# Concepts describing and assessing individuals' environmental sustainability: An integrative review and taxonomy

## Supplementary Material

## List of definitions

**Table S1**

*List of conceptual definitions of constructs included in the taxonomy*

Note: We added information on the concept types and contextual scopes indicated in the operationalization in the respective column using “Items:" for construct subject to a conceptual-operational divide, i.e. if concept type(s) and/or contextual scope(s) indicated in the definition diverged from those indicated by the operationalization of a construct.

| Construct | Definition | Concept type | Contextual scope | Synonyms |
|---|---|---|---|---|
| **1 Biospheric values** | “*concern with nonhuman species or the biosphere”* (Stern et al., 1993, p. 326) | Value | Planet | Biospheric personal values (Bouman et al., 2020) |
| **2 Green consumer value** | *“tendency to express the value of environmental protection through one's purchases and consumption behaviors*” (Haws et al., 2014, p. 337). | Value<br>Items: Value, intention, identity | Product<br>Items: planet, personal practice, public | - |
| **3 Environmental consequences** | “e*nvironmental consequences can be measured as concerns on how a product affects the environment, forest depletion, and energy usage in producing the product*” (Ramayah et al., 2010, p. 1421). | Value | Product | - |
| **4 Environmental identity** | “*one part of the way in which people form their self-concept; a sense of connection to some parts of the nonhuman natural environment, based on history, emotional attachment, and/or similarity, that affects the way in which we perceive and act towards the world; a belief that the environment is important to us and an important part of who we are”* (Clayton, 2003, pp. 45–46) | Identity | Planet, practice<br>Items: planet, public, personal practice | - |

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| **5 Connectedness to nature** | *"individuals' trait levels of feeling emotionally connected to the natural world"* (Mayer and Frantz, 2004, p. 503) | Identity<br>Items: identity, attitude | Planet | Emotional affinity towards nature (Kals, Schumacher,& Montada, 1999)<br>Inclusion of nature in self (INS) (Schultz, 2002)<br>Connectivity to nature (Dutcher et al., 2007)<br>Identification with nature (Schmitt et al., 2019) |
| **6 Nature relatedness** | "*individual levels of connectedness with the natural world"* (Nisbet et al., 2009, p. 718). | Identity<br>Items: identity, beliefs, behaviors | Planet<br>Items: planet, personal practice | - |
| **7 Ecological Identity** | *"the extent and ways by which an individual views himself or herself as being a part of an integrated social and biophysical (i.e., ecological) system characterized by mutually beneficial processes and nested webs of relations"* (Walton and Jones, 2017, p. 10). | Identity | Planet<br>Items: product, personal practice, public, planet | - |
| **8 Environmental self-identity** | *"the extent to which one sees oneself as a type of person whose actions are environmentally-friendly"* (Van der Werff et al., 2013, p. 1258). | Identity | Personal practice – without excluding public and products | Pro-environmental self-identity (Dermody et al., 2018)<br>Environmentalist identity (Kashima et al., 2014)<br>Green self-identity (Lalot et al., 2019) |
| **9 Environmental knowledge** | "*a general knowledge of facts, concepts, and relationships concerning the natural environment and its major ecosystems. […] environmental knowledge involves what people know about the environment, key relationships leading to environmental aspects or impacts, an appreciation of "whole systems", and collective* | Knowledge | Planet | - |

