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Review

Exploring Urban Sustainability Understanding and Behaviour: A Systematic Review towards a Conceptual Framework

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Abstract: Social, environmental, and economic problems related to urban living have surpassed the agenda of policy and decision-makers as well as general public opinion in recent decades. To address urban and environmental issues, it is pivotal to examine how people think, feel, judge, and act with respect to sustainability. While some prominent theories exist and various attempts have been made to propose synthesized models, there are still gaps and discrepancies within the literature of environmental psychological theories. As such, the aim of this paper is to critically review the literature by focusing on a few of the most influential environmental, prosocial, and psychological behaviour theories, which include Theory of Planned Behaviour (TPB), Norm Activation Theory (NAT), Value-Belief-Norm Theory (VBN), and the New Environmental Paradigm (NEP). The Scopus database has been searched systematically for the relevant studies. This paper concludes that an integrative approach to urban sustainability understanding and behaviour is needed. A framework is presented that consists of three layers of clustered components: (1) internal socio-psychological determinants, (2) personality traits, and (3) influencing external factors such as social, cultural, economic, and institutional factors. The model proposed in the study provides opportunities to further develop theoretical approaches and establish new measures of an Urban Sustainability Understanding and Behaviour assessment.

Keywords: urban sustainability understanding; sustainable behaviour; pro-environmental behaviour; awareness; perception; attitude; environmental concern; theory of planned behaviour; value-belief-norm theory; new ecological paradigm

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1. Introduction

1.1. Environment, Urbanization, and Sustainable Behaviour

The planet is facing various global challenges, including but not limited to: air pollution, global warming, climate change, overuse of natural resources, loss of biodiversity, and ecological crises. Many if not all of these are a result of unsustainable urbanization and associated urban living habits. In order to combat these threats, which are highly dependent on urban areas, efforts have to be made at both micro and macro levels [1]). The urban environment, being the main living and interaction places of people, is immensely reliant on individual and social behaviours. Changes in human behaviours are seen to be crucial since the efficiency gained by technical developments needs to be accepted and implemented by individuals. In light of these facts, since the 1960s, social and behavioural scientists have been engaged in studies investigating human understanding and behaviour along with the underlying dynamics that influence the formation of these behaviours [2].

Human understanding and behaviour play a critical role in success of efforts to move towards sustainability within an urban context, and are influenced by policy development, sustainability strategies, and environmental interventions. Barr [3] stresses the role of the most appropriate policy implementation on individual decisions about what to buy and how to use and dispose of the waste (i.e., appropriate waste management strategies). Turaga

et al. [4] examines the influence of pro-environmental behaviour on ecological economics. Similarly, Blake [5] remarks on the value-action gap in environmental policy, and stresses the discrepancy between national policies based on 'information deficit' models, and contextualized individual-centric experiences. In their review studies, Abrahamse et al. [6] investigated 38 intervention studies with a focus on household energy conservation, and in order for the studies to prove effective, they identified the prominence of examining the underlying psychological determinants. For instance, environmental knowledge (and values) are found to have explanatory power on intention and ecological behaviour [7]. It is, therefore, possible to deduce that alterations in the daily lives of individuals have the greatest potential in tackling both local and global environmental challenges [8].

The prominence of individual behavioural change as an influence on environmental impact and quality is highly debated. According to Dietz et al. [9], the significance of individual behavioural change on the environment depends on the following aspects:

- The influence of behaviour,
- The number of individuals participating in the behaviour,
- The proportion of people who are willing to change their behaviour.

In order to have a successful behavioural outcome, Steg and Vlek [10] proposed a four step framework, comprising:

- Identifying the behaviour,
- Investigating the principal influencing elements,
- Planning the intervention to alter behaviour,
- Assessing the outcome and consequences.

Huijts et al. [11] explores the psychological factors influencing acceptability and acceptance of sustainable technology, and emphasizes the importance of citizen and consumer behaviour. Consequently, it is clear that individual and community behaviours are the most widely accepted predictors of environmental impact, which, in turn, determines the global environmental challenges that our planet faces.

Pro-environmental and sustainable behaviour needs to be understood fully and in detail in order to provide sustainable urban living areas and a less unsustainable planet. While pro-environmental behaviour is understood in the literature—simply as the conscious behaviour that aims to have a minimum negative impact on the natural environment [12]—it is used interchangeably with sustainable behaviour. In this paper, we prefer to approach behaviour from a sustainability perspective within an urban context, and define sustainable behaviour as "conscious or habitual smart behaviour that is in balance, coherence, and mutual benefit with the natural or built environment in livable and resilient forms, from all perspectives including but not limited to social, economic, environmental, cultural, governance, and institutional, by considering inter and intra-generational equity" [13].

Understanding an individuals' behaviour requires much more attention for its underpinnings. Therefore, it needs to be examined in terms of how the behaviours have been formed [14]. In that sense, it is pivotal to identify the inherent underlying personality characteristics, influencing external factors and inner socio-psychological determinants of sustainable behaviour. For example, what is the effect of foundational characteristic features of individuals on the behaviour formation process, and what are the influential external and situational factors? What do individuals know about issues? What are their concerns? How do they perceive subjects? How are their values and beliefs constituted? How do they develop normative principles, what are their attitudinal responses, and what actions do they take? All these questions and more need to be addressed to comprehend the behavioural outcome(s) of individuals.

1.2. Environmental Psychology and Behaviour

The environmental psychology field has developed considerably since the 1960s, relying not only on well-known psychology theories, but also on various important environmental, social, or behavioural models [15], observing the complex interactions between

nature and human-beings [12]. Brown and Sovacool [16] provide a comprehensive list of the different approaches with their definitions and application areas. There were three central focuses in these studies.

- Defining the essential determinants of the environmental concern and conceptualizing the pro-environmental behaviour,
- Investigating the influencing factors of these processes,
- Supporting empirical evidence for the models and relations explained regarding the socio-psychological determinants of sustainability understanding [2].

The study by Gifford [17] investigated the psychological barriers to a behavioural change. Therein, a number of categories are mentioned, including but not limited to:

- limited cognition (which could be framed as awareness),
- perceived risk (which could be generalized and extended as perception), and
- world view that inhibits attitude and behaviour.

Some social and cognitive psychologists approach behaviour from a rational aspect, relying on the attitude toward a specific behaviour as the central point of evaluation, which is assumed to be valid independent from the external factors, and, therefore, allows the prediction of several distinct behaviours [2,14,18]. In contrast, other groups of researchers approach environmental behaviour from a normative perspective, which relies on the activation of personal norms and altruistic behaviour [19]. Other studies employ environmental concern(s) as a general term that explains the whole environmentally-related social and cognitive processes including knowledge, perception, emotion, value, attitude, and behaviour [2,20,21]. On the other hand, applied behaviourists and economists prefer to interpret behaviour in relation to external factors, which requires situationally sensitive evaluations and results in case- and situation-specific behavioural outcomes [19,22]. According to them, general understanding of individuals is assumed to be based on the evaluation of cost and benefits attached to the object of interest.

Stern [23] describes these distinct kinds of approaches to behaviour as intent-oriented and impact-oriented. While impact-oriented definition relies on the effects of the behaviour that individuals display and, therefore, more of a rational interpretation of behaviour with its outcomes, intent-oriented definition focuses on individual's internal processes such as feelings, beliefs, and motivations, which, in turn, could be understood as a value-based interpretation of behaviour. Accordingly, pro-sustainability behaviour studies could be mainly clustered under two motivational approaches. The first one is the pro-social motives inspired by Norm Activation Theory (NAT) and value system of Schwartz [24,25], which is further developed by the Value-Belief-Norm Theory (VBN) of Stern [23], and the second one is self-interest-oriented theories mainly based on the Theory of Planned Behaviour (TPB) of Ajzen [18]. While the basic premise of NAT assumes moral or personal norms as direct determinants of pro-social behaviour along with personal values that an individual holds, forming and activating a norm is dependent on cognitive, emotional, and social processes. On the other hand, TPB as a goal-directed approach [26] is based on the hedonistic assumption of human behaviour, which is guided by rational consideration of behavioural consequences, or, in other words, judgements about the risks and benefits. The former prioritizes the other people, while the latter concentrates on the self. NAT is further developed by Stern et al. [27], by integrating one of the most prominent environmental concern theories known as the New Environmental Paradigm (NEP, a widely used environmental attitude scale—[21]). Stern et al. [27] named this theory VBN, which assumes behaviour predicted by personal norms, based on beliefs that are formed by values.

Although this diversity of approaches leads to the enhancement of the theory and practice of environmental psychology, it has resulted in complexity when attempting to keep track of the origins and the predictors of the behaviours of individuals. There have been numerous attempts to re-conceptualize (or synthesize) the main trends in order to bridge the gaps between two distinct theoretical models as well as to improve the robustness of the main theories themselves. However, there are still missing components

within current models, and it has long been known that an integrative approach needs to be provided [7]. In order to meet these requirements and provide a sufficiently flexible and robust theory to comprehend complex and intertwined human behaviour, a comprehensive and holistic approach should be developed. This is a compelling philosophy underpinning this research.

Distinct from previous approaches, which are mainly reliant on selective and eclectic integration of some common psychology theories to propose a new model, it is first necessary to understand the main determinants of common theories in a wider context in order to relate them to each other and place them in a relevant structure. Consequently, the generalizability of the theories and their applicability to contemporary needs in relevant urban and environmental sustainability areas would be achieved. Secondly, one must not rely on primary theories alone: complementing them with secondary models is important in providing permanency in the historical development of the literature. This is necessary to ensure the robustness and logical justification of a given approach. Thirdly, there is a need to integrate inner socio-psychological determinants with external factors and given personality characteristics, which are generally investigated separately within the literature. By doing so, the flexibility and comprehensibility of the theory would provide for the complex nature of human behaviour. In addition, a sequential order approach among determinants needs to be revised to include time, space, scale, case, and individual specific variations. These additional considerations will help bridge the gap between psychological determinants of awareness, perception, attitude, and others, with sustainable behaviour. Lastly, in addition to previous specific-behaviour focused research (such as energy use or recycling), a broader understanding of general sustainability behaviour (as a heterogeneous and multi-dimensional concept) should be adopted and integrated. A conceptual framework that satisfies the above requirements would provide a promising, but exhaustive, contribution to Urban Sustainability research. It has the potential to understand human behaviours in different contexts and local conditions, consequently increasing the positive impact on an urban and natural environment.

This paper aims to conduct an exploratory and critical review of the literature on environmental, sustainability, and psychological behaviour theories, including the Theory of Planned Behaviour (TPB), Norm Activation Theory (NAT), Value-Belief-Norm Theory (VBN), and a New Environmental Paradigm (NEP). Moreover, socio-psychological determinants of human behaviours and psychology will be examined with a focus on urban sustainability. In order to fulfill this aim, the following objectives will be pursued. First, existing prominent theories and frameworks will be investigated. This will be followed by in-depth examination of the socio-psychological determinants (i.e., awareness, perception, attitude, and behaviour), personality traits, and external influencing factors. Finally, an overarching integrative conceptual framework for urban sustainability understanding and behaviour will be proposed.

To avoid this review becoming too diffuse, it is important that limitations are applied to narrow the focus through which all studies are viewed and interpreted. Therefore, the focus of the study will be on urban sustainability behaviour, and the scope of the study is limited to well-known environmental psychology, environmental behaviour, and urban sustainability behaviour studies. Theories and frameworks within these areas will be investigated, while ensuring that well-known theories and critical frameworks related to sustainable behaviour more generally have been encapsulated.

