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**A Comprehensive Model of the Psychology of Environmental Behaviour – a Meta-
Analysis**

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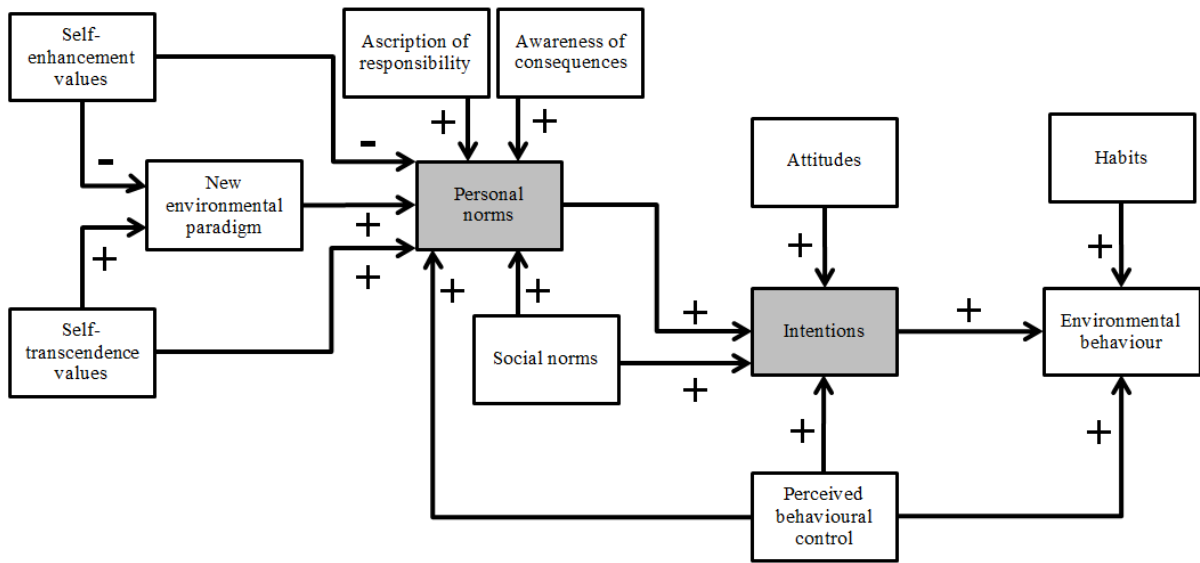
A Comprehensive Model of the Psychology of Environmental Behaviour – a Meta-Analysis

Abstract

To address global environmental challenges it is crucial to understand how humans make decisions about environmentally relevant behaviour, since a shift to alternative behaviours can make a relevant difference. This paper proposes a comprehensive model of determinants of individual environmentally relevant behaviour based on a combination of the most common theories in environmental psychology. The model is tested using a meta-analytical structural equation modelling approach based on a pool of 56 different data sets with a variety of target behaviours. The model is supported by the data. Intentions to act, perceived behavioural control and habits were identified as direct predictors of behaviour. Intentions are predicted by attitudes, personal and social norms, and perceived behavioural control. Personal norms are predicted by social norms, perceived behavioural control, awareness of consequences, ascription of responsibility, an ecological world view and self-transcendence values. Self-enhancement values have a negative impact on personal norms. Based on the model, interventions to change behaviour need not only to include attitude campaigns but also a focus on de-habitualizing behaviour, strengthening the social support and increasing self-efficacy by concrete information about how to act. Value based interventions have only an indirect effect.

Keywords: Meta-analysis, meta-analytic structural equation model (MASEM), environmental psychology, theory of planned behaviour, norm-activation-theory, value-belief-norm-theory

Graphical abstract



Research highlights

- The most common environmental psychological action-theories can be combined.
- Intentions, habits and perceived control are direct predictors of behaviour.
- Personal norms add to explained variation in intentions.
- Personal norms have a mediated influence on behaviour.
- The linear norm-activation chain from value-belief-norm theory is not supported.

A Comprehensive Model of the Psychology of Environmental Behaviour – a Meta-Analysis

1. Introduction

Humankind is facing a number of global environmental challenges, such as climate change, resource depletion, or biodiversity loss. To counter these challenges both international and interdisciplinary efforts have to be made. Undertakings such as trying to understand the key drivers and processes behind behaviour causing these challenges, predicting their development over time and eventually changing the system enough to mitigate negative outcomes are essential. Notwithstanding the important role of technological development and international and national policy making, the contribution of individual behaviour should not be underestimated. Hertwich (2005) argues that household behaviour is the strongest contributor to total energy use and carbon dioxide emissions in most developed countries, when direct energy consumption and indirect energy consumption embedded in consumed goods and services are taken into account. In an analysis of the carbon footprint of 73 nations Hertwich and Peters (2009) conclude that 72% of all carbon dioxide emissions worldwide are connected to household consumption with food, shelter and mobility as the most important subcategories. Tucker and Jansen (2006) confirm this conclusion and calculate that approximately 70% of all life-cycle impacts of products and services consumed by households fall into the categories of food, housing and transport.

Although individuals in households have varying degrees of freedom, Jungbluth, Tietje and Scholz (2000) argue that they can have an important impact by changing their behaviour, in particular their food choices. The degree to which individual behavioural change can reduce the environmental impact depends on several aspects (Dietz, Gardner, Gilligan, Stern & Vandenberg, 2009): (a) the impact the behaviour has, (b) the number of people who perform

the behaviour, and (c) the percentage of those people who are willing or able to change the behaviour, referred to as 'plasticity'. Dietz et al. (2009) estimated the potential impact of changing a list of behaviours on reducing carbon dioxide emissions in the US and came to the conclusion that the implementation of 17 relatively simple changes in behaviour would reduce the household related carbon dioxide emissions by approximately 20%, taking into account plasticities of behaviours. Dietz et al. (2009) argue that implementing such changes would not reduce well-being considerably. It therefore becomes crucial to acknowledge and accept that individual behaviour both significantly contributes to global environmental challenges and that individual behavioural change has the potential to reduce this impact significantly.

Identifying the determinants of human environmental behaviour is pivotal. If we would like to change people's behaviour we need to understand what determines their actions and decisions. What makes some people use a bike while others use a car? What makes some people invest in insulating their house while others do not? What makes some people eat beef and others become vegetarians?

Since the 1980s environmental psychology has made an important contribution to this debate by proposing and testing theories and models that aim to predict environmentally relevant behaviour and to identify entry points for interventions to change the respective behaviour.

Jackson (2005) gives a very comprehensive summary of the models and approaches that environmental psychology has developed. However, different model schools developed in environmental psychology, which lead to a diversity of proposed models and a large variety of variables that are considered to have an impact on environmentally relevant behaviour.

