0.719

Note: Results of Fornell Larcker Criterion in bold. EC - Environmental Concerns; PSIS – Pro-Sustainable Information Search; CC - Circular Consumption; ES - Energy Saving; WS - Water Saving; WM - Waste Management; ZP - Zero Plastic; SM - Sustainable Mobility; **C α** - Cronbach Alpha; CR – composite reliability; AVE - Average Variance Extracted.

4.4. Research model estimation results

Table 3 shows the results of estimating the direct relationships between the constructs established in the research model. All connections are statistically significant.

Table 3.3: Results of direct effects on endogenous variables

Direct Effects on Endogenous Variables	Path (β)	t Value (Bootstrap)	P-Value	Confidence Interval		Hypothesis Support
				2,50%	97,50%	
H1a) Environmental concerns → Energy Saving	0.261	5.037	0.000	0.160	0.364	Yes
H1b) Environmental concerns → Water saving	0.239	5.617	0.000	0.157	0.319	Yes
H1c) Environmental concerns → Waste Management	0.189	4.433	0.000	0.100	0.273	Yes
H1d) Environmental concerns → Sustainable Mobility	0.123	3.138	0.002	0.047	0.199	Yes
H1e) Environmental concerns → Zero Plastic	0.236	5.770	0.000	0.154	0.314	Yes
H2) Environmental concerns → Circular Consumption	0.093	3.887	0.000	0.049	0.139	Yes
H4a) Pro-Sustainable Information Search → Energy saving	0.152	3.755	0.000	0.076	0.230	Yes
H4b) Pro-Sustainable Information Search → Water Saving	0.193	4.843	0.000	0.112	0.269	Yes
H4c) Pro-Sustainable Information Search → Waste Management	0.186	4.416	0.000	0.096	0.267	Yes
H4d) Pro-Sustainable Information Search → Sustainable Mobility	0.187	4.687	0.000	0.103	0.263	Yes
H4e) Pro-Sustainable Information Search → Zero Plastic	0.237	6.154	0.000	0.152	0.309	Yes
H5) Pro-Sustainable Information Search → Circular Consumption	0.110	5.114	0.000	0.069	0.151	Yes
H7a) Energy Saving → Circular Consumption	0.194	6.769	0.000	0.138	0.255	Yes
H7b) Water Saving → Circular Consumption	0.106	3.604	0.000	0.044	0.158	Yes
H7c) Waste Management → Circular Consumption	0.150	5.741	0.000	0.100	0.198	Yes
H7d) Sustainable Mobility → Circular Consumption	0.186	7.674	0.000	0.142	0.238	Yes
H7e) Zero Plastic → Circular Consumption	0.418	14.496	0.000	0.355	0.471	Yes

The results reveal a positive influence of environmental concerns on all circular habits, that is, on energy saving ($\beta = 0.261$), on water saving ($\beta = 0.239$), on waste management ($\beta = 0.189$), on sustainable mobility ($\beta = 0.123$) and on zero plastics ($\beta = 0.236$), confirming hypotheses H1a to H1e. In concrete terms, when there is a 10% increase in the environmental concerns of Portuguese consumers,

they tend to increase their energy savings by 26.1%, water savings by 23.9%, waste management by 18.9%, sustainable mobility by 12.3% and the reduction of plastics by 23.6%. However, the effect of environmental concerns on circular habits is not equally strong, with its more intense influence on energy saving, water saving and zero plastic. A positive influence of environmental concerns on circular consumption was also found ($\beta = 0.093$), confirming H2, that is, when the environmental concerns of Portuguese consumers increase by 10%, their circular consumption increases by 9.3%.

The search for pro-sustainable information by Portuguese consumers positively influences all circular habits, being more intense in the habit of zero plastic ($\beta = 0.237$), followed by water saving ($\beta = 0.193$), sustainable mobility ($\beta = 0.187$), waste management ($\beta = 0.186$), and finally, for energy saving ($\beta = 0.152$). In this way, H4a to H4e are confirmed. This means that when there is a 10% increase in the search for pro-sustainable information, Portuguese consumers increase the reduction of plastics by 23.7%, water savings by 19.3%, sustainable mobility by 18.7%, waste management by 18.6% and energy savings by 15.2%.

The search for pro-sustainable information by Portuguese consumers positively influences circular consumption ($\beta = 0.110$), confirming H5, in other words, a 10% increase in the search for pro-sustainable information by Portuguese consumers increases their circular consumption by 11%. However, the influence of consumers' search for pro-sustainable information on circular consumption is more intense than the influence of environmental concerns. Circular habits positively influence circular consumption. The habit of zero plastic is what most positively influences circular consumption ($\beta = 0.418$), followed by energy saving ($\beta = 0.194$), sustainable mobility ($\beta = 0.186$), waste management ($\beta = 0.150$) and water saving ($\beta = 0.106$), confirming H7a to H7e.

Table 4 contains the results of estimating indirect relationships between constructs established in the research model. All relationships are also significant.

Table 3.4: Results of indirect effects on endogenous variables

Indirect Effects on Endogenous Variables	Path (β)	t Value (Bootstrap)	P-Value	Confidence Interval		Hypothesis Support
				2,50%	97,50%	
H3a) Environmental concerns → Energy Saving → Circular Consumption	0.051	3.616	0.000	0.025	0.080	Yes
H3b) Environmental concerns → Water Saving → Circular Consumption	0.025	2.859	0.004	0.009	0.043	Yes
H3c) Environmental concerns → Waste Management → Circular Consumption	0.028	3.573	0.000	0.014	0.044	Yes
H3d) Environmental concerns → Sustainable Mobility → Circular Consumption	0.023	2.876	0.004	0.009	0.041	Yes
H3e) Environmental concerns → Zero Plastic → Circular Consumption	0.099	5.440	0.000	0.064	0.133	Yes
H6a) Pro-Sustainable Information Search → Energy Saving → Circular Consumption	0.029	3.239	0.001	0.014	0.048	Yes
H6b) Pro-Sustainable Information Search → Water Saving → Circular Consumption	0.020	2.779	0.006	0.007	0.037	Yes
H6c) Pro-Sustainable Information Search → Waste Management → Circular Consumption	0.028	3.361	0.001	0.012	0.045	Yes
H6d) Pro-Sustainable Information Search → Sustainable Mobility → Circular Consumption	0.035	3.861	0.000	0.018	0.055	Yes
H6e) Pro-Sustainable Information Search → Zero Plastic → Circular Consumption	0.099	5.566	0.000	0.060	0.131	Yes

Environmental concerns, when mediated by circular habits (energy saving, water saving, waste management, sustainable mobility and zero plastic), positively influence circular consumption, despite its marginal effect ($\beta = 0.051$; $\beta = 0.025$; $\beta = 0.028$; $\beta = 0.023$ and $\beta = 0.099$, respectively). Hypotheses H3a to H3e are confirmed. The same happens with the influence of pro-sustainable information

research on circular consumption when mediated by circular habits (energy saving - $\beta = 0.029$; water saving - $\beta = 0.020$; waste management - $\beta = 0.028$; sustainable mobility - $\beta = 0.035$ and zero plastic - $\beta = 0.099$), confirming as H6a) to H6e). Thus, we can conclude that environmental concerns and searches for pro-sustainable information by consumers influence their circular consumption, but lose intensity when mediated by their circular habits.

5. Discussion of results and implications

5.1. Discussion of results

Increasing climate change and the need to ensure the sustainability of future generations have triggered greater environmental concerns and the need to transition more quickly to a circular economy. The objective of this study is to evaluate the influence of environmental concerns and the search for pro-sustainable information by Portuguese consumers on their circular habits and the influence of these circular habits on their circular consumption. Furthermore, it assesses the influence of environmental concerns and the search for pro-sustainable information by Portuguese consumers on their circular consumption when mediated by their circular habits.

The results of this study demonstrate that consumers' environmental concerns positively influence the adoption of circular habits such as water and energy savings, waste management, sustainable mobility and the reduction of plastics. Furthermore, the environmental concerns of Portuguese consumers positively influenced their circular consumption directly and indirectly when consumers' circular habits mediated this relationship. Environmental concern is crucial for promoting environmentally sustainable practices (Saari *et al.*, 2021; Yousaf, 2021, Hameed *et al.*, 2020, Nisar *et al.*, 2021) and drives consumers to greater

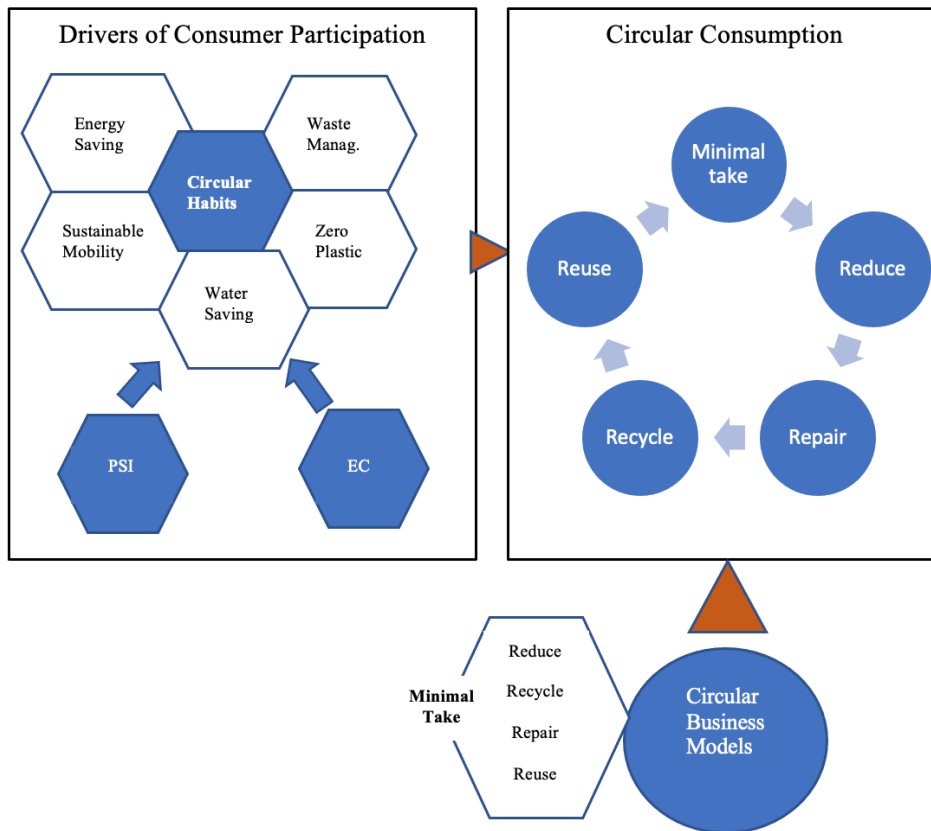
engagement with pro-environmental issues (Kormos and Gifford, 2014). Environmental concerns can result from greater knowledge of environmental problems, the prioritization of these problems by consumers and greater awareness of their role in solving these problems as they compromise future generations (Zhanbayev *et al.*, 2023). These pro-environmental behaviors influenced by environmental concerns can translate into circular habits, that is, daily or routine behaviors (Cruz and Manata, 2020) and circular consumption practices (Arruda *et al.*, 2021, Alhawari *et al.*, 2021), influencing the circular purchasing decision (Szilagyi *et al.*, 2022).

