

Review

Measuring pro-environmental behavioural determinants using closed-answer surveys

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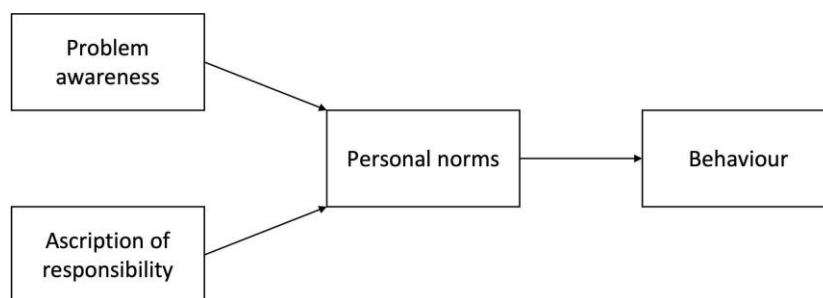
Supplementary Material 1

The data are available in a comma separated values file at doi.org/10.1017/S0030605324001194.

Supplementary Material 2

Determinants were assessed in the content of a number of theories/models. Norm Activation Model (Schwartz, 1975), Theory of Planned Behaviour (Ajzen, 1991), and the Value Belief Norm Theory (Stern et al., 1999) were the most common. More specific, or less well-known, theories/models were also employed, such as the Theory of Green Purchase Behaviour (Han, 2020), the Comprehensive Action Determination Model (Joanes et al., 2020), the Biophilia Hypothesis (Lumber et al., 2017), the Theory of Interpersonal Behaviour (Issock et al., 2020), the Model of Environmentally Responsible Behaviour (Pan et al., 2018), the Habit Discontinuity Hypothesis (Verplanken & Roy, 2016), the Theory of Normative Social Behaviour (Borg et al., 2020), and the Moral Foundation Theory (Jansson & Dorrepaal, 2015). See Table 1 below for more details and Supplementary Material 1 for the full data where any such employed models/theories are noted for each measurement of a determinant.

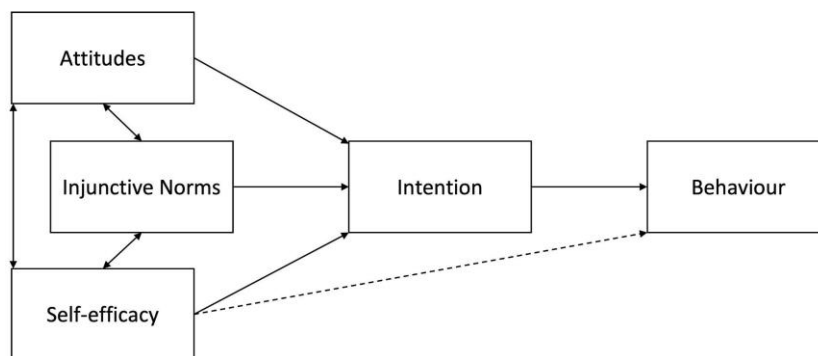
Norm activation model: Discussed in (Schwartz, 1975), this theory contains three determinants leading to behaviour (Supplementary Material 2 Figure 1). These include: problem awareness (i.e., awareness of consequences), ascription of responsibility, and personal norms.



Supplementary Material 2 Figure 1. Norm activation model based on Schwartz (1975).

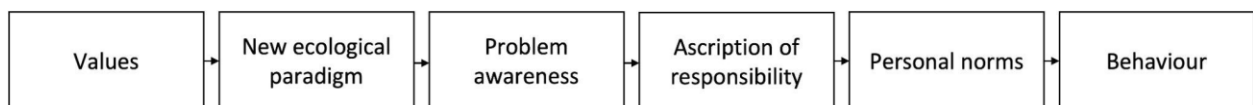
Theory of planned behaviour: Discussed in (Ajzen, 1991), this theory contains four determinants leading to behaviour (Supplementary Material 2 Figure 2). These include: attitudes, injunctive norms

(i.e., subjective norms), self-efficacy (i.e., perceived behavioural control), and behavioural intent (it is not one of the determinants we assessed).



