# Multi-product category choices labeled for ecological footprints: Exploring psychographics and evolved psychological biases for characterizing latent consumer classes

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## Abstract

This paper explores psychographics and evolved psychological biases to characterize consumer segments regarding pro-environmental choices. Based on survey-evidence from Germany, we analyze consumer preferences for two product categories, a food-staple and a non-food staple, labeled for carbon and water footprints. Latent class analysis is employed to identify and characterize distinct consumer segments as a function of consumers' 'ecological worldview', consumer involvement, motivation to attend to product label information, personal values, as well as consumers' environmental group membership and donation behavior. Results suggest that latent segments of ecologically-oriented consumers can be differentiated from price-sensitive segments, with the former appearing less prone to certain evolved psychological biases compared to the latter segments. In contrast to previous work on self-reported ecologically conscious behavior, our results highlight the role of personal values, in particular that of personal health. This is found to be valued less by ecologically-oriented consumers, indicating that such individuals may have a strong communal focus in their value orientation. In terms of policy implications, our findings suggest that sustainability labels can provide valuable and interpretable information to consumers, yet more effective intervention efforts may require a stronger focus on targeted information provision with regard to carbon rather than water footprints.

**Keywords:** carbon footprint; water footprint; environmental sustainability; personal values; Germany; adaptive psychological biases; latent class analysis

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> "Interventions designed to promote sustainable behaviors have not always been successful, because they tend to ignore important facets of human evolved psychology." (van Vugt, Griskevicius & Schultz, 2014: 15)

## (1) Introduction

A growing body of literature suggests that a large portion of climate-related emissions are caused by current diets and individual consumption decisions (Scherer et al. 2016; Armel et al. 2011; UBA 2007). This highlights the importance to improve our understanding of sustainable consumption behavior, and to identify why consumers engage in unsustainable behaviors (McDonagh and Prothero 2014).

In order to further our understanding regarding peoples' incentives to act in a sustainable manner, and to shed light on pro-environmental behavior, a large body of previous work has profiled "green" consumers. To investigate this type of consumer with respect to environmentally responsible consumption behavior, some analyses focused on the role of sustainability labeling as it relates to purchase intention and quality perception of products (e.g., Grebitus et al. 2015; de Andrade et al. 2017). Studies have identified significant market potential for sustainable products (e.g.,Vigani et al. 2015; Zhou et al. 2016), but research regarding attitudinal and behavioral issues underlying particular consumer segments remains relatively sparse. While recent work suggests that consumers committed to environmentally sustainable products believe that their actions will be effective in contributing to sustainable development (e.g., von Meyer-Höfer et al. 2015), there remains a need to investigate to what extent involvement, ecological orientation and other psychographics, and underlying evolved psychological biases of human behavior (van Vugt et al. 2014; Griskevicius et al. 2012), contribute to identifying and explaining consumer segments that are likely to select

environmentally sustainable products.[1] The objective of this paper is to address this gap in the literature with regard to two different product categories, aiming for broader generalizability of our findings.

Our approach builds on earlier explanations of consumer decision making, by incorporating latent psychometric constructs and socio-demographic characteristics in consumer choice models to identify distinct consumer segments (McFadden 1986; Swait 1994). However, despite a large body of literature that has applied latent class analysis (e.g., Nilsson et al. 2006; Koistinen et al. 2013) or hierarchical cluster analysis (e.g., Schnettler et al. 2015) to explore consumer heterogeneity in the context of sustainable production and consumption, there is still a lack of latent class studies on sustainable consumption capturing psychographics and exploring psychological aspects, as they relate to product or label design strategies (e.g., de Angelis et al. 2017). Further, previous work has suggested that most consumer models accounting for sustainability are narrow with regard to the attributes in focus, and that models with a broader perspective focusing on the general population would be valuable (e.g., Pedersen and Neergaard 2006). This paper contributes to the literature, using a widely-encompassing assessment of individual differences to define consumer segments based on data from a survey conducted in Germany (n = 1579). Our research analyzes differences in individuals' environmental attitudes with a particular focus on an 'ecological worldview' (Dunlap et al. 2000), personal values (Rokeach 1973), and other characteristics as a means to provide novel insights into factors that could facilitate interventions toward more sustainable consumption patterns.

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[1] We follow Demby's (1994) definition of psychographics, in terms of "The use of psychological, sociological, and anthropological factors, such as benefits desired (from the behavior being studied), self-concept, and lifestyle (or serving style) to determine how the market is segmented by the propensity of groups within the market--and their reasons--to make a particular decision about a product, person, ideology, or otherwise hold an attitude or use a medium."

