

Explaining Water Conservation Behaviour with the Big Five Personality Traits

by

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Author's declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners. I understand that my thesis may be made electronically available to the public.

Abstract

Climate change has led to increased levels of water scarcity around the globe and heightens the attention paid to the importance of water conservation. Water conservation behaviour, just like other behaviours, is likely to be affected by personality psychology, specifically the Big Five personality traits. However, the current scholarly understanding of how peoples' intentions toward water conservation are affected by their personality traits is limited. The current research helps close this knowledge gap by clarifying how people vary in their intentions toward water conservation and how differences in their personality traits are related to the observed variation in their water conservation behaviour intentions. In pursuit of this goal, the current study examined the relationship between the Big Five personality traits (i.e., *openness*, *conscientiousness*, *extraversion*, *agreeableness* and *neuroticism*) and water conservation intent and, used the Theory of Planned Behaviour as an analytical framework. Data were collected with an online survey of students at the University of Waterloo, Ontario, Canada. The results suggest significant relationships between various Big Five personality traits and several of the Theory of Planned Behaviour constructs. These relationships were tested for demographic effects (i.e., program of study and gender) on their strength or direction. However, the results indicate that most of the relationships were not affected by demographic variables, suggesting that the identified relationships are universal based on the survey population and investigated demographic variables. The results from this study further our understanding of the factors that affect water conservation behaviour.

Key Words: Big Five Personality Traits, Theory of Planned Behaviour, Water Conservation

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1. Introduction

1.1. Background

Water conservation, as a component of resource conservation, is an essential aspect of climate change adaptation, environmental sustainability, and efficient municipal water management and supplies (Dolnicar et al., 2012). It can be a critical strategy to ensure a future water supply. Social norms are an essential predictor of pro-environmental behaviour. Social norms refer to both common behaviours and the beliefs that support the adoption of behaviours by society (Farrow et al., 2017). Water conservation can be seen as a behaviour that promotes the environment; recycling is another pro-environmental behaviour that is more commonly discussed and practiced. Recycling, as a popular global conservation initiative, is well-researched (Gutberlet, 2008). This past research has demonstrated that initiatives targeting social and psychological factors can help encourage participation in recycling programs. For instance, prior research has shown how the willingness to recycle increases with perceived social norms supporting recycling (Hewitt et al., 2023). Therefore, the available evidence suggests that social norms can be a factor that can shift an individual's attitude and intention toward conservation efforts, such as recycling. Recycling, and other pro-environmental behaviours, can become a part of social practice and habitual practice that overlaps with an individual's behaviour (Thomas & Sharp, 2013). If water conservation initiatives had the same level of research and social pressures applied as recycling, then individuals might feel the same social pressure to change their intentions and overall behaviour.

There is a current estimate that four billion people live in areas that suffer from severe physical water scarcity for at least one month per year (Mekonnen & Hoekstra, 2016). High-

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income countries are estimated to have 8.4 million individuals who lack access to water for sanitation purposes, showing the inequalities in access and achieving universal access to water (Mattos et al., 2021). Modern national water strategies in developed countries are built on integrated water resource management (Aboelega et al., 2019). This framework is consistent with achieving water security and linking society with water (Aboelega et al., 2019). Urban water security is multifaceted and includes but is not limited to water-related hazards, ecosystems, climate change, and socioeconomics (Aboelega et al., 2019). The evidence is overwhelming that water resources continue to become more limited, water demand is increasing, and water scarcity is rising in communities worldwide (Mekonnen & Hoekstra, 2016).

Considering environmental aspects of personality psychology can provide deeper insights into how individuals interact with finite resources (Corral-Verdugo et al., 2003). Environmental relations can be seen through the lens of natural resource management, such as water conservation. Environmental psychology is an extension of personality psychology that focuses on behaviours and personality assessments related to the environment (Craik, 1976). Therefore, personality traits and environmental psychology have a direct overlap, and personality traits can assist in predicting an individual's behaviour (Goldberg, 1993).

Openness and Extraversion are personality traits consistent with pro-environmental behaviour (Markowitz et al., 2012). Agreeableness and Conscientiousness as personality traits are seen to be positively correlated with environmental behaviour (Markowitz et al., 2012). Neuroticism, however, has been shown to correlate with the environment negatively (Markowitz et al., 2012). Even though personality traits can be used as predictors of an individual's behaviour,

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they do not predict all aspects of behaviour, as the intentions of an individual may be affected by multiple factors such as beliefs, experiences, and values (Goldberg, 1993).

Past research has shown how water conservation behaviour can be affected by social psychology, resulting in water conservation habits (Singha, 2023; Fielding et al., 2012). The existing literature on conservation behaviour focuses on the universal definition of water conservation and how to tackle the issue of water scarcity and vulnerability (Rodriguez-Sanchez & Sarabia-Sanchez, 2020). There is a gap, however, in the current literature considering how personality traits and the Theory of Planned Behaviour interact in determining water conservation. Previous studies have integrated the concept of water-saving intention into the Theory of Planned Behaviour framework to understand water conservation behaviour (Si et al., 2022). Other previous studies have used personality traits with the Theory of Planned Behaviour to examine energy-saving behaviour (Liu et al., 2021), and to analyze the relationship between personality traits and the Theory of Planned Behaviour in determining the use of mindfulness apps (Kim et al., 2022). However, a knowledge gap remains in our understanding of how the Big Five personality traits and the Theory of Planned Behaviour interact in driving water-saving intention.

1.2. Statement of Purpose

The current study aims to fill a gap in the current literature on how personality traits and social psychological concepts interact to impact individuals' intentions toward water conservation behaviour. The results of this study can be used to mobilize knowledge about water conservation and help individuals understand how to overcome personal barriers to create better water conservation behaviours and habits.

1.3. Research Objectives

In pursuit of the above stated purpose, this research aims to enhance the overall understanding of the connection between personality traits and water conservation behaviour. In addition, this research will explore the effects of possible modifiers such as demographics and socio-psychological factors. Therefore, the research objectives are the following:

1. Investigate the effects of personality traits on water conservation.
2. Investigate the effects of demographic factors on water conservation.
3. Investigate the effects of attitude, social norms, and perceived behavioural control on water conservation.

1.4. Research Questions and Hypothesis

The subsequent research questions have been developed to address the research problem and fulfill the study's purpose. Addressing these three questions will help provide insight into how individuals' personality traits impact water usage intentions. In line with this purpose, I am seeking to obtain answers to the following three research questions:

1. Is there an effect of personality traits on the water conservation intentions of individuals?
2. Is there an effect of socio-psychological factors on the water conservation intentions of individuals?
3. How does the effect of socio-psychological factors on the water conservation intentions of individuals vary with personality traits and demographic factors?

Based on these research questions, three sets of null hypotheses and corresponding alternative hypotheses are formulated:

- Null hypothesis 1: Individuals' intent to save water does not differ with their personality traits.

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- Alternative hypothesis 1: Individuals' intent to save water differs as their personality traits change.
- Null hypothesis 2: Individuals' intent to save water does not differ with socio-psychological factors.
- Alternative hypothesis 2: Individuals' intent to save water differs as socio-psychological factors change.
- Null hypothesis 3: The relationships between individuals' water conservation intentions and socio-psychological factors do not vary with personality traits and demographic factors change.
- Alternative hypothesis 3: The relationships between individuals' water conservation intentions and socio-psychological factors differs a personality traits and demographic factors change.

2. Literature Review

The following section will provide an overview of the current literature on water conservation, value and scarcity, and personality traits and environmental behaviour. This section also will synthesize the literature that provides context on how personality traits are connected with intention within the Theory of Planned Behaviour.

2.1. Water Conservation and Sustainable Development Goals

In 2017, the United Nations and the World Bank High-Level Panel published the Valuing Water Initiative. This initiative produced a global opportunity to rethink the value of water. They concluded an outline with four aspects to add valuation and management for water (Garrick et al., 2017). The four aspects are measurement, valuation, decision-making, and governance. The measurement component uses information on various water aspects, such as water use scenarios and watershed status. This provides the ability to analyze water usage, local water budgets, and the global water cycle (Garrick et al., 2017).

The high stress of water scarcity is due to the temporal and spatial distribution of resources. The current global estimate of the population that experiences the risk of water scarcity for approximately one month per year is around 3.6 billion. This number is estimated to increase to between 4.8 and 5.6 billion individuals worldwide by 2050 (UN-Water, 2018). Also, more than 2 billion people globally lack sufficient access to clean drinking water. These individuals also suffer from unmanaged water sanitation (WHO & UNICEF, 2017). Although water is critical for all human life, over two billion people live in countries experiencing water stress (UN-DESA, 2018).

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It is predicted that there will be a yearly increase of 1% in global water demand to help sustain the exponential population growth, extreme consumption styles, and economic development predictions (UN-Water, 2018). The United Nations has published a list of 17 Sustainable Development Goals to be reached by 2030 (Houngbo, 2018). To achieve these, water governance is needed, consisting of systems of formal and informal rules that structure peoples' behaviours and interactions. Formal rules comprise policies, laws, and international relations (Zwarteveen et al., 2017). Informal rules include the social norms and their implications for water governance (Zwarteveen et al., 2017). The Sustainable Development Goals are common global goals designed at international governance levels, including private sectors, governments, national and international institutions, and communities, including scientific and academic ones (Garrick et al., 2017). Formal and informal governance create an overarching domain that assists stakeholders in strategizing innovation in sustainable development (Garrick et al., 2017). In this context, water governance can be a tool that is utilized to facilitate more advocacy and education regarding the importance of water and water conservation.

The 17 Sustainable Development Goals of the United Nations are interlinked with sustainable water use (Weerasooriya et al., 2021). The current overdemand and stresses on the global water demand are too strenuous for the current global water supply. Several Sustainable Development Goals formally address global issues such as inequality, hunger, poverty, and the worsening effects of climate change. Water directly impacts the Sustainable Development Goals and covers many of their characteristics. Six Sustainable Development Goals are directly related to clean water access and sanitation. Other Sustainable Development Goals emphasize the interconnection between successfully achieving human life's goals, water, and equity. Sustainable

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Development Goal 6, “clean water and sanitation” is critical since there is no life without water. “Good health and well-being” (Sustainable Development Goal 3), “quality education” (Sustainable Development Goal 4), “gender equity” (Sustainable Development Goal 5), “sustainable cities and communities” (Sustainable Development Goal 11) and “climate action” (Sustainable Development Goal 13) also depend on implementing Sustainable Development Goal 6. These Sustainable Development goals depend on access to clean water, the overarching bridge necessary for sanitation, health, and hygiene, promoting gender equity, climate resilience, and sustainable urban communities (UN World Water Development Report, 2021). Therefore, sustainable and equitable economic development is a factor that depends on reliable and adequate water supplies (UNDP, 2015). Water conservation and use are essential factors that must be considered when evaluating progress toward the Sustainable Development Goals.

Water conservation has been linked to equality and women’s empowerment. This correlation has been found through successful water management results and proper water sanitization in participatory approaches (Ernst & Young, 2016). Proper sanitization and education for all genders and individuals will also increase communities' overall health and well-being. Unsafe water resources can create conflict between communities through a lack of transparency and accountability (Daud et al., 2015). Water governance towards conservation-based policy and regulation can be a long-term solution to resolve conflict. To be successful with water conservation, a collaborative effort must be made to address the global water crisis. Improving education can lead to individual and community empowerment, accountability, and more effective water regulations. If there is a way to enhance the quality of education about the importance of life on land, life below water, and climate action, then consumer responsibility can be more effectively

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taught. Also, community empowerment through education can also increase cities' ability to incorporate sustainable practices. This is not limited to policy improvements but includes community infrastructure, clean energy, and economic development (Daud et al., 2015).

Water conservation is the planning and management of water supplies (Baumann et al., 1984). Specific personality traits are important for the generation of an environmental self-concept and for pro-environmental behaviours, as well as for the denial of climate change-related issues such as water scarcity and the need for water conservation. There are many definitions for water conservation across scholarly research and social science. Water conservation can be described as water demand management or water consumption management, and there is a wide range of approaches for measuring and quantifying these behaviours (Rodriguez-Sanchez & Sarabia-Sanchez, 2020). Water conservation is most commonly analyzed and measured employing a consumer behaviour process and perspective (Rodriguez-Sanchez & Sarabia-Sanchez, 2020). According to this perspective, water conservation can be practiced by limiting water use, such as reduced shower length, turning the tap off while completing tasks (e.g., brushing teeth, washing dishes), or limited watering of plants and grass.

Being able to apply and engineer conservation techniques to ensure sustainability is a critical aspect of achieving Sustainable Development Goals. Current consensus of the discourse on global water use is that global water withdrawal is already close to the maximum sustainable level (Weerasooriya et al., 2021). It is important to consider water conservation as a component of the progress towards sustainability management and how water conservation can assist in pursuing many Sustainable Development Goals. Industrial water conservation directly correlates with

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alleviating poverty and other Sustainable Development Goals since food, safe water, and quality of life all are connected to agricultural production which relies on water availability and thus conservation of water resources (Weerasooriya et al., 2021).

2.2. Water Rights in Canada

High-income countries need help to meet the universally agreed-upon goal of achieving adequate water access for all (i.e., equitable water access for drinking and sanitation), which falls under Sustainable Development Goal Six. Despite being a developed, high-income country, Canada has communities that struggle with access to clean and safe water. Canada committed to working toward achieving the UN's Sustainable Development Goals, including universal access to water. Water rights and access must continue to be adequately supported to ensure equity in all citizens' health. The Canadian Council of Ministers of the Environment Water Quality Index (CCME WQI) has created assessments to examine water quality and sanitation and to protect aquatic life (Hurley et al., 2012). This Water Quality Index can be used to represent the variables that culminate in the representation of water quality. CCME WQI was successfully applied to assess water quality required for aquatic life, but it was found to have limited use for assessing spatial variation in water quality downstream of point source pollution sources (Rosemond et al., 2009).

There might be the perception that developed countries, including Canada, have abundant accessible, clean, and safe water. However, this may not be always accurate due to seasonal variability and inequitable distribution. In Canada, these issues can be the consequence of a disconnect between water resource management, stakeholders, and policymakers (Dao et al.,

2020). There remains unsafe drinking water in Canada, including uneven access to safe drinking water for Indigenous communities (Patrick, 2011). Approximately 30% of Indigenous community water systems have been classified as high risk, which is 26 times higher than the national average in Canada for non-Indigenous communities (Eggertson, 2006). Therefore, the existing evidence suggests that access to high-quality water in Canada is inequitably distributed between communities, which conflicts with the United Nations' Sustainable Development Goals.

2.3. Conservation and Consumption in Behavioural Psychology

Social norms can affect personality perception and affect individual's view of environmental issues and water conservation behavior. Group norms have been used to motivated individuals to practice water conservation behaviors (Lede et al., 2019). Unfortunately, water conservation interventions and water-related issues have received far less research attention than other topics such as energy and recycling (Fielding et al., 2013). Environmental science considers many factors that go into assessing consumption and conservation. Many of these studies have found that psychological factors such as beliefs, norms, and values can play a vital role in the outcome of both consumption and conservation behaviors (Singha et al., 2022). Pro-environmental behaviours and positive attitudes toward the environment have a direct positive correlation in terms of the way an individual interacts with the environment (Singha et al., 2022). Knowledge of the social, attitudinal, and behavioural aspects of water conservation is critical to assisting policymakers in creating better conservation initiatives (Gilg & Barr, 2006). In addition, understanding the impacts of psychology on conservation and consumption can help policymakers design more effective approaches to water conservation. A deeper understanding of personality traits and their specific characteristics may even support prediction of water conservation

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behaviors by individuals and thus the planning of specific actions that promote increased water conservation behaviors.