Supplementary Material 2 Figure 2. Theory of planned behaviour based on Ajzen (1991).

Value belief norm theory: Discussed in (Stern et al., 1999), this theory contains five determinants leading to behaviour (Supplementary Material 2 Figure 3). These include: values; The New Ecological Paradigm (i.e., a multi-question, self-contained, validated scale, arguably covering multiple determinants) that assesses ‘pro-ecological world view’ (Stern et al., 1995)); problem awareness (i.e., awareness of consequences); ascription of responsibility; and personal norms.



Supplementary Material 2 Figure 3. Value belief norm theory based on Stern et al. (1999).

Supplementary Material 2 Table 1. Definitions of determinants of pro-environmental behaviour identified by van Valkengoed et al, (2022) and their inclusion in behavioural models/theories.

Ascription of responsibility: Ascription of responsibility is often assessed in the context of the norm activation model (Schwartz, 1975) and the value belief norm theory (Stern et al., 1999; van Valkengoed et al., 2022). We also identified papers that measured ascription of responsibility in the context of theories such as the theory of green purchase behaviour (Han, 2020), the comprehensive action determination model (Joanes et al., 2020), and the theory of planned behaviour (Heidari et al., 2020). It should be noted that across behavioural determinants and pro-environmental behaviour, the theory of planned behaviour (or related versions) and the norm activation model were often employed together (Liu et al., 2017).

Attitudes: Attitudes are often assessed in the context of the theory of planned behaviour and related theories (Ajzen, 1991; van Valkengoed et al., 2022). We also identified papers that measured attitudes in the context of theories such as the comprehensive action determination model (Joanes et al., 2020), the value belief norm theory (S. Wang et al., 2020), and the new model of green consumer behaviour (Paço et al., 2019).

Connection to nature: In our review, connection to nature was assessed in the context of theories such as the sustainable consumption behaviour theory (Wang et al., 2014) and the biophilia hypothesis (Lumber et al., 2017).

Descriptive norms: Descriptive norms are often assessed in the context of the focus theory of normative conduct (van Valkengoed et al., 2022). We also identified papers that measured descriptive norms in the context of theories such as the norm activation model and theory of planned behaviour (Onwezen et al., 2013), theory of interpersonal behaviour (Issock et al., 2020), and the model of goal directed behaviour (Passafaro et al., 2014).

Environmental concern: Environmental concern is often assessed in context of the protection motivation theory (van Valkengoed et al., 2022). We also identified papers that measured environmental concern in the context of theories such as the norm activation model (Confente & Scarpi, 2021), the extended theory of planned behaviour (Chen & Tung, 2014), and the model of environmentally responsible behaviour (Pan et al., 2018).

Environmental self-identity: Environmental self-identity is often assessed in the context of the value identity personal norm model (van Valkengoed et al., 2022). We also identified papers that measured environmental self-identity in the context of theories such as the theory of reasoned action (Shang & Wu, 2022), and the norm activation model and value belief norm theory (Perera et al., 2022).

Habits: In our review it was assessed in the context of theories such as the habit discontinuity hypothesis (Verplanken & Roy, 2016), the theory of planned behaviour, the theory of interpersonal behaviour, and the comprehensive model of environmental behaviour (Russell et al., 2017).

Injunctive norms: Injunctive norms are often assessed in the context of theories such as the theory of planned behaviour and the focus theory of normative conduct (van Valkengoed et al., 2022). We also identified papers that measured injunctive norms in the context of the theory of normative social behaviour (Borg et al., 2020), the moral foundation theory (Jansson & Dorrepaal, 2015), and the value social norm enjoyment-based motivation model (Ahn et al., 2020).

Knowledge: Knowledge is often assessed in the context of theories such as the knowledge deficit model (van Valkengoed et al., 2022). We also identified papers that measured knowledge in the context of the theory of planned behaviour (Mohd Suki & Mohd Suki, 2015), the ability, motivation, and opportunity theory (Fawehinmi et al., 2020), and the value belief norm theory (L. Wang et al., 2020).