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| | *responsibilities necessary for sustainable development"* (Lo and Fryxell, 2003, p. 48) | | | |
| **10 Knowledge about climate change** | *"knowledge about how the climate system works; specific knowledge about the causes, consequences, and potential solutions to global warming; contextual knowledge placing human-caused global warming in historical and geographic perspective; and practical knowledge that enables individual and collective action"* (Leiserowitz et al., 2010, p. 4) | Knowledge | Personal practice, planet | - |
| **11 Green product knowledge** | "*subjective knowledge that is the consumers' understanding of the environmental attributes and environmental impacts of green products"* (Wang et al., 2019, p. 2) | Knowledge | Product | |
| **12 Ecological worldview** | *"fundamental views about nature and humans' relationship to it"* focusing on " […] *beliefs about humanity's ability to upset the balance of nature, the existence of limits to growth for human societies, and humanity's right to rule over the rest of nature"* (Dunlap et al., 2000, p. 427) | Belief | Planet | New environmental paradigm (NEP) (Dunlap and Van Liere, 1978)<br>New Ecological Paradigm (Dunlap et al., 2000) |
| **13 Awareness of consequences** | *"key beliefs […] that a particular condition has harmful consequences for other people (or, in the extended version, for valued objects)"* (Stern et al., 1995, p. 1614) | Belief | Planet | - |
| **14 Ascription of responsibility** | "*key beliefs […] that the individual is responsible for those consequences in the sense that he or she can take action that would prevent them"* (Stern et al., 1995, p. 1614). | Belief | Personal practice | Perceived responsibility for environmental damage (Peloza et al., 2013) |
| **15 Climate change risk perception** | *"a function of cognitive factors (i.e., knowledge about climate change), experiential processing (i.e., affective evaluations and personal experience) and socio-cultural influences (including social norms and broad value orientations)"* (van der Linden, 2015, p. 117) | Belief | Planet | Climate change belief (Brick, Sherman, & Kim, 2017)<br>Concern about climate change (Tobler et al., 2012)<br>Climate concern (Alcock et al., 2017) |

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| | | | | Concern for climate change (Zhu et al., 2020) |
| **16a Environmental attitude** | *"a psychological tendency that is expressed by evaluating perceptions of or beliefs regarding the natural environment, including factors affecting its quality, with some degree of favour or disfavor"* (Milfont, 2007, p. 12). | Attitude<br>Items: beliefs, attitudes, behaviors | Planet<br>Items: personal practice, public, planet | - |
| **16b Environmental attitude** | "*the collection of beliefs, affect, and behavioural intentions a person holds regarding environmentally related activities or issues"* (Schultz et al., 2004, p. 31) | Beliefs, attitudes, intentions | Planet, personal practice | Pro-environmental attitude (Lavelle et al., 2015) |
| **17 Attitude towards green purchase** | Reference to definition of attitudes by (Eagly and Chaiken, 1993, p. 1): "*a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor*" | Attitude | Product | - |
| **18 Personal pro-environmental norms** | "*the belief that the individual and other social actors have an obligation to alleviate environmental problems*" (Stern et al., 1999, p. 91) | Norm | Planet, personal practice, without the exclusion of the product and public scope | Ecological citizenship (Seyfang, 2005)<br>Sustainability citizenship (Barry, 2005) |
| **19 Personal norms to act pro-environmentally** | *"personal feeling of obligation to act pro-environmentally"* (Bouman et al., 2020, p. 4). | Norm | Personal practice, without the exclusion of the product and public scope | - |
| **20 General pro-environmental intentions** | *"a more general intention to make efforts to protect the environment"* (Lalot et al., 2019, p. 83) | Intention | Personal practice | - |
| **21 Consciousness for sustainable consumption** | *"an intention to consume in a way that enhances the environmental, social and economic aspects of quality of life"* (Balderjahn et al., 2013, p. 182) | Intention<br>Items: beliefs, values | Product | - |
| **22 Green purchase intention** | *"the likelihood that a consumer would buy a particular product resulting from his or her environmental needs"* with (Chen and Chang, 2012, p. 507) referring to (Netemeyer et al., 2005) and (Morrison, 1979), | Intention | Product | Purchase intention for environmentally sustainable products (PI) (Kumar et al., 2017) |