Socio-structural components also impact people's behaviours and intentions (Benight & Bandura, 2004). Awareness development encapsulates the development of self-awareness, which develops into consciousness. A person's conscious consists of many cognitive layers that link personality traits to a deeper level of cognitive function (Barrouillet, 2015). Therefore, different components comprise an individual's core personality traits that dictate behavioural habits and actions. Therefore, cognitive decisions are based on the personalities and behavioural patterns of individuals (Barrouillet, 2015).

Personality traits are associated with environmental values and concerns (Milfont & Sibley, 2012; Abdollahi et al., 2017) and have been found to impact conservation behavioural intentions (Wang et al., 2021). However, there are limited studies that connect the Big Five Personality Traits to pro-environmental behaviours and even fewer studies that connect the Big Five Personality Traits to water conservation behaviour. However, recent research has provided evidence of positive and negative relationships between constructs of behavioural psychology and water conservation behavior (Singha et al., 2022).

2.4. Water Conservation on an Individual Level

Understanding and facilitating water conservation should be assessed at an individual level, as is the case for other conservation-oriented behaviours, such as energy conservation and recycling (Campbell et al., 2004). Psychological factors are important for understanding water

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conservation behaviour, including the impact of attitude, belief, and concern (Aprile & Fiorillo, 2017). Next to these psychological factors, water-saving behaviour can also be affected by other factors such as environmental knowledge, demographics, and socio-economics (Aprile & Fiorillo, 2017). There is evidence of a strong correlation between psychosocial factors and water use behavior, where attitude, norms and perceived control all show positive correlation with water conservation behavior (Fielding et al., 2012).

On the other hand, socio-economics measured as household income have a negative correlation with water conservation behavior (Fielding et al., 2012; Palazzo et al., 2017). And socio-economics tend to show positive (e.g., perceived control) and negative (e.g., attitude) correlations with psychosocial factors (Fielding et al., 2012). When individuals have a positive attitude towards water conservation, they are more inclined to view water as the finite resource that it is. However, those same individuals may also feel vulnerable in times of scarcity but hold to their intentions of water conservation (Fielding et al., 2012).

The aspects that influence behaviour are only sometimes transparent, and psychologists often measure behaviour patterns that are the most attainable. Every individual views the world inherently differently, as we all experience and go through life differently. There are a variety of experiences that an individual can go through with nature, which can lead to feeling more aligned or separated from the natural environment due to physical, mental, or emotional factors, including awareness of water consumption habits. Fielding et al. (2012) have shown that residential water usage strategies in Queensland, Australia, promoted to residents during a drought as well as household social norms are strong indicators of water conservation.

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The social aspect of psychology can indicate trends and behavioural habits. Informal rules create social norms and can form the basis of peer learning, creating pressure on individuals to enact certain behaviors. Social norms can come from all aspects of society including communities and families. Social norms as a societal construct are also used in the Theory of Planned Behaviour (Figure 1). Peer influence through peer learning and peer pressure can affect water management. Peer pressure was more impactful than peer learning (or encouragement) for saving water in smaller social groups and networks and can predict behaviour habits, such as water conservation (James & Rosenberg, 2022). Psychology can yield results in discovering factors impacting individual water conservation and environmental sustainability (Caputo et al., 2022). It was stated that care for water conservation in the consumer behaviour approach had a more strongly positive effect when there was a sense of necessity for survival with an emphasis on community (Caputo et al., 2022). Understanding personality is directly intertwined with clinical psychology, which highlights the significance of the Big Five Personality Traits (Widiger & McCabe, 2020). These traits were shown through the community's desire to improve their overall environmental awareness. Participants of the Caputo et al. (2022) experiment expressed that they felt they needed more awareness regarding deforestation and water sustainability. The authors recommended to help improve their sustainability management was an increase in economic resources to assist in fundamental re-orientation from an individualistic stance toward collective action and regulations (Caputo et al., 2022).

2.5. Comparing Behavioural Theories

When comparing social-psychological theories to determine the best fit for this study, it is important to note the differences between each theory and how they approach quantifying both personality traits and behaviour while examining water-saving intention. Different environmental

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conditions can produce divergent developmental results, such as how people interact with the environment due to their perceived ecological connections and psychological development (Härkönen, 2007). Early childhood development and education are aspects of environmental surroundings (Puroila & Karila, 2001). Bronfenbrenner's ecological theory of human development (1979; 2002) describes how human development and ecology (i.e., the dependencies between organisms and their surroundings) are intertwined. Growing up, an individual acquires a deeper and valid understanding of their ecological environment (Bronfenbrenner, 1979; 2002). Because of this, a developing brain becomes more motivated to interact with the environment, practice sustainability, and restructure their environment as a part of their cognitive development (Bronfenbrenner, 1979; 2002). If individuals who interact more with their environment become more motivated to protect their environment, they are willing to create changes concerning various sustainable practices, such as water conservation. But not all individuals are willing to create these changes.

So, how do individuals go from wanting to sustain their environment to being disconnected from it? The Big Five Personality Traits have been examined more so through Piaget's cognitive development theory. Cognitive psychologists have been revising Piaget's theories to make them more modern and advanced with new neuropsychological discoveries. Social cognitive theories state that an individual's behaviours can be dictated by self-efficacy. Simultaneously, socio-structural components also impact an individual's behaviours and intentions (Benight & Bandura, 2004). These relationships connect personality traits to a deeper level of cognitive function. Therefore, different components comprise an individual's core personality traits that dictate behavioural habits and actions.

Table 1. How behavioural theories could be applied to investigate water conservation behaviour.

Theory	Key Concepts	Relation to Water Conservation Behaviour
Nudge Theory	Attitudes, beliefs and behavioural patterns.	Behaviour changes through education towards better environmental practices.
Cognitive Dissonance Theory	Cognition and behaviours to self-esteem and self-image.	External pressures into shifting towards more environmentally friendly behaviour.
Norm Activation Theory	Ability, awareness, responsibility, emotions and denial.	Attachment through norms to behaviour.
Theory of Reasoned Action	Intention, attitude, subjective norms.	Environmental values such as exposure through subjective norms and attention.
Fogg Behaviour Model	Motivation, ability, and prompt.	Ability to indicate tangible behaviour, or behaviour change.
Theory of Planned Behaviour	Attitude, subjective norms, perceived behaviour control, intention and behaviour.	Prediction of intention and overall behaviour. It also has the flexibility to add other constructs to the model to better predict intended behaviour.

Individuals make cognitive decisions based on their personality traits and behavioural patterns, which is why different behavioural theories must be compared before selecting one for research purposes, as they all measure different factors. Nudge Theory suggests ways for policymakers to create change through context-supporting behaviour change (Thaler & Sustein, 2008). Approximately 97% of climate scientists agree that climate action is urgently needed, while almost 30% of Americans believe climate change is not real (Leiserowitz et al., 2018). Climate change denial is a belief that has a direct influence on an individual's actions, such as water consumption behaviours. Cognitive consistency intervention can be used through Nudge Theory to help shift an individual's choices toward pro-climate change actions (Gehlbach et al., 2019). It

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is through this theory that supplying sufficient evidence to individuals can help shift their attitudes and beliefs to alter their behavioural patterns (Gehlbach et al., 2019).

Cognitive Dissonance Theory highlights the interactions between cognition and behaviour of an individual (Festinger, 1957). Cognitive dissonance can also be the reflection of cognition and behaviours that directly reflect individual self-esteem or perceived social image (Aronson, 1994). Cognitive Dissonance Theory can also be used to model cognition impacting an individual's beliefs, abilities, and experiences (Prendergast & Stole, 1996; Rabin, 1994). Another critical aspect of Cognitive Dissonance Theory is how cognitive dissonance has been utilized to implement behaviour change. Many people care about the environment and have strong moral convictions (Thøgersen, 2004). It may therefore be possible to activate environmental responsible behaviours by reminding people of the beliefs and values that they are holding already which might cause them to act pro-environmentally to reduce cognitive dissonance (Thøgersen, 2004). Water conservation can be an aspect of cognitive dissonance through behaviour, self-esteem, and image. Initiatives could aim to make individuals cognisant of their actions and behaviours towards their water usage to cause them to understand the critical aspect of conservation and match their behaviours to their moral values.

The complete model framework of Norm Activation Theory examines input components such as ability, awareness of consequences, situational responsibility, pride and guilt emotions, and denial of responsibility (Savari et al., 2021). According to this behavioural theory, these factors play a significant role in an individual's norms, which create their behaviours. Norm Activation Theory was found to be the most accurate and relevant theory when studying the impact of farmers'

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behaviours toward water conservation compared to other behavioural theories (Valizadeh et al., 2018). This theory examines community attachment through responsibility and norms that are set because of the social benefits of pro-social behaviours (Landon et al., 2017). Behaviour change, including in agricultural such as water resources use, can be measured with this theory.

The Theory of Reasoned Action has been used to predict intention, attitude, and subjective norms. Intention can be seen as the predictor of an individual's behaviour, as it indicates the readiness of that individual to engage in a particular behaviour, such as water conservation (Untaru et al., 2016). Attitude refers to the positive or negative evaluation of the outcome of one's behaviour, and subjective norms are perceptions of the pressure that an individual faces to conform to the expectations of the communities they are a part of (Untaru et al., 2016). Attitudes and subjective norms influence intention and behaviour within the Theory of Reasoned Action (Trumbo & O'Keefe, 2005). But intention does not perfectly predict behaviour in the Theory of Reasoned Action (Trumbo & O'Keefe, 2005). However, in this theory, intention and behaviour toward water conservation can be affected by environmental values that influence subjective norms and attention to the information about water conservation that people are exposed to (Trumbo & O'Keefe, 2005).

The Fogg Behavior Model looks at behaviour within three elements with their variable measurements. These three elements are motivation, ability, and prompts and they must occur simultaneously for the behaviour to be enacted (Fogg, 2007). Motivation itself is driven by three polarized components: pleasure and pain, hope and fear, and acceptance and rejection (Fogg, 2007). Ability is measured along three pathways and is defined as the 'ability' that makes a behaviour

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possible (Fogg, 2007). The paths for ability fall under skill and resources (Fogg, 2007). The last aspect, and arguable the most important one of the Fogg Behaviour Model, is prompts. Without a prompt (i.e., a facilitator, signal, or spark), whether it be external or internal, the behaviour will not happen (Fogg, 2007). In its conceptual orientation, the Fogg Behavior Model can be interpreted as a community-based social marketing approaches in pursuit of sustainable behaviour change (Stephens, 2014). Community-based social marketing examines barrier removal, enhances benefits, and applies behaviour change tools (e.g., props, norms, and incentives) (Stephens, 2014).

The Theory of Planned Behaviour is an extension of the Theory of Reasoned Action and allows to explore in more depth the drivers of behavioural intention and of behaviour itself (Ajzen, 1991). The Theory of Planned Behaviour is the theory that best supports investigation of behavioural intention and the overall prediction of intentions that lead to the behaviour enacted by individuals (Ajzen, 1991). The Theory of Planned Behaviour integrates both personality psychology and behavioural psychology, two subcategories in psychology. Since the Theory of Planned Behaviour can be adapted as needed to fit various criteria, the model can be extended to add additional variables. For example, the Big Five Personality Traits can be categorized into the overarching theme of personality, which can be added to the Theory of Planned Behaviour as extra variables.

The different psychology models presented above display a variety of frameworks for the investigation of behaviour change regarding water usage or conservation. The Theory of Planned Behaviour is a critical framework in which behaviour and personality can be examined for a more detailed description of an individual's interactions with water use. The comprehensive framework

of the Theory of Planned Behaviour and the option to add more variables, such as personality traits, supports more fully understanding of the investigated behaviour.

2.6. Influential Studies

Four former studies have provided an important backdrop for the current study. In different study contexts, these studies have employed a range of variables that address personality traits, behavioural intent, and behaviour. In their totality, these three studies highlighted the possibility of using the Theory of Planned Behaviour, in combination with the Big Five Personality Traits framework, to investigate water saving intentions: First, Brandt et al. (2020) employed different questionnaire tools to assess how the Big Five Personal Traits of participants change through their life course. They found that although personality traits can vary, they become more stable around age 25. Second, in a study of determinants of socializing in the metaverse, G et al. (2023) employed the Big Five Personality Traits framework. They found that study participants high in Extraversion showed lower levels of enthusiasm for this social interaction while participants with higher Agreeableness showed higher interest (G et al., 2023). The authors explained these effects with the influence of personality traits on behavioural intent and behaviour. For example, people with higher Agreeableness tend to have a higher capacity to adapt to changes in their surroundings (Chung, 2017; G et al., 2023). Individuals with higher levels of Extroversion tend to be more outgoing, while people with higher levels of Neuroticism are less likely to seek new situations, and people with higher levels of Conscientiousness are more likely to feel responsible for decisions (G et al., 2023). Third, Si et al. (2022) applied the Theory of Planned Behaviour, extended with the concepts of environmental concern, perceived risk, and information spread, to investigate participants' water-saving intentions. They found that attitude, subjective norms, and perceived

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behavioural control in the Theory of Planned Behaviour, all were affected by environmental concern and perceived risk, but they did not assess the effect that personality traits might have (Si et al., 2022). Finally, a study by Su et al. (2021) concluded that strengthening public information about water-saving can change individuals' behaviours toward saving water.

Several other studies inspired the analytical approach of the current study. Fraj and Martinez (2006) tested the influence of personality on ecological consumer behaviour. Their study examined how the Big Five Personality Traits (plus emotional stability) impact overall personality traits and ecological consumer behaviour and used a structural equation modeling to test the relationship between personality and behaviour. Fraj and Martinez's (2006) study was inspirational to the current study because they investigated the effects of personality traits on pro-environmental behaviour. Kim et al. (2022) used structural equation modeling to investigate the relationships between Big Five Personality Traits, the Theory of Planned Behaviour, and the use of mobile mindfulness apps. While their study used only two of the five Big Five Personality Traits, strong relationships between the constructs were found. Again, Si et al. (2022) applied structural equation modeling to investigate water-saving intentions within the Theory of Planned Behaviour framework.

In summary, the literature review for the current study highlights the crucial role that water conservation has in achieving the SDGs. The literature review also places emphasis on the importance of addressing water scarcity and inequitable access to clean water on both the global scale, and within Canada, through the lens of water governance and management. Furthermore, this section examines the relationships between personality traits and environmental behaviour,

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specifically through the connection of the Big Five Personality Traits and water-saving intentions as well as the importance of behavioural theories, including the Theory of Planned Behaviour. The Theory of Planned Behaviour can provide a useful framework for analyzing and understanding the factors that influence both water conservation behaviour and water-saving intentions.

3. Methods

This chapter describes the research methodology applied in the current study. Its context includes the background for the model's theories, research approach, data collection and analysis, and ethics clearance.

3.1. Personality Psychology

When psychologists refer to personality psychology, they refer to the Big Five personality traits, also known as the Big Five Factor Model (Costa & McCrea, 1999). The Big Five personality traits construct a framework of interindividual differences in personality dimensions (John & Srivastava, 1999). Individuals' differences in personality characteristics can be found in the Big Five personality traits as they are broad spectrums for personality subsets (Costa & McCrae, 1985). Personality traits can outline predictions of an individual's behaviour as they create overarching, reoccurring and consistent patterns (Costa & McCrea, 1999).

Each of the Big Five personality trait (i.e., Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism), are defined as independent variable as they each have specific individual, highlighting different personality traits. Openness, for example, indicates readiness to new experiences, which may be either intellectual, cultural, and aesthetic experiences (American Psychological Association Dictionary, 2013). Individuals with high levels of Conscientiousness display higher levels of organization, responsibility, and self-awareness (American Psychological Association Dictionary, 2013). Extraversion is used to describe the personality of those who exhibit social, outgoing, and expressive behaviours (American Psychological Association Dictionary, 2013). Agreeableness is a trait that is expressed strongly in individuals who act selflessly in their behaviour towards others and the world (American Psychological Association

Dictionary, 2013). If an individual has high levels of Neuroticism, they are more prone to psychological distress and display higher levels of emotional instability (American Psychological Association Dictionary, 2013).