Outcome efficacy: Outcome efficacy is often assessed in the context of theories such as the norm activation model, the value belief norm theory, and the protection motivation theory (van Valkengoed et al., 2022). We also identified papers that measured outcome efficacy in the context of the comprehensive action determination model (Joanes et al., 2020) and the extended model of planned behaviour (Kang et al., 2013).

Personal norms: Personal norms are often assessed in the context of theories such as the norm activation model, the value belief norm theory, and the value identity personal norm model (van Valkengoed et al., 2022). We also identified papers that measured personal norms in the context of theories such as the theory of planned behaviour (Si et al., 2020), the moral foundations theory (Jansson & Dorrepaal, 2015), the theory of interpersonal behaviour and the focus theory of normative conduct (Issock et al., 2020).

Problem awareness: Problem awareness is often assessed in the context of theories such as the norm activation model and the value belief norm theory (van Valkengoed et al., 2022). We also identified papers that measured problem awareness in the context of the theory of planned behaviour (Si et al., 2020), the theory of green purchase behaviour (Han, 2020), and the comprehensive action determination model (Joanes et al., 2020).

Risk perception: Risk perception is often assessed in the context of the protection motivation theory (van Valkengoed et al., 2022). We also identified papers that measured risk perception in the context of

theories such as the theory of planned behaviour (Zhu et al., 2020), the cognitive theory of stress model (Chen, 2015), and the value belief norm theory (Liobikiene & Juknys, 2016).

Self-efficacy: Self-efficacy is often assessed in the context of the theory of planned behaviour and the protection motivation theory (van Valkengoed et al., 2022). We also identified papers that measured self-efficacy in the context of theories such as the norm activation model (Ataei et al., 2022), the value belief norm theory (Wynveen & Sutton, 2015), and the model of private proactive adaptation to climate change (Burnham & Ma, 2017).

Self-focused emotions: Self-focused emotions are often assessed in the context of the norm activation model and the value belief norm theory (van Valkengoed et al., 2022). We also identified papers that measured self-focused emotions in the context of theories such as the cognitive theory of stress model (Chen, 2015), the theory of interpersonal behaviour (Issock et al., 2020), and the theory of planned behaviour (Nguyen et al., 2018).

Trust: In our review trust was assessed in the context of theories such as the value belief norm theory (Arbuckle et al., 2015), theory of planned behaviour (Sultan et al., 2020), the rational choice theory, and the subjective expected utility theory (Wheeler et al., 2019).

Values: In our review values were assessed in the context of theories such as the value belief norm theory (Çakır Yıldırım & Karaarslan Semiz, 2019), the theory of reasoned action (Khare, 2015), the new model of green consumer behaviour (Paço et al., 2019), and the value social norm enjoyment-based motivation model (Ahn et al., 2020).

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Supplementary Material 3

Using measures collated through the literature review and using the ‘key considerations’ summarised in the Summary and Application section of the paper, a list of suggested measurement approaches for pro-environmental behaviour and each of the 17 determinants has been compiled (Supplementary Material 3 Table 1). These recommendations are based on what format was found most commonly employed *and* validated by authors, but should not be considered as the ‘only’ or ‘best’ measures for use. Surveyors should employ the question-development tactics discussed in the Literature Review Findings section, taking into consideration the target audience, as well as the survey and data requirements.