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| **23 Ecological behavior** | *"actions which contribute towards environmental preservation and/or conservation."* (Axelrod and Lehman, 1993, p. 153)" as cited by Kaiser et al. (1999b, p. 1). | Behavior | Product, personal practice, planet | Pro-environmental behavior (Bamberg and Möser, 2007)<br>Conservation behavior (Kaiser and Wilson, 2004)<br>Environmentally-friendly behavior (Liobikiene and Juknys, 2016)<br>Environmentally responsible behavior (Thøgersen, 2004)<br>Environmental behavior (Steg and Vlek, 2009) |
| **24 Environmentalism** | *"defined behaviourally as the propensity to take actions with proenvironmental intent"* (Stern, 2000, p. 411). | Behavior | Product, personal practice, planet | Environmentally significant consumer behavior (Stern, 2000) (Gatersleben et al., 2002)<br>Non-activist support for the environmental movement (Stern et al., 1999) |
| **25 Sustainable consumption behavior** | *"individual **acts** of satisfying needs in different areas of life by acquiring, using and disposing goods and services that do not compromise the ecological and socio-economic conditions of all people (currently living or in the future) to satisfy their own needs"* (Geiger et al., 2018, p.5). | Behavior | Product, personal practice | Sustainable consumer behavior (Trudel, 2018) |
| **26 Environmentally responsible consumption** | *"any consumption-related behaviour, namely, acquisition, use, and disposal, undertaken in a manner such that it reduces the negative impact of consumption on the environment"* (Gupta and Agrawal, 2018, p. 525) | Behavior | Product, personal practice | - |

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| **27 Sustainable lifestyles** | *"patterns of action and consumption, used by people to affiliate and differentiate themselves from others, which: meet basic needs, provide a better quality of life, minimize the use of natural resources and emissions of waste and pollutants over the lifestyle, and do not jeopardize the needs of future generations"* (CSD, 2004, p. 48) | Behavior | Product, personal practice | Ecological lifestyles (Arnold et al., 2018)<br>Green lifestyles (Lorenzen, 2012)<br>Pro-environmental behaviors (Gatersleben et al., 2010)<br>Sustainable development lifestyle (Starcic et al., 2018) |
| **28 Ecologically conscious consumer behavior** | *"the ecologically conscious consumer can be defined as one who purchases (avoids) products and services which he or she perceives to have a positive (negative) impact on the environment"* (Roberts and Bacon, 1997, p. 84) | Behavior | Product<br>Items: product, personal practice | Green purchase behavior (Chan, 2001)<br>Responsible consumer behavior (Buerke et al., 2017)<br>Green product consumer choice behavior (Lin and Huang, 2012) |
| **29 Environmentally-motivated consumption reduction** | "*the extent to which consumers lower their consumption in certain domains with the explicit intent to protect the environment*" (Lasarov et al., 2019, p. 282) | Behavior | Product, personal practice | - |
| **30 Environmentally oriented anti-consumption** | "*acts directed against any form of consumption, with the specific aim of protecting the environment"* (García-de-Frutos et al., 2018, p. 413). | Behavior | Product, personal practice | - |
| **31Environmental actions** | "*intentional and conscious civic behaviors that are focused on systemic causes of environmental problems and the promotion of environmental sustainability through collective efforts"* (Alisat and Riemer, 2015, p. 14) | Behavior | Public | - |

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| **32 Environmental citizenship** | *"the engagement in political activities aimed at supporting environmental causes"* (Takahashi et al., 2017, p. 114). | Behavior | Public | Green citizenship (Dean, 2001) Environmental citizenship behavior (Song et al., 2019) Pro-environmental activist behavior (Schmitt et al., 2019) Environmental activism (Lee, Lee, Ma, & Cheung, 2019; Steg et al., 2011) |
| **33a Environmental concern** | *"the affect (i.e., worry) associated with beliefs about environmental problems"* (Schultz et al., 2004, p. 41) | Attitude, belief | Product, personal practice | - |
| **33b Environmental concern** | *"the degree to which people are aware of problems regarding the environment and support efforts to solve them and/or indicates a willingness to contribute personally to their solution"* (Dunlap and Jones, 2002, p. 485) | Beliefs, behaviors, attitudes | Planet, personal practice Items: planet, public, personal practice, product | - |
| **34 Environmental consciousness** | *"multi-dimensional construct, consisting of cognitive, attitudinal and behavioural components*" (Schlegelmilch et al., 1996, p. 41) | Knowledge, attitude behavior | Planet (knowledge), Public and planet (attitudes and norms) , product, personal practice, public (behavior) | Ecological concern (Bohlen et al., 1993) |

