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On the determinants of pro-environmental behavior:
A guide for further investigations

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ON THE DETERMINANTS OF PRO-ENVIRONMENTAL BEHAVIOR - A GUIDE FOR FURTHER INVESTIGATIONS

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On the determinants of pro-environmental behavior - a guide for further investigations

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Abstract

Determinants of pro-environmental behavior (PEB) have been studied rigorously in the past decades. Given this spurt, a systematic review of extant research is required to determine factors involved, analyze impact and identify research gaps and new directions. This paper provides a systematic review of current economic and psychological studies regarding the determinants of PEB. As a result, we show that PEB is determined by an interplay of socio-economic, psychological and further (individual, social, institutional) factors, which need to be considered in its study. In addition, PEB needs to be analyzed with multiple items rather than by focusing on single ones as the impact of the determinants differs depending on the analyzed behavior. To express it in economic terms, the coefficient of each determinant can either be positive or negative, given the specific type of analyzed behavior (low vs high cost behavior). By combining the results from economics and psychology, this work offers a starting point for a more sophisticated understanding of PEB.

\textit{Key words:} determinants of pro-environmental behavior, ecological economics, review

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1. Introduction

Humankind’s impact on the environment is greater than ever before. The current generation has changed the ecosystem faster and more exhaustively than any other generation. Consequently, environmental issues have become more important as, for e.g., plastic in the ocean or global warming threaten our ecosystem and need to be tended to. Fostering pro-environmental behavior (PEB) and designing appropriate interventions to threats requires knowledge about its driving determinants (Heimlich and Ardoin, 2008; Steg and Vlek, 2009).

The success of this change towards the environment is highly dependent on the acceptance and behavior of the populace. The field of environmental psychology has investigated the relationship between nature and human beings since the 1960s (for reviews, see, e.g. Hines et al., 1987; Kollmuss and Agyeman, 2002; Bamberg and Möser, 2007; Heimlich and Ardoin, 2008; Steg and Vlek, 2009; Klöckner, 2013; Gifford and Nilsson, 2014), a relationship that has also caught the interest of economists more recently. While psychologists are more concerned with internal factors, economists focus more on external factors (Clark et al., 2003).

A broad range of socio-economic and psychological determinants influence PEB, but reviewing recent studies indicates that there is still limited exchange between the disciplines. We present an overview of PEB determinants and show that seemingly heterogeneous results in the literature are due to different measurements of PEB in the studies. We find that PEB is determined by a combination of socio-economic and psychological determinants. In economic terms, the coefficient of each determinant can either be positive or negative, given the specific type of behavior analyzed (low vs high cost behavior). A comprehensive understanding of PEB and derivation of a holistic picture requires the consideration of socio-economic and psychological determinants.

This paper is structured as follows: section 2 presents the selection of articles and the methodological approaches taken to measure PEB. In section 3, we explain the socio-economic, psychological and other relevant determinants that influence PEB. Section 4 concludes the paper with its limitations and implications.
2. Methodology

2.1. Selection of articles

The article selection of this review is based on an extensive and systematic review (Jan.-Nov. 2017) of relevant databases (Web of Science, EconLit, PsycINFO and Google Scholar). We searched these databases for commonly used terms of PEB (among others: pro-environmental behavior, ecological behavior, responsible environmental behavior, environmentally/ecologically responsible/friendly behavior). We primarily focused on peer-reviewed journal articles (included: 158), published in the English language, giving a preference to recent articles (post 2000).

2.2. Methodological approaches

“Pro-environmental behavior” covers all the behaviors undertaken by a single individual to reduce one’s negative environmental impact (Kollmuss and Agyeman, 2002).

Studies follow different methodological approaches, namely, questionnaires (cross-sectional & panel data), interviews and experiments (field & laboratory), as elaborated in this section. An overwhelming majority of studies in the field of PEB research are based on survey data, the advantages of which are its low (financial) costs and relative ease of execution (Kormos and Gifford, 2014). Respondents are usually asked if or how often they engage in a particular behavior ranging from ‘never’ to ‘always’ (likert-scale; 5 up to 11 pts). PEBs differ in complexity, investment costs (time, money) and impact on the environment (e.g. Stern, 2000; Schmitt et al., 2018). The number of behaviors (overview: Table 2, Appendix) used to measure PEB differs highly within the studies (from 3 up to 50 different behaviors), causing a broad heterogeneity in study results. The behaviors can be assigned to different clusters (e.g. water/energy saving, political actions etc.). Some studies group behaviors into PEB indices (e.g. Lynn and Longhi, 2011; Binder and Blankenberg, 2017; Schmitt et al., 2018).

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1There is a strong relation between self-reported & objective PEB (Kormos and Gifford, 2014). Self-reported questions about environmental issues are only weakly affected by social desirability bias (Milfont, 2009). There is no evidence for inaccurate reporting (Lam and Cheng, 2002). Peer-reports correspond with self-reports (Villacorta et al., 2003). Cross-evaluation improves the quality of the questionnaires (Lam and Cheng, 2002).
Most studies are based on cross-sectional data with clear focuses (specific topic; tailored questionnaire) but lack the dimension of possibility, allowing causal inferences. In contrast, studies based on panel-datasets allow the establishment of causal links between variables. But, for e.g., household panel-datasets (SOEP, BHPS, etc.) are usually not tailored to a particular research question.