In terms of circular habits, the results also reveal that it is in energy-saving, water-saving, and zero-plastic habits that environmental concerns exert the greatest influence, results that are in line with Linder *et al.* (2022), who states that individuals tend to adopt habits that maximize the efficiency of resources such as energy and water and the reduction of plastics. The positive relationship between environmental concerns and circular consumption is corroborated in several studies (Camacho-Otero *et al.*, 2018, Patwa *et al.*, 2021, Velenturf and Purnell, 2021, Yue *et al.*, 2020). Greater awareness of environmental problems translated by greater environmental concern makes consumers feel that they have and should have responsible consumption behaviors, oriented towards sustainability to minimize their contribution to greater environmental degradation (Camacho-Otero *et al.*, 2018, Alhawari *et al.*, 2021, Velenturf and Purnell, 2021). In turn, the results reveal that there is a positive influence of consumers' environmental concerns on their circular consumption when circular habits mediate this relationship, demonstrating the important role of circular habits in translating environmental concerns into circular behaviors (Lopes *et al.*, 2023a, Szilagyi *et al.*, 2022, and Testa *et al.*, 2020).

The results also reveal that a greater search for pro-sustainable information by Portuguese consumers positively influences their circular habits and their circular consumption directly and indirectly when circular habits mediate the relationship between the search for pro-sustainable information and circular consumption. The search for pro-sustainable information consists of collecting information about sustainable practices and behaviors (Gomes and Lopes, 2023, Landon *et al.*, 2018, Tölkes and Butzmann, 2018) and drives consumers to adopt pro-sustainable actions (Tian and Liu, 2022). The more the consumer is provided with pro-sustainable information in their consumption decision, the more effective their sustainable behaviors will be and the less uncertainty there will be in deciding on their environmental practices (Díaz *et al.*, 2020; Xu *et al.*, 2023). Pro-sustainable information boosts resource conservation efforts and their efficient use (Yang *et al.*, 2022), positively influencing circular habits. Furthermore, the positive relationship between pro-sustainable information research and circular consumption found in this study corroborates the conclusions of several studies (Calvo-Porrá and Lévy-Mangin, 2020, Stangherlin *et al.*, 2023; Lopes *et al.*, 2023b) demonstrating that the search for more information of this type motivates consumers to adopt circular consumption behaviors. Finally, the positive relationship between pro-sustainable information research and circular consumption, when mediated by circular habits, provides us with new knowledge. It demonstrates that when consumers seek to be more informed about sustainability, they tend to adopt circular habits and consumption with a three-dimensional positive influence. Finally, the search for pro-sustainable information about products tends to reduce environmental concerns (Wang e Hazen, 2016) and uncertainty in purchasing behavior contributing to increasingly circular consumption (Chang *et al.*, 2021) supporting the basic principles of Signaling Theory.

5.2. Circular business model proposal

Given the results obtained in this study, we propose in Figure 2 a model of consumer participation in the circular economy articulated with the business model of circular companies. The aim of this model is to include the influence of environmental concerns and consumers' demand for pro-sustainable information on their circular consumption in companies' business models.



Note: PSI – Pro-Sustainable Information; EC – Environmental Concerns

Figure 3.2: Consumer shares in the circular economy

The consumer participation model in the circular economy assumes three dimensions: i) drivers of consumer participation, ii) circular consumption and iii)

adaptation of the companies' linear business model to a circular business model. For this model to be effective, consumers need to be actively involved in its implementation, adopting circular consumption behaviors. These behaviors consist of minimizing the extraction of resources, reusing products, reducing consumption, repairing what is damaged and recycling what is no longer useful. To adopt these behaviors, consumers need to have pro-sustainable information and be aware of the environmental consequences of their choices. Information and environmental awareness influence consumers' intention to participate in the circular economy and to incorporate circular habits into their daily lives. These habits, in turn, reinforce their environmental awareness and are guided by the information they receive about the products and services they use. It is therefore important for consumers to transform their information and environmental awareness into concrete and frequent circular actions. These actions can determine circular consumption decisions, which take into account the dimensions of the circular economy. In this scenario, companies play a key role, as they must adapt their business models to circular principles, offering consumers solutions that meet their circular consumption needs. If companies don't make this adaptation, consumers won't be able to participate fully in the circular economy, discouraging their collaboration. Therefore, companies' business models must follow circular principles (minimize, reuse, reduce, repair and recycle), contrary to consumers' linear behavior.

5.3. Theoretical implications

From this study, we can infer theoretical implications. First, it contributes to extending signaling theory to circular consumption decisions. The search for pro-sustainable information by consumers tends to reduce ambiguity and information asymmetry, supporting purchasing decisions (Agag *et al.*, 2020,

Camacho-Otero *et al.*, 2018). Consumers look for signs in products and services that reveal their characteristics, stimulating purchase intention (Martins *et al.*, 2019, Bu *et al.*, 2022). In addition, consumers with environmental concerns tend to seek more information (signals) to deepen their knowledge, try to obtain solutions and make more assertive decisions regarding their consumption (Ertz and Durif, 2017). Afterwards, this study contributes to the circular economy literature. Despite the growing attention that the circular economy has received from researchers in the last decade, the participation of consumers in this economy still seems to need to be addressed (Camacho-Otero *et al.*, 2018). In this way, this study contributes to deepening the knowledge of consumer behavior in the circular economy context. In addition, it demonstrates that environmental concerns, the search for pro-sustainable information and consumers' circular habits can be antecedents and determine circular consumption choices.

5.4. Practical implications

According to the results obtained, environmental concerns, the search for pro-sustainable information and the circular habits of consumers can influence their circular consumption, encouraging their participation in the circular economy. We can infer, in this way, a set of practical implications. Environmental concerns positively influence circular consumption. There is a need on the part of governments for massive dissemination, using social networks and dissemination in schools, of environmental problems and the need for individuals to have an active role in their resolution. Emphasising the finite life of resources and their current state of degradation awakens us to their appreciation and the role that our behaviors can assume in their minimisation. In addition, the results demonstrate that consumers need access to more pro-sustainable information

about the products and services they consume. To this end, governments should regulate the pro-sustainable information each producer must disclose about their products and services. In addition, companies have to make their production more sustainable so that the information they reveal about the composition of products meets the dimensions of the circular economy. Thus, to promote circular consumption, companies can adopt and disseminate practices that design products' durability, reuse and recyclability, use renewable energy sources and implement closed-loop supply chains. Creating a circular economy market may allow companies to buy and sell recycled, reusable and second-hand materials and products. Companies that implement sustainable practices should have government support, at the bureaucratic, financial and fiscal levels, for a more effective and rapid transformation of traditional business models into circular ones. Finally, in terms of circular habits, since they presuppose a consistent frequency of behaviors in consumers, these can be learned through companies carrying out campaigns to promote circular habits and by governments in schools. Companies' adoption of circular business models will be influenced by consumer adoption. For greater consumer engagement, company managers need to know the circular behavior of consumers to meet their needs. This implies that companies study consumer behavior and demonstrate that the quality of circular products is at least assured. Consumers should not have to pay more to become consumers wrapped in greater environmental awareness.

5.5. Study limitations and future lines of research

This study has limitations. Despite the large sample, the sample used in the study was collected for convenience; there may be bias and response trends, and it is not representative of the Portuguese population. In future studies, it would be important to use other sampling techniques, such as probabilistic sampling and

for the sample to be representative of the Portuguese population. Furthermore, most respondents are women, and the results may be biased by gender. In future studies, a more balanced sample should be ensured, and new insights should be obtained by comparing the results of the research model between men and women and using the gender variable as a mediator of the main constructs of this study. Furthermore, in this study, we consider that consumers have similar behaviors regarding environmental concerns, searching for pro-sustainable information, circular consumption and circular habits regardless of age. It would be interesting to analyse these behaviors from a generational point of view (X, Y and Z). The indicators that measure the constructs were adapted from Ratner *et al.* (2021) and Testa *et al.* (2020). Different indicators for the same constructs could lead to different results. Circular habit studies were limited to energy saving, water saving, waste management, sustainable mobility and zero plastic. It would be interesting to deepen the analysis of consumers' circular habits, extending them to the dimensions of the circular economy: reuse, recycle, repair, reduce and minimal take.

This study focuses on exploring consumer participation in the circular economy. It would be interesting to complement this perspective with the role of companies producing and supplying circular products and services. Circular consumption depends not only on consumer decisions but is influenced by the offer of products and services and the information transmitted by providing companies, as suggested by the model proposed in Figure 2. In this way, analysing the impact of strategic decisions on companies taken within the scope of the circular economy in consumer behavior will allow a more transversal analysis of the drivers of the circular economy and will enable optimising its implementation.

6. Conclusion

The transition to a circular economy has generated intense pressures at government and business levels. The participation of consumers as drivers of the circular economy has been less valued. The awareness that natural resources are finite and their current state of degradation has awakened environmental concerns in consumers and the need to have access to more information that allows them to make decisions about circular consumption. The present study aims to explore the direct influence of environmental concerns and access to pro-sustainable information on circular habits (energy saving, water saving, waste management, sustainable mobility and zero plastic) and circular consumption decisions of consumers. In addition, it also explores the role of environmental concerns and access to pro-sustainable information in circular consumption choices when mediated by consumers' circular habits.

The results reveal that environmental concerns and searches for pro-sustainable information by consumers positively influence different circular habits, with the most intense relationship being energy and water-saving habits and zero plastic. Furthermore, environmental concerns and searches for pro-sustainable information positively influence, in a direct way, circular consumption decisions when mediated by circular habits, despite the intensity of these relationships decreasing.

Given the results obtained in this study, which reveal that their environmental concerns can influence consumer behavior within the scope of the circular economy, the search for pro-sustainable information and circular habits, a model of consumer participation in the circular economy is proposed. Consumers' adherence to responsible circular consumption decisions will allow and drive the

transformation of the company's traditional business models into circular business models, accelerating more efficient management of natural resources, ensuring sustainability at a global level and the survival of future generations.

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CHAPTER 4. Generation Z goes Circular: Participation in Business Models

Reference

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CHAPTER 4. GENERATION Z GOES CIRCULAR: PARTICIPATION IN BUSINESS MODELS

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Abstract

The transition from linear to circular business models has been accelerated in recent years, valuing the role of companies but underestimating consumers' contribution to this transformation. The objective of this study is to explore the willingness of Portuguese Generation Z consumers to participate in the circular economy (CE), with circular habits and the functional value perceived by these consumers of circular products being considered as drivers of this participation. To this end, this study used a quantitative methodology, having collected, by questionnaire, a sample made up of 578 young Portuguese Generation Z and applying the Partial Least Square (PLS) method to a formulated research model. The results reveal that consumers' circular habits positively influence circular products' functional value-price and functional value-quality. In turn, the perceived functional value positively influences consumers' willingness to participate in CE, contrary to circular habits that were not statically significant in influencing this participation. However, circular habits positively influence consumers' willingness to participate in CE when mediated by the perceived functional value of circular products. This study demonstrates, for the first time, that the participation of Generation Z consumers in CE can be signalled through the functional value perceived by consumers of circular products within the scope of signalling theory. It contributes to narrowing the gap in the literature on effective consumer participation in circular business models and on the circular behavior of Generation Z consumers. Furthermore, it is the first study to use five circular habits simultaneously.

Keywords: circular habits; functional value price and quality; consumer participation; circular economy; signaling theory; Generation Z.