Both from a theoretical and a practical perspective it would be helpful to reduce the complexity of environmental psychological theory by integrating the most successful theories into a general theory which additionally includes assumptions about how the variables of the different models relate to each other across different model traditions. So far it is not entirely

clear which of the model variables are central integrating variables, or which of those that are direct determinants of behaviour or those that have a mediated influence. Integrating the major models and theories into a comprehensive model that in turn could be used as a framework for identifying potentially relevant variables across behaviours and cultures is promising. It could potentially increase the impact that environmental psychology would have in the debate about mitigation of environmental problems. This is achievable by pointing out the variables that should be primary targets for interventions and additionally by elucidating which of the more distal variables may be used for achieving a change in variables proximal to behaviour. It would assist in identifying the key determinants of behaviour and indicating the barriers to behaviour change. However, this would require that such a model is sufficiently structurally robust to perform well, not only for specific behaviours of specific groups of people but also on a general level. Therefore, this paper proposes a comprehensive action determination model (CADM) of environmental behaviour and tests the model in a meta-analytical structural equation modelling approach (Viswesvaran & Ones, 1995) across a large variety of environmentally relevant behaviours.

2. Theoretical background

A literature study by Sopha (2011) that analysed the theoretical foundation of the analyses of household related energy behaviour in a very broad sense (including behaviour related to indirect energy consumption) identified the *Theory of Planned Behaviour* (TPB, Ajzen, 1991), the *Norm-Activation-Theory* (NAT, Schwartz & Howard, 1981), and the *Value-Belief-Norm-Theory* (VBN, Stern, 2000) as the most commonly used theories in the environmental psychological domain. NAT and VBN are closely related, with the latter building on the main assumptions of the first and extending it. 39% of all studies used the TPB as theoretical framework, 15% the NAT, 15% the VBN and 13% combined variables from at least two of

the theories, which means that more than four out of five papers found in that literature study used at least one of the three theories as a framework. Given the general support the theories receive in the literature, it seems reasonable to start an integrating approach with these precedent theories before identifying which additional constructs potentially need to be included. In the following sections the theories are first introduced separately before a point is made for introducing habits into action theories. Finally, an integrated model is proposed based on the variables and their relations as suggested by the theories.

2.1. The theory of planned behaviour

The TPB was proposed by Ajzen in the early 1990's as a general model of deliberate behaviour (Ajzen, 1991). *Figure 1* displays the predicting variables and their relations with each other as well as to behaviour. The central assumption is that behaviour is directly determined by the intention to perform this behaviour, which is the will to make an effort to demonstrate the behaviour in question. This intention in turn is determined by the attitude towards the behaviour, the subjective norms connected to the behaviour, and perceived behavioural control (Ajzen, 1991). Attitudes are the sum of all behavioural beliefs about a behaviour activated in a given situation. A belief is the expectation that showing a behaviour would result in a certain outcome, the likelihood that that happens and the evaluation to which degree such an outcome would be favourable. Attitudes are therefore a general measure of the favourability a behavioural alternative has for an individual. Subjective norms are the perceived expectations of relevant other people which behavioural alternative should be performed (in other words the social pressure) times the willingness to comply with that expectation. Finally, perceived behavioural control is a measure that captures to which degree people have the opportunity and ability to perform a certain behavioural alternative.

According to the TPB, people perform a behaviour with positive environmental outcomes if

they hold a positive attitude to them, if other people expect them to act in that way and support them in doing so, and if they perceive themselves as being able to implement their intentions. It is important to recognize that all three constructs are subjective representations, which means that the perceived control is not necessarily identical to the objective or actual control people have or that the subjective norm does not necessarily reflect what other people really expect. Perceived behavioural control can under certain conditions have an additional direct impact on behaviour, for example when conditions change, before the behaviour is performed. The TPB has been applied to environmental behaviour several times and its proposed structure has been supported by past analyses (e.g., Han, Hsu & Sheu, 2010; Heath & Gifford, 2002; Harland, Staats & Wilke, 1999; Tonglet, Phillips & Read, 2004). Although the theory of planned behaviour often receives strong empirical support, it has been criticised for underrepresenting the impact of morality on environmental behaviour and for its lack of prediction of repeated behaviour (e.g. in Klöckner & Blöbaum, 2010).

- Insert Figure 1 about here -

2.2. The norm-activation-theory

In contrast to the TPB which is essentially a general behaviour theory the NAT has initially been developed specifically for one type of behaviour, namely altruism and helping behaviour. Several interpretations of the NAT are used in environmental psychological research (see Klöckner, 2013, for a presentation and discussion of the three most common). The version presented here already integrates some variables from the TPB. It is built on Schwartz and Howard (1981) who were interested in finding factors that predict conditions under which people are willing to help other people. The basic assumption of their theory is that people help other people if they feel morally obliged to in a given situation, a status

which Schwartz and Howard (1981) refer to as an activated personal norm. This personal norm, which is the reflection of the personal value system in a given situation, has to be activated before becoming relevant as a determinant of behaviour. To activate a norm, four conditions have to be fulfilled: (1) a person needs to be aware of the need for help, a construct referred to as awareness of need, (2) a person needs to be aware of the consequences a certain behaviour would have for the person in need, which is called awareness of consequences in the theory, (3) a person needs to accept responsibility for his or her actions, which is referred to as ascription of responsibility, and (4) a person has to perceive him- or herself as capable of performing the helping action, which is a construct comparable to perceived behavioural control. Empirically speaking, awareness of need and awareness of consequences often blend together, which has led to several researchers either using awareness of need or awareness of consequences in their studies. The formal structure of the NAT has not been elaborated by Schwartz and Howard (1981), a fact that consequently resulted in considerable variations of applications of the NAT (see Klöckner, 2013). *Figure 2* summarizes the adaptation of the NAT as applied in this paper.

- Insert Figure 2 about here -

Given that the NAT had been developed to explain altruistic behaviour its application to environmentally relevant behaviour is not self-evident. However, Thøgersen (1996) argued that environmental behaviour belongs to the moral domain, which means that it is not solely determined by cost-benefit-calculations as described in the TPB but by moral beliefs about what is right and wrong to do. This link makes the NAT a valuable theory to analyse such a relation. Following Thøgersen many researchers have applied the NAT to explain environmentally significant behaviour with promising results, showing that pro-environmental

behaviour in fact is influenced by NAT variables (e.g., Harland, Staats & Wilke, 2007; Hunecke, Blöbaum, Matthies & Höger, 2001). In contrast to the TPB the NAT focuses strongly on moral drivers of pro-environmental behaviour, ignoring non-moral motivations which would be captured by the TPB. Furthermore, similar to the TPB it has problems explaining repetitive behaviour.