In contrast to the self-reports, device measurements (e.g. meter readings of electricity), peer-ratings and observations by trained persons are more objective ways of measurements (Kormos and Gifford, 2014).

Experiments (Sturm and Weimann, 2006; Osbaldiston and Schott, 2012), which help analyze “cause and effect” by way of their simple (non-complex) design, prove to be another efficient method to study PEB. The increasing number of experiments requires its own review.

3. Determinants of PEB

PEB is determined by an interplay of socio-economic\(^2\) and psychological determinants. The coefficient of the determinant can either be positive or negative, given the specific type of analyzed behavior (low vs high cost behavior\(^3\)). Therefore, to completely understand PEB determinants requires a consideration of socio-economic (3.1) and psychological determinants (3.2). Apart from the two, there are other determinants (individual, social and institutional) that may influence PEB (3.3). This section identifies and outlines these determinants.

3.1. Socio-economic determinants

3.1.1. Age

Age impacts the consumption of fair trade products negatively (McCluskey et al., 2009) but it would be simplistic to assume that older people do not care about environmental issues in general, as there exists a broad variability between concerns and attitudes amongst older people (Wright et al., 2003). Environmental beliefs decline with age and older people engage less often in “active” behaviors (joining environmental groups, outdoor recreation activities) but they report more “homebased” PEBs (reading environmental magazines; recycling). This

\(^{2}\)Socio-economic determinants impact e.g. on the ecological footprint (Bleys et al., 2017) and on environmental citizenship (EC) (Stern et al., 1999).

\(^{3}\)Discussion about this, see e.g. Diekmann and Preisendörfer (1992).
is explained by the level of energy and stamina required to participate in different activities (Johnson et al., 2004). These findings are supported by a meta-analysis (Wiernik et al., 2013) covering different behavioral clusters (like avoiding harm, engaging with nature, conserving nature, spreading knowledge of sustainability, sustainable consumption, political behaviors, etc.).

PEB seems to follow a life-cycle, with the lowest possible point situated at the life milestone where people begin parenting (children bring in constraints - such as money and time - for parents) (Longhi, 2013). Individuals below 30 and individuals between 60 to 69-years, in specific, are inclined to act more ecologically in 2010, in comparison to their behavior in 2001 (cohort & learning effects) (Otto and Kaiser, 2014).

3.1.2. Education

Education increases PEB (environmental reading, recycling, joining an environmental group, nature participation) (Johnson et al., 2004). Educated people are more aware and more concerned with social welfare (Johnson et al., 2004; Torgler and Garcia-Valiñas, 2007; Meyer, 2015). Higher education impacts positively on certain behaviors (consumption of recycled paper products, boycott of over-packaged items, avoiding turning the heating up, turning off the tap), while a lower level of education is positively related to other forms of PEB (turning TV off overnight, switching off lights, using public transport) (Lynn and Longhi, 2011). An increase in years of schooling is related to higher PEB (8 behaviors about technical change and saving behaviors) without exerting an impact on cost-saving pro-environmental actions (Chankrajang and Muttarak, 2017).

When compared to factors like income or employment status, education has the highest impact on PEB and is correlated with more awareness and interest in environmental issues (Longhi, 2013). Education usually affects environmental concerns by increasing knowledge about environmental issues (Franzen and Meyer, 2010), but analyzing global warming concerns shows that education (treated as endogenous) does not have any impact on this type of concern (Chankrajang and Muttarak, 2017).

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4Educated individuals score on average 1.4- 1.6 points higher on the PEB scale (0 - 44 points).
3.1.3. Income

Income has no effect on going green (De Silva and Pownall, 2014) and no impact on being a strong environmentalist (Owen et al., 2010). But there is a small observable positive connection between income and PEB (Hines et al., 1987). An increase in greenhouse gas emissions (GHG) (Ala-Mantila et al., 2014), and other types of emissions (Büchs and Schnepf, 2013; Bruderer-Enzler and Diekmann, 2015), and the energy requirement (Moll et al., 2005) in households is directly related to an increase in income. But households with higher incomes are also more likely to participate in green electricity programs (Clark et al., 2003) and the willingness to pay for green electricity also increases with income (Zorić and Hrovatin, 2012).