Supplementary Material 3 Table 1. Summary of suggested measurement of pro-environmental behaviour and determinants

Behavioural Determinant	Common Question Format
Pro-environmental Behaviour	Varies across multi-choice, binary, and scale questions. Ideally, look for a relevant previously validated scale before designing your own, such as Brick et al. (2017), or the General Ecological Behavior (GEB) measure (Kaiser, 2006), or (Markle, 2013) for 42 different multi-item measures.
Ascription of responsibility	Generally a 7-point scale with multiple statements, averaged to create a composite variable if internal correlation is sufficient. Ideally, look for a relevant previously validated scale before designing your own, such as (De Groot & Steg, 2009).
Attitudes	Generally a 7-point semantic scale with multiple statements, averaged to create a composite variable if internal correlation is sufficient. Ideally, look for a relevant previously validated scale before designing your own, such as (Milfont & Duckitt, 2010).
Connection to nature	Generally a 7-point scale with multiple statements such as the Nature Relatedness scale (Lumber et al. 2017), or use the inclusion of Nature in Self (INS) scale (Schultz, 2002).
Descriptive norms	Generally a 7-point scale with multiple statements, varying the referent (e.g., people like me, friends, colleagues). Consider the relevance of local vs global norms, and dynamic or prospective norms.
Environmental concern	Generally a 7-point scale with multiple statements, averaged to create a composite variable if internal correlation is sufficient. Ideally, look for a relevant previously validated scale before designing your own, such as (Dietz et al., 1998) or (Kim & Choi, 2005).
Environmental self-identity	Generally a 7-point scale with multiple statements, averaged to create a composite variable if internal correlation is sufficient. Ideally, look for a relevant previously validated scale before designing your own, such as (Whitmarsh & O’Neill, 2010).
Habits	Generally a 7-point scale with multiple statements, averaged to create a composite variable if internal correlation is sufficient. Ideally, look for a relevant previously validated scale before designing your own, such as the SelfReport Habit Index (SRHI) (Verplanken & Orbell, 2003).
Injunctive norms	Generally a 7-point scale with multiple statements, averaged to create a composite variable if internal correlation is sufficient. Ideally, look for a relevant previously validated scale before designing your own, such as Ajzen’s validated Theory of Planned Behavior scale (Ajzen, 1991).
Knowledge	Generally either multiple-choice questions to assess <i>actual</i> knowledge, or a 7-point scale with multiple statements to assess <i>perceived</i> knowledge.
Outcome efficacy	Generally a 7-point scale with multiple statements, averaged to create a composite variable if internal correlation is sufficient. Ideally, look for a relevant previously validated scale before designing your own - see (Roser-Renouf & Nisbet, 2008) for a review of measures.
Personal norms	Generally a 7-point scale with multiple statements, averaged to create a composite variable if internal correlation is sufficient. Ideally, look for a relevant previously validated scale before designing your own, such as (Schwartz, 1975; Abrahamse et al., 2005; Dolnicar & Leisch, 2008).

Problem awareness	Generally a 7-point scale with multiple statements, averaged to create a composite variable if internal correlation is sufficient. Ideally, look for a relevant previously validated scale before designing your own, such as (De Groot & Steg, 2009; Onwezen et al., 2013).
Risk perception	Generally a 7-point scale with multiple statements, averaged to create a composite variable if internal correlation is sufficient. Ideally, look for a relevant previously validated scale before designing your own, such as the Climate Change Risk Perception Index (Leiserowitz, 2006). Consider the referent - e.g. me, people like me, my city.
Self-efficacy	Generally a 7-point scale with multiple statements, averaged to create a composite variable if internal correlation is sufficient. Ideally, look for a relevant previously validated scale before designing your own – see (Roser-Renouf & Nisbet, 2008) for a review of measures.
Self-focused emotions	Generally a 7-point scale with multiple statements. Ideally, look for a relevant previously validated scale before designing your own, such as (Kugler & Jones, 1992) guilt inventory or Tracy and Robins' (2007) authentic pride scale.
Trust	Generally a 7-point scale with multiple statements. Ideally, look for a relevant previously validated scale before designing your own. Consider the relevance of social vs institutional trust to the subject matter.
Values	Generally a 7-point scale with multiple statements, averaged to create a composite variable if internal correlation is sufficient. Ideally, look for a relevant previously validated scale before designing your own, such as (Schwartz, 1992; Steg & de Groot, 2012; Steg et al., 2014).

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