1. Introduction

In recent years, the circular economy (CE) has grown in terms of academic interest and practical interest for different societal stakeholders, namely companies and political decision-makers (Korhonen et al., 2018; Vidal-Ayuso et al., 2023). The CE can be defined as a sustainable economic model that seeks to reduce waste and maximize the efficient use of resources (Murray et al., 2017). CE emerges as an alternative to linear and conventional business models, as it is more environmentally sustainable and improves the performance of economic processes (Ghisellini et al., 2016). CE is not only an individual process of reconversion of companies' business models but also of consumption. This implies a change at the company level and in consumer behaviors, attitudes and values (Chizaryfard et al., 2021). The circular economy generates economic and social value, promoting a sustainable model of production and consumption. The economic value of attitudes and behaviors in the circular economy is generated by cost reduction (companies save by reusing materials and reducing waste), new business opportunities (markets for recycled products, repair services and rental of goods emerge), efficiency and innovation (more sustainable production processes reduce dependence on virgin raw materials) and job creation (stimulation of sectors such as recycling, reconditioning and the sharing economy), according to Tapaninaho and Heikkinen (2022). The social value of attitudes and behaviors in the circular economy is generated by the creation of local jobs (sectors such as reverse logistics and repair promote work in communities), reducing inequality (circular models make products more accessible, such as reused clothing and electronics), improving quality of life (reducing pollution and waste improves public health) and by environmental engagement and education (stimulates cultural changes and more conscious

consumption), according to Ayaz and Tatoglu (2024). The circular economy strengthens economic sustainability and promotes a fairer, more resilient society.

CE has been studied in different areas, from environmental and social sciences (Machado et al., 2019; Perez-Castillo and Vera-Martinez, 2020). In social sciences, most studies focus on the regeneration of companies' business models, and the role of consumers in CE has been neglected, as has been demonstrated in several studies Gomes and Lopes (2023), Lopes et al. (2023), Vidal-Ayuso et al. (2023), Camacho-Otero et al. (2018). Consumers are agents of CE processes and must be aware and motivated to actively participate in CE. In some studies, as Camacho-Otero, Boks, and Pettersen (2018) mentioned, the approach to the role of consumers in CE focuses on their circular purchasing intention or the extension of the meaning of the CE concept to the demand side. However, few studies still focus on the relationship between CE and the consumer. These studies consider their active role in CE, exploring their availability to participate in this process. To this end, it is necessary to know more about consumer behavior in EC, their attitudes, decision-making and circular habits that can provide important insights into companies' business models and political decision-making within the scope of CE (Stankevich, 2017). Deepening consumer knowledge is vital since greater consumer engagement in CE may involve behaviors that change their daily routines and lifestyle.

Within consumers, a generational cohort has been arousing interest in the most recent research on the circular and sustainable economy: Generation Z (Djafarova and Fouts, 2022; Michel et al., 2023; Gomes et al., 2023). These are young people born between 1997 and 2012, representing around 32% of the world population (WorldBank, 2024) and 20% of the Portuguese population

(Pordata 2023). There are several motivations for focusing studies on Generation Z on topics of circularity and sustainability: young people from Generation Z are the generation that has more accessible access to information since they are digital natives, and they have demonstrated that they are more aware of environmental problems, they are called green-friendly, those who value money more and are more conscious in their consumption choices when compared to other generations (Gomes et al., 2023; Ham et al., 2022; Kaplan, 2020). They make consumption decisions based on authenticity, sustainability, and purpose, as well as defend values such as diversity, activism, and immediacy. On the contrary, generations X (1965-1980) valued stable work and hierarchy; they were loyal to traditional brands and valued independence, pragmatism and hard work, and Generation Y (1981-1995) sought experiences and personalization in their consumption and defended values such as collaboration, purpose and innovation.

To contribute to narrowing the gap in the relationship between the CE and consumers, two research questions arise: i) What is the influence of the circular habits of Generation Z consumers on their willingness to participate in the CE? and ii) What is the influence of the perceived functional value of consuming circular products on your availability to participate in CE? Therefore, the objective of this study is to explore the willingness of Portuguese Generation Z consumers to participate in the CE, with circular habits and the functional value perceived by these consumers of circular products being considered as drivers of this participation. Five circular habits were considered: recycling, reusing, repairing, reducing and circular shopping. The perceived functional value of circular products was measured by functional value-quality and functional value-price. To this end, a quantitative methodology was applied to a sample of 578 Portuguese Generation Z consumers, and a research model was proposed and

estimated using the Partial Least Square (PLS) method.

The results demonstrate that circular habits positively influence the perceived functional value of circular products and that this perceived functional value influences consumers' willingness to participate in CE. It was also found that there is a positive influence of the relationship between circular habits and consumers' willingness to participate in CE, which is mediated by the perceived functional value of circular products.

This study makes several contributions. In theoretical terms, firstly, it contributes to expanding the scope of application of signalling theory by demonstrating that the participation of Generation Z consumers can be used as a signal translated by the perceived functional value of the consumption of circular products, and not just that consumption of products is only flagged if it is expensive or luxury (Gomes et al., 2023). Second, it narrowed the gap regarding the need for more information about consumer behavior and its role in CE (Camacho-Otero, Boks, and Pettersen 2018). Third, it focuses specifically on the relationship between consumers and CE, with few studies that do so and explores some drivers of consumers' active participation in CE (Lopes et al., 2023; Vidal-Ayuso et al., 2023). Fourth, as far as we know, this is the first study that brings together many circular habits. Most existing studies focus on just one or two circular habits (e.g. Shevchenko et al., 2023; Maitre-Ekern and Dalhammar. 2019). Fifth, this study contributed to a better understanding of Gen Z's circular consumer behavior, contributing to the literature on generational cohorts. Finally, the results of this study can be used strategically in reconfiguring companies' business models and boosting government decision-making within the scope of the CE.

2. Theoretical Framework

2.1. Signalling Theory

The framework of this study is the Signalling Theory, which allows behavior to be described in two dimensions (individuals and companies) that have undifferentiated access to information (Connelly et al., 2011). In this relationship, the sender of information chooses how to signal the information, and the receiver decides how to interpret the received signal. Within the scope of social sciences, Signaling Theory has been used in several academic studies, namely in the area of green consumer behavior (e.g. Ki and Kim, 2022; Cao and Xu, 2023; Waites et al., 2020) and circular consumer behavior (e.g. Wang et al., 2020; Gomes et al., 2022; de Morais et al., 2021). When this theory is applied to information sent and received about product quality, it becomes interesting to explore product signalling, particularly circular products. In the case of circular products, information on their quality is ambiguous, and there is little consensus among consumers in the pre-purchase phase. It becomes even more important when the products are new, when there is little information about the products because they are not widely consumed, and when consumers are uninformed and have an elastic behavior about the quality of the products (Sun et al., 2021). The ultimate objective is that quality product signalling reduces information asymmetry and uncertainty in consumer behavior and promotes purchase intention (Zhang 2021). Some studies have associated the Signaling Theory with the behavior of consuming green products, in which consumers can signal that they are willing to buy products with a higher price because they associate quality and health benefits with green products (Berger, 2019; Wang et al., 2020). Especially useful in this study are consumers' perceived functional value of circular products, whether through their functional quality-value or functional

price-value, which are signals that, if well received by issuers, can encourage consumer participation in CE. This means that consumer behavior can be changed to support CE and that one of the motivations can be through the information they receive about the perceived functional value of circular products.

3. Literature Review

3.1. Consumer participation in circular business models

The circular business model consists of creating, delivering and capturing value within the scope of CE (Elzinga et al., 2020). In addition to satisfying customer needs and creating economic value for society, organisations create environmental and social value for customers, other stakeholders and future generations (Geissdoerfer et al., 2017). Circular business models mainly focus on protecting and rationalising natural resources and circularising products, materials and waste to capture and preserve the greatest possible value (Reike et al., 2018). On the contrary, in linear business models, the flow of products, materials and waste is unidirectional. The circular business model has changed with the inclusion of consumer participation in different processes due to their growing demand burdening the environment and compromising future generations (Vidal-Ayuso et al., 2023; Esposito, 2018). If in the linear model, consumer participation was summarized in the “disposal” phase, in linear economic models, consumers are involved in different phases from “making” to “discarding”. Thus, consumers are engaged in the “make”, “distribute”, “buy”, “reduce”, “reuse” and “recycle” phases. In this way, consumers are more aware of the impact of their consumption in environmental terms and feel greater responsibility for their actions about the environment and society in general

(Patwa et al. 2021). In response to the appreciation of consumer behavior, companies tend to involve consumers in their circuit in different business models, despite the high demands of consumers in terms of circularity can be an obstacle to circular production (Patti, 2017). To achieve this, production must adapt to the demand of circular consumers to guarantee greater participation, resulting from greater acceptance of CE by consumers (Peronard and Ballantyne, 2019).

3.2. Circular habits

Consumers' circular habits refer to sustainable consumption practices aligned with the principles of the circular economy, aiming to reduce waste and extend the life cycle of products. These habits encourage more conscious consumption, minimizing environmental impacts and maximizing the efficient use of resources. Consumer decisions are strongly influenced by the information they collect and assimilate and their education. The information consumers access, particularly regarding products, is a driver of CE (Musova et al., 2021; Ozanne et al., 2021). This information can be transmitted through education and by capturing signals about the quality, availability and access to informative product details (Bigerna et al., 2021). The demand for products will depend on consumers' perceptions of them, whose characteristics were communicated and triggered bonds in the consumer with these products, accepting the market for these products (Confente et al., 2020).

Consumers' pro-sustainable information and environmental concerns positively influence circular habits (Gomes and Lopes 2023). Circular habits are actions and behaviors that individuals frequently adopt to reduce their environmental impact (Akram et al., 2023). Studies have identified circular habits transforming consumers from conventional to sustainable behavior (Linder et al., 2022). Some

examples of circular habits are recycling packaging and products and avoiding disposable or heavily packaged products (Civancik-Uslu et al., 2021), reducing consumption to what is strictly necessary (Maitre-Ekern and Dalhammar, 2019), reusing products such as clothes, bath water, product packaging, and repairing to extend their useful life instead of discarding them (Cooper and Gutowski, 2017) and purchasing circular products (recycled, eco-efficient, repaired, rechargeable and with low carbon emissions). The literature suggests that consumers' adoption of circular habits leads to a greater predisposition to participate in CE (Testa et al., 2020).

3.3. Perceived functional value of circular products

The perceived value of products by consumers is a competitive advantage for companies (Zeithaml et al., 2020) and positively influences consumer satisfaction and loyalty (Devi and Yasa, 2021). Consumers' perceived value of products becomes a competitive advantage by generating differentiation, justifying higher prices, increasing consumer loyalty, and strengthening the brand image. Companies that understand and meet consumer expectations about quality, functionality and sustainability gain an advantage over their competitors. Perceived value can be defined as the contribution the consumer perceives to achieve their purposes (Prohl and Kleinaltenkamp, 2020). It can encompass several dimensions, such as economic value and functional value (Sweeneya and Soutar, 2001). In this study, we address the functional value-price and the functional value-quality consumers attribute to the consumption of circular products. Regarding CE, functional value refers to perceptions of circular products' quality, usefulness, price and performance (Majeed et al., 2022). Functional value can influence the implementation of a circularity system (Fehrer and Wieland, 2021). Value creation in CE is diverse and systemic, as it can be

shaped by different business models such as recycling, reusing and reducing (Ranta et al., 2021). In this way, circularization is not a closed and unique process for one company but requires the collaboration of other companies to create circular flows of materials, creating functional value (Harala et al., 2023). Thus, the greater the functional value attributed to circular products by consumers, the greater their predisposition to participate in CE (Qasim et al., 2019; Kushwah et al., 2019). In this study, two dimensions were considered in the functional value of circular products: quality and price. The functional value quality of circular products is associated with the perceived utility attributed by consumers to circular products, which is formulated through their physical performance, durability, functionality, serviceability, usefulness, and environmentally friendly and is normally promoted by the attributes of the products (Mohd Suki, 2016; Kianpour et al., 2014). Many consumers of circular products do not only evaluate the price when making a purchase decision but also other functional attributes and their compositions (namely the ingredients). The price functional value of circular products can be described as consumers' perception of the fairness of their price (Alam et al., 2025). According to Diller (1997), there are five dimensions in functional value-price assessed by consumers: relative price (comparison of prices with similar products), reliability (price expectation) and confidence (favorable price) in the price, price transparency (fair view of the prices charged) and price-quality relationship (balance between price and perceived quality). These drivers influence the choice of environmentally friendly products, predispose consumers to pay more (Majeed et al., 2022), and influence consumer behavior (Khan and Mohsin, 2017). In this way, we can conclude that consumers' attitudes will influenced circular consumption choices, values (e.g. functional, social, epistemological) and habits, influencing their participation in CE.