3.2. Theory of Planned Behaviour

The Theory of Planned Behaviour states that individual behaviour is directly predicted by behavioural intentions, meaning the motivation to perform a specific behaviour (Ajzen, 1988, 1991). Accordingly, the stronger the intention to perform a specific behaviour, the greater the likelihood that the behaviour will be performed (Ajzen, 1991). However, three variables are used to predict behavioural intent itself: Attitude, Subjective Norms, and Perceived Behavioural Control (Si et al., 2022) (Figure 1, Table 2). Attitude reflects a person's beliefs about the value of a specific behaviour; Subjective Norm is the perceived social pressure to enact a specific behaviour; perceived behavioural control is a person's perceived ability to enact a specific behaviour (Ajzen, 1988, 1991). The combined effect of these three variables determines the behavioural intent (Figure 1).

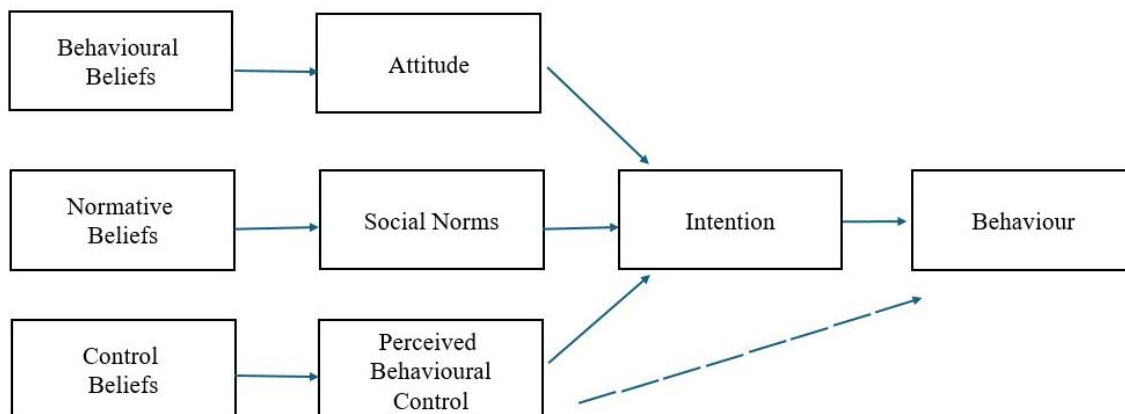


Figure 1. The Theory of Planned Behaviour. Adapted from Ajzen (2006).

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Subjective norms can be felt through perceived expectations of others for an individual to participate in water conservation (Armitage & Conner, 2001; Trumbo & O’Keefe, 2001). Subjective Norms can also hold influence through personal norms and past behaviours to indicate water conservation (Chaudhary et al., 2017). Crucially, social support or lack of it can affect the Subjective Norms of water conservation behaviour (Chaudhary et al., 2017). Incorporating Subjective Norms into professional places, such as workspaces that facilitate water conservation practices and initiatives, could help improve the water consumption behaviours of peers (Chaudhary et al., 2017). Attitude towards water conservation can also be a positive or negative aspect of water conservation behaviours (Armitage & Conner, 2001; Trumbo & O’Keefe, 2001).

Table 2. Theory of Planned Behaviour constructs and definitions. Adapted from Ajzen (2006).

Behavioural Construct	Definition
Behavioural Beliefs	The behaviours that link behaviour to the expected outcomes. These are the beliefs that are based on the probability that a specific behaviour will lead to the expected outcome
Attitude	The negative or positive views one has towards the behaviour
Normative Beliefs	The expectations of important individuals in the person’s life (family, friends, community). Normative beliefs question the likelihood of the subject performing a certain behaviour if it matters to those important to them.
Subjective Norms	The perceived social pressure to perform a specific behaviour. The individual may perceive that they are expected to behave a specific way, and the subjective norms will shape the impacts of social pressures
Control Beliefs	The belief that specific factors could hinder or help a behaviour
Perceived Behavioural Control	Based on the individual’s belief of what/how they can perform regarding the behaviour. This is powered by the control belief.
Intention	The interest level a subject has in performing the behaviour
Behaviour	Observable response of all above factors

3.3. Research Approach

The current study applied an anonymous non-experimental survey design. The survey was aimed at young adults and produced data on individuals' water conservation behaviour, personality traits, and demographic factors, which were used to test the research hypotheses.

3.4. Survey Design and Questionnaire

The survey made use of an online questionnaire and covered students at the University of Waterloo in all faculties, programs, and degree levels. The survey was rolled out with the support of University of Waterloo Institutional Analysis and Planning (IPA) – which reports to the Office of the Provost – and University of Waterloo Graduate Studies and Postdoctoral Affairs (GSPA) – which reports to the Associate Vice-President, Graduate Studies and Postdoctoral Affairs.

The support by IPA was essential for reaching undergraduate students because university requirements stipulate that data collection from over 400 undergraduate students had to go through IPA. After obtaining clearance from the IPA, the Registrar's Office directly emailed all University of Waterloo undergraduate students about the contents of the study. This email also gave undergraduate students the choice to follow a link to the online questionnaire, if they wanted to participate (Appendix 2). The support by GSPA was important for reaching graduate students. GSPA produces a weekly e-newsletter for all registered graduate students and shared information about the study through this e-newsletter. The newsletter linked to a University of Waterloo webpage that covers calls for graduate students to serve as volunteer participants in various studies. This webpage contained information that explained how to contact the student researcher, if a graduate student was interested in participating in the study. When a graduate student contacted

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the student researcher, they were provided with a link to the survey. The survey started on January 10, 2024, and remained open for three weeks until January 31, 2024.

The questionnaire developed based on prior studies in water conservation behaviour (Si et al., 2020) and personality traits (Brandt et al., 2020; Gerlitz & Schupp, 2005; Lang, 2005) (Appendix 3). The online questionnaire was created in Qualtrics XM and consisted of 38 question items that covered the following topics: water conservation behaviour and its antecedents, personality traits, and demographic factors. Except for the question items that covered the demographic factors, responses to all other questionnaire items used a five-point Likert scale, with answers ranging from strongly agree (coded 1) to strongly disagree (coded 5).

The Big Five Factor Structure Scale for Personality Psychology was used as underlying model of personality traits. Personality traits were assessed using the short instruments design based on the Big Five Inventory-SOEP Version (BFI-S; Brandt et al., 2020; Gerlitz & Schupp, 2005; Lang, 2005). The BFI-S assesses four personality traits (i.e., Conscientiousness, Extraversion, Agreeableness, and Neuroticism) with three questionnaire items (one reverse-coded item for each personality trait), and one personality trait (i.e., Openness) with four questionnaire items due to the natural diversity of this trait without any reverse-coded items (Appendix 3; Lang, 2005).

Following Si et al. (2022), the questionnaire items only covered Attitude, Subjective Norms, Perceived Behavioural Control, and Behavioural Intent, as constructs of the Theory of Planned Behaviour. Therefore, Behavioural Beliefs, Normative Beliefs, Control Beliefs, and Behaviour,

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which also are constructs of the Theory of Planned Behaviour, were not assessed. The demographic factors covered were age, gender, the program of study that the participant was enrolled in, and the level of study (i.e., Bachelor, Masters, or PhD).

In November 2023, the student researcher conducted a pilot study of the questionnaire. Participants in this pilot study were current Masters students in the 2024 graduating cohort for Sustainability Management in the Faculty of Environment at the University of Waterloo. The students who volunteered to help with the pilot testing were asked to complete the questionnaire and offer high-level feedback. This feedback helped to confirm that the questionnaire was clear and could be completed in a reasonably short period of time.

3.5. Reliability and Validity

The convergent validity of the BFI-S indicates the degree to which the BFI-S achieves the same results as the BFI-44 (John et al., 1991), which is one of the original Big Five personality Traits measurement instruments. Convergent validity of the BFI-S was confirmed by prior studies (i.e., Gerlitz & Schupp, 2005; Lang, 2005; and Hahn et al., 2012).

The predictive validity of a model is its ability to predict future outcomes. The Theory of Planned Behaviour (Ajzen, 1991) has been criticized by some researchers for missing validity (e.g., Sniehotta et al., 2014) but has been defended by other researchers pointing out misguided criticism (e.g., St Quinton et al., 2021). The predictive validity of the Theory of Planned Behaviour has been confirmed in a study by Armitage and Connor (1999). At this time, the Theory of Planned Behaviour remains a much-used framework for examination of psychological drivers of behaviour. Importantly, the Theory of Planned Behaviour is confirmed to be “open to the inclusion of

additional predictors if it can be shown that they capture a significant proportion of the variance in intention or behaviour after the theory's current variables have been taken into account" (Ajzen, 1991, p. 199). This has led many researchers to report that they have incorporated a variety of additional psychological and environmental factors into the Theory of Planned Behaviour core variables to help improve the understanding of various behaviours, including water conservation behaviours (e.g., Clark & Finley, 2007; Lam, 1999; 2006; Trumbo & O'Keefe, 2001).

3.6. Data Analysis

The relationships between personality traits, the antecedent constructs of the Theory of Planned Behaviour, and of water conservation behavioural intent, were analysed with structural equation modeling, more specifically with partial least squares path modeling (PLS-PM) (Sanchez, 2013). PLS-PM is a statistical method used to understand relations among variables that can be measurable (i.e., manifest) or unmeasurable (i.e., latent). The manifest variables are used to estimate values for the latent variables and their relationships quantified. For this study, the manifest variables were the question items of the questionnaire, while the latent variables were the Big Five Personality Traits and the constructs of the Theory of Planned Behaviour. The relationships between the manifest variables and the latent variables are known as the "outer model" and the relationships between the latent variables are known as the "inner model". Path effects quantify the relationships between the latent variables and can be direct (i.e., unmediated effect of one variable on another) or indirect (i.e., an effect from one variable on another that is mediated by a path through other variables) (Sanchez, 2013).

PLS-PM does not make stringent assumptions about variable distribution and is well suited for prediction and theory development of complex models (Wong, 2013; Hair et al., 2017; Dash

& Paul, 2021). The goodness of fit of the PLS-PM model indicates the overall predictive power of the model for all manifest and latent variables (Sanchez, 2013). In social-psychological research, the overall goodness of fit of the PLS-PM is usually lower than the commonly accepted threshold (0.7) because of self-report errors and can still be accepted (Sanchez, 2013). The loading coefficients are used to indicate the ability of the manifest variables to reliably quantify latent variables and is commonly expected to be 0.7 or larger (Sanchez, 2013). The PLS-PM analysis was implemented in R Studio using the 'plspm' package by Sanchez (2013).

Three comparison analyses were run to test if different demographic factor values would yield different relationships between the latent variables. For this purpose, the dataset was split in two subgroups by gender, faculty, and program of study and the resulting path effects were compared between the subgroups using bootstrap validation (Sanchez, 2013; Klesel et al., 2022). The first comparison looked at the difference between students enrolled in a program in the Faculty of Environment and those who are not. There were 25 different programs, and both Bachelor and Masters students were included. The second comparison test examined differences in the relationships between students taking a STEM-related program (i.e., science, technology, engineering, mathematics) compared to those who were not taking a STEM program. In order to determine which subjects qualify as STEM, the University of Waterloo's list of Bachelor of Science, Masters and Doctoral programs were used. STEM programs included programs such as Accounting, Kinesiology and Psychology (for complete list of programs see Appendix 4). The third comparison tested relationships for differences between genders. The comparison was completed between those who identified as "Women/Transwoman" and "Men/Transmen." Not

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enough participants identified as Genderqueer, Gender non-conforming, Gender non-binary, Gender Fluid or self-defining to be included within the comparison (only 2.5% of all participants).

3.7. Ethics Approval

The University of Waterloo Office of Research Ethics reviewed the research proposal and provided ethics approval (ORE #45369). In addition, IAP had to review the research materials before the survey could be administered to undergraduate students. For this purpose, the Survey Advisory Committee of the IAP reviewed the questionnaire and also granted approval. To make the survey available for graduate students, it also needed to be approved by GSPA. After approval by GSPA, information about the survey was accepted as a part of the e-newsletter for graduate students.

4. Results

This section outlines the characteristics of the participant sample, the results from the PLS-PM analysis for the entire data set, and the results from the comparison analysis between demographic subgroup PLS-PMs.

4.1. Participant Sample

Table 3. Summary of demographic characteristics of study participants.

	Demographic Characteristic	Frequency	%
Gender	Man/Transman	430	33.4%
	Woman/Transwoman	770	59.7%
	Genderqueer/Gender non-conforming/Gender non-binary/Gender Fluid	47	3.6%
	Two-Spirited	0	0.0%
	Self-define	11	0.8%
	Prefer not to answer	31	2.4%
	Age (Years)	17-20	731
21-25		502	38.5
26-30		21	1.6
31-35		14	1.1
36-40		10	0.8
41-45		8	0.6
46-50		2	0.2
51-60		7	0.5
61 and older		8	0.6
Education Level	Undergrad	1260	97.2
	Masters	26	2.2
	PhD	9	0.5
Faculty	Arts	252	20.2
	Engineering	307	24.6
	Environment	147	11.8
	Health	104	8.35
	Math	200	16.1
	Science	223	17.9
	Not Specified	12	1.0

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The survey was made available to all students enrolled at the University of Waterloo (40,408) (Institutional Analysis & Planning, 2024), consisting of 34,398 undergraduate students and 6,010 graduate students at the time of the survey rollout. The online questionnaire was accessed and started by 1,607 students (3.98%). However, only 1,295 students completed the questionnaire, equal to a response rate of 3.20% of the entire student population. Only completed questionnaires were analyzed for this study. Of the participants who completed the questionnaire, 1,260 were undergraduate students (97.3%), 26 were Masters students, and nine were PhD students (Table 3). The majority of participants identified as Woman/Transwoman (59.7%). The most common age was 19 years (18.8%), and 1,233 participants (94.5%) were between 17 and 25 years old (Table 3). Most participants (24.6%) were enrolled in a program in the Faculty of Engineering (Table 3).

4.2. Personality Traits and Social-psychological Factors

Table 4. Summary results for constructs and questionnaire items.

Construct	Questionnaire item	Mean	Mode	Standard Deviation
Extroversion	I talk to a lot of different people in social settings	3.1	4	1.3
	I consider myself outgoing and social	2.9	2	1.5
	I do not like to draw attention to myself	2.3	2	1.1
Agreeableness	I have a forgiving nature	3.9	4	1.1
	I am considerate and kind to almost everyone	4.2	4	0.8
	I am sometimes rude to others	3.0	4	1.1
Conscientiousness	I am always doing things efficiently	3.5	4	1.1
	I often forget to put things back in their proper place/ leave my belongings around	2.9	2	1.4
	I always do a thorough job	3.9	4	0.9
Neuroticism	I get stressed out easily	3.6	5	1.3
	I get nervous easily	3.7	4	1.2
	I am relaxed most of the time	3.1	4	1.2

Table 4. Continued.