The following evolutionary psychology perspective put forward, and its focus on evolutionary biases, is motivated by several factors. First, the evolutionary psychology literature emphasizes the benefits of market segmentation, as it highlights individuals' varying sensitivity to different environmental interventions, suggesting that a "diversified, market-segmented approach might work best" when designing interventions to promote sustainable behavior (van Vugt et al. 2014: 26). Second, an evolutionary perspective enriches and improves our understanding of human behavior, resulting in an improved effectiveness to respond through product labelling and public (information) policy provision. In the words of van Vugt et al. (2014: 3), the aim of an evolutionary bias perspective is "to show how we can better respond to environmental problems through an improved understanding of evolved human nature", thereby complementing insights from other theory frameworks (e.g. Ajzen 1991; Thaler and Sunstein 2008). A focus on psychological biases through an evolutionary framework provides, thus, the benefit of an integrative theory for understanding the ultimate reasons why we do the things we do, and is therefore not in competition with these models (Griskevicius et al. 2012; Vugt et al. 2014).

Although an evolutionary perspective does not assume that people will always be consciously aware of the ultimate reasons for their decisions (van Vugt et al. 2014: 5), we need to distinguish between *proximate* behavioral causes (e.g., put forward by the theory of planned behaviour, Ajzen (1991): the consumer is impulsive) and *ultimate* behavioral causes which refer to relatively immediate psychological triggers for behavior (e.g., Kenrick et al. 2010: what leads the consumer to make impulsive choices?) that influence environmental outcomes (van Vugt et al. 2014), and are thus relevant for effective private and public interventions. Therefore, understanding the ultimate reasons for choices helps us with regard to the search for suitable private labelling initiatives and public intervention strategies, whereas neglecting ultimate reasons limits the search for intervention strategies (van Vugt et al. 2014: 5). More specifically,

and as further discussed below, a key benefit of accounting for evolved psychological biases lies in the insight that strategies aimed to change consumer behavior might fail if those strategies are mismatched with evolved psychological tendencies (van Vugt et al. 2014).

For the purpose of our empirical study, we concentrate on those biases which we deem most relevant in the context of the issues at hand, including self-interest, social imitation, individuals' tendency to disregard concerns they cannot see or feel, and future discounting. We are therefore drawing a sub-set from a broader set of psychological biases discussed by van Vugt et al. (2014) and in related work (Griskevicius et al. 2012). In Appendix I, we provide a summary of these and other key biases, and arising opportunities for intervention.

The remainder of the manuscript is as follows: section 2 provides a discussion of relevant literature, followed by the presentation of methods and the discussion of our empirical results (section 3) and conclusions (section 4).

## (2) Literature

Faced with a vast and growing literature (e.g., Akehurst et al. 2012; Diamantopoulos et al. 2003; do Paço et al. 2009; Jansson et al. 2009; Pedersen and Neergaard 2006; Straughan and Roberts 1999; Thomsen and McAloone 2015), McDonagh and Prothero (2014) have identified five streams of sustainability discourse with a focus on consumer behavior and marketing. Our work falls into their first research stream, which relates to consumer attitudes, behavior and preferences, and investigates various characteristics of the individual. This literature stream has studied pro-environmental behavior (e.g., Turaga et al. 2010; de Angelis et al. 2017; Kumar et al. 2017) and consumers' underlying motivations (e.g., de Medeiros et al. 2016). The literature has put forward evolutionary psychology explanations, including self-interest, social imitation (copying the behaviors of others), future discounting (valuing the present more than the future) and individuals' tendency to disregard concerns they cannot see or feel and thus experience

(Griskevicius et al. 2012; van Vugt et al. 2014). As for the latter, the evolutionary basis relates to how the brain developed in an ancestral world, in which a physical and instinctual link between behavior (e.g., I pollute my cave) and the environment (the cave becomes uninhabitable) existed. The evolutionary consequence was that since early humans did not face distant, slow-moving environmental problems, the brain did not evolve to be alarmed when confronted with dangers that we cannot experience with our senses (van Vugt et al. 2014: 22). This early environment contrasts today's world of consumption with its frequent disconnect between behavior (e.g., I buy a manufactured product in the store) and its environmental consequences (the factory is poisoning the river downstream) (Griskevicius et al. 2012). Thus, in a world of packaged and manufactured goods, it is more difficult to appeal to our evolved sensory mechanisms to motivate environmental action (van Vugt et al. 2014). As a consequence, in the modern world of consumption, where tangible links and visceral cues are difficult to implement at the point of sale of a typical retail environment, the challenge is to employ proxy stimuli that appeal to pro-environmental behavior and peoples' innate love for nature (biophilia). One strategy for using such stimuli is to have consumers focus on distant environmental problems by presenting them with statistics (Griskevicius et al. 2012) and, possibly, by linking such statistical and facts-based information with other visual measures at the retail level (e.g., a pro-environmental product label with carbon or water footprint numbers). Therefore, it is of interest to consider insights gained from research on product labeling as it relates to sustainable consumption in general, and footprint labeling in particular.