3.4. Summary of key findings and gaps identified

Table 1 presents the main key findings, authors and gaps identified in the literature review for each topic.

Table 4.1: Summary of key findings and gaps

Topic	Key Findings	Authors	Gaps Identified
Consumer Participation in Circular Business Models	<ul style="list-style-type: none"> - Consumers are increasingly involved in the entire life cycle of products, not just in the disposal phase. - Participation covers the phases of "making", "distributing", "buying", "reducing", "reusing" and "recycling". - Companies need to adapt to meet the demands of circular consumers and ensure greater participation in CE business model. 	<p>Vidal-Ayuso et al. (2023), Esposito (2018), Patwa et al. (2021), Peronard and Ballantyne (2019)</p>	<ul style="list-style-type: none"> - Lack of detailed understanding of how companies can effectively encourage consumer participation at different stages of the circular cycle. - Need for more studies on the barriers perceived by consumers to engage with circular business models.
Circular Habits	<ul style="list-style-type: none"> - Circular habits include recycling, reusing, reducing consumption and purchasing circular products (e.g., recycled, eco-efficient). - Education and access to information are decisive for the adoption of these behaviors. - Pro-sustainability information positively influences the adoption of circular habits. 	<p>Musova et al. (2021), Akram et al. (2023), Linder et al. (2022), Civancik-Uslu et al. (2021)</p>	<ul style="list-style-type: none"> - Lack of studies that empirically analyze consumers' circular habits. - Most studies only address one or two circular habits - The research lacks more data on the impact of awareness campaigns on changing consumer behavior.
Perceived Functional Value of Circular Products	<ul style="list-style-type: none"> - Consumers' perceptions of quality and price influence their willingness to participate in CE. - Quality is linked to durability, performance and environmental sustainability. - Price fairness and the price-quality relationship influence consumer choices. 	<p>Majeed et al. (2022), Fehrer & Wieland (2021), Qasim et al. (2019), Kushwah et al. (2019)</p>	<ul style="list-style-type: none"> - Need for more research on how consumers evaluate the cost-benefit ratio of circular products in different cultural and economic contexts. - Lack of clarity about which functional value attributes (quality, price, performance) are most valued by consumers in practice.

4. Formulation of hypotheses

Taking into account the literature review, the following hypotheses were formulated:

H1: The circular habits of a) recycling, b) repairing, c) reusing, d) reducing and e) circular purchasing of young Portuguese Generation Z positively influence the functional value and price attributed by these consumers to circular products.

H2: The circular habits of a) recycling, b) repairing, c) reusing, d) reducing and e) circular purchasing of young Portuguese Generation Z positively influence the functional value quality attributed by these consumers to circular products.

H3: The circular habits of a) recycling, b) repairing, c) reusing, d) reducing and e) circular purchasing of young people from the Portuguese Generation Z positively influence the willingness of these consumers to participate in CE.

H4: The circular habits of a) recycling, b) repairing, c) reusing, d) reducing, and e) circular purchasing of young people from the Portuguese generation Z positively influence the willingness of these consumers to participate in CE when mediated by the functional value attributed by these consumers to circular products.

H5: The circular habits of a) recycling, b) repairing, c) reusing, d) reducing, and e) circular purchasing of young people from the Portuguese Generation Z positively influence the willingness of these consumers to participate in CE when mediated by the functional value quality attributed by these consumers to circular products.

H6: The functional value attributed to circular products by young Portuguese Generation Z positively influences their willingness to participate in CE.

H7: The functional quality value attributed to circular products by young

Portuguese Generation Z positively influences their willingness to participate in CE.

5. Methods

5.1. Sample

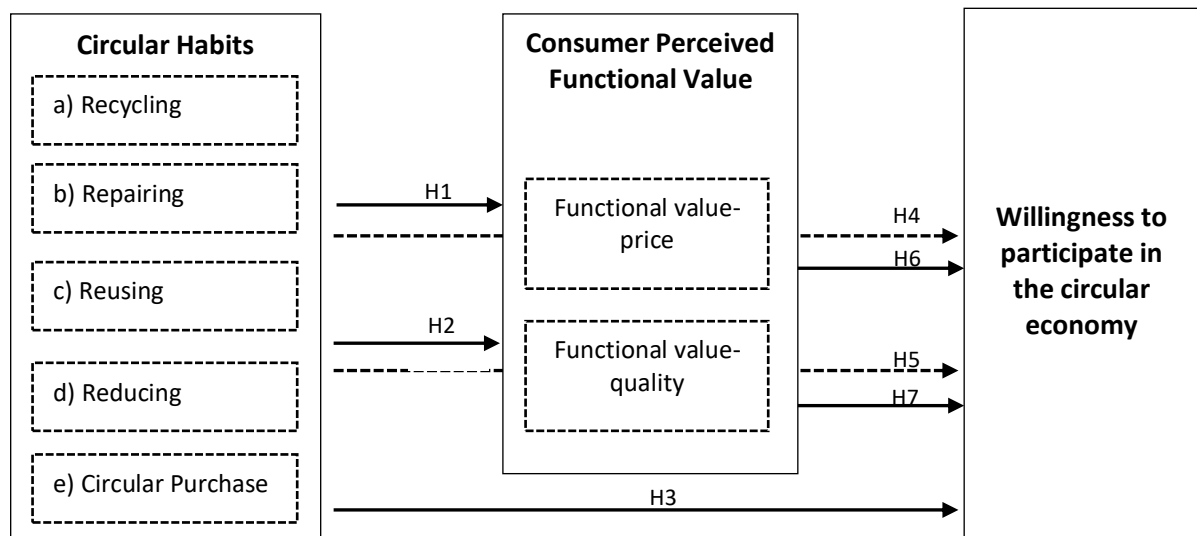
The sample for this study was obtained through an online questionnaire, the link to which was made available by the authors on their social networks (Facebook and LinkedIn) and both contact networks. As such, the sample is non-probabilistic and was collected for convenience. Responses were obtained between October and December 2023. The questionnaire was anonymous, informed consent was obtained from all participants, and the purpose of the study was explained. A pre-test was conducted with 15 participants (with different sociodemographic characteristics) to evaluate the average response time and understanding of the questions. This pre-test revealed that, on average, participants took around 4 minutes to respond, and there were no difficulties in understanding the questions.

The eligibility criterion for participating in the questionnaire is young people from Generation Z over 18 years old, that is, between 18 and 28 years old. To this end, the questionnaire contained the following question: ("I declare that I am between 18 and 28 years old - yes or no"). If respondents did not meet this condition, the questionnaire ended. If they answered affirmatively, they had access to the remaining questions in the questionnaire. We received a total of 598 responses, of which 578 responses met the eligibility criteria. In Portugal, according to data from Pordata (2023) around 1.1 million young people belong to Generation Z. If we consider an error term of 3% and a confidence level of 95%, 1,067 responses would be needed, with fewer responses obtained.

Regarding sociodemographic characterization of the sample, 50.5% are male, 47.8% are female, and 1.7% are other. The average age of the sample is 23.5 years old, with 19% between 18 and 20 years old, 74% between 21 and 24 years old and 7% between 25 and 28 years old. Regarding education, 45.7% have a degree, and 46.7% have completed secondary education. Most participants do not earn any monthly net income (58.8%), 28.4% have a maximum monthly net income of €750, and 4.2% have between €751 and €1,000.

5.2. Research model

Based on the literature review, Figure 1 shows the research model and the hypotheses formulated. The five circular habits (recycling, repairing, reusing, reducing and circular purchase) influence consumers' perceived functional value (price and quality) of circular products by consumers and their willingness to participate in the circular economy. A mediating effect of consumers' perceived functional value of circular products between circular habits and willingness to participate in the circular economy was also formulated.



Note: Direct effects (→) and mediating effects (→).

Figure 4.1: Research Model

5.3. Data Measurement

The questionnaire consists of four groups of questions. The first group refers to the sociodemographic characteristics of the participants. The second group refers to five circular habits: i) recycling with five items, ii) repairing with four items; iii) reusing with six items; iv) reducing with five items and v) circular purchases with six items. The circular economy is based on the principle of minimizing waste and maximizing the efficient use of resources, being guided by the 5 R's: Refuse (manifested in circular purchases), Reduce, Reuse, Recover and Recycle. These principles connect directly with the five circular habits, promoting sustainable practices in everyday life. These items were adapted from Lee et al. (2013) and Ratner et al. (2021). The third group referring to perceived value included two dimensions: four functional value-quality items and four functional value-price items. This group of questions was adapted from Mohd Suki (2016) and Mostaghel and Chirumalla (2021). The fourth group of questions relates to the willingness of consumers to participate in circular business models and consists of six items, adapted from Hao et al. (2020), Ignacio et al. (2019) and Rezaei and Ghofranfarid (2018). The second group of questions relating to circular habits was measured on a 5-point Likert scale of frequency (1 – never to 5 – very often), and the remaining groups on a 5-point Likert scale of agreement (1 – completely disagree to 5 – I totally agree). The details of the items for each question and scale are described in Appendix A.1.

5.4. Data Analysis

The data analysis of this study was carried out in five stages. Firstly, a statistical analysis was carried out on the items that measure the constructs included in the research model. Afterwards, a factor analysis was carried out, and an exploratory factor analysis (EFA) was implemented to divide the items by factors and a

confirmatory factor analysis (CFA) to evaluate the factor loadings of each construct and the reflective nature of the research model (Watkins, 2021). In the third stage, the Partial Least Square (PLS) method was applied to the research model. This method combines factor analysis with the estimation of linear regressions using the Ordinary Least Square method (Hair et al., 2018). The PLS method stands out for its flexibility, statistical robustness and ability to deal with small samples and non-normal data. Furthermore, its ability to model complex relationships and optimize variance explanation makes it a powerful tool for analyzing research models (Hair et al., 2018). Despite its flexibility and applicability to exploratory models, the PLS method presents limitations in global adjustment, potential bias in estimates and difficulty in confirmatory tests. Furthermore, choosing between reflective and formative indicators can significantly impact the model results. Poorly specified models can lead to wrong conclusions (Hair et al., 2018). It is a method already used by other authors in studies on circular consumer behavior, such as Chao and Yu (2023) and Gomes and Lopes (2023). The model obtained after applying the PLS method was evaluated in terms of convergence, feasibility and discriminant validity using the measures proposed by Hair et al. (2018): (i) Cronbach's Alpha ($C\alpha > 0.70$); (ii) Composite reliability ($CR > 0.70$); (iii) Average Variance Extracted ($AVE > 0.5$) and (iv) discriminant validity tested by the Fornell-Larcker criterion. The fifth stage consisted of implementing a bootstrap analysis to test the relationships between the constructs included in the research model. The implementation of bootstrap analysis is essential for testing the relationships between the constructs of the research model, as it improves the precision of the estimated coefficients, overcomes statistical limitations, reinforces the validity of the results and increases the reliability of inferences about the model (Alfons et al., 2022).