Construct	Questionnaire item	Mean	Mode	Standard Deviation
Openness	I have an active imagination	4.0	5	1.1
	I have excellent and original ideas	3.6	4	1.0
	I value artists and aesthetic experiences	4.1	5	1.0
	I spend time reflecting on things	4.1	5	1.0
Attitude	Water conservation is a good idea	4.8	5	0.5
	Water conservation is the smart thing to do	4.7	5	0.6
	Water conservation has a meaningful impact	4.5	5	0.8
	It is necessary to conserve water	4.5	5	0.8
Subjective Norms	People who are important to me (friends, family, peers) will support my actions in water conservation.	4.0	4	0.9
	People who are important to me will also conserve water	3.4	4	1.0
	People who are important to me think I should conserve water	3.3	3	1.0
	Society advocates the importance of conserving water	3.6	4	1.2
Perceived Behavioural Control	Conserving water is easy for me	3.5	4	1.0
	Whether I participate in limiting my water use is entirely up to me	4.1	4	1.0
	As long as I want, conserving water is easy	3.4	4	1.1
	I have the knowledge and time to conserve water	3.5	4	1.1
Water Saving Intention	I would like to conserve water	4.4	5	0.8
	I will make efforts in the future to conserve water	4.1	4	0.9
	I intend on conserving water	4.2	5	0.9
	I will persuade others to take on water conservation practices	3.1	3	1.2

On average, survey participants neither agreed nor disagreed with the questionnaire items that related to Extroversion (mean ranging from 2.3 to 3.1) (Table 4). However, on average they tended to disagree with most other questionnaire items. This was true for the remaining Big Five Personality Traits (i.e., Agreeableness, Conscientiousness, Neuroticism, and Openness) for

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which average responses ranged from 2.9 to 4.2, as well as for all examined constructs of the Theory of Planned Behaviour (i.e., Attitude, Subjective Norms, Perceived Behavioural Control, and Behavioural Intention [here: Water Saving Intention]) for which averages ranged from 3.1 to 4.8 (Table 4).

For the Big Five Personality Traits, on average the strongest agreement was found for the questionnaire item “I do not like to draw attention to myself” (Extroversion) (average = 2.3), while on average the strongest disagreement was found for the questionnaire item “I am considerate and kind to almost everyone” (Agreeableness) (average = 4.2). For the constructs of the Theory of Planned Behaviour, on average the strongest agreement was found for the questionnaire items “I will persuade others to take on water conservation practices” (Behavioural Intent) (average = 3.1), while on average the strongest disagreement was found for the questionnaire item “Water conservation is a good idea” (Attitude) (average = 4.8). For all questionnaire items, the standard deviation ranged from 0.5 to 1.5 (Table 4).

The coefficient of determination quantifies how much of the variation of an endogenous latent variable can be explained by other latent variables – exogenous latent variables are not explained by other latent variables but only by manifest variables. The endogenous latent variables are Attitude, Subjective Norms, Perceived Behavioural Control, and Behavioural Intention (i.e., Water Saving Intention). The coefficient of determination in this study ranged from 0.0361 to 0.5554 (Table 5). This indicates that the Big Five Personality Traits respectively explain 8.2% of the variation of Attitude, 4.5% of Subjective Norms, and 3.6% of Perceived Behavioural Control. The Big Five Personality Traits together with the constructs of the Theory

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of Planned Behaviour explain 55.5% of the variation in Water Saving Intention (Table 5). Next to Water Saving Intention, the best explained construct of the Theory of Planned Behaviour was Attitude with 8% of its variation explained by the Big Five Personality Traits.

4.3. Partial Least Squares Path Modeling of Water-saving Intention

Table 5. Summary of inner model, exogenous and endogenous variables, and coefficient of determination.

Latent variable	Type	Coefficient of Determination
Extroversion	Exogenous	0
Agreeableness	Exogenous	0
Conscientiousness	Exogenous	0
Neuroticism	Exogenous	0
Openness	Exogenous	0
Attitude	Endogenous	0.0819
Subjective Norms	Endogenous	0.0446
Perceived Behavioural Control	Endogenous	0.0361
Water Saving Intention	Endogenous	0.5554

The PLS-PM analysis yielded a goodness of fit value of 0.323, indicating a predictive power of 32%, when considering the complete model with all manifest variables. The minimum acceptable value for the loading of manifest variables on latent variables is 0.7. However, the results from the outer path model showed that nine out of 32 manifest variables had a loading value < 0.7 . When the manifest variables with loading values below the acceptable limit were removed (Table 6), the goodness of fit value increased to 0.361, indicating a predictive power of 36% for the reduced model. The reduced outer and inner model is shown in Figures 2 to 6. The various figures highlight the respective outer and inner model for Extroversion (Figure 2), Agreeableness (Figure 3), Conscientiousness (Figure 4), Neuroticism (Figure 5), and Openness (Figure 6).

Table 6. Loadings values for all manifest variables in the reduced PLS-PM model only with acceptable loading values > 0.7. The loading values for manifest variables with loading value < 0.7 are not provided (NA).

Latent Variable	Manifest Variable	Loading Value
Extroversion	Q2	0.940
	Q3	0.924
	Q4	NA
Agreeableness	Q5	NA
	Q6	1.000
	Q7	NA
Conscientiousness	Q8	0.794
	Q9	NA
	Q10	0.861
Neuroticism	Q11	-0.894
	Q12	0.910
	Q13	0.800
Openness	Q14	NA
	Q15	NA
	Q16	1.000
	Q17	NA
Attitude	Q18	0.847
	Q19	0.853
	Q20	0.851
	Q21	0.846
Subjective Norms	Q22	0.789
	Q23	0.879
	Q24	0.831
	Q25	NA
Perceived Behavioural Control	Q26	0.872
	Q27	NA
	Q28	0.786
	Q29	0.809
Water Saving Intention	Q30	0.853
	Q31	0.918
	Q32	0.920
	Q33	0.769

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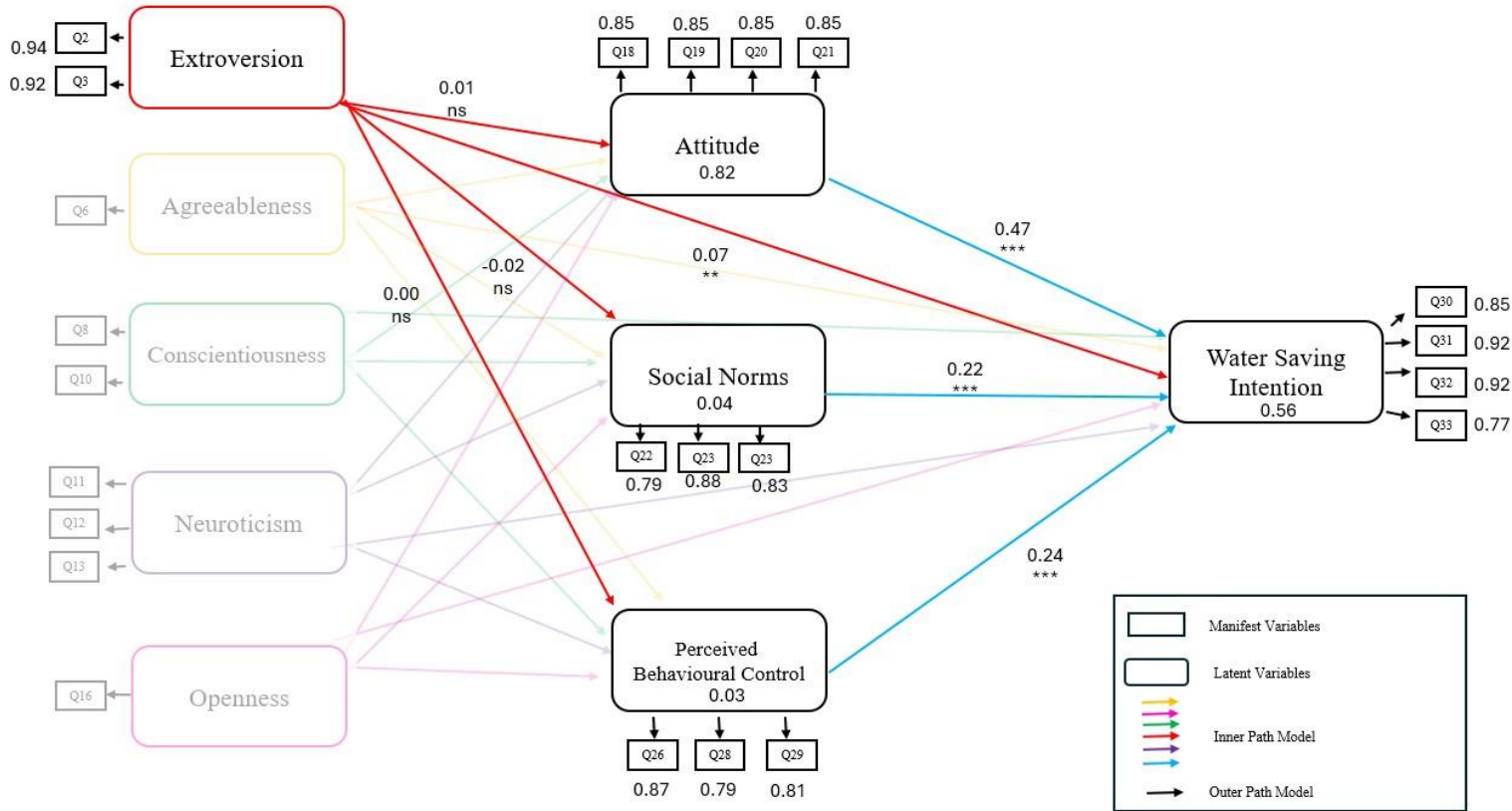


Figure 2. Diagram of the reduced PLS-PM for Water Saving Intention – Extroversion. Shown are path coefficients (along arrows), coefficients of determination (inside boxes), and loading values (next to square boxes) with values only shown for Extroversion and exogenous latent variables. The following superscript symbols represent the p values in the inner path: ^{ns} $p > 0.05$, * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$.

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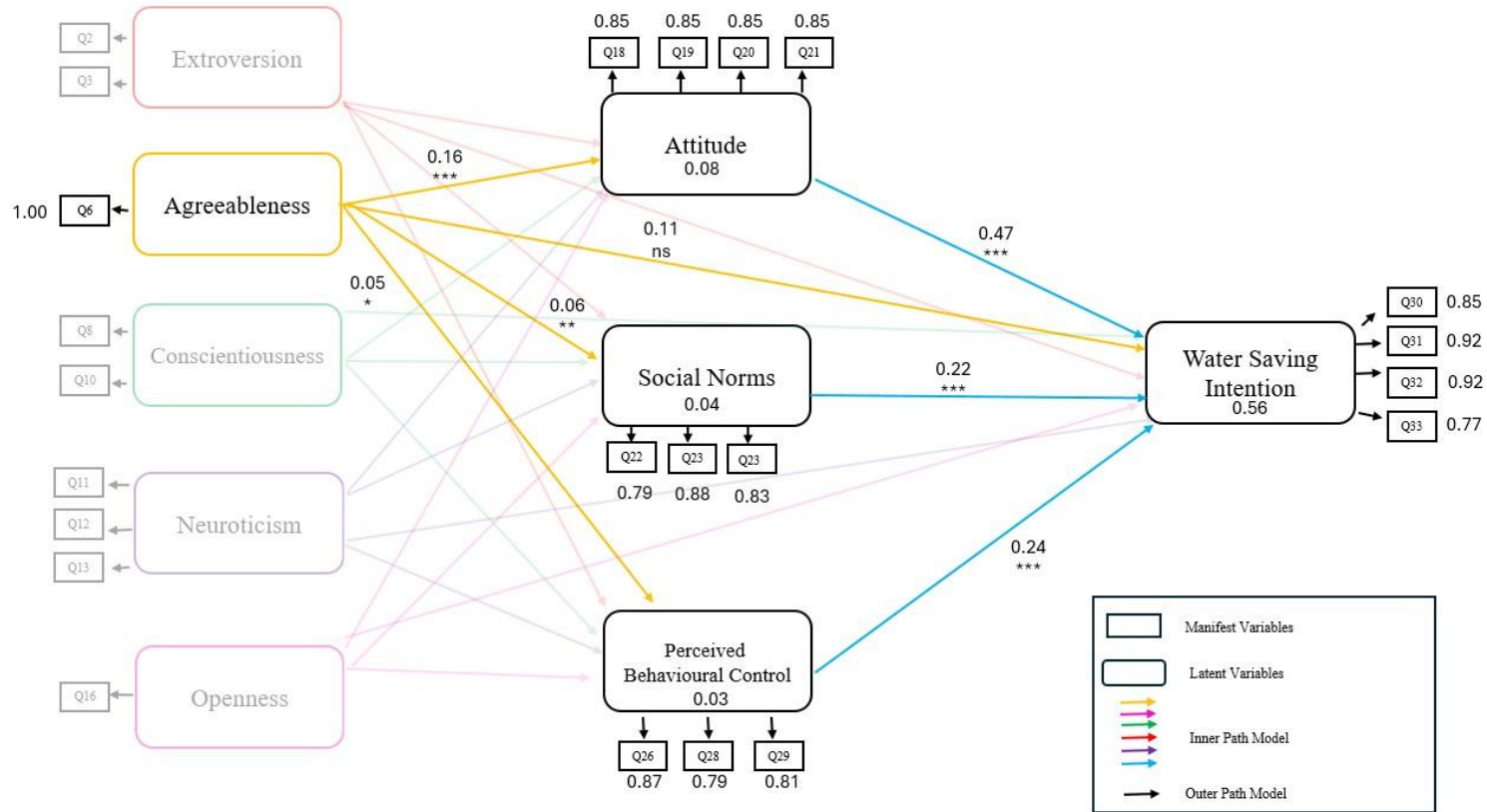


Figure 3. Diagram of the reduced PLS-PM for Water Saving Intention – Agreeableness. Shown are path coefficients (along arrows), coefficients of determination (inside boxes), and loading values (next to square boxes) with values only shown for Agreeableness and exogenous latent variables. The following superscript symbols represent the p values in the inner path: ^{ns} $p > 0.05$, * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$.

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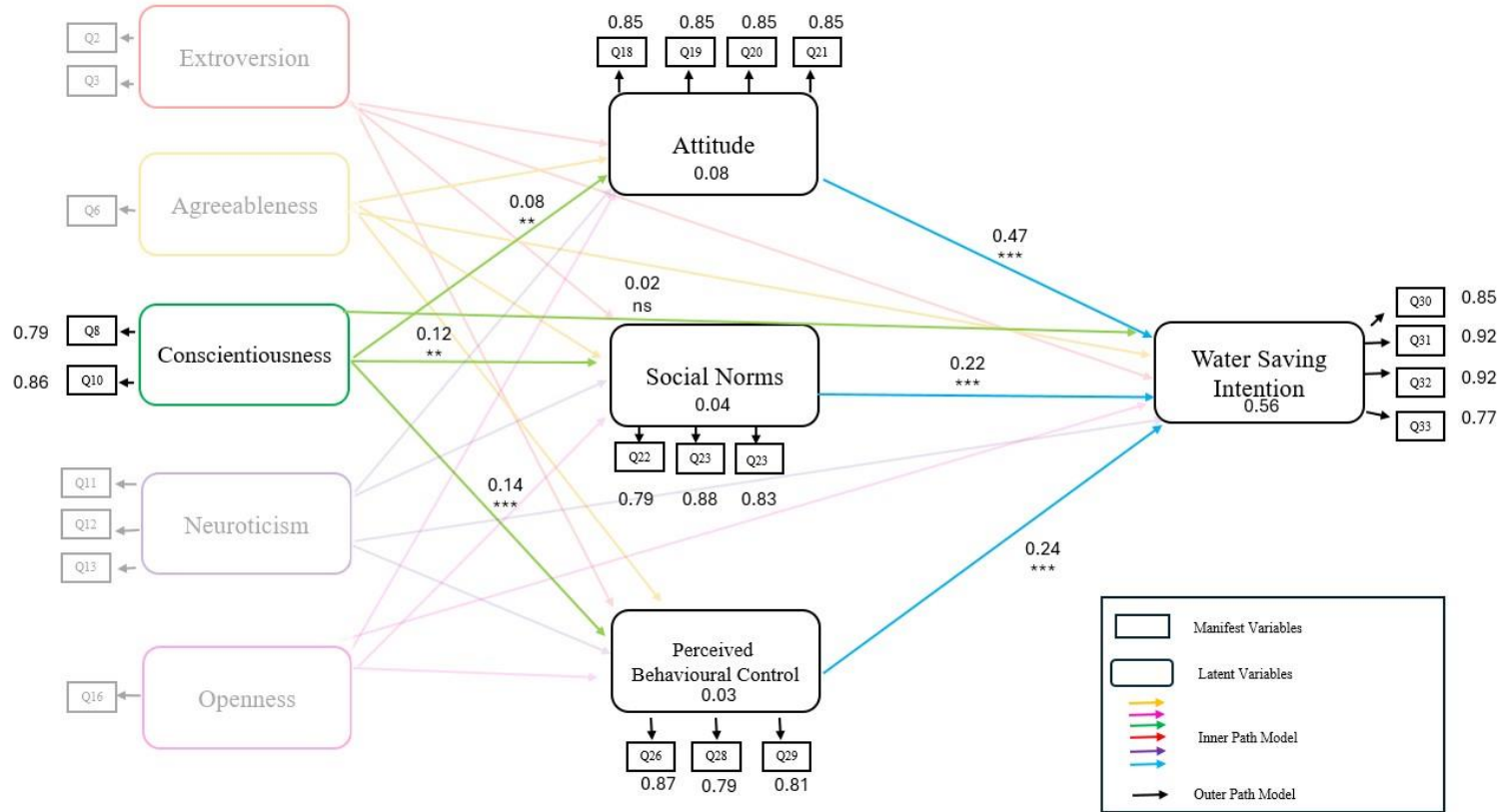


Figure 4. Diagram of the reduced PLS-PM for Water Saving Intention – Conscientiousness. Shown are path coefficients (along arrows), coefficients of determination (inside boxes), and loading values (next to square boxes) with values only shown for Conscientiousness and exogenous latent variables. The following superscript symbols represent the p values in the inner path: ^{ns} $p > 0.05$, * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$.