2.3. The value-belief-norm-theory

Stern's value-belief-norm-theory (2000) is an attempt to link assumptions of the NAT to findings about the relation between general values, environmental beliefs and behaviour. It is thereby also an integrative theory in itself. It assumes that the behaviour is determined directly by personal norms, which is based on the NAT. Attributing to the NAT Stern additionally assumes that these personal norms have to be activated by ascription of responsibility and awareness of consequences. However, he ranks them into a causal chain where awareness of consequences is a necessary prerequisite of ascription of responsibility. Awareness of consequences is according to the VBN related to a general ecological worldview, which is measured by the New Environmental Paradigm (Dunlap, van Liere, Mertig & Jones, 2000). This ecological worldview consists of accepting general beliefs that human activity endangers the natural equilibrium, that resources are limited, and that humans are not allowed to dominate nature. Although the new environmental paradigm (NEP) is often used as a measure for general environmental attitudes, its function in the VBN theory is not that of an attitude but rather that of a link between value orientations and personal norms, an understanding that the author of this study follows. The ecological worldview is related to relatively stable general value orientations such as biospheric values, altruistic values, egoistic values or self-transcendence and self-enhancement values. While biospheric, altruistic and self-transcendence values make it more likely to hold an ecological worldview, egoistic and self-

enhancement values are negatively related. Self-transcendence and self-enhancement are two higher order value orientations in Schwartz' universal value system (Schwartz, 1994). Self-transcendence is the overarching value orientation for values such as universalism and benevolence while self-enhancement on the other hand is the overarching value orientation for valuing power, achievement and hedonism. Self-transcendence, in particular, means accepting others as equals and being concerned for their welfare and includes being concerned for the environment, should be positively related to pro-environmental behaviour and a new environmental worldview as expressed in the NEP. Stern (2000) and Stern and Dietz (1994) argue for that self-transcendence values contain two dimensions that may be relevant for environmental action: altruistic values, defined as being concerned about the welfare for other humans, and biospheric values, defined as being concerned about nature and the biosphere itself. In other words, while people holding altruistic values will protect nature because it benefits other humans, people holding biospheric values will protect nature because it is valuable in itself even without serving humans. Stern and Dietz (1994) therefore differentiate between biospheric, altruistic and egoistic values (the latter being similar to self-enhancement values). Figure 3 displays an adapted version of the value-belief-norm-theory. The version depicted here assumes a strictly linear chain of the variables. A less rigid version of the theory would assume that each variable at a later stage in the model is predicted by all variables at its earlier stages. However, the structure of this less rigid version of the VBN is not empirically falsifiable because the model would be saturated (all variables would be related to all other variables). The VBN theory has been applied in the environmental domain and received empirical support (e.g., de Groot & Steg, 2007; Poortinga, Steg & Vlek, 2004; Hansla, Gamble, Juliusson & Gärling, 2008). Its strong focus on personal norms as the integrative variable contributes to the same problems as with the NAT.

- Insert Figure 3 about here -

2.4. Habits

Typically the TPB and the NAT / VBN tradition perform notoriously poorly for repeated behaviours. Already in the 1980s Triandis questioned the assumption that intentions to perform a behaviour do predict all types of behaviour equally well. He argued that for behaviours repeated often enough the influence of intentions becomes weaker and weaker, while at the same time the influence of habits – which are the automatic performance of behavioural patterns triggered by context cues – grows (Triandis, 1980). In a meta-analysis Ouellette and Wood (1998) found the predicted effect: for behaviours performed only annually or biannually intentions had a strong influence and past behaviour, which was used as a proxy for habit strength, had a weak influence. In contrast they found that the relations were reversed for behaviour performed daily or weekly (Ouellette and Wood, 1998). While it might appear that habits as routine actions, as opposed to deliberate actions, would call for fundamentally different models than deliberate actions, which would challenge the endeavour of this paper, a strong tradition of integrating measures of *habit strength* as a person variable into both TPB and NAT has developed since the 1990s in environmental psychology.

Verplanken and Aarts (1999) argue that habit strength should be entered into the theory of planned behaviour as an additional predictor of behaviour and as a moderator of the intention-behaviour-link for behaviours that are performed frequently. Klöckner, Matthies and Hunecke (2003) and Klöckner and Matthies (2004) found similar effects also in the context of the norm-activation-theory, which means that strong habits also weaken the relation between personal norms and behaviour and increase the amount of explained variation in behaviour. Granted that for a single person, deliberate decisions are based on different cognitive mechanisms than routine decisions, the models integrated here are describing differences

between people. It can be argued that if it is possible to measure the degree of habitualization a person has in a given situation for a given type of action, then this person-related measure should be able to predict differences between people in the strength of the intention-behaviour-link. Furthermore, strong habits to perform a behaviour should relate directly to the frequency with which that behaviour actually is performed. The theoretical status of a person-related measure of habit strength has been debated since the variable became popular.

Verplanken and Aarts (1999) make a point that habit as an independent variable in an action model needs to be more than just a technical measure of behavioural stability. They outline the following characteristics of a habit: habits are automatic responses to specific stable situations and habits are functional in achieving goals (Verplanken and Aarts, 1999). Habit strength would then be the degree of automaticity a behaviour has in a given stable situation. Habits develop by repeating the same behaviour in the same situation over and over again and being rewarded for it (by achieving the desired goals). Moreover, the measurement of habit strength has been a topic for discussion for a couple of years now and it appears that the Response Frequency Measure (Verplanken, Aarts, van Knippenberg & van Knippenberg, 1994) and the highly correlated Self-Report Habit Index (Verplanken & Orbell, 2003) are the most common and accepted operationalizations.

The degree of habitualization of a behaviour can theoretically be analysed on two different levels: (1) related to characteristics of the behaviour itself, namely its frequency and the situational stability, and (2) related to a person's characteristics, namely the degree to which one person is habitualized in a situation compared to other people in the *same* situation. The second level of analysis is chosen for this paper. The rationale being that since a general model of environmental behaviour across behaviours, which is proposed here, does not differentiate between behaviours with different characteristics.

2.5. The comprehensive action determination model - an integrated approach

In an attempt to integrate the aforementioned models and individual habit strength and to avoid the weaknesses of the single models while providing a general model framework that would apply in a larger variety of situations, Klöckner and Blöbaum (2010) proposed a model which they referred to as the “comprehensive action determination model” (CADM). In line with the TPB, the model assumes that individual environmentally relevant behaviour is determined directly by intentions and perceived behavioural control. In addition it integrates habit strength as a third direct predictor of behaviour. Habit strength is also assumed to moderate the relation between intention and behaviour, meaning that the intention behaviour link is weakened if habits are strong. Intentions typically integrate the influence of attitudes, social norms (or subjective norms as they are referred to in the TPB) and perceived behavioural control, but furthermore include the impacts of personal norms. Personal norms have repeatedly been shown to have only an indirect impact on behaviour completely mediated by intentions, if intentions are included in the model (e.g., Bamberg, Hunecke & Blöbaum, 2007; Bamberg & Möser, 2007). Personal norms are in line with the NAT assumed to be predicted by awareness of consequences and ascription of responsibility, perceived behavioural control, and social norms. Likewise, VBN theory’s assumption that general values and the ecological worldview have an additional impact on personal norms is also applied into the model. NEP as a measure of the general ecological worldview is not used as an attitude measure. Attitudes in contrast are included as *specific* evaluations of the respective behaviour. Although habit strength is theoretically not related to the other model variables, correlations with the central determinants of behaviour might still appear, given that the deliberate determinants of behaviour are stable over time. Habits are generated by repeated action in stable contexts (Klöckner & Matthies, 2012). At an earlier point in time, when a behaviour was performed for the first couple of times, intentions and PBC were the main