6. Results

6.1. Descriptive Analysis

Table 2 contains a statistical analysis (mean and standard deviation) of the items considered in the research model. The results demonstrate that participants' circular habits do not all occur with the same frequency. Thus, on average, the most frequent circular habit is repairing (M = 3.88), recycling (M = 3.47), reusing (M = 3.38), circular purchasing (M = 3.25) and, finally, reducing (2.98). Regarding perceived value, the items that generated the greatest agreement among participants were those relating to functional value-quality (M = 3.52). In the willingness to participate in the CE construct (M = 3.38), the item that generated the greatest agreement was WP5 – “I will support the development of a circular economy in Portugal”.

Table 4.2: Descriptive statistics of items

Constructs	Mean	Std. Deviation
Recycling	3.47	1.248
REC1	3.66	1.163
REC2	3.67	1.184
REC3	3.83	1.167
REC4	3.13	1.37
REC5	3.04	1.358
Repairing	3.88	1.032
REPAIR1	3.78	1.062
REPAIR2	4.02	0.962
REPAIR3	3.89	0.991
REPAIR4	3.81	1.016
Reusing	3.38	1.13
REUT1	4.06	1.092
REUT2	3.75	1.276
REUT3	1.77	1.191

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REUT4	3.00	1.189
REUT5	3.99	1.006
REUT6	3.71	1.033
Reducing	2.98	1.108
REDUCE1	3.31	1.154
REDUCE2	3.05	1.034
REDUCE3	2.91	1.031
REDUCE4	2.90	1.042
REDUCE5	2.75	1.280
Circular Purchase	3.25	1.050
PURCH1	3.04	1.116
PURCH2	3.17	1.037
PURCH3	3.33	1.056
PURCH4	3.11	1.079
PURCH5	3.57	1.031
PURCH6	3.27	0.982
Functional value-quality	3.52	0.834
VF1	3.51	0.837
VF2	3.52	0.816
VF3	3.55	0.819
VF4	3.50	0.821
Functional value-price	3.29	0.879
VPF1	3.21	0.905
VPF2	3.29	0.899
VPF3	3.28	0.820
VPF4	3.37	0.873
Willingness to participate in the CE	3.38	0.897
WP1	3.19	0.961
WP2	3.09	1.000
WP3	3.08	0.948
WP4	3.57	0.818
WP5	3.76	0.774
WP6	3.57	0.879

6.2. Data analysis

The sample for this study is adequate according to the statistical value obtained by applying the Kaiser–Meyer–Olkin test (0.842). The results of the implementation of EFA and CFA are included in Appendix A.2. The implementation of EFA resulted in the division of items into eight factors corresponding to the constructs in the research model. No items were deleted. The accumulated variance of the factors is 64.68%, with no factor individually explaining more than 50% of the total variance. As such, the responses have no biases according to the common bias method. The implementation of the CFA demonstrates that all items present high confirmatory factor loads (greater than 0.70), and the reflective nature of the model was confirmed.

6.3. Measurements of the research model after applying the PLS method

The model obtained after applying the PLS method to the research model was evaluated regarding reliability, convergence and discriminant validity (table 3) according to reference values by Hair et al. (2018). The results presented for Cronbach Alpha, Composite Reliability and Average Variance Extracted are superior to the reference values ($C\alpha > 0.70$; $CR > 0.70$ and $AVE > 0.50$), and as such, the model is convergent and reliable. Furthermore, the results of applying the Fornell Larcker criterion demonstrate the model has discriminant validity since the square root AVE of each construct (in bold on the diagonal of Table 3) is greater than the correlations between that construct and all other constructs in the model.

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Table 4.3: Model evaluation after applying the PLS method

Constructs	R^2	CR	AVE	Recycling	Repairing	Reusing	Reducing	Circular Purchase	Functional value-quality	Functional value-price	Willingness to participate in the CE
Recycling	0.849	0.894	0.636	0.797							
Repairing	0.825	0.881	0.650	0.312	0.806						
Reusing	0.717	0.808	0.514	0.528	0.570	0.717					
Reducing	0.720	0.816	0.575	0.297	0.366	0.550	0.758				
Circular Purchase	0.874	0.905	0.615	0.411	0.423	0.543	0.480	0.785			
Functional value-quality	0.925	0.947	0.816	0.279	0.218	0.262	0.155	0.319	0.893		
Functional value-price	0.925	0.947	0.816	0.277	0.179	0.275	0.184	0.313	0.705	0.904	
Willingness to participate in the CE	0.836	0.877	0.548	0.275	0.247	0.284	0.218	0.361	0.700	0.636	0.740

The quality of the model fit was also evaluated according to measures of Hair et al. (2018). The model presents a good fit considering the values obtained for the Chi-Square ($p = 0.081$), Goodness-of-Fit (0.976), the Comparative Fit Index (0.812), and Standard Root Mean Square Residual (0.090). The Variance Inflation Factor (VIF) coefficients were used to detect collinearity between independent variables. As all VIFs obtained are less than 3, there is low collinearity, that is, a low probability of roundness between the variables (Hair et al., 2018). The endogeneity of the model obtained after applying the PLS algorithm was further evaluated in terms of endogeneity. To this end, the Latent Variable Score Approach was applied, which uses the residuals of the latent variables to check whether there is a correlation with the error and, if necessary, includes a residual latent variable to capture the endogenous effect. The results demonstrate that the residuals of the latent variables are not related to the model error terms (correlation less than 0.30), and as such, endogeneity is not a significant problem

(Hair et al., 2018). The model obtained was also evaluated regarding the coefficient of determination (R^2) and predictive relevance (Stone-Geisser Q^2) based on the cross-validated redundancy approach. The results demonstrate that the model's independent variables referring to circular habits explain 54.9% of the variance of the dependent variable willingness to participate in the circular economy, 22.9% of the functional value-quality variable and 22.7% of the functional price-quality variable (Table 4). Furthermore, the model has predictive relevance since the Q^2 coefficients are greater than zero.

Table 4.4: Coefficient of determination and predictive relevance of the model

	R^2	Q^2
Willingness to participate in the CE	0.549	0.290
Functional value-quality	0.229	0.100
Functional value-price	0.227	0.107

6.4. Estimation of the relationships contained in the research model

Tables 5 and 6 contain the results of the bootstrap analysis, which allowed for estimating the direct and mediating relationships between constructs established in the research model.

Table 4.5: Results of direct effects between constructs

Direct Effects	Coefficient	T Statistics	P Values	Confidence Interval		Hypothesis Support
				2.5%	97.5%	
H1a: Recycling -> VPF	0.147	3.301	0.001	0.055	0.229	Yes
H1b: Repairing -> VPF	0.005	0.113	0.001	0.084	0.080	Yes
H1c: Reusing -> VPF	0.092	1.605	0.009	0.011	0.202	Yes
H1d: Reducing -> VPF	0.009	0.189	0.005	0.092	0.083	Yes
H1e: Circular Purchase -> VPF	0.210	4.996	0.000	0.119	0.277	Yes
H2a: Recycling -> VF	0.155	3.745	0.000	0.076	0.237	Yes
H2b: Repairing -> VF	0.066	1.618	0.006	0.004	0.151	Yes
H2c: Reusing -> VF	0.047	0.835	0.004	0.063	0.150	Yes
H2d: Reducing -> VF	0.050	1.096	0.004	0.130	0.041	Yes
H2e: Circular Purchase -> VF	0.226	5.159	0.000	0.135	0.309	Yes
H3a: Recycling -> WP	0.017	0.514	0.608	0.053	0.078	No
H3b: Repairing -> WP	0.050	1.553	0.121	0.013	0.112	No
H3c: Reusing -> WP	0.021	0.576	0.565	0.097	0.048	No
H3d: Reducing -> WP	0.041	1.157	0.248	0.028	0.110	No
H3e: Circular Purchase -> WP	0.093	2.840	0.005	0.026	0.155	Yes
H6: VPF -> WP	0.259	6.021	0.000	0.176	0.338	Yes
H7: VF -> WP	0.471	10.344	0.000	0.378	0.560	Yes

Note: WP: Willingness to participate in the CE; VF: Functional value-quality; VPF – Functional value-price

Estimating direct effects (Table 5) between the constructs reveals that all circular habits positively influence the functional price value attributed to circular products, confirming hypotheses H1a to H1e. However, the influence between circular habits and functional value-price is not uniform. The circular shopping habit is what most influences the functional value price ($\beta = 0.210$), followed by recycling ($\beta = 0.147$), reusing ($\beta = 0.092$), reducing ($\beta = 0.009$) and repairing ($\beta = 0.005$). Circular habits also positively influence the functional value-quality of circular products, confirming hypotheses H2a to H2e. Although circular purchasing ($\beta = 0.226$) and recycling ($\beta = 0.155$) are the habits that most

influence the functional value-quality of circular products (as has already been seen for the functional value-price), there is a new intensity of influence of the remaining habits: repairing ($\beta = 0.066$), reducing ($\beta = 0.050$) and reuse ($\beta = 0.047$). It should also be noted that circular habits more positively influence the functional value quality attributed by consumers to circular products than their functional value price.

Furthermore, the results reveal that circular habits are not statistically significant in affecting consumer participation in CE, rejecting hypotheses H3a to H3e.

Finally, hypotheses H6 and H7 confirmed that the functional value-price ($\beta = 0.259$) and the functional value-quality attributed to circular products ($\beta = 0.471$) positively and significantly influence these consumers' willingness to participate in the CE. This perceived value influence on circular products is more intense regarding functional value-quality.

Table 4.6: Results of mediating effects between constructs

Mediating Effects	Coefficient	T Statistics	P Values	Confidence Interval		Hypothesis Support
				2.5%	97.5%	
H4a: Recycling -> VPF > WP	0.038	2.831	0.005	0.013	0.005	Yes
H5a: Recycling -> VF > WP	0.073	3.471	0.001	0.034	0.008	Yes
H4b: Repairing -> VPF > WP	0.001	0.113	0.910	0.022	0.022	Yes
H5b: Repairing -> VF > WP	0.031	1.581	0.114	0.002	0.001	Yes
H4c: Reusing -> VPF > WP	0.024	1.540	0.124	0.003	0.003	Yes
H5c: Reusing -> VF > WP	0.022	0.828	0.408	0.030	0.001	Yes
H4d: Reducing -> VPF > WP	0.002	0.186	0.853	0.024	0.022	Yes
H5d: Reducing -> VF > WP	0.023	1.076	0.282	0.061	0.019	Yes
H4e: Circular Purchase -> VPF > WP	0.054	3.694	0.000	0.028	0.005	Yes
H5e: Circular Purchase -> VF > WP	0.107	4.663	0.000	0.059	0.005	Yes

Note: WP: Willingness to participate in the circular economy; VF: Functional value-quality; VPQ: – Functional value-price

The results of the mediating effects of the perceived value constructs between circular habits and the willingness of Portuguese consumers of Generation Z to participate in the circular economy are described in Table 6. All circular habits positively influence the willingness of Portuguese consumers of Generation Z to participate in the circular economy when mediated by functional value-price and functional value-quality. Thus, the mediating hypotheses H4a to H4e and H5a to H5e are confirmed. The circular purchase habit most influences the willingness to participate in the CE ($\beta = 0.107$), when mediated by functional value-quality, followed by the recycling habit ($\beta = 0.073$). The same happens when mediated by functional value-price.