The footprint labeling literature is based on the concept of ecological footprints espoused by Rees (1992). Following this concept, carbon footprints refer to the amount of $CO_2$ created, and water footprints refer to the amount of water used in the supply chain, from production through distribution. The footprint labeling literature suggests that a plethora of sustainability labelling schemes may affect consumers' purchase intentions and quality

perceptions (Grebitus et al. 2015; de Andrade et al. 2017). Furthermore, it points out communication challenges for consumers and regulators alike (Dendler 2014), and suggests that a broadened use of information strategies - including ecolabels - is necessary in an effort to look beyond the minor market share of specific green consumers (Rex and Baumann 2007). The rapidly expanding body of literature has explored consumer practices holistically across key consumption areas, providing a systematic overall framework to identify opportunities to promote climate change mitigation (Schanes et al. 2016). Yet, the majority of the work addressing green consumerism is focusing on individual consumption areas to identify consumer purchasing behavior for sustainable products, mainly by employing data from surveys capturing individual consumer purchase habits, attitudes, and demographic features (e.g., Akehurst et al. 2012; Diamantopoulos et al. 2003; do Paço et al. 2009; Jansson et al. 2009; Pedersen and Neergaard 2006; Straughan and Roberts 1999). Such survey work has also analyzed green consumerism in terms of the food-miles notion, suggesting that typical UK consumers intercepted in supermarkets are concerned about where their food has come from, although a substantial attitude-behavior gap could be identified (Kemp et al. 2010). Comparative survey analysis from Japan and the UK (Günther & Saunders 2012) has also investigated consumer knowledge regarding sustainability issues, attitudes and preferences, comparing different label claims (incl. information on a package's recycling and reusability, eco-friendly packaging, carbon emissions labeling), to show that in terms of relative desirability, recycling claims were the most desired label claims in both countries, and that water footprint knowledge was low in both countries. This finding regarding recycling claims had previously also been identified for UK consumers, while highlighting that consumers placed most value on attributes such as price, quality and taste (Gadema and Oglethorpe 2011). Carbon footprint labeling has been further explored with regard to consumers' ability to process such information (Japanese undergraduate students), contrasting read-only conditions (such as

in our paper) with consumers' ability to actively search for such information, to conclude that the latter exerts a greater positive impact on consumers' information comprehension and product valuation (Kimura et al. 2008; Kimura et al. 2010). Other survey-based work on carbon footprint labeling based on Chilean consumers has highlighted that further attributes, such as packaging and country-of-origin, are also relevant attributes in the case of cheese (Schnettler et al. 2015).

Survey-based work from Germany on tea suggests that products labeled as sustainable appeal mainly to consumers who already care about the environment (von Meyer-Höfer et al. 2015). Similarly, survey-based analysis from Asia suggests that prior purchase or consumption experience of green products is an important predictor for subsequent purchase of green products (Biswas and Roy 2015). A survey-based study on green process and product characteristics for potential automobile and furniture purchases by de Medeiros et al. (2016) also suggests that risks associated with these products (incl. social and financial risk) can be highly relevant to purchase decisions. An earlier study by Straughan and Roberts (1999) combines demographic and psychometric variables to predict self-reported ecologically conscious consumer behavior. Their analysis replicated profile characteristics from a previous study (Roberts 1996), based on a narrow student-based convenience sample. Straughan and Roberts (1999) and Diamantopoulos et al. (2003) each stress the importance of adding psychometric variables to profile "green consumers". Akehurst et al. (2012) build upon Straughan and Roberts's (1999) study by incorporating an additional component of assessing self-reported green choices, namely ecological consciousness. Using a convenience sample, the authors find gaps between stated intentions to purchase and self-reported purchases to be smaller when ecological consciousness was high. The study also concludes that individuals' ecological consciousness is highly influenced by altruism and the perceived effectiveness of own behavior. Do Paço et al. (2009) use a convenience sample and psychometrics to identify a

sustainable consumer segment using self-reported environmental behavior constructs, including environmental shopping behavior and recycling. Jansson et al. (2009) study Swedish car owners' values, beliefs, norms, habits, and personal capabilities to identify pro-environmental purchases via cluster analysis. Instead of considering psychometrics as potential drivers for pro-environmental choices, a recent analysis by de Angelis et al. (2017) uses product design as driver of new green product acceptance, in a study aligning sustainable consumption with sustainable innovation (sunglasses).