determinants. By repeating it, a habit was established and it took over control from the two variables. However, if intentions, behavioural control and personal norms did not change, they would remain correlated to habit strength because they determined behaviour at a previous point in time. The model has received good empirical support in a series of studies in different behavioural domains (Klößner & Friedrichsmeier, 2011; Klößner & Oppedal, 2011; Söpha & Klößner, 2011). For the present meta-analysis a simplifying assumption had to be made: The interactions between habit strength and intention cannot be tested, primarily because the analysis is based on a correlation matrix and raw data would be needed to calculate the interaction terms. Hence a model was specified as displayed in Figure 4. On the one hand, the dotted arrows show the relationship between intention, personal norms and perceived behavioural control. While on the other hand, habit strength in reality occur across points in time and are only reflected by the exhibited relations at one point in time, given that intentions, norms and behavioural control are substantially unchanged.

The comprehensive model has several advantages over the individual models for theory development and practitioners. With its claim to be applicable in a wider range of situations and behaviours it is exceedingly general compared to individual models. Comparisons between different behaviours can be made within the same model framework. Furthermore, it makes assumptions about relations between variables that cannot be created in the individual models, for example, the assumption on how direct the impact of personal norms on behaviour is. Finally, it can explain why relations between distal variables and behaviour do not invariably appear as expected by naming relevant mediators or moderators.

3. Method

The general model of environmental behaviour as derived from theory in the previous section was tested by means of a meta-analytical structural equation model (MASEM). A MASEM is

constructed and tested in three steps (Viswesvaran & Ones, 1995): (1) Relevant research articles are identified and the correlations between the model variables reported in each article are collected. (2) The correlations are pooled into a combined correlation matrix for further analysis. (3) A structural equation model is tested based on the pooled correlation matrix.

3.1. Identification of relevant research papers

This meta-analysis is based on three literature search criteria that were used to identify the relevant articles. The criteria were as follows: (1) The paper aims to explain an environmentally relevant behaviour or its direct predictors (such as intention). (2) The paper should include at least two of the constructs included in the CADM and use an operationalization of them that is in line with standardized measures as set forth for consideration by the authors proposing the initial theoretical TPB, NAT or VBN. (3) A correlation table and the number of participants in the study were reported. Fourteen databases were used for the literature research with the search terms such as “pro-environmental behaviour” or “energy behaviour”. A list of the databases is presented in the Appendix. Selection criteria were that the article proposed a theoretical model/hypothesis and tested the model/hypothesis against empirical data through an empirical survey. All papers published after 1980 were included in the initial literature research, which resulted in 97 articles. In these articles sufficient correlation tables that covered correlations between at least two model variables as well as the number of participants were provided for 56 independent data sets, which were subsequently used for this analysis. Papers used for the meta-analysis are indicated with an asterisk in the reference list. The data sets used for the analysis were analysing mobility behaviour (car use, park-and-ride, use of public transportation) (20 data sets), general indices of environmental behaviour combining several aspects (10 data sets), waste behaviour (recycling, waste reduction, reuse) (9 data sets), energy behaviour (energy

saving, energy use) (6 data sets), car purchase (3 data sets), water use (2 data sets), food related behaviour (meat consumption , organic food) (2 data sets), switching electricity providers to green electricity (2 data sets), green tourism, environmental activism and investment in wood pellet stoves (1 data set each). The author acknowledges that the behaviours span a large variety of different behaviours contrastingly divergent such as everyday use of energy or recycling and large investments as in a fuel efficient car or a wood pellet stove. A separate analysis for different behaviour types would have been interesting in order to determine how much the relevance of the different predictors varies for different types of behaviour. Nevertheless this was not possible with the available data material due to limited coverage of the CADM variables in the studies. However, for the most fundamental assumption that the intention-behaviour link is stronger for repetitive behaviour as opposed to behaviour seldom performed, a comparison on the pooled correlations resulted in no difference: The pooled correlation for low frequency behaviour such as car purchase and choice of electricity provider was .57 [CI .29 .76], whereas the one for high frequency behaviour such as car use, recycling or meat consumption was .56 [CI .45 .64]. As surprising as the result of that analysis is, it reduces the expected influence of behavioural diversity on the model test.

3.2. Pooling of the correlations

For pooling the correlations reported in the primary studies the method suggested by Hedges and Olkin (1985) was used: Firstly, the primary correlations were converted into standard normal metric by a Fisher r -to- Z -transformation. Secondly, these transformed correlations were weighted by the inverse of their within-study variances and pooled into an initial mean correlation, which is based on the assumption that there is homogeneity in correlations between studies (the so-called “fixed effect” model). The assumption of homogeneity is then

tested by the Q -test (Hedges & Olkin, 1985). Cheung (2000) suggests using a Bonferroni-corrected at-least-one approach. This means that the assumption of homogeneity should be rejected if the Q -statistic for at least one of the pooled correlations has a p -level below the Bonferroni-corrected cut-off point (which is $p < .0008$ in this study). For 48 out of 65 initial pooled correlations the Q -statistic's p value was below this cut-off point, which means the assumption of homogeneity is violated. As a result, the pooled correlations were calculated in a "random effect" model where the transformed correlations were weighted by the inverse of a variance term including both their within- and between study variance components (Hedges & Vevea, 1998; DerSimonian & Laird, 1986). This recalculated correlation matrix was transformed back to the r metric reversing the initial r -to- Z transformation. Table 1 presents the resulting correlations for a random effect model with estimated confidence intervals reported in Table 2. Table 3 presents the N and number of studies each pooled correlation was based on. Since the number of participants varies considerably between studies, the problem of how the N for the structural equation modelling should be determined arises. Bamberg and Möser (2007) discuss this problem and come to the preliminary conclusion to use the harmonic mean, which is also used in this analysis. The harmonic mean for this study is $N=4672$. The pooled correlations and all test statistics were calculated using the R-script "metacor".

- insert Table 1-3 about here -

4. Results

To test the CADM a path model as displayed in Figure 4 was specified and tested on the pooled correlation matrix with the harmonic mean N in Mplus 6.1. All exogenous variables (ST, SE, AR, AC, ATT, PBC, and SN) were specified to covariate. The respective

correlations can be found in Table 1. A maximum-likelihood estimator was used. An additional covariance was added between attitudes and the residual of personal norms to cover for a considerably large overlap between the two constructs, which otherwise would have resulted in a poor model fit.¹ No other modifications of the model were conducted. The model fit of the resulting model was acceptable according to criteria formulated by Hu and Bentler (1999): $\chi^2=490.95$; $df=20$; $p<.001$; $CFI=.965$; $TLI=.922$; $SRMR=.023$; $RMSEA=.071$ [.066 .077]. Figure 4 presents the estimated coefficients and explained variation in the dependent variables. All displayed coefficients were significantly different from zero on the $p<.001$ level.