7. Discussion and implications

7.1. Discussion

Literature on the transition from linear to circular business models has grown significantly in recent years, essentially focusing on the role of companies and neglecting the contribution of consumers (Camacho-Otero et al., 2018). In particular, there is still little information about the factors that can drive greater consumer participation in circular business models. This study contributes to this research gap by exploring the influence of circular habits and the perceived functional value of circular products by young Portuguese consumers of Generation Z on their willingness to participate in CE.

The results demonstrate that circular habits, that is, attitudes and behaviors frequently carried out by consumers within the scope of circularity, positively influence the perceived value of circular products in its two dimensions (functional value price and functional value quality). Previous studies have shown that habits can transform consumers' conventional or linear behaviors into

sustainable ones with less environmental impact (Linder et al., 2022). Recycling and repairing habits are the most frequent habits among young Portuguese consumers of Generation Z participating in this study, as found by Svensson-Hoglund et al. (2023). Recycling and repair are among the most studied consumer attitudes in various areas of CE, such as electronic products (Islam et al., 2021) and textiles (Paço et al., 2021; McNeill et al., 2020; Musova et al., 2021). However, recycling and circular purchasing habits most positively affect the functional value attributed to circular products by consumers in both dimensions (functional value-price and functional value-quality), creating more value for the consumer of circular products (Prohl and Kleinaltenkamp, 2020). As such, by influencing consumers' perceived value of circular products, these circular habits can increase their satisfaction and loyalty to products (Devi and Yasa, 2021) and generate competitive advantages for companies (Zeithaml et al., 2020). Furthermore, previous studies have already demonstrated that the functional value attributed to circular products can influence the implementation of a circularity system (Fehrer and Wieland, 2021) as in the results obtained in this study. The circularization system is an open and collaborative process with other stakeholders (consumers, suppliers, companies and government) that allows the creation of functional value through circular flows of materials (Harala et al., 2023), which in turn increases consumers' predisposition to participate in CE (Qasim et al., 2019; Kushwah et al., 2019). However, the results demonstrate that circular habits do not directly affect consumers' willingness to participate in CE. However, suppose the relationship between circular habits and consumers' willingness to participate in CE is mediated by the functional value-price and the functional value-quality. In that case, we find a positive relationship between the constructs. These results demonstrate that it is not because consumers have frequent circular attitudes that they are more predisposed to participate in CE,

contradicting the results of Testa et al. (2020) and, as such, creating new knowledge about consumer behavior in CE. Consumers must recognize the perceived value of circular products in terms of price and quality and then be available to be active agents in CE business models (Laukkanen and Tura, 2022; Mostaghel and Chirumalla 2021). Therefore, the consumption of circular products must create value for consumers through functional value to create consumer perceptions of the quality, usefulness, price and performance of circular products (Majeed et al., 2022).

7.2. Theoretical implications

Theoretically, this study contributes new knowledge to signalling theory and research on the role of the consumer in CE. First, signalling theory demonstrates that circular products can be signalled through their functional value-price and functional value-quality and that if consumers receive these signals well, they can encourage their participation in the CE. Consumers' perception of the functional value of circular products results from obtaining more information about them, particularly in terms of prices and quality, reducing information asymmetry and positively influencing their acceptance of circularity systems (Fehrer and Wieland, 2021). This information is signals emitted by companies about the perceived usefulness, materialized in the physical performance, durability, functionality, serviceability, usefulness, and environmentally friendly of circular products (Mohd Suki, 2016; Kianpour et al., 2014) as well as the reliability and reliability of prices, relative prices and price transparency (Diller, 1997). Previous studies have shown that green products can have a signalling benefit when consumers are willing to pay more for these types of products (Berger, 2019). Our study demonstrates that the signalling of circular products does not have to be through a higher price but through the functional value

attributed to these products. To our knowledge, this is the first study to use the perception of the functional value of circular products as a signal to consumers. Second, the results of this study contribute to narrowing the existing gap regarding the need to have more information about consumer behavior and their role in CE (Camacho-Otero et al., 2018) for several reasons: i) it demonstrates that habits circulars can be antecedents of the functional value of circular products and that this functional value drives consumer participation in CE; ii) demonstrates that circular habits alone do not increase consumer participation in CE but that this relationship can be positively affected when mediated by functional value price and functional value quality, that is, consumers will only be willing to participate in CE if they recognize that there is functional value created in the consumption of circular products; iii) as far as we know, this is the first empirical study to consider five circular habits of consumers, whereas in other studies one or two circular habits were considered; iv) contributes to the literature on generation Z consumer behavior, which, due to the expressiveness and potential of this generation, can change the most classic paradigms about consumption.

7.3. Practical implications

This study provides valuable practical implications for three key audiences: consumers, companies, and policymakers, highlighting how they can collectively drive and benefit from the transition to a CE.

For consumers, adopting circular habits is an environmental choice and a pathway to making more informed and sustainable purchasing decisions. The study suggests that pro-sustainable information and environmental concerns significantly influence consumers' circular behaviours (Gomes and Lopes, 2023). To support this, consumers must be empowered with clear, accessible

information about the circularity of products, materials, and processes. This includes knowledge about how their choices impact the environment across various phases, from "making" to "disposing" (Vidal-Ayuso et al., 2023). Enhanced transparency enables consumers to engage more meaningfully in CE, making informed decisions on reducing waste and conserving resources. Additionally, consumers are more likely to adopt circular behaviors when they perceive high functional value in circular products. This includes considerations of the products' durability, reparability, quality, and price—factors that, if communicated effectively, can increase willingness to participate in CE.

For companies, this study underscores the importance of providing accurate and comprehensive information to bridge the information asymmetry gap that often hinders consumer participation in CE. Companies can create value by signaling the circularity of their products, specifically through the communication of functional value, quality, and price transparency. Companies can build consumer trust and loyalty by focusing on authentically circular products—such as reducing plastic in packaging, enhancing product longevity, promoting repair services, and ensuring end-of-life product recovery. Clear labeling with product details on materials, ingredients, circular systems, and quality can improve consumer confidence. Moreover, offering circular products that are both environmentally responsible and economically competitive can position companies as leaders in sustainability, ultimately enhancing their market share. Companies should also invest in consumer education, providing the necessary tools and resources that empower individuals to engage in circular practices.

For political decision-makers, the findings suggest several opportunities to promote circular habits and enhance CE adoption. Policies should encourage the public to engage in more sustainable behaviors through media campaigns, educational programs, and company collaborations. Promoting circular habits

through the media, schools, and businesses can increase public awareness and adoption. Furthermore, governments should consider providing financial incentives—such as tax benefits and non-refundable funds—for companies that commit to circular business models. This would incentivise sustainability and support innovation in circular product development. Another key policy recommendation is the mandatory inclusion of clear information on the circularity of products, especially on labels, so that consumers can easily access details on the product's functional value. Furthermore, integrating circular behaviours into educational curricula at all levels—from primary to higher education—can instil sustainable consumption patterns in future generations.

8. Conclusion

The objective of this study is to explore the influence of the circular habits of young Portuguese Generation Z on the functional value attributed by them to circular products and on the availability to participate in CE, either directly or when the relationship between circular habits and participation in CE is mediated for the functional value, price and quality of these products. Furthermore, the influence of the functional value of circular products on consumers' willingness to participate in CE was explored.

The results reveal that consumers' circular habits positively influence the functional value-price and the functional value-quality of circular products. However, the intensity of influence is not uniform among the five circular habits considered. Furthermore, the functional value of these products positively influences consumers' willingness to participate in CE. On the contrary, circular habits do not directly influence consumers' participation in CE, but when this relationship is mediated by consumers' perception of the functional value of products, this relationship is positive.

The authors perceive that consumers' circular habits, such as recycling, reuse, and conscious consumption, positively impact how they evaluate the functional value of circular products, both in terms of price and quality. This suggests that consumers more accustomed to sustainable practices tend to see greater value in these products. However, the authors highlight that this influence is not uniform among the five circular habits analyzed, indicating that not all sustainable behaviors affect value perception in the same way. Some habits may generate a positive view of the product more effectively than others. Another important point is that although perceived functional value increases consumers' willingness to participate in the CE, circular habits alone do not directly lead to participation. In other words, being sustainable in their daily lives is not enough; consumers will only engage in the CE if they perceive that circular products offer fair quality and price. This shows that the perception of functional value acts as an essential mediator between sustainable habits and effective participation in the CE. For the authors, this reinforces the importance of companies communicating and delivering real value (both environmental and functional) in their circular products to stimulate consumer engagement.

This study has some limitations. Only Portuguese consumers from Generation Z participated in this study, the sample being non-probabilistic and therefore not representative. To overcome this limitation in future studies, it is suggested that a representative sample of young Portuguese people from generation Z be obtained. In future research, this topic should be further explored, highlighting the points observed in this study, namely the non-uniform influence of different circular habits on the functional value of circular products and the mediating role of perceived functional value in encouraging consumer participation in the Circular Economy. It is important to deepen the understanding of which specific habits most strongly impact value perception and how companies can better

communicate both the functional and environmental benefits of their circular offerings. It would also be interesting to replicate the research model to other generations (X and Y), making a comparison of results. As the research was confined only to Portugal, it would still be interesting to replicate this study with young people from Generation Z in other European countries to explore the impact of the sociocultural context on the research model. Furthermore, in this study, only circular habits were considered antecedents to the perceived functional value of circular products. It would be interesting in future studies to consider the impact of personality traits on the adoption of circular habits and on the functional value attributed to circular products, given that certain personality traits can be learned and taught and, as such, drive greater consumer participation in the CE.

Appendix

A.1. Questionnaire available at: <https://drive.google.com/file/d/1GRFBBss01XCut0v2ZvQNPRT-PMqWSVz0/view?usp=sharing>

A.2. Results of EFA and CFA

	Factor Loading	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Communities
Recycling										
REC1	0.916	0.873								0.866
REC2	0.892	0.874								0.866
REC3	0.571	0.861								0.836
REC4	0.616	0.745								0.759
REC5	0.916	0.786								0.709
Repairing										
REPAIR1	0.830		0.794							0.779
REPAIR2	0.825		0.734							0.793
REPAIR3	0.774		0.743							0.751
REPAIR4	0.795		0.786							0.703
Reusing										
REUT1	0.774			0.798						0.749

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REUT2	0.739	0.789		0.705
REUT3	0.776	0.784		0.796
REUT4	0.710	0.702		0.706
REUT5	0.777	0.744		0.723
REUT6	0.772	0.791		0.738
Reducing				
REDUCE1	0.766		0.761	0.712
REDUCE2	0.703		0.733	0.794
REDUCE3	0.798		0.741	0.707
REDUCE4	0.747		0.761	0.736
REDUCE5	0.794		0.744	0.765
Circular Purchase				
PURCH1	0.721		0.724	0.715
PURCH2	0.794		0.724	0.795
PURCH3	0.743		0.795	0.771
PURCH4	0.838		0.771	0.729
PURCH5	0.771		0.722	0.765
PURCH6	0.834		0.742	0.718
Functional value-quality				
VF1	0.883		0.818	0.735
VF2	0.923		0.832	0.743
VF3	0.912		0.831	0.747
VF4	0.895		0.831	0.748
Functional value-price				
VPF1	0.889		0.756	0.765
VPF2	0.910		0.748	0.807
VPF3	0.916		0.743	0.827
VPF4	0.857		0.753	0.719
Willingness to participate in the CE				
WP1	0.782		0.778	0.726
WP2	0.715		0.765	0.726
WP3	0.780		0.722	0.661
WP4	0.855		0.715	0.647
WP5	0.823		0.813	0.709
WP6	0.835		0.781	0.682

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CHAPTER 5. Analysis of overall results, discussion and conclusions

CHAPTER 5. ANALYSIS OF OVERALL RESULTS, DISCUSSION AND CONCLUSIONS

1. Main conclusions of published articles

This doctoral thesis focused on circular business models – active consumer participation. Specifically, it aimed to demonstrate that, in addition to companies, consumers also need to play an active role in the circular economy and in circular business models to successfully implement the transition from linear to circular processes. To this end, antecedent, mediating, and moderating factors influencing consumers' willingness to participate in circular business models were identified. This identification was carried out through three empirical studies.