An increase in income is usually related to a reduction of available free time (value of time increases), leading e.g. to a reduction of recycling behavior (Ferrara and Missios, 2005). Analyzing cross-sectional data indicates that on the level of individual action, household income has no effect on PEBs in general (Whitmarsh and O’Neill, 2010). A more detailed analysis of panel-data, using a PEB index, shows that higher wages and a higher equivalised household income are correlated with lower individual PEB (Longhi, 2013). A focus on single behaviors shows that poorer people tend to exhibit more PEB - e.g., increased usage of public transportation and a reduction of their heating costs (Longhi, 2013). People are more likely to engage in PEB if it is not costly (in terms of money, time, effort and convenience) (Diekmann and Preisendörfer, 2003). They do not readily give up more essential, costly behavior, like e.g. traveling, in specific, as it is considered an important part of people’s lifestyle (Lorenzoni et al., 2007). Traveling is rather determined by restrictions on income and personal resources (King et al., 2009). But on the contrary, increase of income is associated with an increasing EC behavior (Stern et al., 1999) and people with higher income and education are more likely to engage in water conservation practices (Berk et al., 1993).

Being unemployed is a special situation in which a person faces a fall in income and an increase in available time. On considering unemployment, it is revealed that PEBs related to time and effort will increase, while behaviors primarily based on money will decrease (Meyer, 2016). Being unemployed or retired predicts cases of higher PEBs (index, 11 behaviors like transport and water saving behaviors) (Binder and Blankenberg, 2017). A work-life imbalance does not affect PEB (Melo et al., 2018).
3.1.4. Household structure

Living in a household restricts people’s behavior regardless of their attitudes, as it requires coordination with other peoples attitudes, and comes with time constraints (Shove, 2010). PEB of individuals is shaped by their household structure, the size of which has a negative effect on PEB (Clark et al., 2003; Johnson et al., 2004; Longhi, 2013) and environmental concerns in general (Johnson et al., 2004), but impacts positively on PEBs like recycling and nature participation (Johnson et al., 2004). As mentioned with regard to the Income factor, households with a higher income are more likely to participate in green electricity programs but a larger number of household members decreases the likelihood of participation (Clark et al., 2003). Individuals increase emissions (household gas & electricity) with their everyday behavior (Abrahamse and Steg, 2011). Analyzing household structures shows that single women scored highest in PEB, followed by couples without children. Couples with children (see 3.1.1) show the lowest PEB (Longhi, 2013).

3.1.5. Gender

Men and women differ significantly in their PEB (Eisler et al., 2003)5. Women exhibit higher PEB than men (Lynn and Longhi, 2011; Longhi, 2013), a difference which has been confirmed across nations (Hunter et al., 2004). All other things being equal, women are 3.9% more likely to buy environmental-friendly products and combat cold by wearing more clothes rather than by turning on the heating in their surroundings (Lynn and Longhi, 2011). Women report stronger environmental attitudes and more PEB (meta-analysis) (Zelezny et al., 2000) and are readier to make a connection between environmental conditions and their other values, performing more environmental action (Stern et al., 1993). Women are more concerned than men, even when controlling for other variables like income or educational background (Franzen and Meyer, 2010). These findings are robust across time, nations and samples (McCright and Xiao, 2014).

Some studies find no (Hines et al., 1987) or only small gender effects (Blocker and Eckberg, 1997), which can be explained by the chosen behavior. Women, for e.g., report more

5Altruism (more distinct for females) explains PEB differences (Gilligan, 1982; Stern et al., 1993; Dietz et al., 2002).
recycling behavior (home-based environmental behavior), but men show more external behavior (reading environmental material or participating in environmental groups) (Johnson et al., 2004).

3.2. Psychological determinants

Associated literature in the field of psychology began by studying linear models of PEB and subsequently evolved to consider more complex models like the “Norm Activation Theory” (Schwartz, 1973, 1977), “Theory of Reasoned Action” (Ajzen and Fishbein, 1980), “Theory of Planned Behavior” (Ajzen, 1985, 1991), “Values-Beliefs-Norms Theory (VBN)” (Stern et al., 1999). Further works (Shove, 2010; Klöckner, 2013) build upon these models, like the integrated framework designed to encourage PEB (Steg et al., 2014). For each of the theories we can find empirical support, but it remains still an open question, which framework is the best one to explain PEB. In this section, we present the determinants of PEB embedded in these frameworks but abstain from putting it into one framework.

3.2.1. Beliefs

Belief describes the expectation that behaving in a certain way leads to a certain outcome (Klöckner, 2013). Beliefs are indirectly related to PEBs as they influence their respective constructs (attitudes, perceived behavioral control, and injunctive and descriptive norms) (Klöckner, 2013; De Leeuw et al., 2015). Festinger (1962) proposes that we unconsciously seek consistency in our beliefs. The inconsistency between information about environmental degradation and current beliefs leads to an avoidance of information about environmental problems as a means of retaining mental consistency, partly explaining climate denialism (Lorenzoni et al., 2007). An individual’s belief in climate change only has a small up to moderate effect on their willingness to behave in a climate-friendly way (meta-analysis) (Hornsey et al., 2016). In general, the sum of beliefs (cognitive and affective) about a specific behavior results in attitudes (Klöckner, 2013).