**Guiding framework for the choice of the construct of interest**

**Figure S1** Guiding framework for the selection of constructs (Part 1: concept types: values, identities, knowledge, beliefs, attitudes and norms)

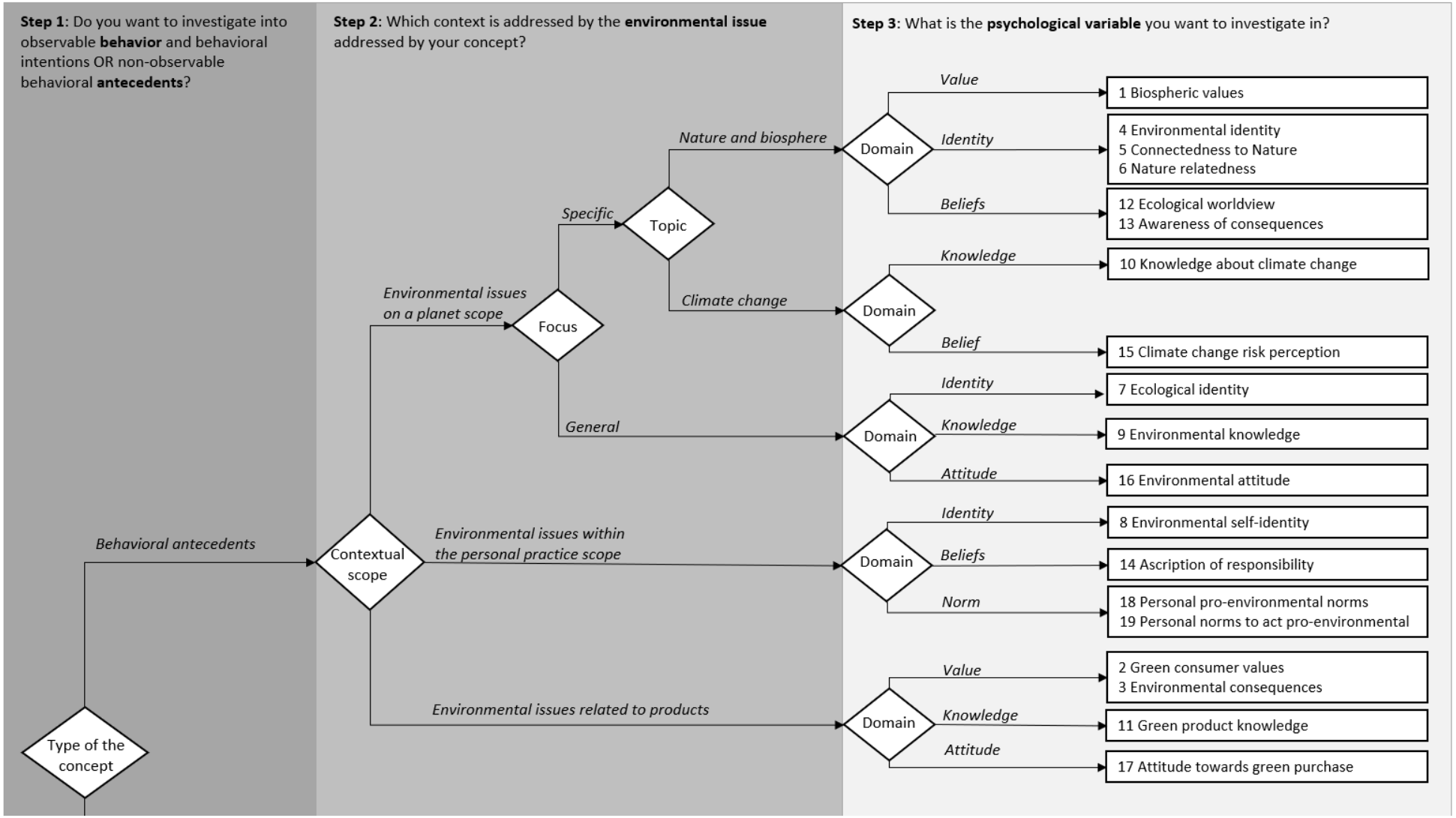
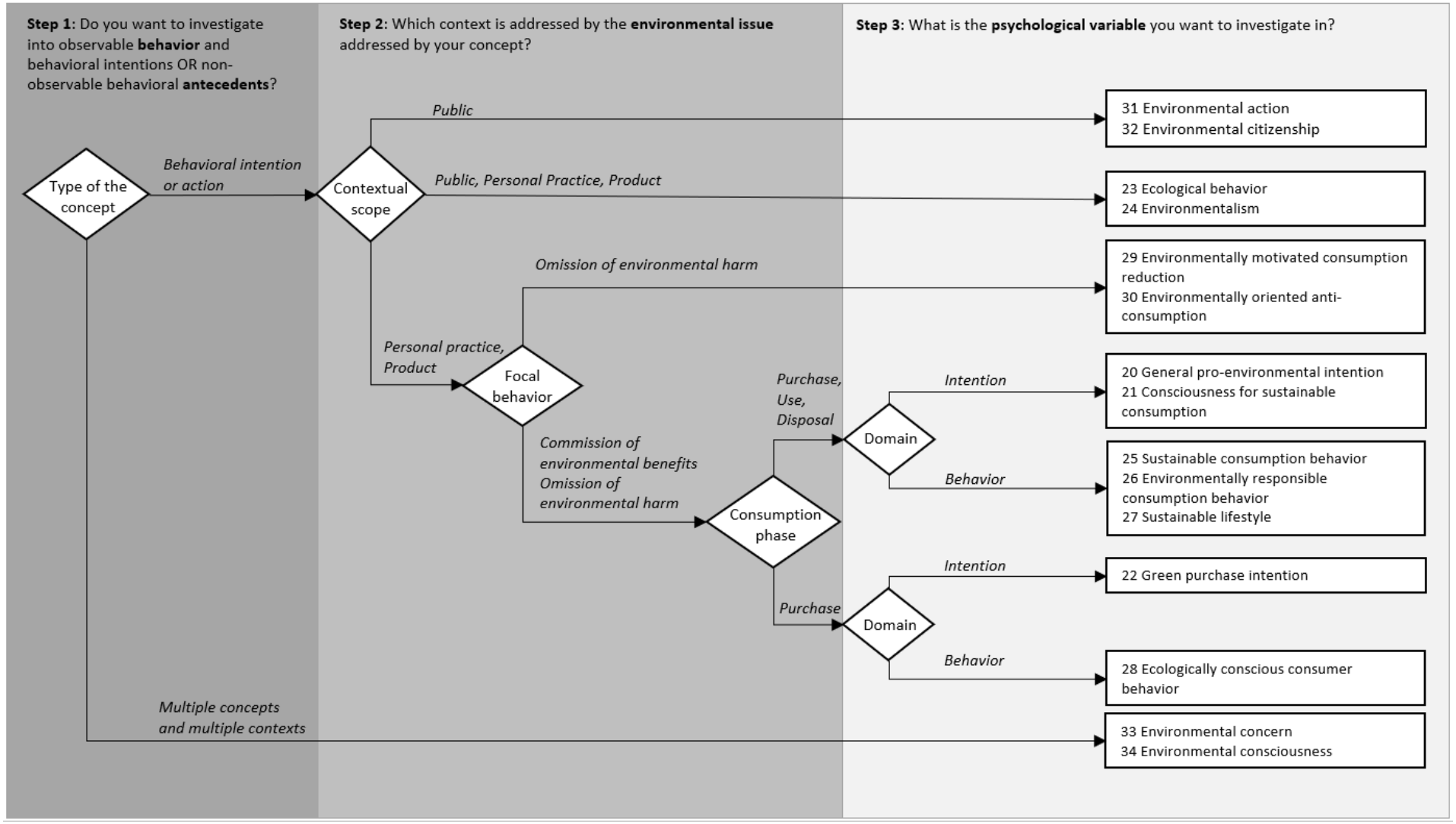