- insert Figure 4 about here -

The strongest predictor of environmental behaviour was intentions, followed by habit strength. Perceived behavioural control had a weaker impact on behaviour. While the relatively strong effects of intentions and habit strength were expected, the standardized regression weight of perceived behavioural control on behaviour is unexpectedly low, even if it was anticipated that the majority of the impact of perceived control would be mediated by intentions and personal norms. 36% of variation in behaviour was explained by the three variables, which is relatively low compared to models tested on a specific behaviour. Intentions are the first integrative variable, being influenced by attitudes, perceived behavioural control, personal norms and social norms (in descending order of the magnitude of their impact). These four variables explain 55% of variation in intentions. Both the amount of explained variation and the strength of the impact of the variables fulfilled the expectations. The second integrative variable is personal norm, which is significantly predicted by social norms, perceived behavioural control, awareness of consequences, ascription of

responsibility, self-transcendence values, self-enhancement values (negative relation), and the new environmental paradigm (in descending order of the magnitude of their impact). Together these seven variables explain 47% of variation in personal norms. There is not much variation in the impact the seven variables have on personal norms. This is contrary to the expectation that – based on VBN – ascription of responsibility should be more closely related to personal norms than for example general value orientations. Habit strength is related to intention, personal norm, and perceived behavioural control as expected. The three variables explain 26% of variation in habit strength. As expected, only a relatively small (but significant) part of variation in habit strength is explained by determinants of deliberate decision making. This is because the relation would particularly appear if intentions, personal norms and perceived control remained stable, which is not the case for all people. The new environmental paradigm is predicted positively by self-transcendence and negatively by self-enhancement values. However, the strict causal chain leading from NEP via awareness of consequences and ascription of responsibility to personal norms could not be confirmed since an alternative model including this chain did not fit the data ($Chi^2=2917.31$; $df=38$; $p<.001$; $CFI=.830$; $TLI=.749$; $SRMR=.131$; $RMSEA=.127$ [.123 .131]).

5. Discussion

The results of the meta-analysis show that the proposed CADM has a robust structure that is able to reproduce a pooled correlation matrix sufficiently well. The results were based on 56 different data sets that span across a large variety of different behaviours and were collected in different countries. This can be surmised as a strong argument for the validity of the proposed model. In contrast to a comparable meta-analysis conducted by Bamberg and Möser (2007), the present analysis identifies not only intentions as predictors of environmentally relevant behaviour, but also perceived behavioural control and habits. Despite habits not being

included in the analysis by Bamberg and Möser (2007), they did integrate perceived behavioural control. The reason for the difference in the direct impact of perceived behavioural control on behaviour could be that the statistical power of the present analysis is higher than Bamberg and Möser's because the N is considerably higher. This has an impact particularly on the smaller estimated coefficients, given that the estimated standard errors become smaller with larger N . The pooled correlation between perceived behavioural control and behaviour is only slightly higher in the present study compared to the pooled correlation in Bamberg and Möser's meta-analysis. The results confirm therefore both the assumptions of the TPB and the necessity to include habits into a general behavioural model.

On the first level closest to behaviour, intentions perform as an integrative variable, joining the impact of attitudes, social norms, perceived behavioural control and personal norms. The mediated effect of perceived behavioural control on behaviour has the same impact as the direct effect. Personal norms add a fourth aspect to intentions that is missing in the TPB, a finding that is in line with Bamberg and Möser (2007) and Bamberg et al. (2007). The aspect of moral motivations behind environmental behaviour is obviously not sufficiently represented in the TPB in its pure form. However, it should be noted, that attitudes and personal norms showed so much overlap in the empirical data that a covariance between the attitudes and the residual of personal norms had to be implemented in the model. Two explanations for this can be provided: (1) Part of the impact of personal norms on intentions is mediated by attitudes, meaning that what people consider favourable also takes into account if the respective behaviour is in line with personal values. (2) The measurement of personal norms and attitudes are not sufficiently or satisfactorily discriminating the two variables. Although the initial models (TPB on the one hand and NAT/VBN on the other) did not include intentions and personal norms at the same time, several authors have previously included both of them in the same model (e.g., Bamberg & Möser, 2007; Abrahamse & Steg,

2009; Tonglet, Phillips & Bates, 2004). Problems of discriminant validity between the two have not been reported in the aforementioned studies. An inspection of the individual correlations between attitude and personal norms establishes that only three of 26 are above .70, which persuades the author of this paper to favour the first explanation.

On a second level more distal to behaviour, personal norms act as an integrating variable for value and norm related aspects. They integrate parts of social norms and partially mediate their influence on intentions, perceived behavioural control (which thereby has a third path to behaviour mediated by personal norms and intentions). Furthermore this mediated influence impacts awareness of consequences, ascription of responsibility, an ecological worldview (NEP) and values. It can be concluded that people embracing self-transcendence values (as opposed to self-enhancing values), holding an ecological worldview, being aware of potentially adverse consequences of behaviour, ascribing responsibility for these consequences to themselves, being supported or expected by others to act environmentally friendly and perceiving at least some control about their behaviour would experience a feeling of moral obligation to act in an environmentally friendly manner. This feeling of moral obligation (or activated personal norm) may together with the other aforementioned factors have an impact on intentions. It is obvious that the path from values to behaviour is long and can be interrupted by many variables, for example habits, low perceived control, interfering attitudes, and so forth – something that would not have been detectable in the VBN theory or the NAT alone.

In contrast to the assumptions of the value-belief-norm-theory (Stern, 2000) no causal chain from values, over NEP, awareness of consequences and ascription of responsibility could be established empirically. A model assuming this chain and not the direct impact of all variables on personal norm did fit the data significantly poorer than the alternative model with correlations between the variables and direct impacts on personal norms. This might be partly

due to the large N because even relatively small estimated coefficients on the direct links between a variable and personal norm cause enough deviation between the observed and the model predicted correlation matrix for large N , if they are omitted. An alternative model with all earlier variables in the chain affecting later models would have received a good fit, but because of its saturated nature this good fit would have had no value as a test of the structure. The results of this meta-analysis are engaging for several reasons: First, they show that a model structure that was derived based on the integration of theories and previous studies provide insights into the relations of a high number of variables to each other that the individual models were not able to show. Variables are grouped into proximal predictors of behaviour and distal predictors with increasing degrees of distance to behaviour. Although it has been previously demonstrated that the impact of personal norms is most likely mediated by intentions, this finding is important for theory development, as is the finding that personal norms add to explaining variation in environmental intentions above and beyond the TPB variables. Reflecting back on the initial models, the analysis confirms the assumptions that the VBN and NAT lack mediating variables between personal norms and behaviour, which is the case, because feeling of moral obligation is only one determinant of the intention. On the other hand, the analysis establishes that moral motivations are important for environmental behaviour, which is not adequately represented in the TPB. Even if the strict causal chain of variables in the VBN theory could not be supported by the data, it is a relevant finding that all variables mentioned in the VBN theory and NAT have a significant impact on personal norms. Environmental behaviour can ultimately be traced back to basic value orientations, even if the distance between such values and behaviour is bridged by a long line of mediating variables.