Considering the above evidence on survey-based work, the footprint labeling literature has assisted us to advance our understanding of the effects of fact-based environmental labeling information on consumer choices. This also applies to experiment-based work. On the basis of computer-based experiments in Sweden, footprint labeling has been judged to be effective in influencing sustainable choices for less ecologically-oriented consumers as well as for those who are committed (Grankvist et al. 2004). More recently, and while not accounting for psychographics, Vecchio and Annunziata (2015) employ an experimental auction approach to analyze determinants of willingness-to-pay for chocolate bars with differing sustainability labels. Other work based on footprint labeling has employed single- and double-bounded dichotomous choice models to study consumers' willingness to pay for products labeled for carbon emission in Egypt (Mostafa 2016). Furthermore, attributed-based choice experiments were conducted to analyze willingness to pay for toilet paper, potatoes, ground beef and yoghurt labeled for water and carbon footprints, focusing on cultural, trust and value differences between European and North American consumers (Grebitus et al. 2016; Grebitus et al. 2013; Grebitus et al. 2015).[2] In a recent study comparing Canadian and German consumers, Peschel

[2] Other work on perceptions of potential consumers has also accounted for cultural differences as they can affect consumer choices (de Medeiros et al. 2016).

et al. (2016) emphasize the importance of objective and subjective knowledge as well as usage experience in making decisions for environmentally friendly products, notably minced beef and potatoes. Minced beef has also been studied in Finland, to conclude that the presence of carbon footprint information decreases the popularity of minced beef relative to minced pork, while such information was associated with low utility levels (Koistinen et al. 2013). Most recently, de Andrade et al. (2017) employ preference mapping to explore the influence of sustainability labeling on the sensory acceptance of products (chocolate), highlighting the importance of sensory attributes, an aspect that has previously been emphasized by Kimura et al. (2010).

**(3) Theory**

The above literature has accounted for several behavioral constructs in the context of sustainable consumption, which we discuss below more in-depth, to motivate the subsequent empirical analysis. These behavioral constructs can be related to several theoretical frameworks, including Rokeach's (1973) personal values framework, nudge theory (Thaler and Sunstein 2008) and the theory of planned behavior (Ajzen 1991). In the context of the following empirical study, Rokeach's (1973) theory of personal values is most notable. This theory defines a value as an "enduring belief that a specific mode of conduct or end-state of existence is personally or socially preferable to an opposite or converse mode of conduct or end-state of existence" (Rokeach, 1973: 5). We apply this theory and the underlying Rokeach Value Survey (Rokeach 1973) as part of our subsequent latent class choice analysis, noting that there is widespread evidence that these personal values can predict consumer attitudes and behavioral intentions (e.g., Kamakura and Novak 1992), also in the context of sustainable consumption (e.g., Thøgersen and Ölander). Considering that such enduring beliefs can impact consumers' pro-environmental choices, it is unsurprising that 'nudging', which relates to "any aspect of the choice architecture that alters people's behaviour in a predictable way without forbidding any

options or significantly changing their economic incentives" (Thaler and Sunstein 2008: 6), has been applied to the debate of informing versus nudging in environmental policy (e.g., Ölander and Thøgersen), as well as in the health and labeling debate involving traffic light food labeling (e.g., Oliver 2013; Marteau et al. 2011). The study of pro-environmental preferences and behavior has also been explored through the lens of Ajzen's (1991) theory of planned behavior and extensions (e.g., Kumar et al. 2017; Chen 2016; Steg et al. 2009; Kollmuss et al. 2002). In this model, subjective norms (e.g., individual perceptions driven by judgment of others), perceived behavioral control and an individual's evaluation of behavior (e.g., attitude toward the purchase of pro-environmental goods) drive individual readiness to perform behavior (purchase intention), ultimately impacting the behavior in question. While Ajzen and Fishbein's (1980) earlier theory of reasoned action and its extension (Ajzen's 1991) has been widely applied to the study of ethical consumption, it has primarily focused on modeling consumers' decision-making up to the point of behavioral intention (e.g., Shaw et al. 2013; Arvola et al. 2008; Shaw et al. 2000).[3]

As suggested by van Vugt et al. (2014), the above established theoretical frameworks (Ajzen 1991; Thaler and Sunstein 2008) may ultimately appeal to evolutionary theory as an overall framework, if we seek ways to influence pro-environmental behavior.[4] In the following