**Figure S2** Guiding framework for the selection of constructs (Part 2: concept types: intentions, behaviors, and concepts with multiple concept types)



**List of scales**

This list of tables is provided to facilitate the overview on a total of 76 scales and measures identified in the course of the review on constructs describing and assessing individual-level environmental sustainability. Due to the number of scales and relevant revisions, the list does not include each revision of a scale, but only the latest version or most frequently used version. The scales are listed according to the numbering of the relevant construct in the taxonomy. Scales that were additionally identified in the review but not mentioned in the main part of this paper are ordered chronologically.

**Table S2**

*List of scales identified for each focal construct*

| Construct | • Scales |
|---|---|
| **1 Biospheric values** | • Schwartz value survey - Biospheric values (Schwartz, 1992)<br>• Environmental portrait value survey – biospheric values (Bouman et al., 2018) |
| **2 Green consumer value** | • GREEN scale (Haws et al., 2014)<br>• Sustainability focused value orientation (Buerke et al., 2017) |
| **3 Environmental consequences** | • Environmental consequences measure (Ramayah et al., 2010) |
| **4 Environmental identity** | • Environmental identity scale (EID) (Clayton, 2003) |
| **5 Connectedness to nature** | • Emotional affinity towards nature scale (Müller and Kals, 2008)<br>• Connectedness to nature scale (CNS) (Mayer and Frantz, 2004)<br>• Inclusion for nature in self measure (INS) (Schultz, 2002)<br>• Disposition to connect with nature scale (Brügger et al., 2011) |
| **6 Nature relatedness** | • Nature relatedness scale (NR Scale) (Nisbet et al., 2009)<br>• Nature relatedness scale (NR6 Scale) (Nisbet and Zelenski, 2013) |
| **7 Ecological Identity** | • Ecological identity scale (Walton and Jones, 2017) |
| **8 Environmental self-identity** | • Pro-environmental self-identity measure (Whitmarsh and O'Neill, 2010) adapted from (Cook et al., 2002; Sparks and Shepherd, 1992), also used to assess environmentalist identity in an adapted version (Kashima et al., 2014) |