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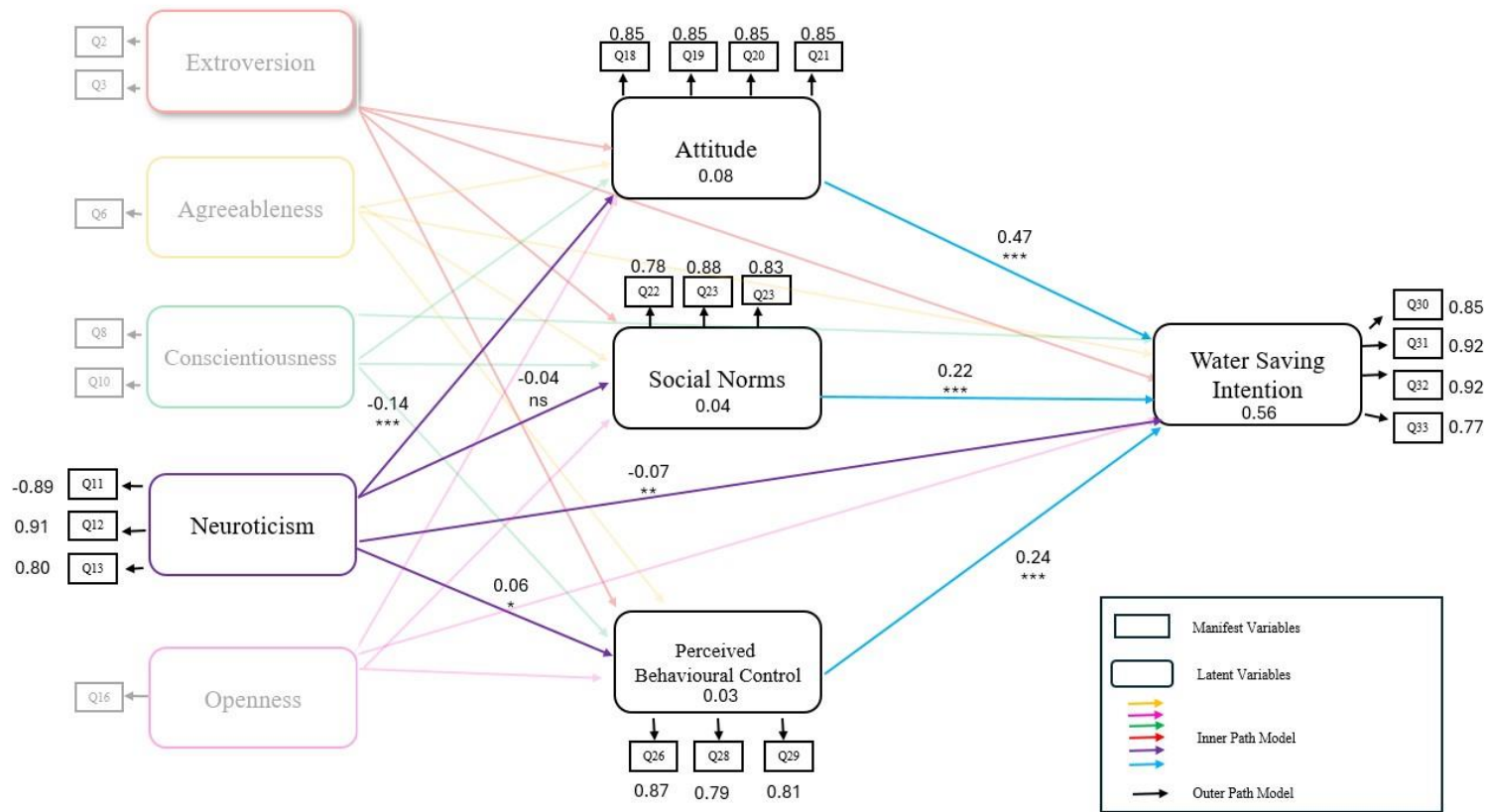


Figure 5. Diagram of the reduced PLS-PM for Water Saving Intention – Neuroticism. Shown are path coefficients (along arrows), coefficients of determination (inside boxes), and loading values (next to square boxes) with values only shown for Neuroticism and exogenous latent variables. The following superscript symbols represent the p values in the inner path: ^{ns} $p > 0.05$, * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$.

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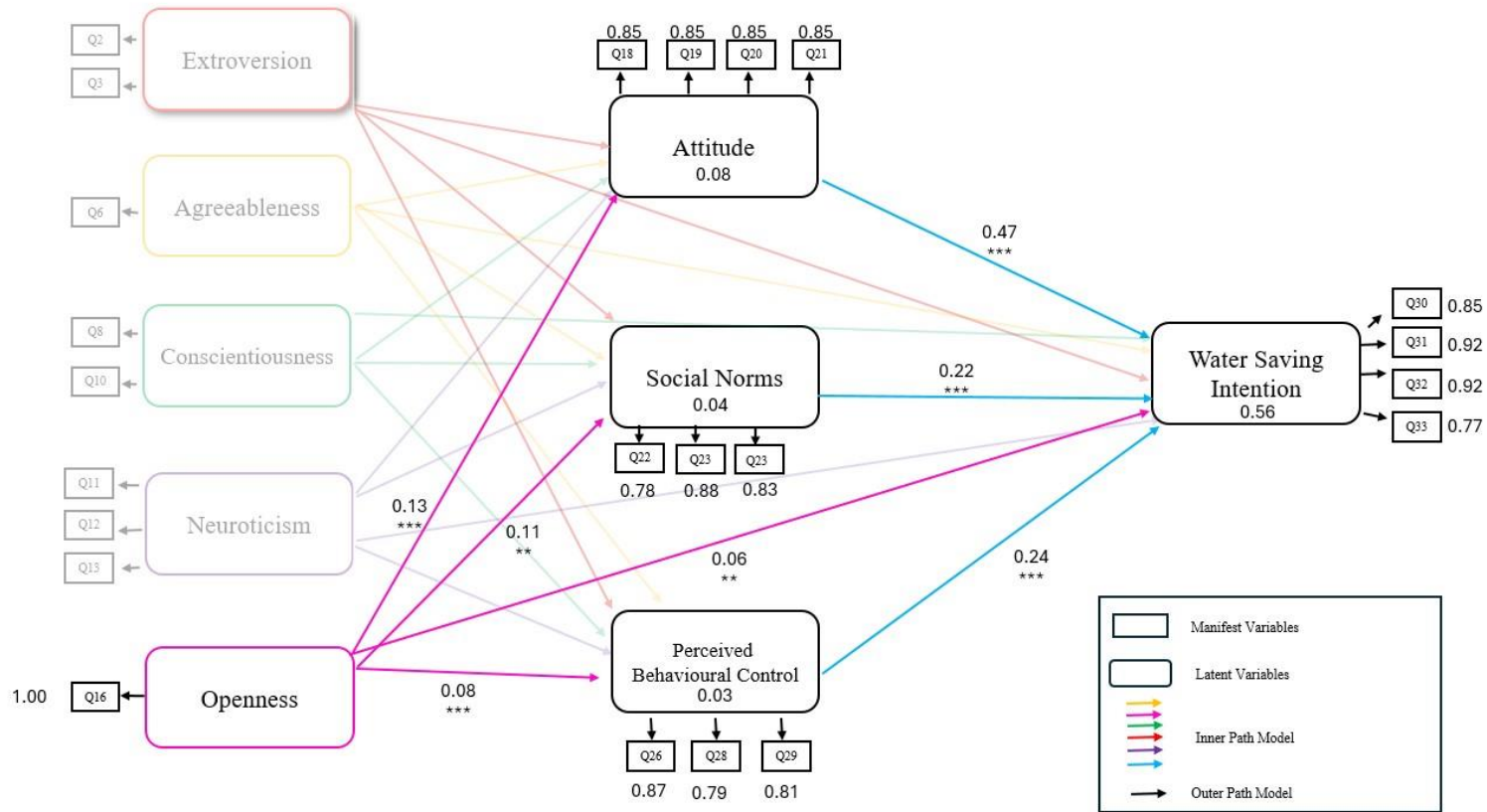


Figure 6. Diagram of the reduced PLS-PM for Water Saving Intention – Openness. Shown are path coefficients (along arrows), coefficients of determination (inside boxes), and loading values (next to square boxes) with values only shown for Openness and exogenous latent variables. The following superscript symbols represent the p values in the inner path: ^{ns} $p > 0.05$, * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$.

Table 7. Inner path results for reduced PLS-PM model for Water Saving Intention.

Path from	Path to	Path Coefficient	P-value
Extroversion	Attitude	0.010	0.714
Agreeableness		0.160	< 0.001
Conscientiousness		0.076	0.005
Neuroticism		0.140	< 0.001
Openness		0.132	< 0.001
Extroversion	Subjective Norms	0.028	0.922
Agreeableness		0.109	< 0.001
Conscientiousness		0.120	< 0.001
Neuroticism		-0.040	0.166
Openness		0.109	< 0.001
Extroversion	Perceived Behavioural Control	0.001	0.971
Agreeableness		0.059	0.040
Conscientiousness		0.140	< 0.001
Neuroticism		0.062	0.030
Openness		0.085	0.003
Extroversion	Water Saving Intention	0.068	0.001
Agreeableness		0.049	0.014
Conscientiousness		0.015	0.426
Neuroticism		0.074	< 0.001
Openness		0.059	0.002
Attitude		0.466	< 0.001
Subjective Norms		0.218	< 0.001
Perceived Behavioural Control		0.244	< 0.001

The PLS-PM analysis suggests that most inner paths were significant (Figures 2 – 6, Table 7). Of all 23 inner paths, only five were not significant. Three of these non-significant paths originated from Extroversion leading to Attitude, Subjective Norms, and Perceived Behavioural Control (Figure 2, Table 7). However, the inner path from Extroversion to Water Saving Intention was significant. The two other non-significant inner paths led from Neuroticism to Subjective Norms, and from Conscientiousness to Water Saving Intention (Table 7). The strongest inner path

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(0.466) led from Attitude to Water Saving Intention. The strongest inner path from a Big Five Personality Trait (0.160) led from Agreeableness to Attitude (Table 7).

Five paths led directly lead from the Big Five Personality Traits to Water Saving Intention (Figures 2 – 6) without mediation by other Theory of Planned Behaviour constructs. However, there also were 15 indirect paths from the Big Five Personality Traits to Water Saving Intention mediated by Attitude, Subjective Norms, and Perceived Behavioural Control (Figures 2 – 6). The PLS-PM analysis suggested that indirect paths led to four large (Agreeableness, Conscientiousness, Neuroticism, and Openness) and one small (Extroversion) indirect path effects resulting into differences in total (direct plus indirect) effects (Figure 7):

- Extroversion to Water Saving Intention indirect effect: 0.004
- Agreeableness to Water Saving Intention indirect effect: 0.112
- Conscientiousness to Water Saving Intention indirect effect: 0.095
- Neuroticism to Water Saving Intention indirect effect: -0.059
- Openness to Water Saving Intention indirect effect: 0.106

4.4. Comparisons between Demographic Groups

The subgroup analyses compared all direct inner paths between separately conducted PLS-PM analyses performed on the various subgroups. Each PLS-PM model consisted of 23 inner paths. The use of three demographic factors (i.e., gender, faculty, and program of study), resulted in six different PLS-PM models arranged in three pairs of models (Women/Trans-women versus Men/Trans-men, Faculty of Environment versus not Faculty of Environment, STEM program versus non-STEM program) and 69 inner path comparisons. Of these 69 inner path comparisons, only six indicated a significant difference between the demographic subgroups.

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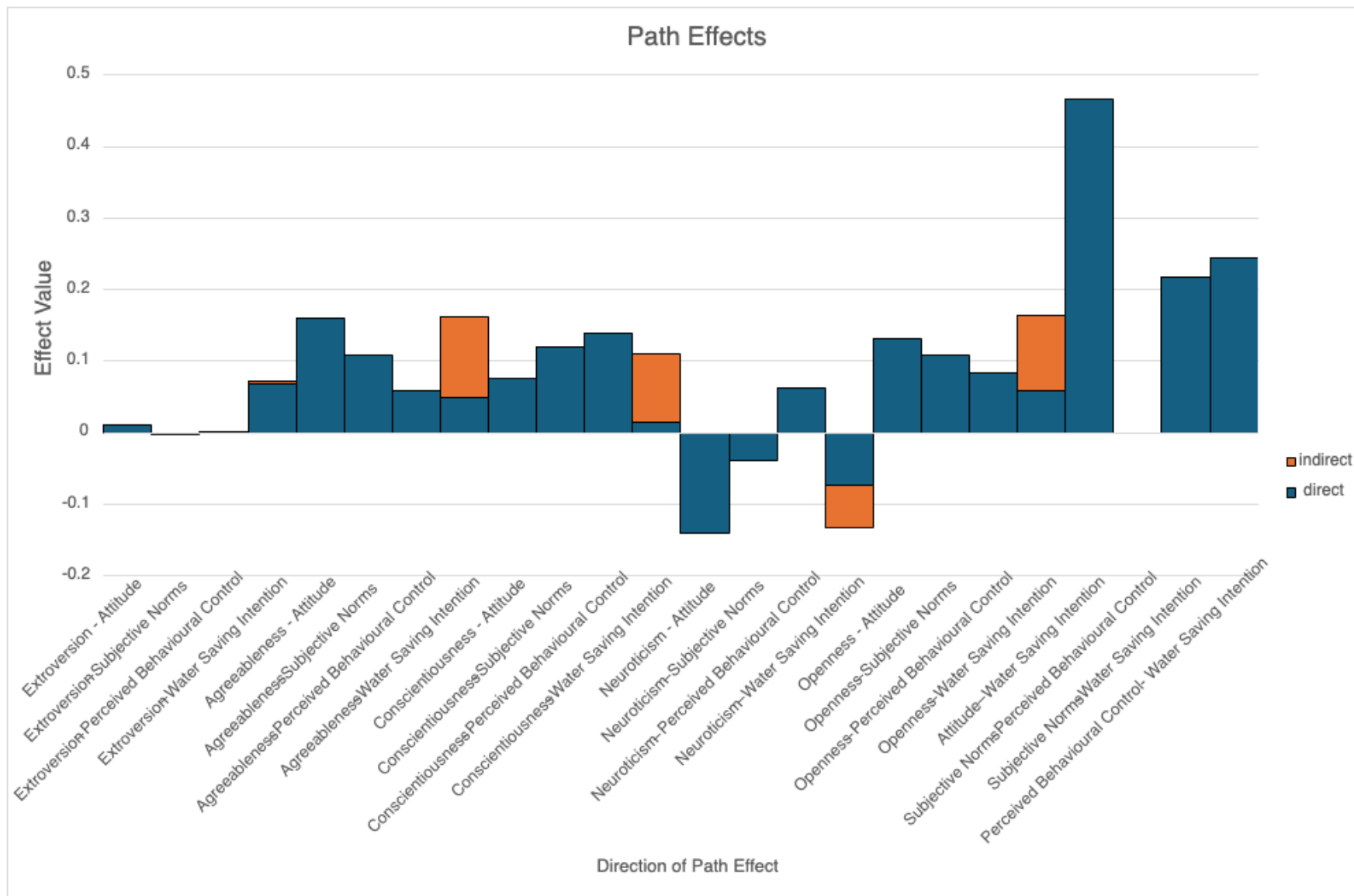


Figure 7. Indirect and direct path effects for the inner model of the PLS-PM of Water Saving Intention.