The first study aimed to explore the influence of Big Five personality traits on consumer engagement with the circular economy and their willingness to participate in circular business models. The results showed that personality traits directly affect consumer engagement with the circular economy but not the desire to participate in circular business models. However, for personality traits to influence consumers' willingness to participate in circular business models, this relationship must be mediated by their engagement with the circular economy. The association between consumer engagement and the desire to participate in circular business models is stronger among women and younger consumers.

The second study investigated how environmental concerns and their access to pro-sustainable information directly impact consumers' circular habits (energy, water, waste, sustainable mobility, and zero plastic) and circular consumption choices. Furthermore, it examined how customers' circular

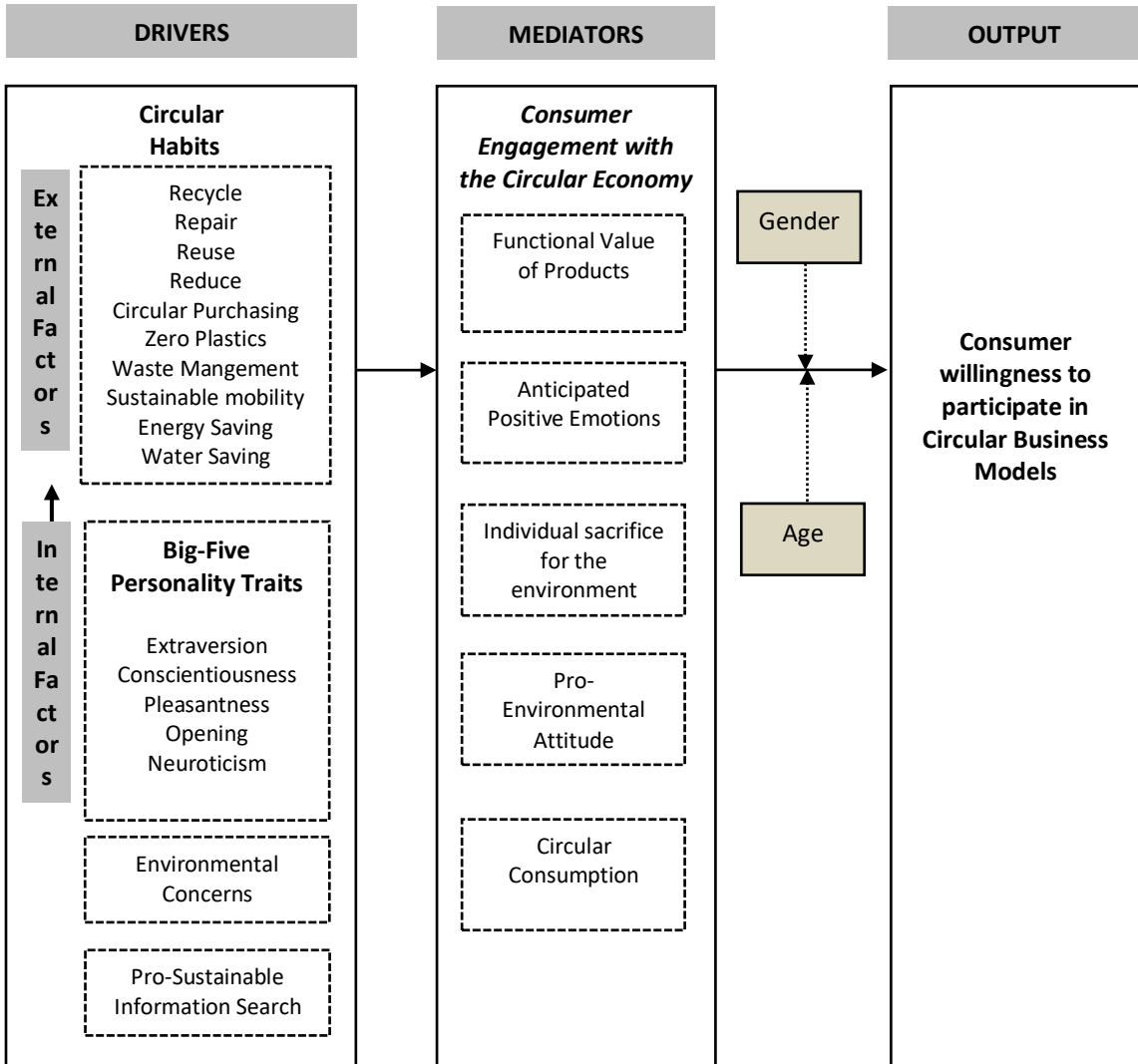
habits mediate the influence of environmental concerns and access to pro-sustainable information on circular consumption decisions. The findings show that customers' environmental concerns and pro-sustainable information searches benefit a variety of circular habits, with energy and water-saving practices and zero plastic showing the strongest correlations. Furthermore, despite the strength of these correlations, environmental concerns and sustainability-supporting information searches directly impact circular purchasing decisions when mediated by circular habits.

The third study aimed to explore the influence of circular habits among Portuguese Generation Z youth on the functional value they attribute to circular products and their willingness to participate in circular business models, both directly and when the perceived price-value and quality-value of these products mediates the relationship between circular habits and participation in circular business models. Additionally, the study explored the influence of the functional value of circular products on consumers' willingness to participate in circular business models. The results reveal that consumers' circular habits positively influence the perceived price and quality value of circular products. However, the intensity of influence varies among the five circular habits considered. Moreover, the functional value of these products positively influences consumers' willingness to participate in circular business models. Conversely, circular habits do not directly influence consumers' participation in circular business models. Still, when this relationship is mediated by the consumers' perception of the functional value of the products, the relationship becomes positive.

Finally, a unifying theoretical model of the results of these three studies is presented. Thus, Figure 3 proposes a synthesized theoretical model that

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theoretically outlines the antecedents of consumer engagement with the circular economy and their willingness to participate in circular business models.



Source: The author
Figure 5.1 - Theoretical synthesis model

Although not empirically tested as a whole, this synthesis model is proposed based on the results obtained from the three previously presented studies.

From this model, we can deduce some important inferences.

First, the studies have shown that consumers' willingness to participate in circular business models is not directly influenced by their circular habits, personality traits, environmental concerns, or pro-sustainable information search. Therefore, a set of drivers was identified, which the results suggest act as mediators in the relationship between circular habits, consumer personality, environmental concerns, pro-sustainable information search, and the willingness to participate in circular business models. Based on the multidimensional definition of the concept and the literature review, this set of drivers was termed consumer engagement with the circular economy.

Thus, consumer engagement with the circular economy is driven by the functional value (price and quality) attributed to circular products, the anticipated positive emotions of participating in the circular economy, the personal sacrifices made in favor of the environment, pro-environmental attitudes, and consumers' circular consumption.

Second, the antecedents of this consumer engagement are classified into external and internal factors. External factors relate to circular habits, as daily routines are strongly influenced by the information we gather and assimilate from our external environment. Internal factors refer to personality traits, environmental concerns, and the search for pro-sustainable information. Personality is the primary psychological mechanism that coordinates individuals' cognitive, emotional, and behavioral actions. As such, personality traits can also influence consumers' circular habits.

Moreover, to adopt these circular habits, consumers need access to pro-sustainable information and be aware of the environmental consequences of their choices.

Third, consumers' sociodemographic characteristics—gender and age—are moderators of the relationship between consumer engagement with the circular economy and the willingness to participate in circular business models. The first study demonstrated this, showing that the relationship was stronger among women and young people.

These findings show that consumers must be engaged in the circular economy before they are willing to participate in circular business models. Therefore, a deeper understanding of consumers (through both internal and external factors) is needed so that they become active agents in circular processes and so that companies and policymakers can effectively gain their collaboration and commitment in building increasingly circular business models..

2. Discussion

The three publications analyzed in this doctoral thesis allow us to infer important contributions both to the scientific and practical contexts (macroeconomic and business-related) through the effective implementation of circular economy principles.

The first study on personality traits and circular business models presents several contributions. First, it addresses the circular economy and circular business models from the demand side, that is, the consumers, contrary to other studies that have addressed this topic (Mostaghel and Chirumalla, 2021). Second, based on the 3M Model, it directly associates personality traits with consumer behavior in the circular economy and their willingness to participate in circular business models, thus contributing to the extension of the 3M Model to the circular economy—something that had never been

applied in this context before. Specifically, we identified the personality traits that most drive consumer engagement with the circular economy and their participation in circular business models, and we demonstrated that personality traits have a latent effect on consumer behaviors in the circular economy. The studies that have considered personality traits in the context of sustainability and circularity usually focus on their indirect impact on consumer behavior (e.g., purchase intention) and not as explanatory factors for actual participation in the circular economy.

Third, we contribute to conceptualizing consumer engagement, a multidimensional concept intrinsically linked to consumer behavior—particularly consumption attitudes and actions—which has been scarcely used in the circular economy (Camacho-Otero et al., 2020). The results of this study show that consumers' participation in circular business models requires engagement with the circular economy, thereby expanding the application of this concept and how it is measured.

Fourth, the use of demographic factors as moderators of the relationship between consumer engagement with the circular economy and their willingness to participate in circular business models demonstrated that women and younger consumers are those with the highest levels of engagement and, consequently, the most willingness to participate. Thus, companies play an important role in raising awareness among consumers regarding the circular economy.

The second study, on circular consumption choices presents three relevant contributions. First, it expands the application of signaling theory to the context of circular consumption decisions. The analysis is conducted through this theoretical lens, which describes how individuals use signals to convey

information about themselves or their products to others. Signaling theory helps to explain why certain consumers adopt sustainable consumption practices: by seeking pro-sustainable signals in products and services, they reduce ambiguity and information asymmetry, which can strengthen their purchase intention. Environmentally conscious consumers use these signals to gain knowledge and make more informed decisions.

Second, this study contributes to the circular economy literature by focusing on consumer participation, a dimension that remains underexplored despite growing scientific interest. Third, it demonstrates that environmental concerns, the search for sustainable information, and circular habits directly impact circular consumption choices.

The third study, which focuses on Generation Z's participation in circular business models, makes several theoretical contributions. First, it expands the scope of signaling theory by showing that Generation Z's participation can serve as a signal expressed through the perceived functional value of consuming circular products. Traditionally, signaling has been associated with consuming expensive or luxury products (S. Gomes & Lopes, 2024).

Second, the study helps narrow the gap regarding the need for more information on consumer behavior and its role in circular business models (Camacho-Otero et al., 2020). Third, it focuses specifically on the relationship between the consumer and the circular economy, a relationship that few studies have explored, and it identifies key drivers of active consumer participation in circular business models (Lopes et al., 2024; Vidal-Ayuso et al., 2023).

Fourth, to our knowledge, it is the first study to bring together such many circular habits. Most existing studies focus on only one or two circular habits

(e.g., Shevchenko et al., 2023; Ta et al., 2022; Maitre-Ekern & Dalhammar, 2019). Fifth, the study contributes to a better understanding of circular consumer behavior among Generation Z, enriching the literature on generational cohorts.

Finally, this study's results can be strategically used to reconfigure business models and support decision-making by companies and governments in the circular economy.