The findings attribute that all three integrated theories are relevant for environmental behaviour. However, the variables of the TPB are more proximal to behaviour than the

variables of the NAT and the VBN. If model parsimony or quick results of behavioural interventions are the goal, then a reduced model would focus on intentions, habits and perceived control with attitudes, social norms and personal norms as determinants of intentions. Changes in these variables would have the largest effect on behaviour. However, habits, attitudes, perceived control, social norms and personal norms are very different variables and interventions that have an impact on them appear significantly dissimilar. Interventions that focus on norms require an understanding of the norm generation and activation process, which makes it important for some applications to also comprehend the more distal parts of the model.

For practitioners and environmental campaigners and communicators the results have important implications. They establish that attitude campaigns are not enough to create intentions. Social norms among people that are relevant for the individual, as well as low perceived control might act against the attitudes. Creating a feeling of self-efficacy, which is the ability to perform the necessary act, is at least as important as creating a positive attitude. Interventions to increase perceived behavioural control and efficiency are therefore very relevant. People require information about what to do and how to do it.

However, even if intentions are formed, they alone are not sufficient; strong old habits or low perceived control can still interfere with performance of the behaviour. In particular, for frequent behaviour in relatively stable contexts (such as travel mode choice for frequent trips or showering behaviour, for instance) habits are a powerful predictor and need to be deactivated before a change in behaviour has a chance to be sustainable. Verplanken and Wood (2006) outline strategies how to break habits and then change behaviour, when a window of opportunity opens. They advocate combining contextual change which deactivates the triggering contextual cues for the habit with other intervention techniques that target

norms or attitudes. Context change can either be naturally occurring (e.g., by life events such as becoming a parent) or induced.

Despite value based intervention techniques that strengthen personal ecological norms possessing a high risk of failure because the path from personal norms to behaviour is rather indirect and other variables can interfere, they offer a potential benefit that should not be underestimated. This being that personal norms are relatively stable compared to attitudes and intentions. If a personal norm is created, the effect of that norm can last for a long time. Matthies, Klöckner and Preißner (2006) could show that norm-centred interventions like personal commitment had an effect even five months after the intervention was finished, especially when combined with habit-breaking interventions. However, norms need to be activated, which signifies that people need to be reminded in a given situation that there are negative consequences of behaviour and that they are responsible.

Finally, the influence of social models and social expectations on behaviour should also not be underrated. As demonstrated in a study by Goldstein, Cialdini and Griskevicius (2008) where relatively simple notes about behaviour of other people in the same situation could motivate people to change their own behaviour (in this case the re-use of towels in a hotel room). People tend to react to what other people expect them to do and even more to what other people do. This social influence is according to the model both relevant and pertinent while generating an intention and over time as an input to create personal norms.

Insightful as the results of the analysis are, the study also has some important weaknesses that should be noted. Firstly, the number of studies each pooled correlation is based on, varies between 1 and 36. This connotes that some of the correlations are very much impacted by the peculiarities of one or two studies and that generalizations should be made with caution. Very few studies included a larger selection of the variables the CADM consists of. Studies that

primarily include combinations of basic values, NEP and habit strength are scarce. This justifies for more systematic and comprehensive research about determinants of environmental behaviour with the CADM as a framework. Secondly, the results of the homogeneity tests demonstrate that almost all pooled correlations could not be considered as being homogeneous. For this analysis, the inhomogeneity is controlled for by pooling the correlations in a random effects model. However, the inhomogeneity is most likely meaningful. Conceivably the correlations between variables depend on the type of behaviour or the culture the study was conducted in. Especially, the intention-behaviour and habit-behaviour link should be dependent on the type of behaviour analysed (frequent vs. singular, see Ouellette & Wood, 1998). Interestingly, a comparison of the pooled correlations between intentions and behaviour for studies of high frequency versus low frequency behaviour presented no such effect in this study. Some authors suggest cluster-analysing the correlation coefficients prior to entering the analysis with sub-groups of pooled correlation tables based on more homogeneous correlations (Cheung & Chan, 2005). However, given the relatively small number of correlations most pooled correlations were based on, this approach was not feasible. Finally, a serious problem in the estimation of the impact of habit strength arises from the fact that the construct of habit was included naturally only in studies that dealt with high frequency behaviour. This signifies that there is a lack of information about the size of the correlation for less frequent behaviours where habit strength is assumedly low but was not measured. As a consequence, the impact of habit strength is most likely over-estimated, particularly for less frequent behaviours.

6. Conclusion

The CADM is supported by the data as a general model of environmental behaviour which has important implications for how the human dimension in global environmental challenges

is understood and addressed with interventions. The model can serve as a general framework in identifying important proximal and distal predictors of varying kinds of environmentally relevant behaviour. The key constructs are attitudes, personal norms, perceived behavioural control, and social norms, which together form the intention. A more comprehensive model of environmental behaviour benefits the practical design of intervention strategies for the reasons that it both identifies potential entry points for interventions and explains why some strategies alone will most likely fail and how strategies need to be combined. Achieving this, the CADM provides a valuable tool for dealing with challenges caused by global environmental change.

Footnote

¹ Technically, a covariance between an endogenous variable (personal norm) and an exogenous variable (attitudes) can only be added between the residual of the endogenous and the exogenous variable. Otherwise, it would be a directed effect (attitudes influencing personal norms) which lacks a theoretical background to support it. It means that the part of variance that is *not* explained by the predictors of personal norms has a relevant overlap with attitudes.