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Comparing the Women/Trans-women PLS-PM with the Men/Trans-men PLS-PM, two significant inner path differences emerged: the inner paths from Extroversion to Water Saving Intention and from Subjective Norms to Water Saving Intention (Table 8).

Table 8. Statistically significant differences in inner paths between the Women/Transwomen PLS-PM and the Men/Transmen PLS-PM.

Inner Path	Global	Women/ Transwomen	Men/ Transmen	t	p value
Extroversion - Water Saving Intention	0.221	0.267	0.148	2.070	0.019
Subjective Norms - Water Saving Intention	0.234	0.255	0.206	1.272	0.102

Comparing the Faculty of Environment PLS-PM with the non-Faculty of Environment PLS-PM, three significant inner path differences emerged: the inner paths from Openness to Subjective Norms, from Openness to Perceived Behavioural Control, and from Attitude to Water Saving Intention (Table 9).

Table 9. Statistically significant differences in inner paths between the Faculty of Environment PLS-PM and the non-Faculty of Environment PLS-PM.

Inner Path	Global	Faculty of Environment	Non-Faculty of Environment	t	p value
Openness - Subjective Norms	0.104	0.243	0.085	1.934	0.027
Openness- Perceived Behavioural Control	0.079	0.314	0.051	3.004	0.001
Attitude - Water Saving Intention	0.459	0.595	0.442	2.064	0.020

Comparing the STEM programs PLS-PM with the non-STEM programs PLS-PM, one significant inner path difference emerged: the inner path from Neuroticism to Subjective Norms (Table 10).

Table 10. Statistically significant differences in inner paths between the STEM program PLS-PM and the non-STEM program PLS-PM.

Inner Path	Global	STEM programs	Non-STEM programs	t	p value
Neuroticism- Subjective Norms	-0.0414	0.0011	-0.1808	1.7806	0.0376

5. Discussion

The Theory of Planned Behaviour (Ajzen, 1991) is a social-psychological theory that has enjoyed widespread use by researchers in studies aimed at quantifying the drivers of pro-environmental intention and behaviour (e.g., Yuriev et al., 2020). To understand human behaviour, it is critical to identify the determinants of an individual's intention (Ajzen, 1985). One of these determinants is the supply of information – such as provided through formal education – about the subject context in which a behaviour takes place. When new information is presented, the intentions of an individual can be changed and overall lead to behaviour change (Ajzen, 1985). These changes can be the outcome of information influencing an individual's attitudes or normative beliefs, which is then affecting an individual's intention and leading to a different behaviour (Ajzen, 1985). The current study draws attention to the relevance of personality traits and how they can interact with social-psychology and other factors such as educational orientation to determine differences in individual behavioural intent.

The Theory of Planned Behaviour and its extensions have been used widely to study pro-environmental behaviour (Yuriev et al., 2020; Lui et al., 2021). However, there have been a limited number of studies that bridge the Big Five Personality Traits (or personality psychology in general) with the Theory of Planned Behaviour, for investigations of pro-environmental behaviour. The number of studies that examine these relationships with respect to water conservation behaviour and water-saving intention is even more limited. Therefore, the current study aimed to close a knowledge gap on how personality traits impact water conservation behaviour. The study addressed this knowledge gap by investigating water-saving intentions in university students at a Canadian university, and by bridging the Big Five Personality Traits framework with the Theory of Planned Behaviour, to further understanding of the relationships between personality traits and

pro-environmental behaviour. The results from this study are relevant to understanding how young adults interact with water conservation, as water-saving intention is the most significant predictor of water-saving behaviour.

The current study used the Theory of Planned Behaviour as theoretical framework to analyze the impact of the Big Five Personality Traits on Water Saving Intention, implemented with structural equation modeling through partial least squares modeling (PLS-PM). After removal of variables with low loading values, the goodness of fit for the PLS-PM model was 0.361, indicating that 36% of the variation of the model was explained. While this goodness of fit is not large, it is not uncommon in social-psychological research that PLS-PM models have lower levels of goodness of fit (Sanchez, 2013).

5.1. Personality Trait and Socio-psychological Factor Effects on Water-saving Intention

The analysis results suggest that personality traits impact directly and indirectly various constructs of the Theory of Planned Behaviour (Ajzen, 1991) and overall water-saving intention. The strongest relationship between one of the Big Five Personality Traits and the Theory of Planned Behaviour constructs was between Agreeableness and Attitude toward water-saving intention. This result indicates that individuals characterized by greater selflessness show a more positive attitude toward water conservation. The finding aligns well with previous studies such as by Kaiser and Byrka (2011) in the Netherlands who found that people with more prosocial characteristics also tend to be more likely to be engaged in pro-environmental behaviours. The weakest relationship between one of the Big Five Personality Traits and the Theory of Planned Behaviour constructs was between Extroversion and Perceived Behavioural Control to engage in

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water conservation, indicating a lack of effect. A missing effect of Extroversion on behavioural intention for household energy consumption was also found by Wang et al. (2021) in a study of Chinese households.

Considering the sum of direct and indirect effects, the relationship between Openness and water-saving intention was strongest, closely followed by Agreeableness and water-saving intention. The strength of some of these indirect effects of personality traits on water-saving intention corresponds with the strong direct effects of some personality traits on the Theory of Planned Behaviour constructs (i.e., Attitude, Social Norms, and Perceived Behavioural Control). These findings corroborate other studies such as by Wang et al. (2021) who found that Chinese households whose family members tended to score higher on the Openness personality trait also showed stronger Subjective Norm and Perceived Behavioural Control. Notably, though, in the current study Extroversion showed a very low sum of direct and indirect effects on water-saving intention, which reflects its general lack of effect on the Theory of Planned Behaviour constructs.

A study by Kim et al. (2022) in South Korea examined the effects of the personality traits Conscientiousness and Neuroticism on behavioural intention for mindfulness activities. Their results suggest that integrating Conscientiousness and Neuroticism into the Theory of Planned Behaviour framework increased the predictive ability of their model, but that Conscientiousness did not directly affect behavioural intent, while Neuroticism did (Kim et al., 2022). In the current study, Conscientiousness had effects on Attitude, Subjective Norms, and Perceived Behavioural Control, but not on behavioural intention. In contrast, Neuroticism had effects on Attitude, Perceived Behavioural Control, and Behavioural Intention, but not on Subjective Norms.

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In the study of household energy conservation in China, Wang et al. (2021) examined how the Big Five Personality Traits together with the Theory of Planned behaviour constructs affected intent for energy conservation. Their analysis indicated that all personality traits except for Extroversion impacted household energy conservation intention (Wang et al., 2021). In the current study, while Extroversion did affect behavioural Intent, it did not affect the other factors of the Theory of Planned Behaviour (i.e., Attention, Subjective Norms, and Perceived Behavioural Control).

In the current study, the strongest relationships between water-saving intention and the other latent constructs were with the conventional factors of the Theory of Planned Behaviour (i.e., Attitude, Subjective Norms, and Perceived Behavioural Control). Of these factors, Attitude had the strongest effect on water-saving intention. The second strongest relationship was between Perceived Behavioural Control and water-saving intention, but this was closely followed by Subjective Norms and water-saving intention. Overall, the results from the current study and from Wang et al. (2021), suggest that all three factors of the Theory of Planned Behaviour (i.e., Attention, Subjective Norms, and Perceived Behavioural Control) are consistent predictors of pro-environmental behaviour intention. However, different from the current study Wang et al (2021) found that Perceived Behavioural Control was the strongest predictor.

The study on individual water conservation intention in China by Si et al. (2022) did not address the effects of personality traits but, utilized the Theory of Planned Behaviour in combination with factors that addressed general environmental concerns, risks to water resources, and desire for public information campaigns about water conservation. Similar to the current study,

they found that all conventional Theory of Planned Behaviour constructs affected water-saving intention, with Attitude being the strongest predictor (Si et al., 2022), thus supporting the results from the current study.

5.2. Demographic Effects on Water-saving Intention

The analysis results produced information about possible effects of students' demographic characteristics (i.e., gender, home faculty, and program of study) on the relationships between the Big Five Personality Traits and water conservation intention. The comparisons between demographic subgroups suggest that women/trans-women show stronger relationships between Extroversion and Water Saving Intention, as well as between Subjective Norms and Water Saving Intentions, relative to men/trans-men. The results imply that more outgoing and self-aware women/trans-women show stronger intention for water conservation, compared to similarly outgoing and self-aware men/trans-men. This finding parallels the results from many other studies that found that women tend to show higher levels of environmentalism than men (e.g., Zelezny et al., 2002).

At the same time, the comparisons suggest that students of the Faculty of Environment show stronger relationships between Openness and Subjective Norms, between Openness and Perceived Behavioural Control, as well as between Attitude and Water Saving Intentions, relative to students of other faculties. These results suggest that students of the Faculty of Environment who are more ready for new experiences and who have a more positive attitude toward water conservation, also show a stronger intention for water conservation, compared to students of other faculties with similar levels of readiness for new experiences and positive attitude. Additional

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comparisons using more detailed data on study orientation indicate that students of non-STEM programs show a negative relationship between Neuroticism and Subjective Norms, while STEM students showed no relationship. This negative relationship implies that non-STEM students who are more emotionally stable experience more social pressure for water conservation, relative to STEM students who do not show this relationship. These results might hint at a possible psychological mechanism for previously observed effects of educational orientation on pro-environmental behaviours. A study by Tikka et al. (2000) found that Finnish students who studied in environment-related programs (e.g., Biology, Forestry) showed more interest in nature-related activities and had a more pro-environmental attitude, compared to students in technical or finance-related programs (e.g., Engineering or Economics).

The analysis of various demographic factors, including gender, faculty, program of study, program level, and age, encompassed a thorough population representation. However, only gender, faculty, and program of study provided sufficient amounts of spread to allow an analysis of demographic effects. Effects of demographic factors were found for just a few of the investigated relationships. Despite these few differences, these comparisons suggest that overall, the relationships between the Big Five Personality Traits and the Theory of Planned Behaviour constructs hold across demographic groups as tested for this population. Only one sign change (change in direction) existed in all of the tested relationships. Therefore, it appears that overall, the investigated relationships are universal given the examined student participant population and demographic factors (i.e., gender, faculty, and program of study).

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The results of the current study partially support alternative hypothesis 1: Individuals' water-saving intent differs as their Extroversion, Agreeableness, Neuroticism, and Openness change. However, individuals' water-saving intent does not differ as Conscientiousness changes. The study results also support alternative hypothesis 2: Individuals' water-saving intent differs as their Attitude, Social Norms, and Perceived Behavioural Control change. Finally, also alternative hypothesis 3 is partially supported: The relationships between individuals' water-saving intent and socio-psychological factors (i.e., Attitude, Social Norms, and Perceived Behavioural Control) change through the indirect effects of Agreeableness, Conscientiousness, Neuroticism, and Openness. However, these relationships do not change through the indirect effect of Extroversion. In addition, while the relationships between Subjective Norms and water-saving intent as well as between Attitude and water-saving intent were affected by demographic factors (i.e., gender and faculty), the relationship between Perceived Behavioural Control and water-saving intent was not affected.

5.3. Strengths and Limitations

The Theory of Planned Behaviour is a theoretical framework for the study of behaviour that has been widely used and that provides flexibility for inclusion of other factors such as personality traits, addressed through the Big Five Personality Trait framework. The implementation of these frameworks through partial-least squares modeling allowed the analysis of multiple variables and numerous relationships within the study's framework (Sanchez, 2013).

Despite of the described results, the comparisons between the current study and prior work by other studies (e.g., Kim et al., 2022; Wang et al., 2021; Si et al., 2022; Zelezny et al., 2002;

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Tikka et al., 2000) highlight important differences. The findings from these comparisons emphasize that any results from the current study should not be over-generalized, especially not to different kinds of behaviours such as pro-environmental versus health behaviours and perhaps not to other populations.

A limitation of the current study is that it did not include a quantifiable variable to measure behaviour; instead, only the individual's behavioural intent was measured. Adding a water footprint was debated for measuring the behaviour variable. However, acquiring the data would have been difficult and would have led to a considerable increase in the model complexity. Nevertheless, behavioural intent toward saving water is a very commonly used variable to address water conservation behaviour (e.g., Rodriguez-Sanchez & Sarabia-Sanchez, 2020; Si et al., 2022); the validity of this approach is supported by the consistently very strong relationship between behavioural intent and actual behaviour in the Theory of Planned Behaviour.

A second limitation of the current study is a possible lack of variation in the sample population with the issue of water scarcity. Though the current study did not assess whether students had experienced water scarcity or water inequality, it is likely that they had not. This lack of experience may have influenced students' responses, as those who have experienced these challenges may already be aware of the impacts and the need for water conservation. On the other hand, students who have not faced water scarcity, may not be cognizant of the importance of water conservation.

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The fact that this study relied on self-reported data could be seen as a third limitation. However, the Big Five Personality Traits framework commonly is implemented through self-reported assessments with reportedly high level of reliability and its integration into many disciplines in the psychology and social sciences (Lang et al., 2011). Nevertheless, although personality self-assessments have been proven reliable for psychological assessments, there is still a risk of various biases, such as social desirability bias, which leads participants to over-report “good” and under-report “bad” behaviours.

Finally, the variability in several demographic factors was too low to test their effects on water-saving intention. While there was sufficient variability in gender, faculty, and program of study, this was not the case for age and program level. In addition, other demographic factors could have been included such as parents’ household income, citizenship status, or ethnicity.

5.4. Future Research

The study findings suggest correlations between the Big Five Personality Traits and water-saving intention. However, more research should be done with other populations to strengthen the generalizability of the results. Furthermore, including a variable that estimates actual water-saving behaviour would provide a more robust indication of individuals' current consumption habits, not just their intentions. To gain a deeper understanding, a mixed methods approach could be adopted for this study. This could be implemented through an added section where individuals who have experienced water inequity or scarcity could share their experience, and how this has impacted their behaviour and relationship with water as a valued resource.

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It would also be interesting to examine the impact of interventions in a longitudinal, experimental study design. For example, after completing the survey, a random sample of participants could receive information about water conservation practices, while the remaining participants would not receive this information. After some time, the participants could be contacted again and asked to fill the survey a second time to investigate whether water-saving behaviour has changed differently between the two groups (i.e., intervention versus control).