3.2.2. Attitude

“A person’s attitude toward some object constitutes a predisposition on his part to respond to the object in a consistently favorable or unfavorable manner” (Ajzen et al., 1973,
There is a relationship between protective action and attitudes towards specific PEB (energy conservation; recycling) (Hines et al., 1987), but the degree of the relationship between environmental attitude and behavior depends on the scale used (Tarrant and Cordell, 1997). Attitudes impact behavior (Ajzen, 1987) and the willingness-to-pay for the environment (Kotchen and Reiling, 2000; Choi and Fielding, 2013). Attitudes towards energy conservation in combination with perceived behavioral control increase people’s intention to reduce household energy use (Abrahamse and Steg, 2011). The intensity of organic food consumption is also significantly related to the respondent’s attitude towards consumption and the environment (Welsch and Kühling, 2016), but implicit attitudes towards environmentally-friendly food are not associated with sustainable consumption6 (Panzone et al., 2016).

3.2.3. Awareness

Awareness is "knowing the impact of human behavior on the environment" (Kollmuss and Agyeman, 2002). People often state that they are uncertain about the causes of climate change and perceive it as a distant threat (Lorenzoni et al., 2007). When natural disasters occur, people become more aware of climate change. Values, place attachment and the awareness of disaster’s consequences impact PEB positively (Zhang et al., 2014). Awareness, in combination with education, impacts people’s willingness to participate in a green electricity program (Zorić and Hrovatin, 2012). People with a high awareness of ecotourism are more likely to financially support ecotourism projects in the locations visited by them, showing a willingness to pay more today in exchange for a better experience in the future (Meleddu and Pulina, 2016). The complexity of environmental problems, people’s incapability to trace climate change directly to its origin and the lack of observable, overwhelmingly significant signs - such as a natural disaster - to prove that it is an ongoing process act as limitations to environmental awareness (Kollmuss and Agyeman, 2002).

6Overview of SC: e.g., Jackson (2005); Tripathi and Singh (2016).
3.2.4. Norms

Norms\(^7\) are shared beliefs and can be described as vague guides to behavior in actual situations (Schwartz, 1977). Norms impact positively on PEB (Nordlund and Garvill, 2003; Thøgersen, 2008; Culiberg and Elgaaied-Gambier, 2016; Farrow et al., 2017) and can be divided into social and personal norms (Schwartz and Howard, 1982; Thøgersen, 2006), with social norms impacting a wide range of behaviors (review: Farrow et al., 2017). The impact of norms on PEB depends on the degree of its internalization (Thøgersen, 2006). Social norms become personal norms through internalization (Schwartz, 1977), but their impact on individual energy-saving practices is, at best, small (Arimura et al., 2016).

Displayed norms, like the internalized motivation of parents to behave environmentally friendly, influences children’s self-determined motivation for PEB (Grønhøj and Thøgersen, 2012). Country-level norms influence the norms of family and friends, which in turn affect their PEB (Culiberg and Elgaaied-Gambier, 2016). People are aware of norms (like preventing pollution), but if others pollute, they are likely to do so as well. Social norms which guide people to base their actions on symbolic-affective motives (e.g. referring to cars as status symbols) negatively affect PEB (Steg et al., 2001). Behaviors such as traveling by plane for holidays or using the car regularly are socially-accepted, guided by present norms and go unquestioned and are therefore difficult to change (Jackson, 2005; Lorenzoni et al., 2007). If being green became a shared social norm in a society, the benefit of a green-self image would multiply (Welsch and Kühlung, 2017). Acting in accordance with one’s (environmental) norms is either accompanied by positive (pride) or negative (guilt) feelings, in cases where one does not act in accordance with these norms (Steg et al., 2014). The influence of norms on PEB is also mediated by anticipated emotions (3.2.9) (Rezvani et al., 2017).

3.2.5. Values

Values influence behavior indirectly by activating norms, thereby creating a feeling of moral obligation (Schwartz, 1977) to act pro-environmentally (Nordlund and Garvill, 2003). Values are the basis of environmentalism (Stern, 2000) and a stable source of ongoing PEB.

\(^7\)Economists describe norms as informal institutions (based on e.g., imitation & tradition) influencing behavior.
Both ecocentric and anthropocentric values are associated with PEB (Kaida and Kaida, 2016) and they slightly increase awareness of environmental problems (Nordlund and Garvill, 2003). PEBs like reduction and reuse behavior are determined by a mixture of values, knowledge, and concerns (Barr, 2007). Values generally influence PEB through three different channels: by the perceived importance and likelihood of behavioral consequences, by norm activation and via environmental self-identity (Steg et al., 2014).

3.2.6. Identity

Norms and values impact behavior, but they are dependent on a person’s position in a certain social context. Identity defines who somebody is - their social category (Akerlof and Kranton, 2000, 2010) - by considering the influences exerted on them by social interaction. Community characteristics impact self-proclaimed environmentalism and influence a person’s predisposition to an environmental-friendly identity (Owen et al., 2010). Social identity predicts PEB, but the visibility of behavior moderates the relationship (Brick et al., 2017). People are more likely to make pro-environmental decisions if their social identity is related to a group that beholds environmental norms (Fielding and Hornsey, 2016). The self-expression of individuals is analogous, or at least close, to their perceived identity, which impacts PEB (Owen et al., 2010; Whitmarsh and O’Neill, 2010), even stretching to different choices of consumption (Barbarossa et al., 2017). People who identify themselves as green are likely to have, for e.g., positive perceptions of electronic vehicle attributes (Schuitema et al., 2013).