Due to closely related and intertwined meanings of sustainable behaviour with pro-environmental behaviour, and sustainability understanding with sustainable psychology, these terms will be used interchangeably for the rest of this paper. Moreover, the concepts of 'pro-environmental' and 'sustainability' are used while bearing in mind the urban focus of the study. First, the methodology will be given in Section 2. Following the presentation of existing prominent theories and approaches in Section 3, Section 4 examines the components of behavioural models, which are grouped under socio-psychological determinants, influential external factors, and inner personality values, traits, and characteristic features

(in relation to sustainable behaviour). In the Section 5, a new conceptual framework is proposed. The discussion and conclusions are given in Section 6.

2. Methods

In order to specify the relevant studies, the Scopus database was diligently searched while limiting the scope to include peer-reviewed articles, books, and conference papers, and selecting English language also as a filter. Two searches were conducted in "title only" and "title-abstract-keyword" fields. Four groups of search algorithm were created in the first search, while the search string consisted of three groups in the second search. While the OR operator was used within the groups, the AND operator was implemented between them. The first search string was:

- TITLE (sustainab*)
- TITLE-ABS-KEY (urban* OR city* OR environment*)
- TITLE (psycholog* OR understand* OR aware* OR percept* OR behav* OR knowledge* OR concern* OR attitude* OR practice* OR relev* OR judgement* OR action* OR value* OR belie* OR intention*)
- TITLE-ABS-KEY (public* OR citizen* OR resident* OR household* OR community OR stakeholder)

The second search string is specified as:

- TITLE-ABS-KEY (pro-environmental)
- TITLE-ABS-KEY (psycholog* OR understand* OR aware* OR percept* OR behav* OR knowledge* OR concern* OR attitude* OR practice* OR relev* OR judgement* OR action* OR value* OR belie* OR intention*)
- TITLE-ABS-KEY (public* OR citizen* OR resident* OR household* OR community OR stakeholder)

The first search resulted in 2924 articles. When implementing the second search string the results from the first search were excluded by using the following command: "Search 2 AND NOT Search 1". As a result, 1150 articles remained. The total from both searches was, therefore, 4074 articles. Results were merged in the Endnote Library. The following criteria were specified to decide which articles to include:

- Focusing on urban sustainability
- Focusing on sustainable and pro-environmental behaviour
- Focusing on environmental sustainability
- Focusing on one of the determinants specified in the search string (i.e., awareness, perception, attitude, understanding, knowledge, concern, value, belief, and intention)
- Focusing on sustainability psychology

All articles were monitored based on the title relevance in the first instance. They were inspected according to their relevance with the search strings, scope, and the aim of the review. As a result, 233 articles remained. Thereafter, the remaining articles were investigated by reviewing their abstracts and full texts if necessary. Following all the steps mentioned above, 28 studies were specified for in-depth review. The whole process is given in Figure 1.

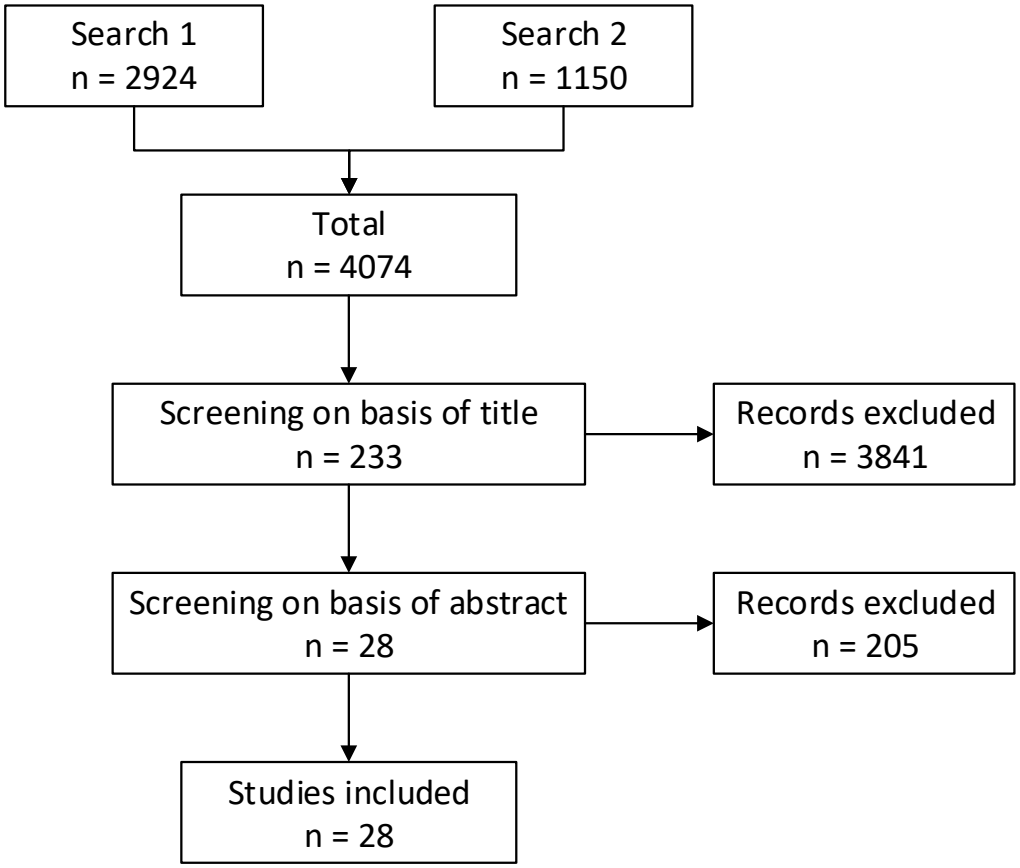

Figure 1. Article selection process.

3. Cognitive-Behavioural Theories

In the meta-analysis study by Klöckner [28], in order to propose an integrated environmental behaviour model, most well-known behaviour theories that are used commonly in the environmental psychology field are analyzed. These theories consist of the Theory of Planned Behaviour (TPB) [18], the Norm Activation Theory (NAT) [24], the New Environmental Paradigm (NEP) [21], and the Value Belief Norm Theory (VBN) [23]. In another study, Si et al. [29] conducted a comprehensive bibliometric analysis of the application of the TPB in environmental science. They identified that it has a universal acceptance in predicting the environmental behaviours of various areas, of which the most widely mentioned ones are waste management, green consumption, climate and environment, conservation behaviour, and sustainable transportation use. The theories applied in these areas mainly used prolonged models of TPB with the inclusion of the relevant parts of NAT and VBN. As being the extended version of NAT, VBN employs the main variables from it and, in addition, it employs NEP of Dunlap [21]. Table 1 shows the utilization of common theories in some of the most prominent articles selected.

There are also several important integrated models of environmental behaviour which largely relying on the previous four main models (TPB, NAT, VBN, and NEP). However, it is proposed that a new model is needed, specifically one that strengthens the main weaknesses and utilizes the main strengths of the models in the literature, by synthesizing them using a holistic approach that considers external dynamic and internal static variables along with these socio-psychological determination processes. It is, therefore, reasonable to start with previously mentioned theories and their extensive versions, and then structure them under a newly defined framework. In the following sections, some of these theories will be introduced with the inclusion of critiques about them in the literature, and then their components will be analyzed in relation with our approach.

Table 1. Common environmental behaviour theories.

Theories	Relevant Studies
Theory of Planned Behaviour (Ajzen)	[7,11,15,28,30]
Norm Activation Theory (Schwartz)	[11,15,28,31,32]
New Environmental/Ecological Paradigm (Dunlap)	[20,21,27,32,33]
Value Belief Norm Theory (Stern)	[23,28,34]
Other (Synthesized) Concern Theories	[35,36]
Other (Synthesized) Attitude Theories	[7,15,22,28,30,37–39]
Other (Synthesized) Value Theories	[19,27,40]
Other (Synthesized) General Theories	[3,11,12,15,41–43]

3.1. Theory of Planned Behaviour (TPB)

The TPB originates back to 1980s, and has gained importance in the 1990s [18,26]. It was proposed as an approach of deliberate behaviour. The actual model of TPB relies on the extension and enhancement of Theory of Reasoned Action (TRA) [44]. TRA assumes that behavioural intention, which is the immediate and main predictor of behavioural outcome, is a function of the belief that performing the behaviour will result in an outcome, and that outcome is perceived in the form of positive and negative consequences. Fishbein and Ajzen [45] splits this belief into two parts, which are behavioural belief that is named as Attitude, and normative belief that is named as Subjective norm (SN) in Figure 2 [46]. In other words, intention is accepted as a function of attitude towards a specific behaviour and subjective norms (SN) [7].

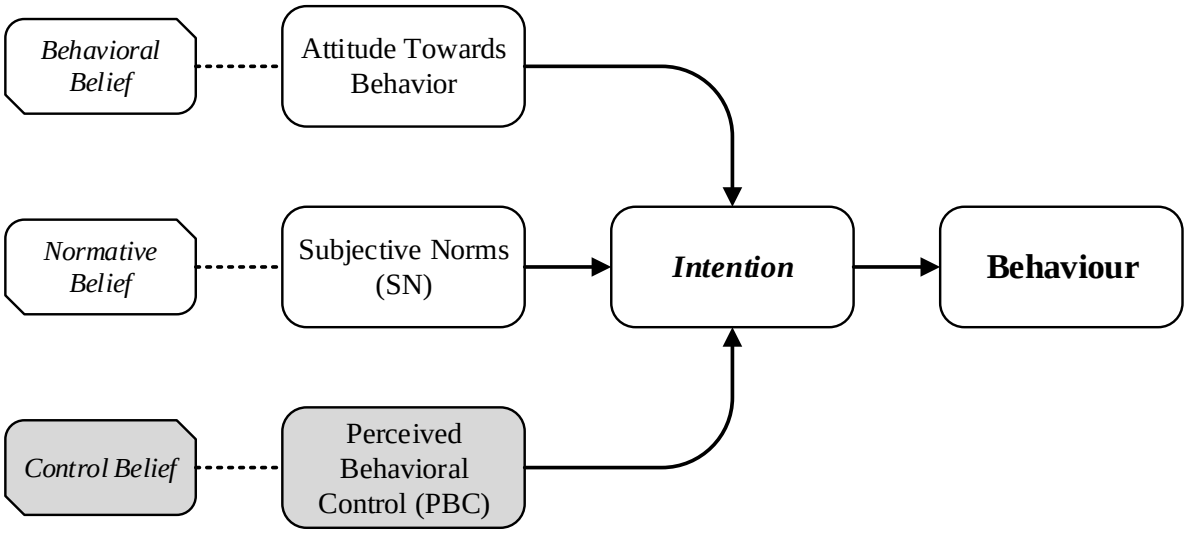

Figure 2. The Theory of Planned Behaviour (TPB) [18].

TPB extends this model by adding the belief of ability to perform and the expected outcome of a behaviour, which is named as Perceived Behavioural Control (PBC) [46], as shown in Figure 2, and grouped under two categories that are perceived self-efficacy and perceived controllability [47]. Addition of PBC has greatly improved the predictive power of the initial model. The main assumption of the model is that behaviour is directly predicted by behavioural intention, which is the willingness to perform this behaviour. This intention, in turn, has antecedents of Attitudes, SN, and PBC. Therein, the belief in TPB can be explained as the expectation that performing a behaviour will have an outcome, the favourability of that outcome (Attitude), likelihood of that outcome (PBC), and the evaluation of the importance of that outcome with respect to others (SN) [28].