6. Conclusions

The study examined the water-saving intentions of young adults studying at a large Canadian university, and examined how water-saving intentions were affected by personality traits, socio-psychological factors, and demographics. Overall, the study's results point to personality traits – in interaction with the socio-psychological constructs – as important factors that directly and indirectly impact water conservation behaviour. Attitude toward water conservation was the most important factor affecting water-saving-intent; and Agreeableness was the most important personality trait affecting Attitude. Agreeableness is a trait of people who act selflessly (i.e., pro-social), which often also connects with a pro-environmental disposition. This relationship points toward a link between pro-environmental worldview and water conservation behaviours. The study results also suggest that water conservation behaviour may be affected by various demographic characteristics, such as gender and formal education. Future research could focus on other study populations to increase generalizability of the results, and on experimental interventions, such as providing information about water conservation, to examine their possible effects on water conservation behaviour.

Water conservation behaviour adaptation is an issue of increasing urgency. To further increase the impact of the current study, and help increase water-saving behaviour at the University of Waterloo, we offer up the following recommendations:

1. Implement Community-Based Social Marketing (CBSM) for water conservation. CBSM offers a framework to understand the targeted audience's motivations and behaviours, which could inform the design and implementation of a campaign to encourage behaviour change by the students at the University of Waterloo. This could

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- include audience targeting to create specific messaging and delivery for these demographics. CBSM and the feedback of the marketing initiatives may help improve pro-environmental social norms regarding water conservation.
2. Foster collaborative development in support of pro-environmental decisions regarding water conservation behaviour norms, regulations, and technologies. At the University of Waterloo, a collaborative effort of researchers, policy analysis, technology experts, and community-based social marketers should be pursued to identify the most promising strategies for fostering pro-environmental behaviour change in terms of water.
 3. Implement strategies to promote water conservation behaviours based on research findings. This could include providing information to individuals at the University of Waterloo about different types of water conservation practices and how to participate in them. The installation of water-saving fixtures within campus buildings would be an example of technology that facilitates water-saving behaviours, such as low-flow showerheads within dorms or on-campus apartments, low-flush toilets, and timer faucets. Another strategy could be creating a campus-wide competition or initiative to encourage students as well as faculty to encourage water conservation.

Water conservation is essential not only for developing countries but also for those who live in developed countries. Water is a critical resource, interlinked with multiple Sustainable Development Goals such as SDG 3 (“good health and well-being”), SDG 6 (“clean water and

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sanitation”), SDG 11 (“sustainable cities and communities”), and SDG 13 (“climate action”).

Due to these linkages, water conservation is an integral part of all people’s lives, and water-saving intentions should be a high priority for all.

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Appendices

Appendix 1: Study Information Letter, Consent Form, and Questionnaire.

Study Title: Big Five Personality and Attitude Impacts on Water Behaviour and Conservation
Faculty

Student Investigator: Autumn Bland, MES, School of Environment, Enterprise and Development (SEED), University of Waterloo.

Email: abland@uwaterloo.ca

Primary Investigator and Thesis Supervisor: Michael Drescher PhD, School of Planning, University of Waterloo.

This letter explains what the study is about, possible risks and benefits, and your rights as a research participant. You may print/save a copy for your records. If you do not understand something in the letter, please ask one of the investigators before consenting to participate.

What is the study about?

You are invited to participate in a research study to learn more about the relationship between personality psychology and water conservation efforts. The purpose of this study is to find out how psychology and water behaviour are correlated. We plan to combine perspectives from students at University of Waterloo with the results we obtain from the literature and document review of psychology and water conservation.

What does participation involve?

Participation in the study will consist of an online anonymous questionnaire that takes approximately 5-10 minutes. The survey will start January 10th, 2024, and will close January 31st, 2024. The questions will ask about your perspective about your personality traits and attitude towards water conservation and water usage. At the end of the survey, you will be asked some demographic information such as age, gender, and major at University of Waterloo.

Who may participate in the study?

To participate in the study, you need to be enrolled as a student at the University of Waterloo.

Is participation in the study voluntary?

Your participation in this study is voluntary. You may decline to answer any question(s) you prefer not to answer by leaving it blank and by skipping to the next question and may stop participating at any time by not submitting your responses and closing your web browser.

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Will I receive anything for participating in the survey?

As this study is not being funded, there will be no monetary incentives to complete this survey.

What are the possible benefits of the study?

Participation in this study will not provide any personal benefit to you. Data from this study may contribute to the public thesis defense on the impacts that personality traits have on water conservation. Survey results will include only summarized results, ensuring that no individual can be identified.

What are the risks associated with the study?

There are no known short- or long-term risks associated with this study.

How is data collected, stored and protected?

This confidential questionnaire will not ask for your name or other identifying information. Removing your responses later is not possible because the researchers will have no way of identifying which responses are yours. You will be completing the survey by an online survey operated by Qualtrics. Qualtrics has implemented technical, administrative, and physical safeguards to protect the information provided via the Services from loss, misuse, and unauthorized access, disclosure, alteration, or destruction. However, no Internet transmission is every fully secure or error free. Results will be stored by study investigators for a period of one year in a secure, encrypted, password or key protected location.

Who is sponsoring/funding this study?

This study has not received any sponsorship or funding.

Has the study received ethics clearance?

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Board (REB 12345). If you have questions for the Board, contact the Office of Research Ethics, toll-free at 1-833-643-2379 (Canada and USA), 1-519-888-4440, or reb@uwaterloo.ca.

Who should I contact if I have questions regarding my participation in the study?

If you have any questions about this study or need more information before you decide whether to participate, please contact one of the researchers named above (abland@uwaterloo.ca)

By agreeing to participate in the study you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

- I agree to participate in the study, I do not agree to participate in this study

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In this section, we ask a series of questions about your behaviour to understand personality traits. Please tell us how strongly you agree, or do not agree with the following statements.

- I talk to a lot of different people in social settings
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I consider myself outgoing and social
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I do not like to draw attention to myself
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I have a forgiving nature
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I am considerate and kind to almost everyone
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I am sometimes rude to others (+)
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I am always doing things efficiently
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I often forget to put things back in their proper place / leave my belongings around (+)
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I always do a thorough job
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I get stressed out easily
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I get nervous easily
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I am relaxed most of the time (+)
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I have an active imagination
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I have an active imagination
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I value artists and aesthetic experiences
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I spend time reflecting on things
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree

Water conservation can be defined as the practice of using water efficiently to reduce unnecessary water usage.

In this section, we ask you for your perspectives on water conservation. Please tell us how strongly you agree or disagree with the following statements.

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- “Water conservation is a good idea”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- “Water conservation is the smart thing to do”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- “Water conservation has a meaningful impact”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- “It is necessary to conserve water”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- “People who are important to me (friends, family, peers) will support my actions in water conservation”
- Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- “People who are important to me will also conserve water”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- “People who are important to me think I should conserve water”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- “Society advocates the importance of conserving water”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree

In this section of the survey, we ask you questions about your personal ability and skills regarding water conservation. Please tell us how strongly you agree or do not agree, with each statement.

- “Conserving water is easy for me”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- “Whether I participate in limiting my water use is entirely up to me”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- “As long as I want, conserving water is easy”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- “I have the knowledge and time to conserve water”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I would like to conserve water”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- “I will make efforts in the future to conserve water”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- “I intend to insist on conserving water”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- “I will persuade others to take on water conservation practices”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree

This fourth section to the survey is demographic questions, we are collecting this information to further help identify personality traits in this survey All answers are voluntary, confidential and will be used to describe the group who responded to the survey and will not be linked to any

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other information, or data. The information from the answers will not be used to identify those who respond to the questions.

What gender do you most identify with?

- Woman/Transwoman, Man/Transman, Genderqueer/ Gender non-confirming / Gender non-binary / Gender Fluid, Two-spirited, I prefer to self-define (with open response), I prefer not to answer

What is the program of study you are in at the University of Waterloo

- (open text response)

Program Level

- Bachelor, Master, PhD

What is your age

- (open text response)

Would you like to be notified once the thesis is uploaded? If yes, please enter email address below *email address is stored separately from survey responses*

- (open text response)

Thank you so much for participating in our survey 'Explaining water conservation behaviour with the big five personality traits'. Your feedback is extremely valuable.

If you indicated on the survey that you would like a copy of the results, they will be sent to you by email at the address you provided by [insert date].

This study has been reviewed and received ethics clearance through the University of Waterloo Research Ethics Board (REB [45369]). If you have questions for the Board, contact the Office of Research Ethics, toll-free at 1-833-643-2379 (Canada and USA), 1-519-888-4440, or reb@uwaterloo.ca.

For all other questions, general comments, or questions related to this study, please contact Autumn Bland, SEED, at abland@uwaterloo.ca (Graduate Student Investigator)

Dr. Michael Drescher, Planning at mdrescher@uwaterloo.ca (Principal Investigator)

Appendix 2: Email to Send to Faculty/Department Advisors

Hello,

My name is Autumn Bland, and I am a Sustainability Management (Water) master's student working under the supervision of Dr. Michael Drescher in the School of Environment, Enterprise and Development in the Department in the Faculty of Environment at the University of Waterloo. We are conducting a study that examines personality traits and water conservation. We are currently inviting people to participate in this study. I am contacting you in hopes that you can forward the following information to the students in your department.

Information copy/paste for the emails to students:

This email is being sent on behalf of the researchers.

My name is Autumn Bland, I am a master's student working under the supervision of Dr. Michael Drescher in the School of Environment, Enterprise and Development at the University of Waterloo. I am inviting students at the University of Waterloo to participate in a research study that examines personality traits and water conservation.

Participation in this study involves answering questions on an online survey about how they interact with water. Participation is voluntary and confidential. You may decline to respond to any question by leaving it blank. Participation in this study would take approximately five to ten minutes of your time. Public reports will include only summarized results, ensuring that no individual can be identified

This study has been reviewed and received ethics clearance through the University of Waterloo Research Ethics Board.

The study will be open for three weeks, from the date of January 10th until January 31st, 2024.

If you are interested in participating, please use the link below. If you have any comments, or questions about the study, please contact Autumn Bland at the abland@uwaterloo.ca .

https://uwaterloo.ca1.qualtrics.com/jfe/form/SV_cwoha8umUv1XOlw

Sincerely,

Autumn Bland

Appendix 3: Questionnaire Sections with Headings and Descriptions

Big Five Factor Structure Scale for Personality Psychology (+ indicates inverted meaning)

Extroversion

- I talk to a lot of different people in social settings
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I consider myself outgoing and social
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I do not like to draw attention to myself (+)
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree

Agreeableness

- I have a forgiving nature
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I am considerate and kind to almost everyone
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I am sometimes rude to others (+)
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree

Conscientiousness

- I am always doing things efficiently
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I often forget to put things back in their proper place / leave my belongings around (+)
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I always do a thorough job
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree

Neuroticism

- I get stressed out easily
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I get nervous easily
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I am relaxed most of the time (+)
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree

Openness

- I have an active imagination
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree

Explaining Water Conservation Behaviour with Big Five Personality Traits

- I have an active imagination
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I value artists and aesthetic experiences
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- I spend time reflecting on things
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree

Theory of Planned Behaviour Questions

Attitude

- “Water conservation is a good idea”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- “Water conservation is the smart thing to do”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- “Water conservation has a meaningful impact”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- “It is necessary to conserve water”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree

Subjective Norms

- “People who are important to me (friends, family, peers) will support my actions in water conservation”

Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree

- “People who are important to me will also conserve water”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- “People who are important to me think I should conserve water”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- “Society advocates the importance of conserving water”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree

Perceived Behavioural Control

Water conservation can be defined as the practice of using water efficiently to reduce unnecessary water usage

- “Conserving water is easy for me”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- “Whether I participate in limiting my water use is entirely up to me”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- “As long as I want, conserving water is easy”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree

Explaining Water Conservation Behaviour with Big Five Personality Traits

- “I have the knowledge and time to conserve water”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree

Water-saving Intention

- “I would like to conserve water”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- “I will make efforts in the future to conserve water”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- “I intend to insist on conserving water”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree
- “I will persuade others to take on water conservation practices”
 - Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree

Demographics

Gender

- Woman/Transwoman, Man/Transman, Genderqueer/ Gender non-confirming / Gender non-binary / Gender Fluid, Two-spirited, I prefer to self-define (with open response), I prefer not to answer

Program of Study

- Open response

Program Level

- Bachelor, Master, PhD

Age

- Open response

Explaining Water Conservation Behaviour with Big Five Personality Traits

Appendix 4: Programs of Study Sorted by Faculty

Arts	Engineering	Environment	Health	Math	Science
Anthropology	Electrical and computer engineering	Environment	Health (n= 2)	Applied Math	Actuarial Science
Anthropology / Social Development Studies	Geological Engineering (n= 2)	Environmental Science - Geoscience	Honors Health Science (n= 2)	Combinatorics and Optimization	Actuarial Science & Statistics
Arts - French	MASc in Civil Engineering (Water)	Environmental science - water science	Rec and Sport Business & Therapeutic Recreation	Computational Math (n= 2)	Biological and Medical Physics
Arts & Business / English	Meng ECE	Environmental Science Ecology	Recreation and Leisure Studies (n= 3)	Computer Science, Pure Mathematics, Combinatorics & Optimization	Biology with Psych minor
ARBUS - Soc	Architectural engineering (n = 9)	Environmental Science, Ecology specialization	Recreation and Sports Business (n= 2)	Computer Science, Pure Mathematics, Honours Co-op	Biostatistics
Arts and Business - psychology	architecture (n= 20)	Environmental studies (n=2)	Recreation and Sports Business	Data Science (n= 2)	Biotechnology/Economics
Arts PSYCH	Civil Engineering (n= 27)	Geography	The Health Sciences	Honors Math/Ba	Chemical Physics
Arts and Business, majoring in PACS	Biomedical engineering (n= 20)	Honours Environment & Business - Coop	Therapeutic Recreation (n= 2)	Honours Computer Science	Doctor of Optometry
Arts - SDS	Chemical Engineering (n= 23)	Honours Environment, Resources, and Sustainability & Honours Biology	Tourism Development	Math/CPA	Doctor of Pharmacy
Arts Undergrad - Social Development Studies	Computer Engineering (n= 21)	Honours Environmental Science	Health sciences (n= 28)	Mathematical Economics	General Science (n= 2)
Arts - Psychology and Social Development Studies	Electrical Engineering (n = 13)	International Development	Health studies (n= 6)	Mathematics - Statistics	Honors Biology Co-op Joint Honors Music
Bachelor of Social Work = 2	Engineering (n=27)	Knowledge Integration (n= 2)	Kinesiology (n= 45)	Mathematics/Teaching	Honours Biology
Master of Social Work	Environmental Engineering (n= 23)	MES	Public Health (n= 11)	Mathematics Computer	Honours Biology (min. Anthropology)
Classical Studies	Management Engineering (n= 11)	MES(SUSM)		MMath in CS	Honours biology co-op
Classics	Mechanical engineering (n = 29)	SERS		Pure Mathematics/Teaching (n= 2)	Honors chemistry
Communication studies = 3	Mechatronics Engineering (n= 30)	SERS		Computer science (n= 54)	Honour science (n= 2)