Identity mediates the relationship between values and PEB (Gatersleben et al., 2014) and values impact identity, which in turn impacts consumer intentions (Barbarossa et al., 2017). Californian environmentalists make greener consumption choices for household transportation, compared to the average consumer (Kahn, 2007). A green identity increases the extent and intensity of green behavior. But even the greenest (self-identified) individuals do not exhibit all PEBs all the time (Binder and Blankenberg, 2017).

3.2.7. Environmental knowledge

The possession of environmental knowledge increases the likelihood of PEB (Hines et al., 1987). One strategy to change peoples behavior is to provide them with new knowledge to influence attitudes towards environmental issues (Steg and Vlek, 2009). Providing households
with tailored information regarding their energy use reduces their energy use (Abrahamse et al., 2007). Contrarily, direct repeated information about the causes of climate change do not lead to the cutting down of carbon consumption (King et al., 2009), indicating that the type of information and information delivery is relevant.

An individual’s ecological world-view varies strongly from that of the other, depending on environmental knowledge in combination with socio-economic determinants (Halkos and Matsiori, 2017). People with environmental knowledge (e.g. about GHG emissions), knowledge about energy saving behaviors and environmental values are more likely to engage in energy-saving behaviors (Pothitou et al., 2016). The environmental knowledge of tourism students positively impacts their intention to take part in eco-tourism activities (Fatima et al., 2016). Lack of knowledge, confusion created by conflicting information, etc., act as PEB barriers (Lorenzoni et al., 2007).

3.2.8. Environmental concern

Environmental concern is defined as “the awareness or insight of individuals that the natural state of the environment is threatened through resource overuse and pollution by humans” (Franzen and Meyer, 2010, p.220). Actual disasters lead to worries regarding nature and as a result, more environmental concern (Goebel et al., 2014; Berger, 2010). Environmental concern positively impacts PEB (39 behaviors) (Schmitt et al., 2018) and leads to an increased propensity to volunteer, especially if individuals are very concerned about the environmental situation at hand (Binder and Blankenberg, 2016). They also influence purchasing behavior, energy consumption, (Tatić and Činjarević, 2010; Urban and Ščasný, 2012) and sustainable food consumption (Panzone et al., 2016).

The impact of environmental concerns on PEB (recycling of paper, plastics and organic material; use of watersaving installations) decreases with increasing behavioral costs (Diekmann and Preisendörfer, 2003). Wealth, measured in Per Capita GDP (1000$) predicts pro-environmental concern (Franzen and Meyer, 2010). Environmental concerns increase garbage reduction but do not impact any other PEB (reduction of garbage and electricity, 

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8Studies about the facets of environmental concerns: e.g., Van Liere and Dunlap (1980); Fransson and Gärling (1999); Schultz (2001); Xiao and Dunlap (2007); Dorsch (2014).
gas and automobile use) (Fujii and Gärling, 2003). Climate change concerns positively impact water and electricity mitigation behavior, especially in pro-environmentally motivated households (Nauges and Wheeler, 2017), and increase the probability of undertaking relevant action or paying for climate change mitigation (Dienes, 2015).

3.2.9. Emotions

Emotions as a predictive force for behavior have been neglected in cognitive psychology and neuro-science for a long time (Damasio, 1998). Emotions are a mental state of readiness, based on one’s own thoughts or appraisals of events (Bagozzi et al., 1999), and are related to behavior. An emotional involvement with the topic increases the likelihood of relevant action, given that the emotional involvement shapes attitudes and awareness (Kollmuss and Agyeman, 2002). Emotions can support PEB promotion and education programs, especially in the field of consumer behavior (Rezvani et al., 2017). Anticipated emotions influence consumption decisions more than experienced emotions (Mellers et al., 1999; Schuitema et al., 2013) and they affect the intention to act pro-environmentally (Rezvani et al., 2017). Emotions have no impact on the probability of giving (pro-environmental donation behavior), but influence the donated amount (Ibanez et al., 2017).

3.2.10. Habits

Habits are automatic responses in specific situations which do not require conscious intention (routine behavior) (Ouellette and Wood, 1998; Knussen et al., 2004). A resistance to change behavioral patterns as a result of long held habits is a PEB barrier (Lorenzoni et al., 2007; Carrus et al., 2008). Behavior, like travel patterns, is determined by habit rather than by rational calculation (Verplanken et al., 1997; Bamberg et al., 2003; Lorenzoni et al., 2007) and habitual drivers, for e.g., usually do not weigh the pros and cons of alternative transportation modes (Steg and Vlek, 2009). Giving up car use in favor of public transportation is found to involve “high costs” (Diekmann and Preisendörfer, 2003), even if public transportation is more environmentally friendly. However, a temporal interruption of people’s travel patterns (car drivers have to use public transportation) leads to a long-term reduction in car