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| | • Environmental self-identity measure (Van Der Werff et al., 2013) |
| **9 Environmental knowledge** | • Environmental knowledge scale (Lo and Fryxell, 2003)<br>• Environmental knowledge scale (Frick et al., 2004)<br>• Environmental knowledge test (Geiger et al., 2019) |
| **10 Knowledge about climate change** | • Climate-related knowledge scale<br>• Knowledge about climate change (van der Linden, 2015) |
| **11 Green product knowledge** | • Environmental knowledge measure (Kumar et al., 2017b) adapted items from the research of (Ramayah et al., 2010)<br>• Green product knowledge measure (Wang et al., 2019) used items from the research of (Liobikiene et al., 2016)<br>• Green product information measure (Ritter et al., 2015) |
| **12 Ecological worldview** | • New ecological paradigm (NEP)revised scale (Dunlap et al., 2000) |
| **13 Awareness of consequences** | • General awareness of consequences (GAC) scale (Stern et al., 1995)<br>• Societal consumer instrumentally awareness (Buerke et al., 2017) |
| **14 Ascription of responsibility** | • Ascription of responsibility (AR) scale (Steg and Groot, 2010)<br>• Perceived consumer effectiveness (Kim and Choi, 2005; Lee et al., 2014)<br>• Ascription to responsibility to self-scale Adapted from previous research within the marketing literature (Peloza et al., 2013) by (Wu and Yang, 2018) |
| **15 Climate change risk perception** | • Risk perception index items (van der Linden, 2015)<br>• Concern about climate change scale (Tobler et al., 2012)<br>• Climate concern measure (Alcock et al., 2017)<br>• Climate change belief measure (Brick, Sherman, & Kim, 2017) |
| **16 Environmental attitude** | • Environmental attitude and knowledge scale (EAKS) (Maloney et al., 1975)<br>• Environmental attitude related scales (Kaiser et al., 1999a)<br>• Environmental attitudes inventory (EIA) (Milfont and Duckitt, 2010)<br>• Pro environmental attitude (Lavelle et al., 2015) |

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| **17 Attitude towards green purchase** | • Attitude towards green purchase (Chan, 2001) |
| **18 Personal pro-environmental norms** | • Personal pro-environmental norms measure (P. C. Stern et al., 1999) |
| **19 Personal norms to act pro-environmentally** | • Personal norms to act pro-environmentally measure (Steg et al., 2011)<br>• Personal norms measure I (Steg and Groot, 2010)<br>• Personal norms measure II (Van der Werff et al., 2013)<br>• Personal norms measure III (Verplanken and Roy, 2016) |
| **20 General pro-environmental intentions** | • General pro-environmental intention scale (Lalot et al., 2019) |
| **21 Consciousness for sustainable consumption** | • Consciousness for sustainable consumption (CSC) scale (Balderjahn et al., 2013) |
| **22 Green purchase intention** | • Green purchase intention measure (Chen and Chang, 2012)<br>• Purchase intention for environmentally sustainable products measure (Kumar et al., 2017) |
| **23 Ecological behavior** | • General ecological behavior scale (GEB) (Kaiser, 1998), most recent version of GEB applied by (Arnold et al., 2018)<br>• General responsible environmental behavior measure (Cottrell, 2003)<br>• Environmentally relevant behaviors measure (Thøgersen, 2004)<br>• Environmental behaviors measure (Kilbourne and Pickett, 2008)<br>• Pro-environmental behavior scale based on (DEFRA, 2008) adapted by (Whitmarsh and O'Neill, 2010)<br>• Pro-environmental behavior scale (Markle, 2013)<br>• Three types of pro-environmental behavior measure (Lee et al., 2014)<br>• Recurring pro-environmental behavior scale (REBS) (Brick, Sherman, & Kim, 2017) |
| **24 Environmentalism** | • Environmentalism scale (Stern, 2000)<br>• Types of pro-environmental behaviors measure (Larson et al., 2015) |
| **25 Sustainable consumption behavior** | • Sustainable consumption behavior measure I (Wang et al., 2014)<br>• Sustainable consumption behavior measure II (Watkins et al., 2016) |