7. Appendix

List of databases used for the literature research

- Psychology + Behavior (EBSCO)
- PsycINFO(APA)
- PsycNET(APA)
- ISI Web of Science
- EBSCO
- ECO Electronic Collection (OCLC)
- Ingenta connect
- JSTOR
- SCOPUS
- SpringerLink
- Wiley Online Library
- Blackwell Synergy
- SAGE eReference
- Google scholar

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Tables

Table 1: Fisher's Z-back-transformed pooled correlation matrix under the random-effects assumption

	AC	AR	ATT	BEH	HAB	INT	NEP	PBC	PN	SN	ST	SE
AC												
AR	.51											
ATT	.39	.26										
BEH	.22	.10	.36									
HAB	.18	.08	.36	.46								
INT	.33	.34	.62	.55	.47							
NEP	.43	.45	.32	.09	.16	.32						
PBC	.19	.18	.40	.40	.36	.54	.09					
PN	.49	.48	.64	.32	.39	.59	.41	.35				
SN	.31	.33	.42	.24	.24	.47	.25	.29	.48			
ST	.31	.40	.24	.06	.12	.22	.34	.07	.31	.24		
SE	-.00	.02	.13	.01	-.07*	.05	-.01	.07	-.05	.02	.51	

Notes:

AC = awareness of consequences, AR = ascription of responsibility, ATT = attitudes, BEH = behaviour, HAB = habit, INT = intention, NEP = new environmental paradigm, PBC = perceived behavioural control, PN = personal norm, SN = social norm, ST = self-transcendence values, SE = self-enhancement values; * not based on a pooled correlation, because only one study reported that correlation

Table 2: Estimated 95% confidence intervals for the pooled correlations

	AC	AR	ATT	BEH	HAB	INT	NEP	PBC	PN	SN	ST	SE
AC												
AR	[.37 .62]											
ATT	[.32 .45]	[.18 .34]										
BEH	[.17 .28]	[.03 .17]	[.28 .43]									
HAB	[.07 .29]	[-.04 .21]	[.11 .57]	[.26 .62]								
INT	[.23 .43]	[.21 .47]	[.55 .69]	[.47 .63]	[.23 .66]							
NEP	[.41 .46]	[.42 .48]	[.21 .41]	[.03 .15]	[.10 .22]	[.20 .42]						
PBC	[.14 .24]	[.12 .23]	[.30 .49]	[.29 .50]	[-.03 .65]	[.41 .65]	[.05 .12]					
PN	[.41 .56]	[.31 .63]	[.41 .79]	[.26 .38]	[.26 .50]	[.50 .67]	[.38 .44]	[.26 .44]				
SN	[.25 .36]	[.20 .44]	[.36 .47]	[.18 .30]	[.17 .31]	[.40 .54]	[.16 .34]	[.21 .37]	[.42 .55]			
ST	[.20 .41]	[.25 .53]	[.18 .31]	[-.05 .17]	[.08 .17]	[.13 .30]	[.19 .47]	[.03 .11]	[.26 .36]	[.13 .35]		
SE	[-.03 .03]	[-.06 .10]	[.03 .23]	[-.05 .07]	-*	[-.03 .12]	[-.05 .03]	[-.02 .16]	[-.09 -.01]	[-.06 .10]	[.34 .64]	

Notes:

AC = awareness of consequences, AR = ascription of responsibility, ATT = attitudes, BEH = behaviour, HAB = habit, INT = intention, NEP = new environmental paradigm, PBC = perceived behavioural control, PN = personal norm, SN = social norm, ST = self-transcendence values, SE = self-enhancement values; * not based on a pooled correlation, because only one study reported that correlation

Table 3: Total sample size (upper row) and number of independent correlation matrices (lower row)

	AC	AR	ATT	BEH	HAB	INT	NEP	PBC	PN	SN	ST	SE
AC												
AR	5315 (13)											
ATT	11253 (18)	4454 (9)										
BEH	13215 (24)	4217 (10)	14053 (30)									
HAB	6821 (8)	1747 (3)	6763 (6)	7747 (10)								
INT	12464 (19)	4784 (10)	16949 (33)	12945 (26)	7319 (8)							
NEP	2976 (3)	2976 (3)	4077 (6)	3499 (5)	2020 (2)	4077 (6)						
PBC	12478 (23)	4758 (12)	16605 (35)	15020 (32)	7747 (10)	17489 (36)	3520 (5)					
PN	13440 (21)	4605 (11)	14571 (26)	14451 (29)	7558 (9)	16911 (30)	3351 (4)	16864 (31)				
SN	11963 (19)	4243 (8)	16838 (36)	14170 (31)	7010 (9)	16768 (34)	3340 (5)	17560 (35)	15352 (27)			
ST	5298 (5)	2976 (3)	4786 (7)	4011 (4)	2020 (2)	5655 (8)	3156 (3)	3374 (5)	4623 (4)	3194 (5)		
SE	3831 (4)	2976 (3)	4049 (6)	3274 (3)	1283 (1)	3451 (6)	2419 (2)	2637 (4)	2419 (2)	3194 (5)	3749 (6)	

Notes:

AC = awareness of consequences, AR = ascription of responsibility, ATT = attitudes, BEH = behaviour, HAB = habit, INT = intention, NEP = new environmental paradigm, PBC = perceived behavioural control, PN = personal norm, SN = social norm, ST = self-transcendence values, SE = self-enhancement values

Figures

Figure 1: The theory of planned behaviour (Ajzen, 1991, page 182)

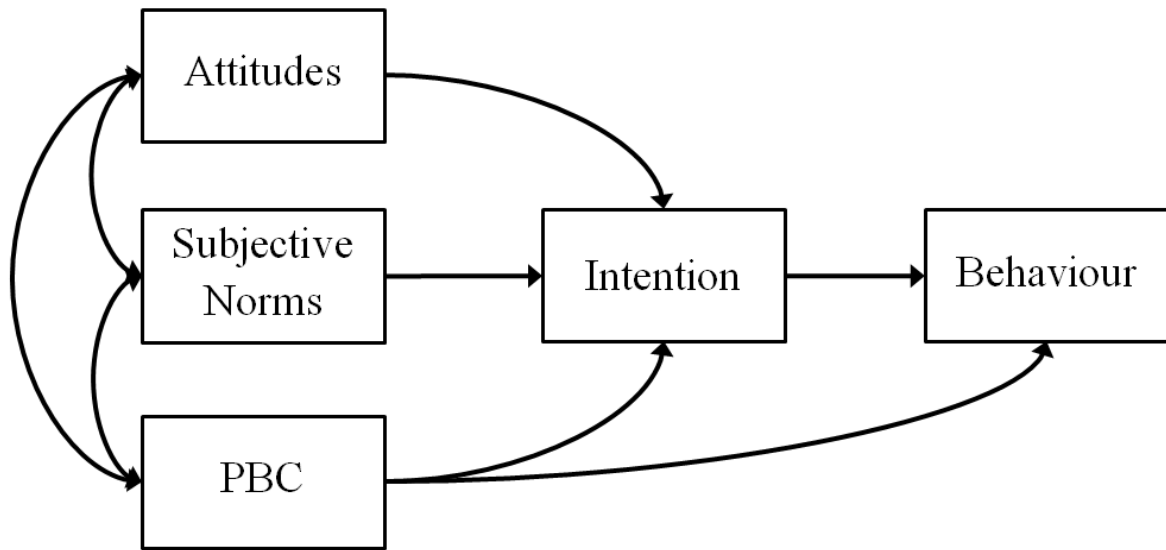


Figure 2: The norm-activation-theory (Schwartz & Howard, 1981)