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9Emotional disconnection is due to the fact that information about environmental degradation is often discomforting & challenges current ways of living (Kollmuss and Agyeman, 2002).
3.2.11. Locus of control & personal responsibility

Locus of control (LOC) refers to the perception of individuals as to whether they can change or achieve a desired outcome by their own actions or not. External LOC attributes an outcome to an external force, whereas an internal LOC means that outcomes can be achieved by personnel behavior. People with an internal LOC are more likely to take action related to PEB as changing an outcome seems more likely (Hines et al., 1987; Knussen et al., 2004; Johnson et al., 2004). If people possess an external LOC, they tend to externalize responsibility and ask for collective action. People in the UK, for e.g., perceive climate change as a collective problem, prioritizing and expecting government action - introduction of regulations or laws that push the people to act - ahead of and more than individual action, which they consider to be an insignificant difference (Lorenzoni et al., 2007). Energy savings and carbon reduction is highly dependent on one’s own moral obligation (felt responsibility), while felt obligation influences behavior that is stronger than one’s own perceived control (Chen, 2016). A denial of personal responsibility seems to be a major barrier for PEB (Lorenzoni et al., 2007).

3.3. Further determinants

Beside the above presented determinants, other individual, social and institutional determinants are likely to influence human behavior. We present further discussed factors below (see Table 1).
Table 1: Overview of further determinants of PEB

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<tr>
<th>Category</th>
<th>Focus</th>
<th>Recent findings</th>
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<tbody>
<tr>
<td>Social</td>
<td>Peers</td>
<td>Individuals do not behave like monads. Individuals with social ties to others who hold pro-environmental norms are more likely to engage in PEB (Videras et al., 2012). Peers positively influence the intensity of green consumption (Welsch and Kühling, 2016), positively impact the guiding of recycling behavior (Ari and Yılmaz, 2016) and influence the adoption of GHG mitigation of their neighbors (Babutsidze and Chai, 2018). Concerns about one’s own reputation impact PEB (Alpízar and Gsottbauer, 2015). A firm’s environmental strategy (green climate) positively influences employees intentions and green behavior (Norton et al., 2017).</td>
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<td>Individual</td>
<td>Subjective well-being</td>
<td>The happiness approach emerged as a novel approach to environmental valuation (Welsch and Kühling, 2009). The expectation of deriving pleasure (i.e. “warm glow”) from PEB impacts positively on the intention to engage in future PEB (Hartmann et al., 2017) and PEB positively impacts SWB (e.g., Villacorta et al., 2003; Welsch and Kühling, 2010; Suárez-Varela et al., 2016; Kaida and Kaida, 2016; Binder and Blankenberg, 2016; Schmitt et al., 2018). For a review of SWB and sustainability, see: Kasser (2017).</td>
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<td></td>
<td>CN (review: Restall and Conrad (2015))</td>
<td>describes the subjective connection of an individual to nature (Zelenski and Nisbet, 2014). It affects (environmental) attitudes and values. CN strongly impacts ecological behavior and SWB (Mayer and Frantz, 2004), but the used scale is discussed controversially (Perrin and Benassi, 2009). People associating themselves with nature are also more likely to possess environmental concern (Schultz et al., 2004).</td>
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<td></td>
<td>Place attachment</td>
<td>Place attachment, an attitude exhibited by people, affects pro-environmental intention (Ramkissoon et al., 2012). Place identification can lead to identity, sustainable behavior and sustainable attitudes (Uzzell et al., 2002).</td>
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<td></td>
<td>Political ideology</td>
<td>Partisanship and ideology influence environmental attitude (Guber, 2013). Democratic and Liberal-Left students show more environmental attitudes than Republican and Conservative students (Dunlap, 1975). Left-wing parties and individuals with similar political orientations exhibit more pro-environmental beliefs and attitudes (Neumayer, 2004).</td>
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<td>Category</td>
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<td><strong>Institutional</strong></td>
<td><strong>Sanctions</strong></td>
<td>While policy-makers emphasize the role of laws and embrace them, the effects of these on PEB have still not been conclusively analyzed. Environmental sanctions, employed in the context of environmental policy, prove to be an appropriate deterrent in Germany (Almer and Goeschl, 2010). Specific policies could be helpful in the promotion of recycling behavior (Kirakozian, 2016). Advice and threat of sanction increase cooperation (waste management) in the beginning, but the effect disappears as soon as the sanction is applied (Festré et al., 2017).</td>
</tr>
<tr>
<td><strong>Institutional</strong></td>
<td><strong>Development status of a country</strong></td>
<td>People in developed economies with intentions of PEB are more likely to exhibit PEB than people in developing countries (meta-analysis: Morren and Grinstein, 2016). The environmental Kuznets curve (EKC) e.g. describes the relationship between income and environmental quality (macro level), assuming that economic beginning is associated with environmental degradation, followed by the second phase of growth related to environmental improvements (turning point: 8000-10000 dollars per capita) (Grossman and Krueger, 1995). The existence of this curve is discussed controversially (Stern, 2004). In general, the rise of GHG emissions (carbon dioxide) in a country is related to the stage of industrial evolution of a country and its share of older people (Menz and Welsch, 2012). Within the EU, there are big differences in green purchase behavior (Liobikienë et al., 2016).</td>
</tr>
</tbody>
</table>
4. Conclusion