Attitudes toward a behaviour refers to the favourability of relevant behaviour. It is assumed to have two types of attitude: toward a general issue, and toward specific behaviour. The former gives a better prediction on the group of related behaviour, while the latter gives better implications about the intention to perform the behaviour [11]. Factual knowledge is seen as a pre-condition for attitude due to its evaluative nature [7]. SN is explained as the social pressure of others about expected behaviour while PBC corresponds to ability (ease) and possibility (difficulty) of performing a behaviour [11]. In other words, performing a behaviour relies on having a positive attitude toward behaviour, expectation of others to perform that behaviour, and being capable of implementing the behaviour.

The TPB has been widely implemented in the environmental behaviour field and includes several subject areas, such as energy acceptance and consumption [11,48], carbon offsetting behaviour [49], transport mode choice [50], citizen's environmental complaint [51], and sustainability in the workplace [52]. While the TPB received strong empirical support [53], and a wide range of application [29] within the literature (as a predictor of intention and behaviour), it has received strong criticism from several perspectives. For example, the theory is found to under-represent the habits and moral effects on behaviour [28]. Additionally, it is seen as more of a gain motivated theory that assumes individuals make rational choices, which overlooks normative motives and hedonic goals [11]. Moreover, the theory does not include the situational constraints [7] and environmental values, which are mostly overlooked [41].

3.2. The Norm Activation Theory (NAT)

NAT is built on Schwartz and Howard [54], based on normative motives, which aims to predict conditions under which people help others, with the assumption based on altruism and 'helping' behaviour. Personal norms in the theory are activated if people are aware of the consequences of their behaviours, and they carry the responsibility of performing that behaviour. The model employs the feeling of guilt when personal norms are violated, and pride when norms are being complied with [30]. Since the formal model of the theory has not been constituted by Schwartz and Howard [54], it has resulted in several interpretations in the literature with the main components of Personal Norms (PN) as the main predictor of behaviour, and Awareness of Consequences (AC) and Ascription of Responsibility (AR) as the secondary determinants. De Groot and Steg [55] have developed two models termed the moderator model and mediator model (Figure 3). In the moderator model, AC and AR have a moderator influence on the direct relationship between PN and behaviour. However, in the mediator model, AC and AR have indirect effects on behaviour. While the relationship between AR and behaviour is mediated by PN, the relationship between AC and PN is mediated by AR. The basic assumption is to activate the personal norm of individuals to help others by making them aware of the consequences of their behaviour, and feel the responsibility to take action about the relevant situation.

Relying on the assumption of altruistic behaviour, NAT differentiates from the cost-benefit-based materialistic approach of TPB by prioritizing the moral beliefs. It has been widely implemented in the literature covering several fields, including energy [56], environment [51], recycling [22,57], and purchasing behaviour [58]. Due to being focused strongly on feelings and the intrinsic moral drivers of environmental behaviours and ignoring the non-moral rationales [28], NAT has received several criticisms within the literature. It is found to be more predictive of behaviour against rather than in favour of something [59]. Moreover, the assumption of activation of the altruistic norms underestimates the likelihood of the activation of egoistic or biospheric norms.

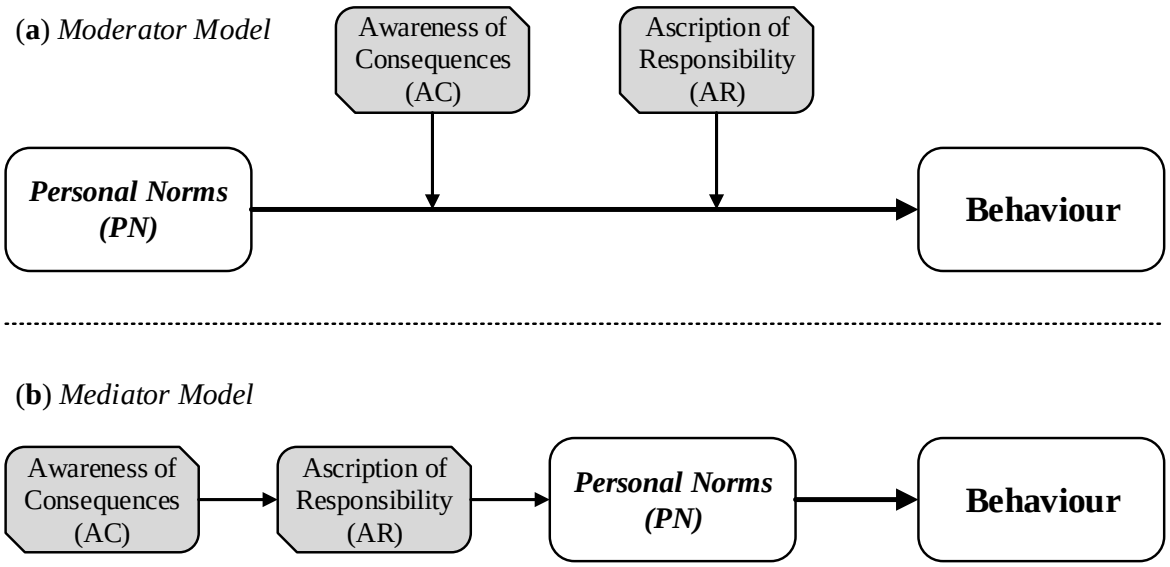

Figure 3. Norm Activation Theory: (**a**) Moderator Model; (**b**) Mediator Model [55].

3.3. New Environmental (Ecological) Paradigm (NEP)

The New Environmental Paradigm developed by Dunlap and Van Liere [21] has become a frequently used tool for measuring environmental concern. It consists of 12 items designed to assess a new world view, which could be accepted as a pro-ecological or eco-centric value orientation. It was an initial attempt to encounter what Dunlap called the Dominant Social Paradigm, which is seen as an anti-ecological approach. His critique about the other existing approaches is that several studies on environmental attitude are generally focusing on topics such as pollution, loss of biodiversity, and natural resources, rather than wider affairs such as limits to growth, balance of nature, human domination over the nature, anti-anthropocentrism, and steady state economy. However, they assume environmental problems as diversified with respect to context, indirectly observable and vaguer [20]. Stern et al. [27] assumes NEP as a general belief and positions it between values and specific beliefs. However, it is further seen important with its role on environmental concern. Other studies describe NEP as an environmentally related measure of AC, which, in turn, indicates its relation with the perception determinant [32].

The original NEP scale has been further improved by Dunlap et al. [20] by employing a wider range of ecological world-view aspects, balancing the pro-NEP and anti-NEP items, and updating the terminology used therein. The new scale is termed "New Ecological Paradigm" and resulted in 15 items of measure. These items are grouped under five dimensions of ecological worldview, limits to growth, anti-anthropocentrism, sensitivity of nature's balance, rejection of exemption, and probability of the eco-crisis [20]. Wording of the items are arranged in such a way that agreement with eight items would reveal a pro-ecological world view, whereas agreement with the other seven items would indicate an anti-ecological world view. Dunlap et al. [20] claim that the new set of 15 items are well-designed in order to establish a single scale. Dunlap points out that the environmental values term is used interchangeably with environmental concern, ecological world view, and environmental attitudes. One of the main questions is regarding how the hierarchical relation between humans and nature will be formed.

The NEP scale is widely used in several academic studies, which focus on areas such as: environment [33,60,61], socio-psychological context [27], green electricity [62], environmental attitudes of high school students [63], or green identity [49].The findings show that its impact (on behaviour) ranges from none [64] to weak [33].

Dunlap reveals significant approval of NEP scale among the general public [21]. He further claims that the scale has been shown to have high predictive validity, in terms of construct and content. However, it has been criticized with regard to its low predic-

tive validity within the literature due to it being considered as a measure for general attitudes. Although the aim of the scale was to measure general attitude regarding environmental concern, it has been widely used to measure specific attitudes toward specific behaviours [30]. For example, it has revealed that environmental concern(s) should be assessed with regard to more specific behaviour. The scale is considered unsuccessful in terms of providing a robust grounding in socio-psychological theories of attitude and behaviour because Dunlap et al. [20] prefers to see NEP as a world view, which could also be called "primitive beliefs" about the human-nature relationship [40]. Therefore, it could and perhaps should be understood as a more evaluative concept [7]. This general belief is seen to have inherent potential to influence a wider range of beliefs and attitudes about more definite environmental concern(s) [19,40]. However, Scott and Willits [33] reveal that, although people were mostly in support for NEP, their behavioural outcomes were highly diversified and less consistent with NEP support.

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

The VBN was developed in an attempt to associate general values, environmental beliefs and subjective norms with each other in a sequential logistic order [23,40]. With its integrative nature, the VBN builds upon and generalizes: the adapted model of the Schwartz Value System [25], the NEP of Dunlap [20], and the NAT of Schwartz [24], as shown in Figure 4. Stern employs the mediator model of NAT [55], which assumes a causal chain and predictive relationship between AC, AR, and PN, which, in return, causes the final behaviour. The central assumption of the model is linking the norm-activation to underlying values.

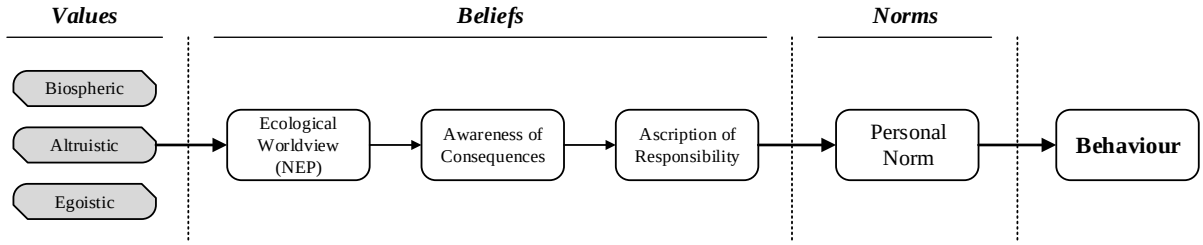

Figure 4. Value-Belief-Norm Theory [23].

Stern [23] defines PN as the feeling of responsibility to perform pro-environmental actions, while categorizing the behaviours as activist, non-activist public sphere, private-sphere, and behaviours in organizations. He further requires the ecological world view from the NEP as an antecedent of AC, which constitutes a beliefs group along with AC and AR. While NEP is generally used as a general environmental concern in the literature, its mission in the VBN is a transition between value orientations and pro-environmental personal norms [28]. While these (more focused) beliefs of the ecological world view are more open to influence, it is predicted by a more stable personality and general value orientation, which is termed 'Values' group in the model [23].

In his model, he adapted the self-transcendence-self-enhancement and conservation-openness to change dimensions of Schwartz [65] as a basis to interpret individual behaviours, and proposed three groups for value orientations: egoistic, social-altruistic, and biospheric. While 'biospheric' and 'altruistic' value-oriented people are more likely to have an ecological world view, the 'egotistic' value orientations lead to less pro-environmental behaviours along with conservative values. The self-transcendence value group covers the two value dimensions of altruistic and biospheric, which can be defined as being concerned about other humans and nature, respectively. On the other hand, the egoistic value orientation corresponds to the self-enhancement value group of Schwartz's value system. However, openness to change and conservation clusters of Schwartz seem to be more unrelated with environmental literature [40].