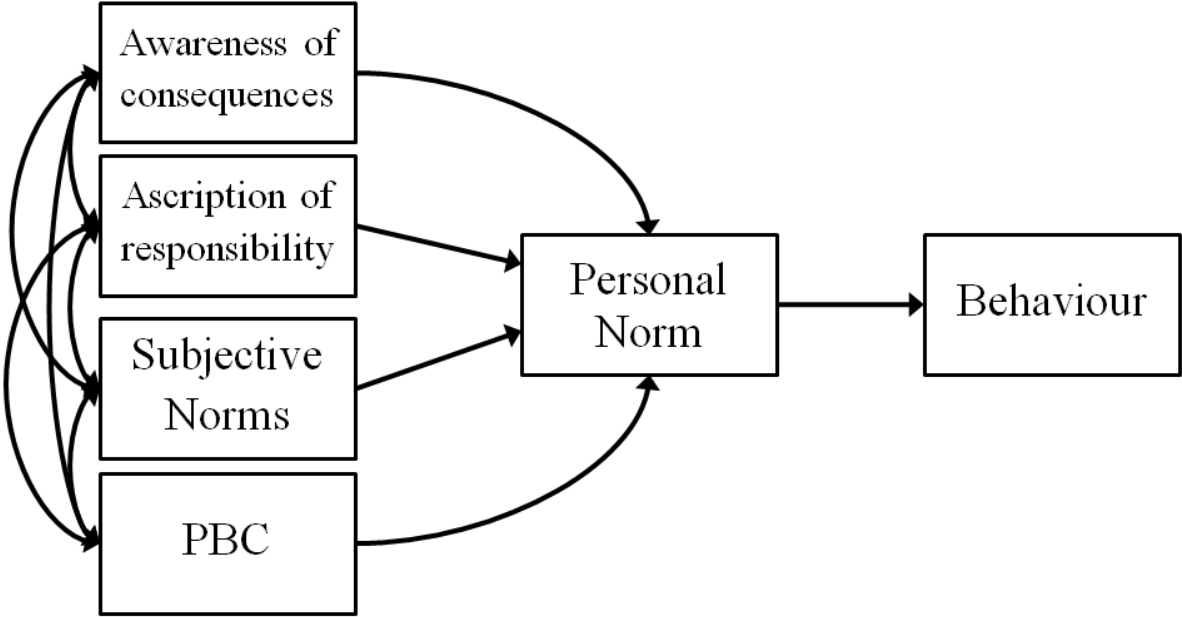


Figure 3: The value-belief-norm-theory (adapted from Stern, 2000, page 412)

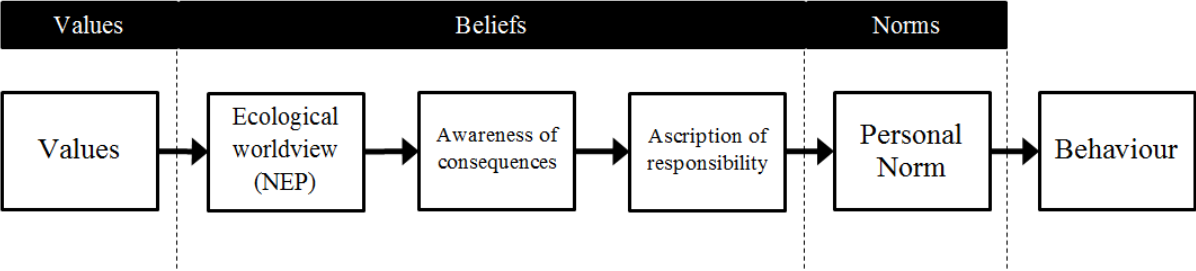
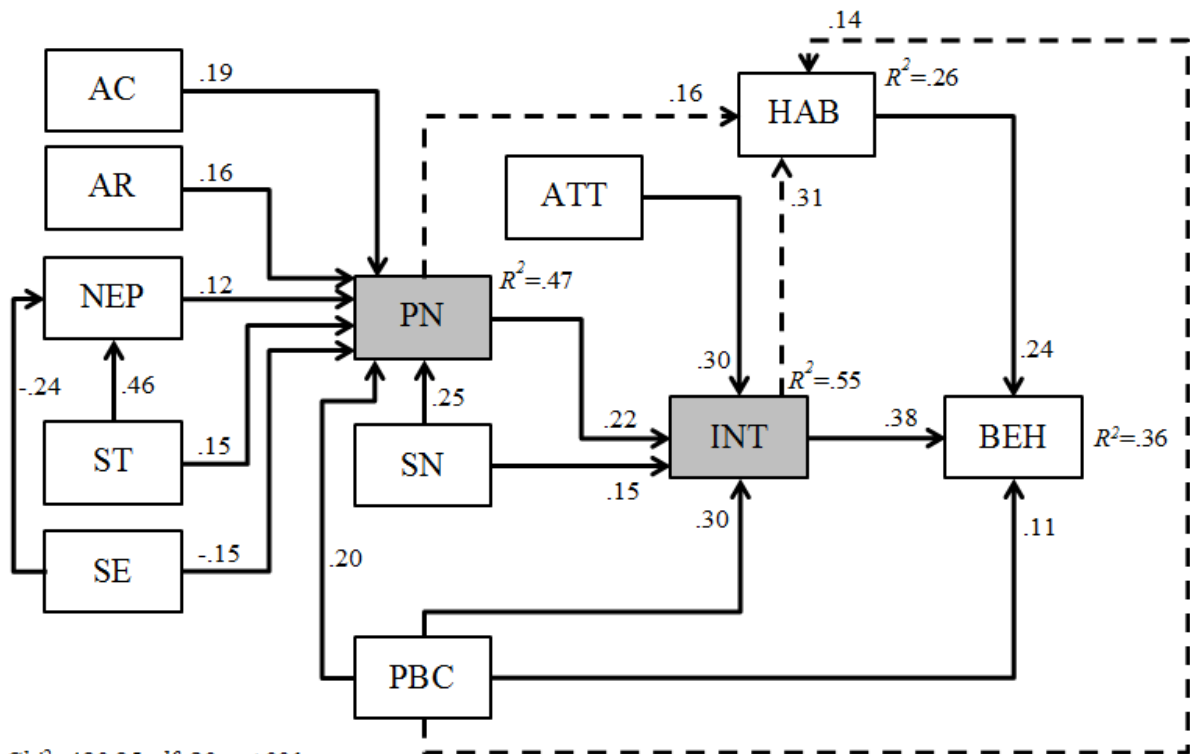


Figure 4: Results of the meta-analytical structural equation modelling based on the pooled correlation matrix.



$\chi^2=490.95; df=20; p<.001$
 $CFI=.965; TLI=.922; SRMR=.023$
 $RMSEA=.071 [.066 .077]$

Notes:

All exogenous variables (ST, SE, AR, AC, ATT, PBC, SN) are specified to covariate. The respective correlations can be found in Table 1.

AC = awareness of consequences, AR = ascription of responsibility, ATT = attitudes, BEH = behaviour, HAB = habit, INT = intention, NEP = new environmental paradigm, PBC = perceived behavioural control, PN = personal norm, SN = social norm, ST = self-transcendence values, SE = self-enhancement values