This paper offers a holistic overview of the economic and psychological PEB literature, presenting the determinants and behaviors which need to be considered in further empirical research. Based on our review, we summarize that PEB is determined by an interplay of socio-economic, psychological and further determinants, which differ in their intensity. Based on this interplay, individuals may have a preference for PEB. The coefficient of each determinant can either be positive or negative, given the specific type of behavior analyzed (low vs high cost behavior). An accurate understanding is important to successfully design studies, questionnaires, experiments and interventions in this research field. We show that the number of behaviors used to measure PEB differs highly within the studies, causing a broad heterogeneity in study results. PEB is a heterogeneous construct and should be treated as such. Focusing only on certain determinants can lead to misinterpretations regarding the causes of PEB. One limitation of this review is that it primarily included studies based on self-reported questionnaires. Experimental approaches have increased in recent years and require its own review.

There are several points that future research can draw and adhere to, given the room for improvement and further discourse. There is a need for more complex models (integrated frameworks), incorporating psychological, socio-economic and further determinants. Finally, researchers should be careful about the validity of variables and consider the necessity of well-defined types of PEB (Lam and Cheng, 2002; Chao and Lam, 2011; Kormos and Gifford, 2014). The conduction of more complex studies, covering all relevant behavioral clusters is required, supporting the understanding the impact of different determinants on single PEBs, leading to the development of a comprehensive PEB index which covers a comprehensive spectrum of behaviors.

Acknowledgements

We thank Martin Binder, Laura Birg, Jorge Guardiola, Anja Köbrich and Nadine Behncke for their helpful comments and suggestions. Special thanks to Avrina Jos Joslin Thambi.
### Table 2: PEB measures

<table>
<thead>
<tr>
<th>Recycling</th>
<th>Separate items for recycling</th>
<th>Use recycling bins for paper, cardboard, cans, glass</th>
<th>Compost garden or kitchen waste</th>
<th>Reuse paper or glass</th>
<th>Buy products with less packaging</th>
<th>When I'm outside, I avoid littering</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g.</td>
<td>Whitemash and O’Neill (2010); Lynn and Longhi (2011); Longhi (2013); De Leeuw et al. (2015); Binder and Blankenberg (2017)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
</tr>
<tr>
<td>Conservation of energy</td>
<td>Hang clothes to dry instead of using dryer</td>
<td>Shut off electrical appliances when not in use</td>
<td>Reduce air-conditioning use</td>
<td>Turn off lights when not in use</td>
<td>Reduce hot water temperature</td>
<td>Leave your TV on standby for the night</td>
</tr>
<tr>
<td>e.g.</td>
<td>Whitemash and O’Neill (2010); Lynn and Longhi (2011); Longhi (2013); De Leeuw et al. (2015); Binder and Blankenberg (2017)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
</tr>
<tr>
<td>Conservation of water</td>
<td>Turn off tap when washing</td>
<td>Minimize number of baths or showers</td>
<td>Turn off tap when washing dishes</td>
<td>Run washer/dryer only when full</td>
<td>Minimize water use in yard or garden</td>
<td>Turn off tap when brushing teeth</td>
</tr>
<tr>
<td>e.g.</td>
<td>Whitemash and O’Neill (2010); Lynn and Longhi (2011); Longhi (2013); De Leeuw et al. (2015); Binder and Blankenberg (2017)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
</tr>
<tr>
<td>Transport</td>
<td>Walk or cycle (for short journeys less than 2 or 3 miles)</td>
<td>Drive economically (e.g., braking or accelerating gently)</td>
<td>Take fewer flights when possible</td>
<td>Car share with others who need to make a similar journey</td>
<td>Use public transport (e.g., bus, train) rather than travel by car</td>
<td>Use an alternative to traveling (e.g., shopping online)</td>
</tr>
<tr>
<td>e.g.</td>
<td>Whitemash and O’Neill (2010); Lynn and Longhi (2011); Longhi (2013); De Leeuw et al. (2015); Binder and Blankenberg (2017)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
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<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
</tr>
<tr>
<td>Consumption - Food</td>
<td>Buy locally produced foods</td>
<td>Buy organic food</td>
<td>Grow your own food</td>
<td>Lawn waste</td>
<td>Buy food at a farmer’s market</td>
<td></td>
</tr>
<tr>
<td>e.g.</td>
<td>Whitemash and O’Neill (2010); Brick et al. (2017); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
</tr>
<tr>
<td>Consumption - Products</td>
<td>Buy energy-efficient appliances / Buy high-efficiency light bulbs</td>
<td>Buy environmentally-friendly products</td>
<td>Buy environmentally-friendly soaps or cleaners</td>
<td>Buy products made from recycled materials</td>
<td>Buy recycled paper products such as toilet paper or tissues</td>
<td></td>
</tr>
<tr>
<td>e.g.</td>
<td>Whitemash and O’Neill (2010); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
</tr>
<tr>
<td>Consumption - Reuse</td>
<td>Trade or share products with others rather than buy</td>
<td>Buy used products instead of new ones</td>
<td>Make your own products instead of purchasing</td>
<td>Fix something rather than buying something new</td>
<td>Use reusable bag / Take your own shopping bag when shopping</td>
<td>Reuse or repair items instead of throwing them away</td>
</tr>
<tr>
<td>e.g.</td>
<td>Whitemash and O’Neill (2010); De Leeuw et al. (2015); Brick et al. (2017); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
</tr>
<tr>
<td>Nutrition</td>
<td>Eat a diet based on organic, local, or free-range food</td>
<td>Eat a vegetarian diet</td>
<td>Eat food which is organic, locally-grown or in season</td>
<td>Avoid eating meat</td>
<td>How often do I eat dairy products such as milk, cheese, eggs, or yogurt</td>
<td>Consume biological products</td>
</tr>
<tr>
<td>e.g.</td>
<td>Whitemash and O’Neill (2010); De Leeuw et al. (2015); Brick et al. (2017); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
<td>Brick et al. (2017); Melo et al. (2018); Schmitt et al. (2018)</td>
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</tbody>
</table>
### Political behavior