[3] In light of existing methodological linkages that are rarely highlighted in other works, consider the link between nudge theory and the evolutionary bias perspective, as van Vugt et al. (2014: 8) highlight: "An evolutionary perspective suggests that strategies to change meat eating behavior could be more effective if they are directly matched to our evolutionary tendencies such that they "nudge" individuals into behaving sustainably (cf. Thaler & Sunstein, 2008).", for example if foods look and taste meaty. Similarly, and in reference to Steven Pinker's (2002) insight that the human mind is not a blank slate, in terms of other factors than culture determining preferences and behaviour, van Vugt et al. (2014) remind us of the practical benefits of accounting for an evolutionary perspective: "A blank slate perspective implies that marketing campaigns can be equally effective in persuading people to behave in one way or in the exact opposite way." (van Vugt et al. 2014: 7).

[4] "An evolutionary framework provides an integrative theory for understanding the ultimate reasons for why we do the things we do and is therefore not in competition with these models. … Evolutionary theory provides a meta-theoretical framework to understand the origins of all living matter." … "we do not suggest that there are no other theoretical frameworks to understand the reasons why humans cause environmental problems. The values framework (Schwartz, 1992), the Value-Belief-Norm framework of environmentalism (Stern, 2000), self-determination theory (Deci & Ryan, 2002), social norm theory (Cialdini et al., 1990), the BUC(K)ET-model

sections, we relate to these theoretical frameworks and the underlying behavioral constructs in more detail, in order to conceptually introduce those psychographics and socio-demographic characteristics that are further analyzed in the subsequent empirical latent class analysis.[5]

*Attitudes* account for the assessment of a psychological entity by the consumer and affect cognitive processes, e.g., perception. Depending on their strength, they can influence purchase decisions (e.g., Barber 2009; Lee and Yun 2015). Consumers develop attitudes based on beliefs associated with the probability and nature of consequences of behavior (Ajzen 1991; Trafimow and Finlay 2002). We hypothesize that a stronger attitude towards ecological issues, as for example encompassed by the 'ecological worldview' of Dunlap et al. (2000), increases the propensity for pro-environmental choices.

*Motivation* is considered one of the cornerstones to attitude change. This can, in turn, influence more sustainable choices. Our reasoning relates also to evolutionary psychology, since people tend to disregard environmental problems that cannot be seen or felt (Griskevicius et al. 2012), thereby impacting environmental behavior. Through our survey instrument, we present a distant environmental problem, as it cannot be experienced during the actions of completing the survey. However, through product-related label information, we aim to create an observable relationship between behavior and environmental consequences (Griskevicius et al. 2012: 118). It is, thus, anticipated that consumers who generally attend to, i.e., usually read product-related label information, are more motivated to make informed choices (e.g., Moorman 1990).

(Fiske, 2004), the theory of planned behavior (Ajzen, 1991), and nudge theory (Thaler & Sunstein, 2008) also provide key insights into relevant psychological drivers of environmental behavior." (Van Vugt et al. 2014: 9).

[5] As is emphasized in the methods section, we conducted focus group discussions to explore the empirical relevance of psycho-demographic characteristics following the overall conceptual considerations.

*Involvement* is driven by current external variables (situation, product, communication) and past internal variables (enduring, ego, central values) that cannot be observed (Rothschild 1984). Put differently, involvement relates to the level of "perceived personal relevance" induced by stimuli that individuals relate to goals that are situation-specific or enduring (Mitchell 1979; Zaichkowsky 1985). Those goals, central values (Rothschild 1984), or a product's symbolic value provide therefore the antecedence for the kind of involvement and the associated consequence of consumer behavior (Kapferer and Laurent 1985). The consequences of involvement are types of searching, information processing and decision-making (Rothschild, 1984), which include how frequently products are used (Verbeke and Vackier 2004). In our case, where the antecedent relates to a consumer's pro-environmental orientation (central value, goal), we hypothesize that such consumers show a greater involvement with regard to stated frequency of product use.

The concept of *lifestyle* is seen to reflect consumers' personal values (Rokeach 1973). Lifestyle metrics are widely used to segment and guide communication strategies (Bruwer and Li 2007). For such strategies, the choice of a segmentation approach has been advocated that builds on the extent to which behavior is aimed toward a particular goal, e.g., sustainable behavior (van Raaij and Verhallen 1994). Beliefs with regard to a specific behavioral goal are anticipated to provide a better explanation for specific behavior than general personal beliefs (e.g., Collins et al. 2007). It is assumed that these lifestyle choices can be associated with environmentally sustainable product choices in the sense that belonging to or supporting environmental groups increases the likelihood of choosing sustainable products. Such behavior is also anticipated from evolutionary psychology: Griscevicius et al. (2012) and van Vugt et al. (2014) state that social imitation (in our case: environmental group membership) helps to explain environmental behavior in that social imitation with respect to copying others to spur

green behavior and foster pro-environmental social norms (van Vugt et al. 2014) is likely more prevalent among ecologically-oriented consumers.