The VBN has been applied in several domains including energy use [66], social movement support [34], travel mode choice [67], environmentalism [34], and tourism [68]. However, the original approach in the VBN assumes a stricter (linear) chain between variables and, as such, highly focuses on personal norms. Therefore, it is not surprising that it has been more criticized within the literature and, as a consequence, less rigid interpretations developed, where they have the assumption that each variable is predicted indirectly to some extent by all variables. Moreover, there is reliance on the premise that beliefs of having adverse consequence on self, others, or even other species activates the personal norms, which is a narrow approach that mandates negative effects for the theory.

3.5. Other Synthesized Environmental Theories

In order to understand responsible environmental behaviour, Hines et al. [37] conducted a meta-analysis with 128 studies. Their aim was to analyze and harmonize the environmental behaviour studies in order to identify the variables of pro-environmental behaviour, and determine the robustness of these affiliations. They formulated four major categories to focus from the meta-analysis:

- cognitive,
- socio-psychological,
- demographic variables, and
- experimental studies

Cognitive variables consist of two knowledge factors termed knowledge of issues and knowledge of action (required for the issues in question). Both refer to the capability of implementing these knowledge-specific issues, even though it is not mentioned in the meta-analysis results. In terms of socio-psychological variables, Hines et al. [37] identify:

- attitude,
- locus of control,
- personal responsibility,
- verbal commitment, and
- economic orientation.

While they group the first three under the group of personality factors, verbal commitment is named as the intention to act about a specific issue, and economic orientation is used in the form of situational factors. Attitude in here comprises both general attitude and attitude toward specific behaviour. The locus of control is seen as a perception of the individual concerning his ability and control over performing a change in behaviour. If people attribute the change to others, this is called external locus of control. However, the internal locus of control is used to express belief in self-activity [47]. Situational factors could behave as a facilitator or enabler of pro-environmental behaviour, and further include variables such as constraints, social pressure, and alternative opportunities to act. Additionally, Hines et al. [37] incorporates age, gender, income, and education variables under a demographic factor group. Meta-analysis reveals weaker or not specific relationships between higher income, higher education, younger age, gender, and responsible environmental behaviour. It has been revealed in the model that attitude towards a specific behaviour has more predictive power than general attitude towards pro-environmental behaviour. Moreover, intention is more likely to act as an outcome of other variables all together. In that sense, intention could be seen as a mediator factor, which bridges other factors to responsible environmental behaviour. While this framework is an advanced version of TPB, it has weaknesses in explaining knowledge, attitude, and intention relationships by positing knowledge and attitude as different parallel layers. In contrast to the TPB, Hines introduces situational factors as an independent external influence group on pro-environmental behaviour, which is a very important step. However, the effect of situation factors on attitudes, knowledge, intention and other determinants has been overlooked.

Based on the approach of Hines et al. [37], Bamberg and Möser [15] replicated and enhanced the meta-analysis on responsible environmental behaviour with 57 samples including more up-to-date papers, with a more focused aim of analyzing the interrelations of eight psycho-social determinants of pro-environmental behaviour. He applied structural equation modelling to those determinants. His model relied upon the combination of two foundational motivations—self-interest and pro-social motives—represented by TPB and NAT, respectively. In line with other theories, he affirms the prominent mediator role of intention on all other variables. Moreover in this theory, behavioural control, attitude, and personal moral norms are determined as secondary important predictors mediated by intention, along with the lesser influence of problem awareness, social norm, feeling of guilt, and internal attribution. The theory replaces the subjective norm in the TPB with a moral norm of NAT as the third predictor of intention. Bamberg and Möser [15] made a considerable improvement and enhancement of the approach of Hines et al. [37] with the help of TPB and NAT, and proves the strong continuity of the association between psycho-social variables and pro-environmental behaviour. That kind of theory-driven meta-analysis generally confirms the proposed models, but, from a wider perspective, some critical psychological determinative groups such as concern, perception, and values are not considered. Moreover, the precedence and association of the variables are open to debate, especially if specific cases, or specific behaviours, are considered.

Barr et al. [41] and Barr [42] developed a conceptual framework to investigate the factors influencing environmental attitudes and behaviour in household waste management, with a focus on waste reduction, reuse, and recycling behaviours. Environmental values, situational characteristics, and psychological factors are found to be significant predictors of behaviour through behavioural intention [3,41]. In a similar vein, Dunlap et al. [20] use the environmental values as the bottom-line of human-held orientations in relation to the physical environment. Situational variables refer to any given personal situation that takes into consideration the given context, individual socio-demographic attributes, and knowledge about the situation at hand. The authors refer to two kinds of knowledge: abstract and concrete. The former corresponds to general knowledge about the situation, whereas the latter refers to concrete knowledge for action. For psychological factors, the authors emphasize the perceptions and personality characteristics of individuals. The psychological factors could be categorised as intrinsic motivation [69], perceived threat, response efficacy, subjective norms, self-efficacy, and environmental citizenship. In De Youngs' model, the environmental values group can be seen to mainly intersect with the model developed by Dunlap et al. [20]. In other words, some of the psychological variables such as subjective norms, response efficacy, and self-efficacy are adopted directly from TPB [70]. The author places environmental values, intention and behaviour as the core and places situational and psychological variables as influencing factors, which inherently (and unfortunately) poses the risk of confusion between psychological processes and external determinants. This is a shortfall as psychological variables (as a cluster) should not be an external group since they form the core of human psychology. The external cluster could and should be the influencing factors on these psychological processes. Moreover, the situational factors within the model have limited content [42], and, therefore, are in need of more customization according to the respective psychological determinants. Moreover, it is difficult to distinguish some of the psychological variables from within the model, which relate to environmental values and knowledge. This is worrying—it is a cognitive process that should be evaluated under the psychological process.

In an attempt to explain acceptability of energy technology, which corresponds to attitude and behaviour, respectively, Huijts et al. [11] grounds his approach on three prominent motives of human behaviour, which are gain, normative, and hedonic goals. Therein, gain-related motives represent a cost-benefit approach (explained by the TPB of Ajzen), normative related motives represent moral evaluations (explained by the NAT of Schwartz), and hedonic goals represent the feelings of self. The model takes TPB as a base and adds PN from NAT as a predictor of intention similar to Klöckner [28]. The author

posits positive-negative effects (e.g., corresponding to senses/feelings such as happiness, satisfaction, anger, fear, etc.), along with perceived cost-risk-benefits as predictors of attitude, while PN are preceded by outcome efficacy and problem perception. Klöckner suggests trust as an indirect measure of attitude (via affects and perceptions), whereas fairness is a direct measure. Lastly, the overall model is assumed to be influenced by experience and knowledge. Knowledge is predicted to affect perception of cost-risk-benefit as well as attitude and behaviour. Similar to others, this model combines TPB and NAT, which are all mediated by intention. While outcome efficacy in the model overlaps with PBC, problem perception, which is assumed to be a predictor of PN, resonates strongly with the perceived cost-benefit-risk. Therefore, the theory itself confuses some of the components. While it misses other kinds of perceptions that would be influential on PN and attitudes, it is not sufficient to include psychological factors.

In his framework termed the Comprehensive Action Determination Model (CADM), Klöckner [28] synthesized the three most common theories, which are TPB, NAT, and VBN. The model is also based on similar approaches to previous ones, assuming behaviour is directly determined by intentions and PBC. Moreover, he added habit strength to the model as the third strong predictor, which he accepts as 'the degree of self-acting a behaviour in a particular steady situation'. Different from TPB where intentions associate the attitudes, SN and PBC, Klöckner theorizes that Personal Norms (PN) also affect intentions. In line with NAT, he assumes that PN are preceded by AC, AR, NEP, ST, and SE, but not necessarily in sequential order. However, all are assumed to be in direct relationships with each other. In conclusion, the model could be summarized as the combination of TPB and VBN, enhanced with a habit strength variable. Therein, it is assumed that VBN is influenced by intention, and all other components of VBN predict PN in the same order. From that point, Klöckner's theory is an attempt to address the absence of moral aspect in utility-focused TPB by integrating NAT. Although this model improves on the previous theories and takes into consideration habit as an important additional component, it does not add much value over the existing approach. Moreover, one could easily critique that a simple eclectic combination of two robust theories, which are based on extensively different approaches, is not enough to fully comprehend and explain human behaviour(s). Additionally, the theory excludes assessment of the wide cluster of external factors that operate on these psychological processes.

4. Analysis of the Components of Behavioural Theories and Models

In this section, components of the behavioural models will be defined and discussed in depth. Section 4.1 includes the main socio-psychological determinants, which are grouped under awareness, perception, attitude and behaviour, followed by secondary determinants in Section 4.2, which are knowledge, concern, value-belief and personal norms. Influential external factors will be discussed in Section 4.3, and, finally, personality values, traits and characteristic features will be explained in Section 4.4. The most widely used components in the literature are presented in Table 2, along with the corresponding determinants from our conceptualization and relevant studies.

4.1. Main Socio-Psychological Determinants

The main socio-psychological determinants group consists of four elements: awareness, perception, attitude, and behaviour. Each determinant will be explored in-depth in the corresponding order by reviewing critical literature first. Critique of the literature along with the hypothesized approach of the current study for each determinant will be provided through the sections.

Table 2. Determinants of behavioural models.

Components Used in the Literature	Corresponding Determinants	Relevant Studies
Knowledge of Issues	**Awareness**, Knowledge	[3,7,11,12,30,37,38,41–43]
Environmental Awareness	**Awareness**, Knowledge	[12,39]
Awareness of Consequences	**Awareness**, Concern	[3,11,15,22,23,28,31,32,34,42]
Environmental Concern	**Perception**, Concern	[12,19,30,33,35,36,38]
Emotion	**Perception**, Concern	[12,15,39]
Values (Environmental)	**Perception**, Value	[3,7,12,19,23,27,30–34,39–43]
Perceived Behavioural control	**Perception**, Belief	[3,11,12,15,28,39,43]
Locus of Control	**Perception**, Belief	[12,15,30,37]
Beliefs	**Attitude**, Belief	[3,12,19,23,27,30,33,34,40–43]
Ascription of Responsibility	**Attitude**, Belief	[22,23,28,31,32,34,37]
Attitude Toward Behaviour	**Attitude**	[11,12,15,19,27,28,30,33,37,38,40,43]
Moral Obligation/Personal Norm	**Attitude**, Personal Norm	[11,12,15,19,23,27,28,30,32,34,42,43]
Behavioural Intention	**Attitude**, **Behaviour**, Personal Norm	[3,7,11,12,15,19,27,28,30,37,40–42]
Habit	**Behaviour**, Practice	[11,12,28,30,38]
Personality Traits	**Characteristic**	[3,12,28,39,41–43]
Situational Factors, Social Context, External Conditions	**External Factors**	[3,12,15,19,22,30,37,38,40–42]

4.1.1. Awareness

It is possible to define awareness simply as knowledge and recognition of an issue [39]. Therefore, when compared with knowledge, the awareness determinant is wider in nature and encapsulates knowledge with the inclusion of cognitive and interpretive processes [52].

As the consciousness level about issues increases, the chance of adopting the appropriate behaviour improves. In the model, Grob [39] stated environmental awareness as one of the five main components, which provides necessary recognition of issues in order to behave in an appropriate way. It comprises factual knowledge and recognition of environmental problems. According to the A-I-D-A model (Awareness, Information, Decision, Action), awareness is required to be the initial point in a behavioural process, with its direct and overarching relation to information and knowledge [42].