<table>
<thead>
<tr>
<th>Action</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signing of (online) petitions</td>
<td>e.g. Stern (2000); Whitmarsh and O’Neill (2010); Dono et al. (2010); Schmitt et al. (2018)</td>
</tr>
<tr>
<td>Write to politicians about an environmental issue</td>
<td></td>
</tr>
<tr>
<td>Demonstration/protest for an environmental issue</td>
<td></td>
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<tr>
<td>Being a member in an environmental-protection group</td>
<td></td>
</tr>
<tr>
<td>Engagement in an environmental-protection group</td>
<td></td>
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<tr>
<td>Support pro-environmental candidates</td>
<td></td>
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<tr>
<td>Voting for “green” candidates</td>
<td></td>
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</tbody>
</table>

### Environmental citizen behavior

<table>
<thead>
<tr>
<th>Action</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Talk to children about how food is grown</td>
<td>e.g. Stern (2000); Dono et al. (2010); De Leeuw et al. (2015); Brick et al. (2017); Schmitt et al. (2018)</td>
</tr>
<tr>
<td>Attend pro-environmental meetings</td>
<td></td>
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<tr>
<td>Boycott products/firms harming the environment (write protest letters)</td>
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<tr>
<td>Spreading environmental knowledge</td>
<td></td>
</tr>
<tr>
<td>Protecting-nature activities</td>
<td></td>
</tr>
<tr>
<td>Reading environmental publications</td>
<td></td>
</tr>
<tr>
<td>Educate yourself about the environment</td>
<td></td>
</tr>
<tr>
<td>Discuss environmental topics, either in person or with online posts (Facebook, Twitter, etc.)</td>
<td></td>
</tr>
</tbody>
</table>

### Long term PEB decisions

<table>
<thead>
<tr>
<th>Action</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installed a more efficient heating system</td>
<td>e.g. Melo et al. (2018); Schmitt et al. (2018)</td>
</tr>
<tr>
<td>Bought/ built an energy-efficient home</td>
<td></td>
</tr>
<tr>
<td>Installed insulation products at home</td>
<td></td>
</tr>
<tr>
<td>Changed to a green energy system (e.g., solar panels, wind turbine)</td>
<td></td>
</tr>
<tr>
<td>Installed a renewable energy system (e.g., solar panels, wind turbine)</td>
<td></td>
</tr>
<tr>
<td>Bought a water-saving product (e.g., low-flush toilet)</td>
<td></td>
</tr>
<tr>
<td>Bought a low-emission vehicle (e.g., hybrid, electric, biofuel)</td>
<td></td>
</tr>
</tbody>
</table>

### Intention - Willingness-to-pay

<table>
<thead>
<tr>
<th>Action</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Willingness to prioritize environment over economy</td>
<td>e.g. Stern et al. (1993); Whitmarsh and O’Neill (2010); Dono et al. (2010); Hornsey et al. (2016); Hartmann et al. (2017)</td>
</tr>
<tr>
<td>Willingness to pay higher prices in order to protect the environment</td>
<td></td>
</tr>
<tr>
<td>Willing to pay much higher prices in order to protect the environment</td>
<td></td>
</tr>
<tr>
<td>Willing to accept cuts in a standard of living to protect the environment</td>
<td></td>
</tr>
<tr>
<td>Willingness to pay extra dollars per year for income tax if the extra money is to be spent to protect the environment</td>
<td></td>
</tr>
<tr>
<td>How much increase in gasoline prices, in cents per gallon you would be willing to pay if the money was spent to protect the environment</td>
<td></td>
</tr>
<tr>
<td>Intention to sign up for a residential green electricity contract</td>
<td></td>
</tr>
<tr>
<td>Support for a tax on carbon dioxide emissions</td>
<td></td>
</tr>
</tbody>
</table>

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References