Similarly, one may conjecture that consumers who live in an urban area are more likely to choose sustainable products, as they are more likely to encounter and imitate social norms and pro-environmental behavior (Griscevicius et al. 2012; van Vugt et al. 2014), compared to consumers living in rural areas. This argument also receives support from earlier empirical evidence which documents that urban consumers express a greater willingness to pay for environmental causes than others (Steentjes and van Vugt 2013).

*Values* are seen as concepts or beliefs, which guide the selection of behavior in order to achieve desirable outcomes, based on their relative importance to individuals (Schwartz and Bilsky 1990; Schwartz and Bilsky 1987). Values can explain personal goals and serve to allow evaluation and justification of behavior, whether it is an individual's own behavior or the behavior of others, contributing importantly to the formation of attitudes (Thøgersen and Grunert-Beckmann 1997). They guide people's actions and impact preferences and decision making (Vinson et al. 1977), including how consumers themselves are engaging in sustainable consumption and/or anti-consumption behavior (Cherrier et al. 2011; McDonagh and Prothero 2014). We expect that in particular three values and value composites from Rokeach's (1973) value survey (Schwartz and Bilsky 1987, for details of composition and earlier relevance in Germany) namely, *delayed gratification* (incl. the values of self-control, wisdom, inner harmony), *personal health*, and *societal security* (incl. the values of world beauty, equality) are relevant for pro-environmental behavior (e.g., Connor et al. 2003; Grebitus et al. 2013).

In particular, we anticipate that *delayed gratification*, due to its focus on self-control, is relevant for environmentally sustainable choices, since consumers are likely to find it difficult to value the present lower than the future, and, thus, will tend to discount the future

(Griskevicius et al. 2012; Appendix I).[6] Therefore, we hypothesize that people whose valuation of the future is lower than that of the present is indicated by scoring low in terms of delayed gratification, and are less likely to choose sustainable products. Support for this hypothesis also comes from recent work which suggests that consumers' exposure to natural landscapes reduces future discounting (van der Wal et al. 2013).

*Personal health* mainly relates to personal wellbeing and self-related goals. Achieving personal health through green consumerism has frequently been observed for credence attributes, such as, for "organic" (Vega-Zamora et al. 2013), and is also hypothesized to be related to footprint label attributes. Considering evolutionary biases, we expect that these biases work in favor of linking personal health with pro-environmental choices, as long as the information or product attributes that consumers can see or feel help to partly overcome consumers' tendency to disregard concerns they cannot experience (Griskevicius et al. 2012). Therefore, we hypothesize that consumers who value personal health highly are less prone to disregard such concerns, and are more likely to be identified with consumer groups that have a greater propensity to select environmentally sustainable products. Furthermore, being less focused on a self-related goal like personal health likely also signals a person's inclination to behave responsibly with regard to resource use in environments where the tragedy of the commons looms and environmental commitment (making a donation, belonging to an environmental group) signals a person's valuation of reciprocal altruism (Ostrom 1990; van Vugt et al. 2014).

*Societal security*, which includes equality and feeling attended to and cared for by others, is closely related to altruism, which is relevant for people's interest in communities and

[6] "Although there are individual differences in the ability to delay gratification, people in modern societies still overwhelmingly weigh immediate outcomes more heavily than distant ones." (Griskevicius et al. 2012: 123).

citizen-values (McGregor 1999; Prothero et al. 2011) and has previously been used to describe sustainable consumer profiles (e.g., Straughan and Roberts 1999) or sustainable household energy use (Poortinga et al. 2004). Societal security relates thus to dense social networks, which have been found to be more prone to support pro-environmental behavior through reciprocal altruism (van Vugt et al. 2014). It follows that consumers who value societal security highly are more likely to be associated with consumer segments that select environmentally sustainable products.