Although the direct relationship of the awareness-knowledge chain on behaviour has been debated, it was considered important for action due to its indirect impact. Along with knowledge, it has been seen as an important cognitive pre-condition for moral norm development and has a large overall effect on both intention and behaviour [15]. Kollmuss and Agyeman [12] introduced two components of awareness: cognitive 'knowledge based-component', and affective 'perception-based component'. The authors stated three cognitive limitations of awareness:

(a) lack of immediacy,
(b) prolonged duration, and
(c) complexity.

The authors further define the perceptional component as an emotional process and mention knowledge and awareness as pre-requisites. Therefore, awareness of the situation has great importance and influence on the perception process [71].

Awareness of consequences is the main determinant found within the literature, which has several complicated relationship(s) with personal norms, attitude toward behaviour, intention, and specific behaviour. However, studies are not sufficient in evaluating the awareness from perspectives other than consequences. People might become aware of something not only from the point of consequence, but also benefits, opportunities, and

other true knowledge channels. It is, therefore, necessary to assume awareness as a wider cognitive state, which precedes other psychological determinants.

4.1.2. Perception

Given its very close relationship with attitude, perception as a cognitive and evaluative process could be described as the interpretation of sensation in order to produce a meaning about a thing or situation [71]. Both cognition and evaluation stages are highly subjective and very much attached to personal, spatial and temporal conditions. Therefore, what is perceived from a situation, or how it is interpreted, could be very different from reality. Pickens [71] emphasizes four steps in a perception processing system:

(a) stimulation,
(b) registration,
(c) organization, and
(d) interpretation.

One of the most-mentioned perceptional determinants within PBC is understood as the belief of ability to perform and belief about the expected outcome of the behaviour [18]. Similarly, 'Locus of Control' is defined as the ability to perform a change by individual behaviours [12], and actually could be accepted as a subset of perception [37]. People can hold either an internal locus of control or an external locus of control. While the internal locus of control perceives individual behaviours as effective actors for change, the external locus of control accepts the change as a result of other influential facts or incidents.

While Bamberg and Möser [15] uses perceived personal responsibility as a predictive intention to act, Huijts et al. [11] indicates that perceived cost, risks and benefits are directly in relation to both personal norms and attitude. Moreover, perceived threat to personal health could be considered as a predictive factor for pro-environmental behaviour [30]. They are also very closely related to the concerns that individuals hold about a situation. Similarly, perceived control is explained with two elements: belief about self-efficacy [72] and the efficacy of science and technology. It could be deduced that concern and belief could be treated as a sub-component of perception.

Perception is found to be one of the most prominent and broadest, yet most overlooked, components of environmental behaviour due to its intertwined content. For instance, Grob [39] argues that emotion is a key component of any environmental behaviour model. This could be understood as the upset caused from any differences found between idealized and real perceptions about the state of the environment. As seen from this model, although perception is the main parameter here, it is placed under a different psychological component. Barr [42] mentioned psychological perceptions as a determinant on which behaviour is dependent. However, perception is the most understated psychological determinant in the literature. Although components such as perceived behavioural control and perception of threat have been widely used by several models, perception as a separate category is not mentioned strongly so far. It is presumed in this study that perception should appear as a distinct psychological condition that provides a cognitive transition between awareness and attitude.

4.1.3. Attitude

Attitude could be defined as "a relatively enduring organization of beliefs, feelings, and behavioural tendencies towards socially significant objects, groups, events or symbols" [73]. Similarly, Eagly and Chaiken [74] describes attitude as "a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor" [74]. Others define attitude with an emphasis on its connection with behaviour—as a mindset or tendency to act [71].

Essentially, two types of attitude exist: attitudes towards a specific behaviour and attitudes used in environmental behaviour studies [37]. They should be measured separately in order to prevent discrepancies in results [75]. For instance, people who are very concerned about climate change could continue to drive more as they are not able

to associate this attitude with the behaviour. Therefore, in TPB, and other subsequent models, attitude toward a specific behaviour is measured on an appropriate scale. Hines et al. [37] reveal in their study that people with more positive attitudes are more likely to be involved in pro-environmental action. Whereas Kaiser et al. [7] points out the variation of approaches to attitude and summarizes them under three components: knowledge, affect, and intention. In general, most people claim to have favourable attitudes about the environment [76]. However, Levine and Strube [76] indicates that a distinction should be made between implicit and explicit attitudes. Explicit attitudes, expressed by individuals who are self-reporting, are subject to significant bias. Implicit attitudes, which are immediate and unconscious reactions to the situation, are less prone to bias.

Awareness or perceptions could be understood as attitudinal components in some studies [39]. This is due not only to highly interconnected relationships between them, but also the predictive and preceding role of them over attitude. Stern and Dietz [19] employs a constructivist approach to attitude, considering it as a process formed by considering personal value orientations. While general attitude is similar to value orientation, specific attitude is assumed as a predicting intention. In the majority of studies, attitude is specified as the most influential and direct determinant of behaviour, mostly mediated by intention [2]. Newhouse [14] indicates that specific measures are more vulnerable than general measures. Therefore, general attitude could be better used for comprehensive environmental criteria.

The motivational factor for attitude is presumed to be the belief about and evaluation of consequences [30]. The AR element of NAT and VBN, which is most widely used in behaviour theories, could be understood as an attitudinal component. However, while attitude is intensely examined in the literature, it should be further analyzed (and conceptualized) in terms of its relationship with other socio-psychological determinant groups, external factors, and personality traits and characteristic features. Moreover, it should be accepted in wider meaning, encapsulating attitude towards a behaviour and general attitude. Hence, the attitude determinant will be treated in this manner.

4.1.4. Behaviour

Behaviour is defined as the actions and practices that individuals perform as a result of internal socio-psychological processes in relation to their surrounding environment [77]. Bergner [78] investigates behaviour in depth from a descriptive psychology perspective and describes it as a function of eight parameters:

(a) identity,
(b) want,
(c) know,
(d) know-how,
(e) performance,
(f) achievement,
(g) personal characteristics, and
(h) significance.

Several behaviour types are discussed. For instance, activist and non-activist behaviour differ in their nature. Moreover, the behaviour that people display in the public sphere and the behaviour that they display a private sphere result in different outcomes [23]. Moreover, there exists a gap between verbal commitment (i.e., statement about what people say they are willing to do for the environment) and actual commitment (i.e., what people actually commit to in practice) [79]. Habit is the unconscious form of behaviour, which is an outcome of enduring and persistent practice. As the practice of a significant behaviour improves, it becomes more habitual [30], enforcing the behaviour.

Behaviour is employed in several ways in environmental literature, such as pro-environmental behaviour or sustainable behaviour [12]. Intention is found to be the most predictive element of behaviour when mediating attitudes, norms and perceptions [11,18,28]. On the other hand, behaviour is claimed to have either a direct or indirect

relationship with all socio-psychological determinants or external influencing factors [3,30]. Intention could be described as the attempt to perform a desired action under the effect of a particular action tendency [80]. Intention is assumed as the immediate predictor of behaviour only when the two conditions are met, which are prior to action and under volitional control [26]. Ajzen [26] argues that intentions are subject to change under the effect of salience of belief and new information. Normative outcomes have a direct impact on intention, and, therefore, serve as a mediator of intention (between attitude and behaviour) and require support from norms. As a critical step to understand behaviour, intention should be understood as the contributory element in the realization of the actual behaviour as a result of some or all socio-psychological determinants and processes.

Behaviour is the final outcome of complicated social psychological processes with several external factors being at play. However, it should not be understood as the final destination. It is more of a journey. For instance, every individual behaviour plays an important facilitator role for other behaviours—internally, each behaviour is part of a progressive and circular enduring process.

4.2. Secondary Socio-Psychological Determinants

4.2.1. Knowledge

The debate about philosophical roots of knowledge is sophisticated and, in some philosophy manuscripts, is defined in substance as "justified true belief" [81]. However, under the umbrella of the psychology field, we simply prefer to define knowledge as information gained through observational or perceptual channels (i.e., from empirical or rational perspectives). This is a view shared by Littlejohn [82].

House et al. [83] introduced two types of knowledge: objective and subjective. On the other hand, Schahn and Holzer [84] adapts another distinction and employs abstract and concrete knowledge terms. While the former corresponds to a general environmental situation, which has more indirect impact on behaviour, the latter stands for specific knowledge for action with stronger predictive power and a moderator role between attitude and behaviour. Maloney et al. [79] implements knowledge as a scale that evaluates the factual knowledge about the issues [7].

Hines et al. [37] suggests that knowledge is a pre-requisite for recognition and formation of subsequent psychological determinants, including action. Since knowledge is found to have both direct and indirect effects on people's perceptions, attitudes and behaviours [8], it is reasonable to place knowledge as a starting point within the model. It is stated that both the knowledge of an issue and how to behave has a moderator role on an attitude-behaviour relationship [30]. Therefore, people with more knowledge (about either the issue or the action) are more prone to exhibit pro-environmental behaviour [37]. Depending on what type of information is asked, Oskamp et al. [38] reveals that knowledge is attributed to and positively correlated with environmental concern [60]. Moreover, it is seen necessary to have essential knowledge about the issues and behaviours in order to act in a conscious way [12]. Therefore, it could be best placed under the awareness determinant along with recognition of issues [39].

Without doubt, knowledge plays a critical function towards behaviour, but this functionality is pertinent to its relationship with other psychological determinants and its influence from external factors. Moreover, how knowledge will be gained and interpreted are highly likely to be a function of personality traits and characteristics.

4.2.2. Concerns

Concern is something that individuals relate to or connect with themselves, and typically it is a matter of engagement, interest or worry. Environmental concern could be defined as value orientation or general attitude towards pro-environmental behaviour [74]. It could be further understood as the level of willingness to take action in relation to the environment in general—or specific facets therein [7]. Bamberg [2] prefers to conceptualize

it as an indirect predictor of situation-specific behaviours by influencing the situationally-related cognitive process.

General environmental concern is influential on the pro-environmental psychology of individuals. Van Liere and Dunlap [36] examined environmental concern and proposed a new mindset called the New Environmental Paradigm (NEP) (see Section 3.3). Although the direct empirical relationship between general environmental concern and behaviour is found to be low to moderate [37], general environmental concern is accepted as an important underpinning component of environmental consciousness that indirectly improves the behavioural outcomes of individuals [2].

There are studies that implicitly or explicitly emphasize the relationship between environmental concern and behaviour. For instance, Stern and Oskamp [85] correlates them through attitude if the attitude and concern is measured at a similar degree of specificity. On the other hand, it is not certain that people who are concerned about one issue will have equivalent concern on others [35]. Notwithstanding this, Van Liere and Dunlap [36] hypothesized that, despite the variation on environmental concerns, they are highly correlated with each other.

Public concern is assumed to be formed mainly by information gained about the case in hand, and links to the values adhered by individuals [40]. Bamberg [2] points out that environmental concern does not have direct impact on intention and behaviour. Instead, it has a robust effect on situation-specific beliefs, which, in turn, affects corresponding perception. It is, therefore, reasonable to position 'concern' under the perception determinant, and between knowledge and value-belief sub-determinants. However, distinction between specific and general environmental concern, as well as its role and relationships with other determinants and external factors, needs further investigation. As a result, concern emerges as an indispensable piece of the sub-determinants.