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| | • Young consumers' sustainable consumption behaviors (YCSCB) scale in the areas of food and clothing (Fischer et al., 2017) |
| **26 Environmentally responsible consumption** | • Environmentally responsible consumption scale (Gupta and Agrawal, 2018) |
| **27 Sustainable lifestyles** | • Sustainable lifestyles measure (Barr and Gilg, 2006)<br>• Pro-environmental behaviors measure (Gatersleben et al., 2010)<br>• Sustainable development lifestyle measure (Starcic et al., 2018) |
| **28 Ecologically conscious consumer behavior** | • Ecologically conscious consumer behavior (ECCB) scale (Roberts and Bacon, 1997)<br>• Green product consumer choice scale (Lin and Huang, 2012)<br>• Responsible consumer behaviour scale (Buerke et al., 2017) |
| **29 Environmentally-motivated consumption reduction** | • Environmentally motivated consumption reduction scale (Egea and de Frutos, 2013) |
| **30 Environmentally oriented anti-consumption** | • EOA has not yet been operationalized. Ortega Egea & García de Frutos (2020) use behavioral measures from the five Eurobarometer studies on climate change (i.e., Eurobarometers 77.1, 75.4, 80.3, 83.4, and 87.1; see GESIS - Leibniz Institute for the Social Sciences, 2020) to approximate EOA ). |
| **31Environmental actions** | • Environmental action scale (Alisat and Riemer, 2015) |
| **32 Environmental citizenship** | • Environmental citizenship measure (Takahashi et al., 2017) |
| **33 Environmental concern** | • Environmental concern measure I (Weigel and Weigel, 1978)<br>• Environmental concern measure II (Schultz, 2001)<br>• Environmental concern measure III (Bamberg, 2003) based on (Preisendörfer, 1996)<br>• Environmental concern measure IV (Kilbourne and Pickett, 2008)<br>• Environmental concern measure V (Mohd Suki, 2016) based on (Tarrant and Cordell, 1997) |
| **34 Environmental consciousness** | • Environmental consciousness scale (Diamantopoulos et al., 2003)<br>• Ecological consciousness measure (Tilikidou et al., 2002) |

**Guidance for researchers dedicated to enhancing conceptual rigor and measurement quality in the field – Examples for relevant constructs**

| **Lack of discriminant validity among concepts** |
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| Our review revealed a total of 38 synonymous concepts (Table S1) and 16 constructs (Construct number: 5-8, 18, 19, 25-32 in Table S1) with partially overlapping domains and facets. In particular, identity, normative, and behavioral concepts are subject to the latter. This often results from the parallel introduction of similar conceptual ideas in different literature streams and render it difficult to grasp the current knowledge across the literature. This can followingly yield a scattered knowledge base (MacKenzie, 2003; Mochon and Schwartz, 2020), which is disadvantageous for advancing knowledge appropriately. |
| **Conceptually distinct concepts carrying identical names** |
| Our review revealed concepts carrying identical names but capturing distinct conceptual ideas (i.e., connectedness to nature, environmental attitudes, and environmental concern). For these concepts the literature offers multiple conceptualizations that considerably differ in their respective understanding of the focal concept. In some cases, such conceptual divides are explicitly discussed in the literature and justified by different conceptual perspectives among authors (for example, conceptualizing connectedness to nature as either an identity (Mayer and Frantz, 2004) or an attitude (Brügger et al., 2011). In other cases, such differences are neither explicitly addressed or theoretically delineated (for example, conceptualizing environmental concern as an exclusively attitudinal construct (Schultz et al., 2004) or as a multi-conceptual construct (Dunlap and Jones, 2002)), but rather seem to result from neglect to adequately account for related concepts when introducing additional concepts. While explicit disagreement on the conceptual core of concepts is legitimate, unintentional reasons for inconsistent conceptualizations should be avoided. In both cases, researchers using these concepts in their research should aim to have a clear understanding of the concept type of a construct at hand, as this is the basis for interpreting substantive research findings (MacKenzie, 2003). |
| **Inconsistent operationalization** |
| Our review identified a total of 10 constructs (Construct number: 2, 4-8, 9, 11, 21, 28, 29 in Table S1) subject to a considerable divide between their conceptual domain on the one hand and their operationalization on the other. In other words, the measurement items do not (fully) correspond to the concept core defined in the conceptual definition. Instead, the items tap other or additional facets not reflected in the underlying concept description (illustrative examples include green consumption values (Haws et al., 2014) and ECCB (Roberts and Bacon, 1997)). Such divides are critical because measures that fail to essentially cover the conceptual domains are likely to cause misinterpretation of substantive findings (DeVellis, 2016; Mochon and Schwartz, 2020). |

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