Regarding *socio-demographics*, the literature provides a variety of evidence on how age and gender influence pro-environmental behavior. Older consumers are often found to be less environmentally conscious in their choices, possibly because they will be less impacted by sustainable behavior due to lower life expectancy (e.g., Loureiro and Lotade 2005 on evidence from eco-labeled coffee; Blend and Van Ravenswaay (1999) on evidence from eco-labeled apples). However, the literature on organic product choices (Hughner et al. 2007) suggests that older consumers are highly receptive toward pro-environmental choices, whereas survey evidence from a large North-American city (Laroche et al. 2001) suggests that age has no significant effect and that previous literature is inconclusive on age. Furthermore, a somewhat ambiguous relationship between age and pro-environmental choices might be expected from considering how age relates to the cognitive capability to process such choices and the underling relationship between choices and environmental impacts. Although some evidence hints at a generally declining cognitive ability of consumers with age (Park 2000), changes in consumers' basic perceptual ability have been found alongside age to explain decreasing accuracy of choice tasks associated with nutritional information (Cole and Gaeth 1990). In sum, we hypothesize that pro-environmental choices are more likely to be observed by younger consumers.

With regard to gender, we expect to find significant differences in pro-environmental choices, in particular, evolutionary biology predicts men to more steeply discount the future

than women, based on theories of parental investment (Griskevicius et al. 2012), suggesting that females are more likely to make future-oriented pro-environmental choices. Further, we also anticipate from previous empirical evidence that men are less likely to make pro-environmental choices (Lee 2009; Diamantopoulos et al. 2003; Jain and Kaur 2006; Laroche et al. 2001), also in terms of eco-labeled coffee and apples (e.g., Loureido et al 2005; Blend et al. 1999), and in terms of carbon and water footprints (Daly and Wilson 2005). Similar evidence for an attitudinal predisposition of female relative to male consumers has been found for eco-labeled food products in general among German consumers (Moon et al. 2002) and for corporate social responsibility in the US (Jones et al. 2017). In sum, in light of the more ambiguous predictions and the more mixed empirical evidence outlined above regarding age relative to gender, we could expect gender differences to take a more prominent role than age differences in influencing consumer choices of sustainable products.

## (4) Methods

### 4.1. Sampling procedure and study design

Following a focus group interview involving 14 consumers for pre-survey design, an online survey (n=1579) was conducted in 2011 among German consumers. The sample was recruited by an international market research firm, and targeted to be representative in terms of region, gender, age, income and education. The sample consisted of 55% female participants, consumers with an average age of 45 years, and a household size of up to 7 individuals (20% of respondents had children in the household). About one third of respondents had received higher education, such as, a bachelor or master degree. The average annual income was 28,000 Euro. Choice experiments were conducted for both products. All respondents answered both the yoghurt and toilet paper choice questions. We used the software Ngene to generate the experimental design (Ngene manual 2012). Each choice set was comprised of the alternatives

A, B, and "none of these". To avoid fatigue effects, we used a blocked design with 10 blocks containing two choice sets each. Each respondent randomly received a block for each of the test product.

In the following, we first introduce the underlying survey metrics before explaining the experimental design further.

### 4.2. Psychographic measures

*Attitudes regarding the environment.* To identify such attitudes, the 15-item New Environmental Paradigm (NEP) question set by Dunlap et al. (2000) is applied, which primarily taps into "primitive beliefs" (Rokeach 1968) about the nature of the earth and humanity's relationship with it (Dunlap et al. 2000). The individual questions relate to the environment as a means to measure individuals' attitudes toward the 'spaceship earth' metaphor addressing whether or not individuals see a need to limit growth and 'be in balance with nature.' Using this scale, each question item is scored individually on a 5-point Likert-Scale with 5 being 'strongly agree' and 1 being 'strongly disagree'.[7] The NEP scale, which was originally designed to measure five dimensions of an "ecological worldview", has since been aggregated and treated as one single ecological worldview factor (Cronbach's alpha coefficient of .83 in the original study) (Dunlap et al. 2000). A higher score is considered to indicate a more ecologically-focused worldview.[8]

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[7] Following Dunlap et al. (2000: 432) "Three items were designed to tap each of the five hypothesized facets of an ecological worldview: the reality of limits to growth (1, 6, 11), antianthropocentrism (2, 7, 12), the fragility of nature's balance (3, 8, 13), rejection of exemptionalism (4, 9, 14) and the possibility of an ecocrisis (5, 10, 15). (Item 5 was in the original NEP Scale and typically showed up in the "balance" dimension.) The eight oddnumbered items were worded so that agreement indicates a proecological view, and the seven even-numbered ones so that disagreement indicates a proecological worldview."

[8] "Though not as foundational as the examples used by Rokeach, beliefs about nature and humans' role in it as measured by the NEP items appear to constitute a fundamental component of people's belief systems vis-à-vis the environment." (Dunlap et al. 2000, p. 428).