4.2.3. Value-Belief

A value could be defined as "a belief pertaining to desirable end states or modes of conduct that transcends specific situations, guides selection or evaluation of behaviour, people, and events, and is ordered by importance relative to other values to form a system of value priorities" [65].

From an environmental perspective, Barr et al. [41] defines environmental value as central and essential bottom-line orientation of a person in relation to the environment. Beliefs, however, are the thoughts that could be accepted as the evaluation of the events and their effects based on the values, i.e., the formation of more solid consideration about the issues. In terms of previously mentioned definitions, it is observable that values and beliefs have close meanings mostly intersecting with each other and exhibiting congruence. It is empirically verified that values perform a prominent role in predicting general and specific beliefs [86]. Therefore, beliefs could be accepted as a more settled and established evaluation and judgement process that is based on (more concrete) values [87].

In some models, values are seen as antecedents of beliefs [23]. However, in others, values and beliefs are used interchangeably [39]. This confusion needs some clarification between intrinsic and evaluative values. Intrinsic value is used as an orientation in the meaning of personality with a more static, inherent and underlying nature, and is understood as personality traits or characteristic features of individuals. On the other hand, evaluative (or relational) values are subject to evaluation of informational or emotional intake from an external environment, under the influences of social, institutional or situational factors. Therefore, it is accepted that dynamic values of individuals are closely related to beliefs (and used interchangeably), and may be employed as guidance for behaviour [31]. These kinds of values have a more interpretive nature constructed by internal judgements, based on social structure, and could be further structured as general world views, i.e., beliefs [40,72]. In other words, while general values that individuals hold (independent from the issues) could be interpreted as personality traits, a persons' specific values could be placed under socio-psychological determinants along with beliefs.

Therefore, value orientations as a concept (characteristic features) and values given to a general or specific subject [88] are investigated separately.

In terms of social and environmental values, three categorical dimensions are used in Barr's [42] study. The first dimension is termed the social value dimension, which relies on the approach proposed by Schwartz [25]. According to Schwartz [25], values range from egoistic to altruistic, and from conservative to openness to change. The second dimension termed relational value is inspired from the work of Dunlap and Van Liere [21]. Values are understood in the continuum ranging from biocentrism to anthropocentrism. The last dimension defines values from a belief-driven perspective. The first dimension corresponds to a personality traits determinant, whereas the second and third groups correspond to a value-belief determinant. In addition, one might hold several values at different levels that are open to individual, social, institutional, and cultural differences [43]. Additionally, in order for values to be active in a given situation, they are required to be activated by concerns [31]. A relationship between values and pro-environmental behaviour is found through their effects on personal norms and a specific attitude [30]. Stern et al. [40] suggests that values are influential on formation of attitudes. In other words, they are guiding principles in the formation of attitudes.

Inspired by the value orientation approach of Schwartz [25], Stern et al. [40] suggested it is possible, from an environmentalist perspective, to cluster value according to three groups—egoistic, social-altruistic, and biospheric values—which are parallel to three ethics of egocentric, homocentric, and eco-centric [19]. While people with egoistic values prioritize cost and benefit to themselves, biospheric valued people give precedence to nature and the ecosystem, and people with social-altruistic values prioritize social order, equality and other people [19]. In other words, the motivation of these values is inspired by self, by other species—the biosphere—and by other people, respectively [89]. Schultz also explains belief as the intermediary agent between values and attitudes. According to Schultz, values have influence on beliefs, which further affects attitude and behaviour. Therefore, individuals form their attitudes by relying on their beliefs about the incidents, by reviewing their values. According to attribution theory, control attributions significantly influence attitude and behaviour [39]. People who attribute behaviour to a specific condition, or who figure out a connection between a problem and their responsibility, tend to perform more responsible behaviours. These attributions could be understood as beliefs about general or specific issues.

In summary, the crucial distinction between intrinsic and evaluative values should be made and this is an important step in order to evaluate socio-psychological determinants and a sustainable behavioural outcome. The approach proposed here needs further conceptualization. Moreover, as hypothesized here, being an influential element of attitude and a predictor variable of norms and behaviours requires a belief component to be posited as a sub-determinant between perception and attitude.

4.2.4. Personal Norms

A personal norm is described as the anticipation held by an individual on how one should behave in a particular situation [24]. In other words, it is a feeling of personal obligation based on values and beliefs. Therefore, personal norms could be accepted as more autonomous drivers of behaviour, and it is indicated to have the strongest predictive power on behaviour in VBN theory [23].

Personal and social norms should be distinguished. While social norms are conditionally followed and stimulated by external conditions, personal norms are followed unconditionally and driven internally [90]. While a social norm is open to external influence such as punishment or reward, a personal norm does not need such enforcement. Alternatively, these have been termed descriptive norms, which correspond to what people do (i.e., personal norms), and injunctive norms, which indicate what people need to do (i.e., social norms) [31].

Personal norms are based on the evaluation of general values and beliefs [23,31]. On the other hand, social norms could be accepted as external factors that are influential not only on value-belief and norms, but also on awareness, information intake (knowledge), concern, attitude and behaviour. However, according to Bertoldo and Castro [91], practices that are encouraged externally by social norms turn into personal norms in time.

Although Klöckner [28] identified that there is much overlap between personal norms and attitudes in the empirical data, personal norms could also act as barriers for individuals to behave according to their attitudes [14]. Inspired from norm activation theory [54], Schultz and Zelezny [32] indicates the significance of underlying norms (as important predictors) on pro-environmental behaviours. Personal norms are found to be highly correlated with behaviour, especially when there is a high degree of awareness of consequences [57]. Moreover, ascription of responsibility is also mentioned to have impact on personal norms [31]. However, Guagnano et al. [22] also mentions the restrictive influence of external conditions on predictive power of personal norms over sustainable behaviour.

Personal norms here, as outcomes of value-belief and sub-determinants of attitudes and behaviours, are accepted as an important predictive element in the model. Therefore, distinction is made between personal and social norms providing a better chance to investigate them under improved conceptualizations.

4.3. Influential External Factors (Situational/Contextual)

Environmental behaviour cannot be understood solely by internal psychological processes. Behaviour in its general form is subject to a much wide range of factors than simply relying on isolated psychological processes [42]. Yet many studies have demonstrated that the socio-psychological theories should be expanded to include other social and personal factors [15,22,30,37,41]. For example, Steg and Vlek [10] suggest external factors may function in four different ways:

(a) They may have direct effect on behaviour,
(b) their effect on behaviour may be mediated by socio-psychological determinants,
(c) they may moderate the relationship between socio-psychological determinants depending on personal factors, and
(d) they demonstrate which determinants predominantly affect behaviour.

Additionally, as Guagnano et al. [22] underlined, there are boundary conditions and external factors that have direct critical influences on the explanatory power of socio-psychological determinants, which they termed external conditions in their ABC model. These situational influences could be understood as constraints and facilitators that are beyond an individual's authority [7] with their mediator effects on the relationship between socio-psychological determinants [80]. Ajzen [26] clusters these situational factors as two groups:

(a) Time and opportunity, and
(b) dependence on others.

Contextual factors are found to be important parameters in attempts to explain attitude-behaviour relationship [38]. Similarly, Barr et al. [41] used situational variables such as contextual, spatial and socio-demographics as a predictor of environmental behaviour. Kaiser et al. [7] emphasizes the inadequacy of considering situational factors on sustainability behaviour as a methodological flaw. As an approach, Gifford and Nilsson [92] conceptualizes factors that influence pro-environmental concern and behaviour as a combination of personal and social factors, but, in order to holistically determine environmental outcome(s), they stress the necessity of considering a total of 18 factors (not outlined here, please refer to [92]).

Consequently, conceptualization of sustainable and pro-environmental behaviour requires influencing factors to be represented under a logical and systematic framework [41]. Although it is not fully possible to comprehend the entire list of external factors, several studies would give some intuition [12] and, therefore, it is possible to embed a preliminary

set of factors within our model. For example, Topal et al. [93] proposed a theoretical framework about urban sustainability understanding, which consists of a wide range of influencing factors grouped under six main and 15 secondary broad categories [93]. For more in-depth examination, this framework could be considered. The dynamic nature of these factors requires sustainable behaviour models to be adaptable to diverse situations. These factors should be understood according to a broader meaning of concepts such as motivator, enabler, supportive, and restrictive, amongst others. Moreover, these factors should not be seen in relation to behaviour only. Other psychological determinants are also open to effects from external factors. Keeping in mind all previously mentioned requirements, some of the most well-known factor groups will be investigated in this section.

(1) Demographics are found to have a varying but prominent relationship with sustainable behaviour in the literature [36,94]. The main demographic factors that have been found to affect behaviour according to Topal et al. [93] are:

    a. age,
    b. gender,
    c. income, and
    d. education.

Generally speaking, younger females with high levels of education and higher income tend to behave more sustainably [35]. However, this result has been criticized considerably and there are several contradictory studies that found older people have more balanced opinions on the environment and growth [95] and behave more sustainably [96]. Moreover, other studies show male individuals to be more knowledgeable about sustainability [97], and those with higher income have been shown to consume more resources—such as electricity and water [98]. In addition, the correlation between higher levels of education and pro-environmental behaviour have been found to be weaker [99]. Additionally, according to a political ideology hypothesis, liberals are found to be more inclined to exhibit pro-environmental behaviour when compared with conservatives [35]. Religion and the world view of individuals are also determined among influencing factors [92]. It is, therefore, possible to deduce that individual or other demographic factors are open to contextual, spatial, temporal, cultural and social influences.

(2) In terms of information and communication, lack of knowledge is mentioned to be a significant barrier on formation of perception and attitude, as well as exhibiting behaviour [38]. Gifford and Nilsson [92] argue that knowledge and education should be seen as a prerequisite for environmental concern [72]. Both information about the environmental issues and the information about relevant solutions are identified as motivators for sustainable behaviour [99,100]. In order to provide the necessary information to people, publicity provided by social campaigns [101] and citizen-oriented training and education projects [102] are required.

(3) Correct policy and governance strategies are other significant factors of sustainable behaviour. The value of well-designed legislation and regulation mechanisms is indisputable [103], not only with its facilitator role in determining the success of sustainability policies [101], but also with its complementary contribution to implementation [104]. Intervention strategies are, therefore, gaining significant importance as a substantial governance tool [10]. Moreover, participatory governance provides opportunities for the engagement of citizens, and, therefore, contributes to sustainable behaviour of individuals [105].

(4) Socio-cultural environment has a very significant role in the constitution of behaviour [7]. For instance, moral and normative concerns over the living environment influence the interpretation and responses of the individuals [10]. Several authors have stressed the role of social norms in preventing people from or encouraging people to behave in a sustainable way [38]. It is found to be more difficult to behave in a sustainable manner when it is against the social norms [106]. Social norms could

be treated as external drivers of behaviour [91]. Liere and Dunlap [35] highlight the relationship between environmental concern and existing social orders, traditional values and institutional structures. People tend to seek praise for their (good) behaviours in order to act more sustainably [107]. Similarly, the more they have trust in social actors behaving well about sustainability, the more they are willing to take actions [103]. For instance, a collective perspective could enhance participation in sustainable actions [108].