3. Conclusions

This thesis addresses a highly relevant research topic due to the growing need to transform companies' linear business models into circular ones. The transition to the circular economy has, until recently, been primarily driven by governmental and corporate pressures. However, the studies analyzed in this doctoral thesis highlight the increasing importance of the consumer as an active agent in this transformation. This work contributes to that understanding by exploring, in an integrated manner, the factors that influence consumer behavior within the context of the circular economy, proposing theoretical models that involve environmental, behavioral, and psychological variables.

The first study introduced a new dimension by exploring the influence of personality traits—based on the Big Five model—on engagement with the circular economy and the willingness to participate in circular business models. The results indicated that conscientiousness, agreeableness, openness to experience, and extraversion are positively associated with involvement in the circular economy. However, this predisposition does not

directly translate into active participation unless high levels of engagement mediate it. Furthermore, it was shown that sociodemographic factors, such as gender and age, can moderate the relationship between engagement and participation, with a stronger link among women and younger individuals.

The second study demonstrated that environmental concerns and access to pro-sustainable information significantly influence the adoption of daily circular habits, such as resource savings, waste management, and plastic reduction. These habits, in turn, influence circular consumption decisions, highlighting the transformative role of sustainable behaviors in everyday life. This result reinforces the importance of promoting clear and useful information and developing interventions that encourage the internalization of circular behaviors from an early age.

The third study focused on Portuguese Generation Z, showed that the perceived functional value (in terms of quality and fair pricing) is a key mediating variable between circular habits and the willingness to participate in the circular economy. Habits alone do not directly explain participation, but when linked to a clear perception that circular products offer real value—both economic and environmental, consumers are more inclined to adopt sustainable consumption models. This finding reveals the importance for companies to effectively communicate the tangible benefits of their circular products—not just environmentally but also in terms of usability, durability, and cost-effectiveness.

The integrated analysis of the three studies concludes that consumer participation in circular business models is a multidimensional phenomenon influenced by environmental, cognitive, emotional, and individual factors. Consumers are not merely passive recipients of sustainable products but

active agents whose motivation and behavior depend on the interaction between personal values, utility perceptions, and psychological traits. Additionally, the results point to the need for a paradigm shift in how sustainability in consumption is conceived. The circular economy should not be seen merely as a technical or logistical process carried out by companies but as a cultural and social transformation that requires consumer involvement, well-aligned public policies, and business models centered on perceived value.

The combination of environmental concerns, circular habits, and individual traits enables the design of more effective strategies aimed at behavioral change and fostering informed, motivated, and sustainable consumption.

In summary, this doctoral thesis contributes to a richer and more integrated understanding of the consumer's role in circular business models, proposing explanatory models that acknowledge the complexity of purchasing decisions and the psychological factors that influence them. This broader approach advances the development of more effective and behaviorally informed policies, business strategies, and educational practices aligned with the realities of today's consumers.

4. Theoretical Contributions

This doctoral thesis, compiled from three articles, offers a robust set of theoretical implications that significantly contribute to advancing knowledge in the fields of circular economy, consumer behavior, and psychological theories applied to sustainable consumption.

First, it highlights the expansion of Signaling Theory into sustainable and circular consumption contexts. Traditionally applied to luxury products or goods of high economic value, this theory is here extended, demonstrating that Generation Z consumers' participation in the circular economy can be signaled through the perceived functional value of circular products (notably quality and fair pricing). This represents a significant conceptual advancement, as it shows that signals of value are not limited to prestige or high price but can also be expressed through sustainable and pro-environmental attributes. The study further shows that consumers use signals such as circular practices and environmental concerns to guide their choices, positioning circular consumption as a new application field for Signaling Theory.

The research contributes to a better understanding of the relationship between circular habits and consumption behavior. It demonstrates that water and energy-saving habits, waste management, sustainable mobility, and plastic use reduction are important mediators between environmental concerns, sustainable information-seeking, and circular purchasing decisions. These habits are thus transformative elements of conventional behavior, facilitating the adoption of circular practices.

Regarding consumer behavior, the study reinforces the importance of the individual's active role in the transition to a circular economy, contrasting with the traditional emphasis on supply-side actors (businesses and governments). This theoretical contribution focuses on psychological and behavioral factors, highlighting the need to consider attitudes, values, and perceptions in analyzing sustainable consumption. A further relevant conceptual distinction is drawn between circular economy—encompassing value chains and production

systems—and circular consumption, an individual and behavioral phenomenon centered on consumers' daily choices.

Moreover, the study successfully applies the Meta-Theoretic Model of Motivation and Personality (3M Model) to the circular economy context, extending its application beyond traditional domains in consumer psychology. It confirms that Big Five personality traits—particularly conscientiousness, agreeableness, openness to experience, and extraversion—positively affect environmental engagement and willingness to participate in circular business models, while neuroticism reveals a negative impact. The research also validates the role of engagement (comprising positive anticipated emotion, willingness to make sacrifices, and attitudes towards circularity) as a mediating variable between personality and active participation. This approach deepens understanding of how psychological factors influence sustainable behaviors, revealing more complex explanatory pathways.

The introduction of moderating variables such as age and gender adds further nuance to the relationships between engagement and participation, demonstrating that sociodemographic factors modulate the intensity of this involvement. This enriches the theoretical model by providing a more refined reading of these dynamics. Lastly, the study helps to fill gaps in the literature by focusing specifically on the consumer's role in the circular economy—a still underexplored aspect—and by providing new empirical data on Generation Z, a generational cohort of particular relevance due to its environmental awareness and influence on the future of consumption.

The integration of five distinct circular habits—recycling, reusing, repairing, reducing, and circular purchasing—into a single empirical model represents both

a methodological and theoretical innovation, offering a more comprehensive and realistic perspective on the factors influencing circular behavior.

In conclusion, the compilation of the three studies deepens and interconnects multiple theoretical dimensions—signaling, motivation, personality, and habits—into a comprehensive and empirically validated model, contributing to a more solid understanding of the consumer's role in the transition to circular business models and to more sustainable consumption practices.

5. Practical Contributions

The findings of this doctoral thesis hold practical value for consumers, businesses, policymakers, and other stakeholders such as civil society, NGOs, and educational institutions. These insights can guide communication strategies, public policy development, business model transformation, and promoting sustainable behaviors. Accordingly:

1. For Businesses:

Companies play a central role in transitioning to circular production and consumption models. The results highlight the need for more effective communication of the functional value of circular products, emphasizing attributes such as quality, durability, and fair pricing. Such communication should be supported by clear and accessible signaling systems, including information about product composition, reuse potential, environmental impact, and price transparency.

Additionally, businesses are encouraged to tailor their marketing strategies to consumers' psychological profiles. For instance, emotionally appealing campaigns may be more effective among individuals who are highly open to experience. Likewise, brand

engagement can be strengthened through loyalty programs, gamification, and participatory actions.

Finally, the findings reinforce the importance of reviewing and transforming existing business models, integrating circular practices coherently with the emerging values of consumers, particularly those of Generation Z.

2. For Consumers:

Consumers need easy and transparent access to information about circular products to recognize their functional and environmental value. Clear communication fosters more informed and conscious consumption decisions. It is also essential to encourage self-reflection on the impacts of consumption, prompting consumers to consider product utility, durability, and environmental consequences.

The perception that positive emotions and individual sacrifices can have a real environmental impact may increase engagement with sustainable practices. Moreover, self-awareness regarding personal values and motivations can help consumers align their behavior with sustainable goals, promoting choices more consistent with the principles of the circular economy.

3. For Policymakers:

Public policy must act on multiple fronts to advance the circular economy. It is recommended that mandatory labeling systems provide clear data on product circularity and environmental impact. Such measures help reduce information asymmetry between producers and consumers.

Investment is also needed in educational and awareness campaigns that inform and promote everyday circular habits, such as plastic

reduction, reuse, and energy saving. These campaigns should be adapted to different target audiences, taking into account variables such as age and gender to maximize effectiveness.

In addition, policymakers should develop educational programs that foster environmental values from an early age and ensure continuous access to pro-sustainable information, creating favorable conditions for adopting conscious behaviors. Another practical implication is the creation of financial, fiscal, or logistical incentives for companies that adopt circular business models, supporting their viability and competitiveness.

4. For Other Stakeholders (Civil Society, NGOs, Educational Institutions):

Civil society and educational institutions also play crucial roles in fostering a culture of sustainability. NGOs and schools can collaborate to promote circular practices through local projects, reuse workshops, school campaigns, and community initiatives.

Universities, in turn, should produce and disseminate applied knowledge, support sustainable entrepreneurial initiatives, and contribute to the education of critical and environmentally conscious citizens who understand their role in transforming economic systems.

In conclusion, the widespread adoption of circular habits can positively impact natural resource management, reduce waste, and promote a more resilient and sustainable economy. When aligned with the psychological and behavioral factors identified in this research, practical actions should be coordinated across the various actors involved in the transition to a circular economy.

6. Limitations and future lines for research

Despite the significant contributions of this doctoral thesis, the studies presented also exhibit limitations that must be acknowledged. Firstly, all studies relied on non-probabilistic samples, limiting the generalizability of the findings. Although the first study considered gender and age as moderating variables, it did not use a sample representative of the Portuguese population. This may have influenced the observed effects of personality traits. The third study focused exclusively on Portuguese Generation Z consumers, further restricting the generalization of the findings to other age groups or cultural contexts.

Additionally, using cross-sectional questionnaires (data collected at a single point in time) limits the ability to infer robust causal relationships between the variables. In some cases, complex constructs such as personality were measured using short-form scales (e.g., TIPI), which, while practical, may not capture the full depth of the phenomenon. Moreover, the studies considered circular habits only as antecedents of perceived functional value without exploring other potentially relevant dimensions such as personal values, lifestyle factors, or contextual variables. Based on these limitations, several future research directions are proposed:

1. **Representative and Diverse Samples:** Future studies should employ probabilistic and diversified samples, including Generation Z as well as Generations X and Y, allowing for intergenerational comparisons. Replicating the proposed models in other European countries would also help assess the influence of sociocultural context.
2. **In-Depth Analysis of Circular Habits:** Further research should examine which specific circular habits have the most significant impact on

perceived product value, as the current studies suggest non-uniform effects among different practices (e.g., recycling vs. reducing plastic use).

3. **Longitudinal Models:** Conducting longitudinal studies would allow us to observe the evolution of consumer engagement and participation in the circular economy over time, identify lasting behavior patterns, and assess the long-term effects of awareness campaigns.
4. **Experiments with Real Behavioral Proxies:** It is recommended that experimental designs use real behavioral measures (e.g., simulated purchasing decisions), which would allow for more rigorous testing of causal relationships between habits, values, and consumer participation.
5. **Deeper Analysis of Personality Traits:** Future studies should use more comprehensive personality scales to explore how various subdimensions of traits influence engagement and circular behavior. Additionally, research should examine whether certain characteristics can be developed or nurtured, expanding the scope of educational interventions.
6. **Business Acceptance of Active Consumer Participation:** It would be valuable to investigate how companies are responding to consumers' increasing proactivity and whether circular business models incorporate co-creation, collaboration, or customization mechanisms.
7. **Integration of Contextual and Emotional Variables:** Further studies should integrate variables such as family, social, and professional context, along with sustainability's emotional and experiential dimensions. This would enrich explanatory models of consumer participation in the circular economy.

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These future research directions could contribute to strengthening the theoretical and empirical body of knowledge on consumers' roles in the circular economy and their participation in circular business models. They also offer a foundation for developing more effective interventions by consumers, businesses, governments, and educational institutions.

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