Explaining Water Conservation Behaviour with Big Five Personality Traits

double degree, legal studies and political science	Nanotechnology engineering (n = 21)	Social and Ecological Sustainability & Collaborative Water Program	Computing and Financial Management (n= 8)	Honours Biochemistry
Economics and Math	Software Engineering (n= 8)	Climate and environmental change (n= 6)	Computer Science & Business Administration (n= 8)	Honours Chemistry (n= 2)
Economics, German	Systems Design Engineering (n= 9)	Environment and Business (n = 22)	Financial Analysis Risk Management (n= 8)	Honours Chemistry
English		Environment, Resources and Sustainability (n= 14)	Honours mathematics (n= 15)	Honours Science and Business
English Literature		Geography and Aviation (n= 4)	Mathematics (n = 63)	international 2+2
English Literature and Rhetoric		geography and environmental management (n = 13)	BMath/BBA Double Degree (n = 8)	Life Physics
English Rhetoric		Geomatics (n= 6)	Math/FARM (n= 5)	Life sciences - Biology Co-op
English/French		Planning (n= 42)	Pure Mathematics (n = 6)	Life sciences, Biochemistry
Fine Art		Sustainability Management (n= 17)	Statistics (n= 7)	Life Sciences, Psychology
Fine Arts		Sustainability and Financial Management (n= 4)		LS and Business
Fine Arts, French		Environmental Sciences (n= 11)		Major: Biology; Minor: Religious Studies
French 3 Year General				MNS
French and History				Non degree Science
General Arts (n= 2)				PhD Physics
Honours anthropology degree				Vision Science
Honours Art English Literature and Rhetoric				Biochemistry (n= 17)
Honours Arts, English Literature and Rhetoric, Legal Studies				Biology (n= 29)
Honours Literature and Rhetoric, LS minor (co-op in environmental service)				biomedical sciences (n= 25)
Honours Arts Social Development Studies & Psychology				Chemistry (n= 13)

Explaining Water Conservation Behaviour with Big Five Personality Traits

Honours Arts - Sociology and Legal Studies	Earth Science (n= 10)
Honours Arts and Business Co-op, Psychology	Honours Physics (n=5)
Honours Arts Co-op majoring in Legal Studies and minoring in Philosophy	Honours Science (n= 24)
Honours Arts-Legal Studies	Materials and Nanoscience (n = 6)
Honours Arts, Spanish	Medicinal Chemistry (n=6)
Honours Business Economics	Optometry (n= 7)
Honours Philosophy w/minor in Religious Studies	Pharmacy (n= 8)
Legal Studies and business	Physics (n= 8)
Legal Studies and Business minor in Political Science	Physics and Astronomy (n= 13)
Legal Studies and Canadian Politics and Public Policy	science (n= 6)
Legal Studies and Sociology	Science and aviation (n= 7)
Medieval Studies	Science and Business (n= 6)
Music	
Peace and Conflict Studies (n= 2)	
Peace and Conflict Studies, Social Development Studies, and Legal Studies	
Philosophy (n= 2)	
Philosophy/PACS/Libe ral Studies	
Physical mathematics	
Political Science	
Political Science major, ERS (Environment, Resources, & Sustainability) minor	
Post degree - Arts (n= 2)	
post grad social work	
Post-degree arts program	
Post-degree student	
Psychology/Sociology	
Sociology (n= 3)	
Spanish and Latin American Studies	

Explaining Water Conservation Behaviour with Big Five Personality Traits

Theatre and
Performance (n= 3)
Accounting and
Financial Management
(n= 32)
Arts and Business (n=
19)
Arts (n= 18)
economics (n= 13)
Gender and Social
Justice (n = 4)
Global Business and
Digital Arts (n= 12)
History (n= 6)
Honours Arts (n= 8)
Honours arts and
business (n= 5)
Honours Psychology
(n= 6)
Legal Studies (n= 6)
Liberal Studies (n= 8)
Psychology (n= 24)
Social Development
Studies (n= 18)

Appendix 5: Gender Analysis Inner Model

	Women/ Transwomen		Men/ Transmen	
	t value	p value	t value	p value
Attitude				
Extroversion	0.619	0.537044	-0.322	0.748
Agreeableness	2.59	0.010657	4.74	0.0000024
Conscientiousness	2.27	0.024602	1.82	0.0694
Neuroticism	-2.07	0.040265	-4.84	0.0000015
Openness	3.37	0.000977	3.39	0.000715
Subjective Norms				
Extroversion	0.463	0.64387	-0.522	0.601654
Agreeableness	1.22	0.2238	3.75	0.000187
Conscientiousness	1.16	0.24863	3.66	0.000262
Neuroticism	-1.33	0.18519	-0.999	0.318222
Openness	2.99	0.00334	2.74	0.006206
Perceived Behavioural Control				
Extroversion	-0.0332	0.973536	0.10	0.920
Agreeableness	1.12	0.264379	2.26	0.0243
Conscientiousness	1.73	0.0851	4.54	0.0000064
Neuroticism	0.824	0.411445	2.40	0.0167
Openness	3.94	0.000131	1.65	0.10
Water-saving Intention				
Extroversion	0.688	0.493	3.09	0.00205

Explaining Water Conservation Behaviour with Big Five Personality Traits

Agreeableness	0.19	0.85	1.93	0.0542
Conscientiousness	0.677	0.50	0.356	0.722
Neuroticism	-0.32	0.75	-4.23	0.0000259
Openness	0.647	0.519	2.93	0.00346
Attitude	9.73	2.56 e - 17	19.00	2.42 e - 69
Subjective Norms	2.41	0.0171	9.89	4.06 e - 22
Perceived Behavioural Control	3.81	0.000206	10.80	6.31 e - 26

Appendix 6: Gender Analysis for Statistical Significance

	global	Women/ Transwomen	Men/ Transmen	t. stat	p.value	sig. 0.5
Extroversion - Attitude	0.0022	-0.028	0.0276	0.7385	0.2302	no
Extroversion – Subjective Norms	-0.0014	-0.0167	0.0117	0.3467	0.3645	no
Extroversion – Perceived Behavioural Control	-0.0044	0.014	-0.0289	0.7875	0.2156	no
Extroversion - Water Saving Intention	0.0595	0.1019	-0.0242	2.5538	0.0054	yes
Agreeableness - Attitude	0.1662	0.1682	0.1746	0.0895	0.4644	no
Agreeableness - Subjective Norms	0.1152	0.1422	0.0735	0.8498	0.1978	no
Agreeableness- Perceived Behavioural Control	0.0663	0.0308	0.1364	1.5854	0.0566	no
Agreeableness - Water Saving Intention	0.0628	0.0395	0.1065	1.2801	0.1004	no
Conscientiousness - Attitude	0.0667	0.0549	0.0783	0.2617	0.3968	no
Conscientiousness- Subjective Norms	0.1062	0.087	0.1345	0.5504	0.2911	no
Conscientiousness - Perceived Behavioural Control	0.1251	0.124	0.1345	0.0138	0.4945	no
Conscientiousness- Water Saving Intention	0.0126	0.0055	0.0506	0.0138	0.1271	no
Neuroticism - Attitude	-0.1307	-0.1237	-0.129	0.0514	0.4795	no
Neuroticism- Subjective Norms	-0.0408	0.007	-0.073	0.8270	0.2042	no
Neuroticism - Perceived Behavioural Control	0.0776	0.1014	0.056	0.4853	0.3138	no
Neuroticism - Water Saving Intention	-0.0718	-0.0867	-0.0452	1.0167	0.1548	no
Openness - Attitude	0.1273	0.1189	0.1337	0.3688	0.3562	no
Openness - Subjective Norms	0.1087	0.079	0.1626	1.3012	0.0967	no
Openness- Perceived Behavioural Control	0.0699	0.085	0.0493	0.4818	0.315	no
Openness- Water Saving Intention	0.0582	0.0458	0.0796	0.6336	0.2632	no
Attitude - Water Saving Intention	0.4618	0.4406	0.4968	1.3441	0.0896	no
Subjective Norms - Water Saving Intention	0.2207	0.2673	0.1477	2.0701	0.0193	yes
Perceived Behavioural Control - Water Saving Intention	0.2344	0.2553	0.2056	1.2717	0.1019	no

Appendix 7: Faculty of Environment vs Other Faculties Analysis Inner Model

	Faculty of Environment		Other Faculties	
	t value	p value	t value	p value
Attitude				
Extroversion	0.619	0.537044	-0.322	0.748
Agreeableness	2.59	0.010657		0.0000024
Conscientiousness	2.27	0.024602	1.82	0.0694
Neuroticism	-2.07	0.040265	-4.84	0.0000015
Openness	3.37	0.000977	3.39	0.000715
Subjective Norms				
Extroversion	0.463	0.64387	-0.522	0.601654
Agreeableness	1.22	0.2238	3.75	0.000187
Conscientiousness	1.16	0.24863	3.66	0.000262
Neuroticism	-1.33	0.18519	-0.999	0.318222
Openness	2.99	0.00334	2.74	0.006206
Perceived Behavioural Control				
Extroversion	-0.0332	0.973536	0.10	0.92
Agreeableness	1.12	0.264379	2.26	0.0243
Conscientiousness	1.73	0.0851	4.54	0.0000064
Neuroticism	0.824	0.411445	2.40E+00	0.0167
Openness	3.94	0.000131	1.65	0.1
Water-saving Intention				
Extroversion	0.688	0.493	3.09	0.00205

Explaining Water Conservation Behaviour with Big Five Personality Traits

Agreeableness	0.19	0.85	1.93	0.0542
Conscientiousness	0.677	0.50	0.356	0.722
Neuroticism	-0.32	0.75	-4.23	0.0000259
Openness	0.647	0.519	2.93	0.00346
Attitude	9.73	2.56E-17	19.00	2.24 e - 69
Subjective Norms	2.41	0.0171	9.89	4.06 e - 22
Perceived Behavioural Control	3.81	0.000206	10.8	6.31 e - 26

Appendix 8: Faculty of Environment versus Other Faculties for Statistical Significance

	global	Faculty of Environment	Other Faculties	t. stat	p.value	sig. 0.5
Extroversion - Attitude	-0.0054	0.0498	-0.0102	0.565	0.2861	no
Extroversion - Subjective Norms	-0.0093	0.0395	-0.0168	0.5901	0.2776	no
Extroversion - Perceived Behavioural Control	0.001	-0.0028	0.0032	0.1047	0.4583	no
Extroversion - Water Saving Intention	0.0653	0.0376	0.0682	0.6578	0.2554	no
Agreeableness - Attitude	0.1550	0.2073	0.149	0.4549	0.3246	no
Agreeableness - Subjective Norms	0.1171	0.1037	0.1198	0.1484	0.441	no
Agreeableness- Perceived Behavioural Control	0.0702	0.0935	0.0722	0.1307	0.448	no
Agreeableness - Water Saving Intention	0.0428	0.0106	0.0428	0.4863	0.3134	no
Conscientiousness - Attitude	0.0706	0.1771	0.055	1.2694	0.1023	no
Conscientiousness- Subjective Norms	0.1119	0.0957	0.1127	0.1475	0.4414	no
Conscientiousness - Perceived Behavioural Control	0.1390	0.1408	0.1398	0.1683	0.4332	no
Conscientiousness- Water Saving Intention	0.0149	0.0367	0.0076	0.5549	0.2895	no
Neuroticism - Attitude	-0.1523	-0.164	-0.1512	0.1272	0.4494	no
Neuroticism- Subjective Norms	-0.0405	-0.1118	-0.0317	0.7251	0.2343	no
Neuroticism - Perceived Behavioural Control	0.0709	0.068	0.0763	0.2439	0.4037	no
Neuroticism -Water Saving Intention	-0.0831	-0.0176	-0.0937	1.2417	0.1073	no
Openness - Attitude	0.1198	0.2585	0.1039	1.5886	0.0562	no
Openness - Subjective Norms	0.1036	0.2428	0.0854	1.9344	0.0266	yes
Openness- Perceived Behavioural Control	0.0791	0.3144	0.051	3.0036	0.0014	yes
Openness- Water Saving Intention	0.0614	0.0365	0.0631	0.4474	0.3273	no
Attitude - Water Saving Intention	0.4585	0.5951	0.4423	2.0637	0.0196	yes
Subjective Norms - Water Saving Intention	0.2253	0.1457	0.2378	1.1254	0.1303	no
Perceived Behavioural Control - Water Saving Intention	0.2431	0.2222	0.2475	0.5569	0.2888	no

Appendix 9: STEM vs Non-STEM Programs Analysis Inner Model

	STEM		Non-STEM	
	t value	p value	t value	p value
Attitude				
Extroversion	-0.0986	0.921	-0.118	0.906112
Agreeableness	4.03	0.0000602	3.59	0.000377
Conscientiousness	2.19	0.0286	1.17	0.244728
Neuroticism	-4.37	0.0000143	-3.12	0.001971
Openness	3.72	0.000211	2.12	0.034864
Subjective Norms				
Extroversion	-0.922	0.357	0.823	0.411265
Agreeableness	3.97	0.0000772	1.53	0.127532
Conscientiousness	3.38	0.000764	2.04	0.042353
Neuroticism	0.0311	0.975	-3.42	0.000683
Openness	3.25	0.00121	1.41	0.158849
Perceived Behavioural Control				
Extroversion	-0.0882	0.93	0.512	0.6089
Agreeableness	1.88	0.0605	1.57	0.1182
Conscientiousness	4.03	0.0000609	2.90	0.0039
Neuroticism	2.26	0.0241	-0.305	0.7605
Openness	2.19	0.0286	1.62	0.1051
Water-saving Intention				
Extroversion	2.48	0.0133	2.13	0.0335

Explaining Water Conservation Behaviour with Big Five Personality Traits

Agreeableness	1.44	0.152	1.50	0.136
Conscientiousness	0.908	0.364	0.385	0.701
Neuroticism	-3.57	0.000383	-2.38	0.0178
Openness	3.20	0.00144	0.966	0.334
Attitude	16.10	8.16 e - 51	14.00	7.13 e - 36
Subjective Norms	7.43	2.79 e - 13	6.78	4.61 e - 11
Perceived Behavioural Control	9.98	3.19 e - 22	5.75	1.88 e - 08

Appendix 10: STEM Programs versus Non-STEM Programs for Statistical Significance

Test	STEM		Non-STEM	t. stat	p.value	sig.
	global	Programs	Programs			
Extroversion - Attitude	-0.0058	-0.0035	-0.0061	0.0512	0.4796	no
Extroversion - Subjective Norms	-0.0132	-0.034	0.0433	0.9087	0.182	no
Extroversion - Perceived Behavioural Control	0.0013	0.00	0.0272	0.3783	0.35	no
Extroversion - Water Saving Intention	0.0650	0.06	0.0719	0.1667	0.43	no
Agreeableness - Attitude	0.1575	0.14	0.1844	0.5358	0.30	no
Agreeableness - Subjective Norms	0.1198	0.14	0.079800	0.9637	0.17	no
Agreeableness- Perceived Behavioural Control	0.0688	0.0682000	0.0826000	0.1598	0.4365	no
Agreeableness - Water Saving Intention	0.0439	0.037	0.05080	0.2474	0.402	no
Conscientiousness - Attitude	0.0703	0.08	0.0582	0.1575	0.44	no
Conscientiousness- Subjective Norms	0.1101	0.12	0.10350	0.1764	0.43	no
Conscientiousness - Perceived Behavioural Control	0.1400	0.14	0.14900	0.2424	0.404	no
Conscientiousness- Water Saving Intention	0.0168	0.02	0.01260	0.1598	0.44	no
Neuroticism - Attitude	-0.1525	-0.1541000	-0.1619000	0.1282	0.4490	no
Neuroticism- Subjective Norms	-0.0414	0.0011	-0.180800	1.7806	0.04	yes
Neuroticism - Perceived Behavioural Control	0.0726	0.08	-0.016300	0.7249	0.23	no
Neuroticism - Water Saving Intention	-0.0832	-0.09	-0.0820	0.4921	0.31	no
Openness - Attitude	0.1211	0.128	0.107000	0.3181	0.38	no
Openness - Subjective Norms	0.1012	0.11	0.0720	0.7534	0.23	no
Openness- Perceived Behavioural Control	0.0797	0.07720	0.0842	0.0752	0.4700	no
Openness- Water Saving Intention	0.0630	0.080	0.032	1.1230	0.13	no
Attitude - Water Saving Intention	0.4584	0.433	0.504	1.5236	0.06	no
Subjective Norms - Water Saving Intention	0.2239	0.206	0.257	1.0111	0.16	no
Perceived Behavioural Control - Water Saving Intention	0.2422	0.26	0.2036	1.2773	0.10	no