(5) Contextual factors have a predictive role in involvement in pro-environmental behaviours [109]. It is, therefore, valuable to conduct cross-cultural studies investigating sustainable behaviours. Therein, childhood experience is an important sub-factor in the formation of environmental concerns and behaviours [72,92]. In that respect, many studies emphasize the strong influence of past habits and associated routines as a significant facilitator (or barrier) of sustainable behaviour, depending on the relationship between concurrent habits and desired environmental actions [10]. Urban dwellers are found to be more environmentally concerned when compared with rural residents [35]. This might be due to urban dwellers being exposed to negative consequences more frequently than those who live in rural areas [30], which puts emphasis on the effect of a physical condition on sustainability psychology. Similarly, the number of residents [110] and the type of residence [38] can influence sustainable behaviours.

(6) Necessary infrastructural provision has been shown to be highly influential to the success (or formation) of many behaviours. For instance, availability and proximity of facilities are either prominent barriers [103] or enablers of pro-environmental behaviour with its impact on a 'psychological cost,' which is defined as time and effort needed to engage in a specific action [12]. Barr et al. [41] stresses the facilitating effect of having closer recycling facilities on recycling behaviour and Noonan et al. [111] mentions that, while the intention to use services might be high, the final behaviour is determined by proximity and/or ease of access to it. Kang [112] emphasizes the role of ICT (information and communication technology) facilities over the conceptual understanding of sustainability. Similarly, quality and functionality, along with the ease and convenience of relevant behaviour, are strong predictors of how individuals form their behaviour [113,114].

(7) Economic factors have a distinctive impact on how individuals think and decide [12]. However, the nuances of this are highly complex to evaluate. While higher cost of services leads to reduced resource consumption, such as is the case with electricity or water [99], financial support by governmental incentives may have a facilitator role [107]. On the other hand, reduced prices may prevent individuals from taking sustainable options. Similarly, increased purchasing power may result in increased usage of resources by changing consumption habits, or it may simply force an individual to mitigate the resource consumption by adapting expensive but smart technologies [109]. Therefore, the economist's assumption of rational choices is not valid in all circumstances. It can be deduced that relying on economic factors (incentives or disincentives) alone is not sufficient. These are highly correlated with social, cultural, and other environmental components.

(8) Environmental determinants, as the last factor group, consists of a wide range of sub-factors. For instance, urban greenery is found to be positively correlated with pro-environmental awareness and perceptions, consequently resulting in sustainable behaviour [115]. On the other hand, the built environment as a function of buildings, streets and open spaces can impact on sustainability perception and the behaviour of individuals [116,117]. According to the risk-perception approach, perceived risk to self, others and nature could form the attitude of individuals [40]. These risks could include functional, physical, financial, social, psychological and temporal risks [17]. Proximity to issues and environmental problems is another factor of influence [92], since safety is an important concern for people. Similarly, place attachment is men-

tioned among influential factors of how individuals form their understanding of and reaction to sustainable behaviour [17].

4.4. Personality Values, Traits, and Characteristic Features

The personality trait could be described as "a characteristic of an individual that exerts pervasive influence on a broad range of trait-relevant responses" [80], which is distinguished from attitude with its non-evaluative nature. It is presented in a simpler manner as a "unique pattern of traits" [118]. In another approach, they could be understood from the value perspective. As stated in Section 4.2 under the value-belief heading contrary to evaluative or relational values, intrinsic value orientations that are either natal or constructed in a life-time period are used interchangeably with personality traits or characteristic features of individuals [34]. Bilsky and Schwartz [119] further advances this distinction by stressing the motivational content for a relational dynamic values determinant, which they define as: "the criteria that individuals hold and evaluate (influences) the relevant behaviour accordingly". The authors favour a trait approach as the centre of personality values.

Five major personality dimensions are used to define traits or characteristics of individuals. These are named as [120]:

- sociability (extraversion-introversion),
- agreeableness,
- conscientiousness,
- emotional stability, and
- culture.

On the other hand, Schwartz [25] groups personality value orientations under four main categories of openness to change, conservation, self-enhancement and self-transcendence. He further supposes 10 motivational types under the four previously mentioned main value orientation dimensions. They are:

- universalism,
- benevolence,
- conformity,
- tradition,
- security,
- power,
- achievement,
- hedonism,
- stimulation, and
- self-direction.

According to Ajzen [121], personality and broad life values are background factors that exhibit great differences from one person to another. While they are open to limited influence of external factors, such as culture and spatial context, the role of personal experiences should not be underrated. Some studies have found a significant and direct effect of personality values (or characteristics) of individuals on pro-environmental behaviour [26,31]. Moreover, personality values could be seen as directive principles for attitude formation towards a relevant matter or case [19]. For instance, Hurst et al. [122] conducted a meta-analysis to assess the relationship between materialistic value orientation and pro-environmental attitudes and behaviour, and found a noteworthy negative correlation between them. Grob [39] explains that the more materialistic value orientation an individual has, the more inappropriate their actions will be. On the other hand, openness and creative thinking value orientations are seen as facilitators in pro-environmental behaviour.

5. Conceptualizing Urban Sustainability Understanding

This section aims to present the conceptualization of an Urban Sustainability Understanding and Behaviour Framework. With this in mind, it will first identify the main

characteristics and important features of the proposed framework based on the review done in the above sections. This will be followed by the formation of the conceptual framework and an explanation of how the proposed framework suits the intended features.

5.1. Primary Features

5.1.1. Internal Processes—External Factors

The study of behaviour should integrate internal processes and external conditions. The utility and functionality of a policy requires incorporation of various aspects in order to overcome the limitation presented by complexity of human understanding and behaviour. Shortcomings of most attitude-behaviour theories point towards the assumption that the approach is evaluated independent from (or less dependent on) contextual effects and boundary conditions [22]. Therefore, it is pivotal to specify external variables that play a dominant role in either development of or transition between all socio-psychological determinants.

On the other hand, the rational action-reaction approach, which tends to interpret behaviour as a direct outcome of external conditions, misses the predictive power of the inherent characteristics of individuals, as well as the complicated inter-relationships between socio-psychological cognitive processes. The approach proposed by Guagnano et al. [22] adopts a model named ABC (Attitude, Behaviour, external Conditions) that stresses the importance of a multi-directional nature of human psychology. The authors reveal that external factors could change attitudinal mechanisms and reactions to external conditions that are influenced by socio-psychological determinants. However, this model has shortcomings in the examination of intrinsic psychological processes. Moreover, personality traits are not included in this model. It is, therefore, apparent that the distinction between inner socio-psychological determinants and external influential situational factors should be made clear. Otherwise, the confusion about the interrelationship of various determinants and between determinants and external factors is inevitable.

5.1.2. Rational Motives—Normative Motives

The approaches proposed by Ajzen [18] and Hines et al. [37] bear explicit similarities mainly dependent on rational choice and expectancy, with a focus on the attitude determinant and intention. Although attitude-behaviour theories have been helpful to understand specific behaviours, they have weaknesses in general understanding, as well as considering the effects of the social and cultural contexts that surround the individuals, with an impact on their attitudes and behaviours [27]. On the other hand, the 'moral theory oriented behavioural model', developed mainly by Schwartz and Bilsky [123] and Stern et al. [34], concentrates on limited determinants of values, beliefs and personal norms. Other important determinants are overlooked, such as awareness, perception or attitude. Moreover, there are other attempts that develop composite models by integrating some of the variables from the above theories, and other specific variables from an environmental behaviour perspective [3,11,28,74]. However, a synthesized approach should make use of both utilitarian motivators, which are based on reward and punishment, and normative motivators, which rely upon approval or disapproval of others.

5.1.3. General Measures—Specific Measures

Oskamp et al. [38] emphasize that, while general environmental attitudes and behaviours did not have a significant predictive value on recycling behaviour, other aspects such as specific knowledge, attitude and behaviour did. On the other hand, Kaiser et al. [7] suggested measuring environmental attitude and behaviour concepts more generally. Consequently, as Scott and Willits [33] remarked, it is necessary to measure all socio-psychological determinants at the same level of specificity or generality. In other words, the more specific the knowledge, the more specific the attitude or behaviour. Similarly, general attitudes dictate general behavioural outcomes. While general environmental awareness, perceptions or attitudes contribute to general environmental behaviour or behavioural

tendency, specific measures are related to specific behaviours. As a result, it is possible to get a more predictive and more valid result when the degrees of determinants are closer to each other. However, the positive influence of general measures is stated to be important in different studies [21]. They are further found to be positively correlated with specific measures [27]. However, a distinction needs to be made between general and specific situations and corresponding psychological responses, while the direct and indirect effects as well as potential predictive power of both specific and general cognitive processes should be kept in mind. It is, therefore, necessary to allow room for both general and specific approaches in pro-sustainability psychology.

5.1.4. Non Linearity—Circularity

Although linear models of behaviour have been criticized in the literature [124], a linear reductionist illustration is inevitable for understandability. Therefore, the model proposed in this study also adopts a linear illustration. However, in reality, the interrelationship between socio-psychological determinants is not linear. On the contrary, we assume this relationship to be semi-linear. That is to say, although the ideal behaviour would occur as a result of a linearly illustrated process, due to the complexity of real-life situations, actual behaviour occurs via a non-linear process. In other words, in spite of the stronger possible predictive power of linear consequent determinants, all determinants have a more or less indirect connection with others in diminishing order with distance, depending on the case, individual, scale and time. Likewise, all socio-psychological determinants are assumed to have a discrete nature [19]. Therefore, in order to form new behaviour, it is not always necessary to have all determinants and follow a sequential order. However, it could be proposed that as the number of linear steps taken increases, the strength and the consciousness level of the behaviour increases. This flexibility is essential in order to provide an explanatory model of human behaviour. Moreover, the circular and ongoing nature of the model actually imposes the facilitating role of habitual formation on behaviour constitution. Similarly, there is not only semi-sequential order between determinants, but also a semi-hierarchical order between the main and sub-determinants.

5.1.5. Time—Case—Scale—Individual Specific Nature

The determinants of environmentally responsible behaviour are subject to time, issue, scale and individual [43]. Individuals tend to simplify the psychological process. They do not consider all circumstances, consequences and factors, and cannot use all the information, values and beliefs they hold. Therefore, their perceptions and attitudes vary at different times, for different issues, at different scales, and for each individual, which results in a particular behaviour [19]. That leads to the case, scale, time, and individual specific nature of sustainability psychology [20]. For instance, one person might be more concerned about environmental contagion of overuse of private vehicles while others might not get interested in it. Similarly, the same person would be more concerned about the environmental impact of their behaviours at some time, while he/she might not care as much at a different time. Moreover, the same person would not exhibit the same level of concern about another issue, such as recycling or reducing behaviour. Additionally, the engagement level of sustainability psychology displays diversification between an individual micro level and a social macro level. That is to say, sustainable behaviour has a peculiarity in nature. Therefore, it is necessary to consider all aspects when necessary.

5.2. Conceptual Approach

Formulation of a new model is a complex procedure involving a number of variables, none of which function without interacting with each other. Moreover, the advantages and shortcomings of existing models should be considered carefully. It is correctly acknowledged to be hard to define and limit the various determinants since most are ambiguous and broad in nature, interrelated with each other, and do not have clear-cut boundaries. However, models help understand the relationships between different components by pro-

viding a visual representation. They require the balance of sophistication and inclusiveness to be achieved. Regarding all previously mentioned requirements and specifications, a new conceptual model to evaluate sustainability understanding and behaviour is illustrated in Figure 5.

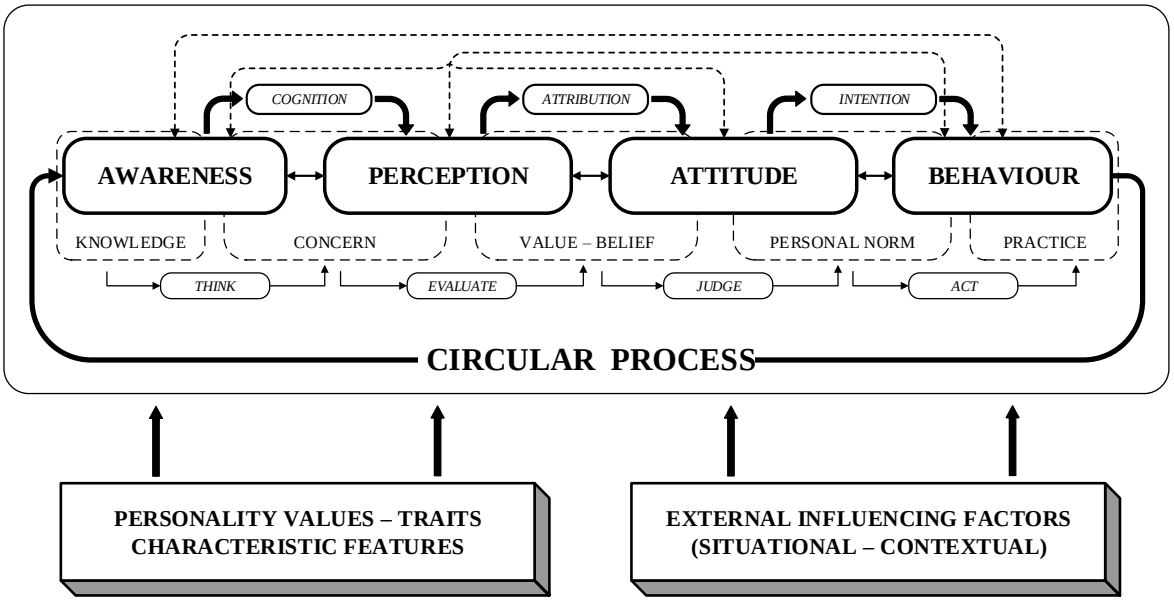

Figure 5. Conceptual framework.

As shown in Figure 5, the theory links four main determinants through a causal chain, which consists of awareness, perception, attitude and behaviour. At the same time, the model utilizes five sub-determinants to help integrate the main determinants above. These are: knowledge, concerns, value-belief, personal norm and practice. As seen from the framework, the knowledge determinant provides the starting point of the socio-psychological process and the practice determinant is adopted as the final outcome of the particular socio-psychological cycle. Concern, value-belief, and personal norm sub-determinants are demonstrated as transition elements between the main determinants with their content being linked between two sub-determinants. In addition, external influencing factors constitute a separate cluster with direct and indirect effects on inner socio-psychological processes. Similarly, personality values, traits and characteristics (features) act as the melting pot where all these processes take place. Last but not least, it should be noted that, due to a circular and continuous nature of the proposed approach, the whole cycle repeats.

Initially, awareness acquisition is considered a necessary foundational baseline. Either perception-attitude or behaviour should rely on proper awareness. In order to acquire awareness, it is mandatory to gain and accumulate knowledge. Therefore, we posit knowledge as a sub-determinant of awareness. After a saturation point, knowledge gained would result in development of concern. Individuals need initial information about an issue in order to have concern for it. This is also a cognitive process that enables the transition from awareness of an issue to development of perception about it. Hence, concern could be placed as a sub-determinant of both awareness and perception.

Perception is an evaluative process that provides an opportunity to create relatively dynamic values and, correspondingly, the beliefs built upon these values. Individuals develop values and corresponding beliefs with respect to their concerns. As the values and beliefs get stronger, this process provides a shift from perception of an issue to attitude formation by establishing attributions, and that is why value-belief could be posited as a sub-determinant of both perception and attitude.

Attitude, as an organization of beliefs and norms, is a judicial process where values and beliefs engender personal norms, i.e., personal normative beliefs constituted. Attitude is a process that ensures behavioural tendencies based on the personal norms developed with regard to the beliefs that individuals hold. As the personal norms of individuals intensify, they shift from personal normative beliefs to personal normative behaviour, i.e., behavioural tendency. This is a process in which intention gets involved. Intention is the critical facilitator that ensures normative shift, which, in turn, enables the transition between attitude and behaviour. Therefore, it is possible to put personal norm as a sub-determinant of both attitude and behaviour. Finally, practice is the clear action that we perform as a result of our behavioural tendency.

Every step of the previously-mentioned socio-psychological processes is subject to numerous external factors, of which some are discussed in Section 4.3. While some factors, such as socio-demographics, are influential (indistinguishably) on all determinants, some others have a specific or more significant relationship with a corresponding sole determinant. Furthermore, these socio-psychological mechanisms are based on personality values, traits and characteristic features of individuals. Therefore, the effect, processing and outcome for each person will be both particular and unique.

In terms of the non-linear interconnectivity of determinants, it should be noted that there is both a forward and a reverse order cross-relationship between them, with a pull and push effect. For instance, how and to what extent an individual will be aware of a situation is highly dependent on pre-existing perceptions, values, beliefs, motivations, personality and attitudes. Similarly, perception about a situation will be developed based on: what individuals are aware of, what their existing attitudes are (about relevant issues), what values and beliefs they hold, and their personality. In other words, sustainable behaviour, or any socio-psychological determinant of it, is a function of: other determinants, external influencing factors, and underlying personality values, traits and characteristic features.

The model proposed here enables theoretical comprehensiveness by including socio-psychological determinants of sustainability psychology in a promising conceptualization. Moreover, the dynamic and unbounded external influential factors group included in the model provides flexibility—thereby, allowing the model to be adaptable to different substantive dimensions of sustainable behaviour. It further provides a foundational base on which to produce specially designed measurement scales, based on the holistic framework. This approach aligns with the necessity of including ecological behaviour components in a broader framework, as emphasized by Kaiser et al. [7], Stern [23], and Kollmuss and Agyeman [12]. As Gifford [72] stated, one main failure of the environmental psychology theories is that they are either too exclusive or too inclusive. The authors of this current research suggest that the model presented overcomes this issue by the introduction of three cluster mechanisms. Putting general but critical elements and essential relationships in place offers flexibility with respect to the internal and cross-relationships of psychological determinants and external situational factors.

Unlike other approaches and theories, the proposed model avoids defining behaviour as a result of specific, limited factors that are not properly distinguished in terms of socio-psychological position. The approach preferred here concentrates on the overarching determinants group and their interrelationships. These determinants are seen as a function of external influences and given personality traits and characteristics, and constitute a wide range of sub-elements that should be conceptualized by an external factor grouping mechanism. All factor groupings hold a distinct character with a unique combination of external factors for each individual or case, and are subject to time and scale considerations.

The model presented could be used in various manners, such as for general environmental or sustainability psychology, or specific behaviour. Moreover, it gives room to be used for particular psychology dimensions, such as awareness of environmental issues, attitudes toward sustainable behaviours or perceptions about pro-environmental actions. While the pathway represented in the model with socio-psychological determinants is the ideal, desirable way, it may be facilitated (or restrained) by external factors and person-

ality characteristics. Moreover, the pathway may not always work in an ideal order. We postulate that, while each determinant is in direct relationship with the nearest other (as shown in the framework), they are all in an indirect and diminishing interaction with other determinants along the causal chain that has a push-and-pull relationship.

6. Conclusions, Limitations, and Future Research

Our decisions and actions are determined by many conflicting and complex factors. In this article, the purpose of critically and systematically reviewing the pro-environmental, sustainability and psychological behaviour literature in order to explore urban sustainability understanding and behaviour is fulfilled. Consequently, a novel comprehensive and overarching conceptual framework is proposed with an aim of enabling its use in evaluating the urban sustainability behaviour in future studies. By reviewing the existing models and approaches, the model proposed in this study seeks to examine the essential interrelationships between three clustered layers—socio-psychological determinants, external factors, and personality traits—and further explore the links within each group.

The conceptual framework has a number of substantial advantages. It improves the understanding of urban behaviour by incorporating three comprehensive clusters. By constituting a relationship between inner and external processes, it provides the flexibility to model the complex nature of humans [26]. Moreover, it classifies the inner determinants of human psychology in a manner that encapsulates and improves the various psychological and environmental approaches in the literature in an understandable way. By doing so, it becomes possible to overcome previous shortcomings stemming from the reductionist and restrictive interpretations given within the literature.

Although it aims to act like a comprehensive approach, the model has its own limitations. First of all, it is not possible to explain and visualize all complex socio-psychological processes of urban sustainability. Therefore, a simplified approach is inevitable. However, the model still provides an advance on existing studies with its more extensive three-step clusters, all of which endeavor to provide a wider approach. Secondly, emotional and motivational parameters need further investigation, and their relationship with existing determinants needs to be further clarified [17,69]. Similarly, although the model presented attempts to encapsulate past behaviours as external factors, and habitual development with its circular and continuous nature, they deserve further attention [121]. Moreover, the value (as a psychological determinant) and value orientation (as a more stable personality and characteristic variables) need to be further developed. The ambiguity in the literature in the meaning and implementation of the 'value concept' causes confusion, and requires further clarification. Likewise, additional sub-categories exist and could be integrated depending on the different urban contexts and local sustainability conditions of where the model is being applied. This includes world views [92], or identity [49,87], which could be used along with or under existing socio-psychological determinants. Moreover, there are many other different external factors in urban areas that are subject to situational and contextual influences that need to be developed in every specific case. In addition, studies that focus more specifically on motivators and barriers of socio-psychological determinants of urban sustainability understanding could be conducted [17].

Human nature and its relationship with the surrounding environment are immensely complex. At the same time, human beings have unlimited demands with an increasing population. In contrast, natural resources are limited and social systems are in need of efficiency in order not to face disruption or failure at any point. Therefore, future studies of urban sustainability behaviour should integrate the three important tools of: (a) machine learning, (b) big data, and (c) optimization, which are inevitably needed to overcome previously-mentioned complications. The complexity of human nature results in complex urban behaviour patterns that require investigation with the help of machine learning algorithms. At the same time, extensive interaction of individuals with their surrounding systems necessitates big data for human understanding and behaviours in urban areas. Moreover, the optimization approach should be adopted to manipulate the

urban behaviours of individuals and society in order to: (a) fulfill the unlimited needs of a growing population with limited resources, and (b) provide efficient and persistent (i.e., sustainable and resilient) urban living systems. The conceptual framework proposed in this study has great potential for future studies in these areas. Our model would serve as a good basis for tools to be integrated into urban sustainability behaviour studies with its comprehensive and holistic, yet a flexible and open-ended, structure. By adopting these tools with the help of our framework, prospective research studies would produce better urban sustainability policies, and utilize the interventions and investments to achieve better outcomes.

Despite the fact that it is not possible to put clear-cut boundaries to psychological processes, clustering and categorizing have substantive advantages in the development of a model that is understandable and applicable to individuals, with its ability to facilitate implementation. The output here did not aim to justify urban sustainability behaviour, but instead, it was an attempt to further understand it. Therefore, the proposed model has a promising conceptualization that could be implemented and empirically tested in future urban sustainability studies, and it provides a theoretical foundation to develop a novel sustainable behaviour assessment scale. This is an area for future work as part of the current authors' research.

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