*Motivation.* We considered respondents' indication of whether they were motivated to read the information provided on a product label ("Do you usually read information provided on a product label?", answered on a 3-point scale: Yes, Sometimes, No). In line with previous work, we assume that this metric indicates motivation in terms of the nature to attend to and process labeling information, reflecting goal-directed arousal (Petty and Cacioppo 1986; Moorman 1996).[9] This may affect perceptions of usefulness of other types of information in product evaluation (Keller et al. 1997), which we perceive is footprint labeling information in the case of our experimental design.

*Involvement.* Consumers' product involvement was assessed based on reported purchase frequency (i.e., one or more times a week, every two weeks, once a month, less than once a month, never) of products from the tested product categories (yoghurt, toilet paper). In this, we follow Zaichkowsky (1985) who suggests to distinguish involvement into brand-decision and product involvement. Zaichkowsky (1985) views product involvement as the perceived relevance of a product class based on inherent consumer values, interests and needs.

*Lifestyle.* To capture lifestyle, survey participants were asked whether they are members of an environmental group, or support groups that aim to protect the environment via donations (environmentalism: Banerjee and McKeage 1994), and whether they live in an urban area.

*Values.* To elicit personal values, we apply the Rokeach Value Survey (Rokeach 1973) that consists of two lists, one of instrumental values (modes of conduct, such as responsibility, honesty) and one of terminal values (desired end-state of existence such as a sense of accomplishment, social recognition). On each list of values, participants are asked to rank the 18 values according to relative importance of each value as a guiding principle in their life.

[9] Earlier work (e.g., Balasubramanian & Cole 2002) has used a slightly different wording, to measure motivation with regard to nutritional information ("Today, I was interested in looking at the nutrition information on the cereal package.").

Then, the values are reduced into seven factors, following Rokeach (1973). Three of these values that we deem relevant in the context of sustainability as a function of previous work, namely *health, societal security* and *delayed gratification*, were included in the following analysis to measure the potential influence of personal values on choices of products carrying environmental footprint labels. In this way, we aim to benchmark our results with previous work that has documented the role of personal values for environmental sustainable behavior in general (e.g., Gatersleben et al. 2014, for evidence from the UK), the role of values with regard to carbon and water footprints (e.g., Grebitus et al. 2013, for evidence from the US) and for the role of values with regard to environmentally responsible water consumption in particular (e.g., Pinto et al. 2011, for evidence from Brazil).

### 4.3. Measuring stated preferences for sustainability

Following standard procedure, attribute-based choice experiments (Hensher et al. 2005; Louviere et al. 2000) were used to collect data on consumers' preferences for products labeled with water and carbon footprints. By presenting respondents with sets of alternatives from which they can choose preferred items (choice sets), the attribute preferences are investigated indirectly instead of asking the participants directly about their subjective valuation of specific product attributes. This approach helps to reduce hypothetical biases (e.g., Hensher 2010). Preferences for alternatives enable estimation of the utility an individual derives from the set of presented attributes. With this approach it is likely possible to limit social desirability bias and obtain results which are closer to real preferences than those obtained via direct questions on preferences (Norwood and Lusk 2011).

Our analysis is based on two product categories in order to provide a broader empirical basis to support the transferability of our results: yoghurt, chosen since it is a staple food in developed countries, and toilet paper, chosen as a familiar non-food staple product. Each

respondent was presented with two purchase scenarios, for each product category, in random order. Since this study was part of a larger research project (Grebitus et al. 2012, 2016), participants also made choices for potatoes and ground beef, and hence were able to evaluate yoghurt and toilet paper while having reference points for other products. In each choice set, we displayed three attributes — carbon footprint, water footprint, price — each of which took one of three different levels. For yoghurt, carbon emission equivalents labelled in kg were as follows: 1.09 kg, 0.95 kg, 0.81 kg; water usage was indicated in liters: 992.74 l, 863.25 l, 733.76 l. Three price levels were specified in Euros for a 750g tub of plain yoghurt: 1.43 €, 1.24 €, 1.06 €. The levels specified for toilet paper were 3.45 kg, 3.00 kg, and 2.55 kg for carbon emission equivalents; 189.75 l, 165.00 l and 140.25 l for water usage; and three prices were specified for a 12-roll pack of toilet paper: 4.79 €, 4.17 €, 3.54 €. These attribute levels systematically varied across alternatives (Hensher et al. 2005). Carbon equivalents and water usage figures were based on estimates from the literature (Chapagain and Hoekstra 2004).[10] Prices were identified based on market observations at different food retailers in Germany. In the choice experiment, two product alternatives were depicted for each scenario and defined in terms of the preceding attributes and attribute levels; participants selected their preferred option or could choose to buy neither of the two options (see appendix for an example of choice alternatives).

[10] So as to provide a common basic understanding of the footprint concepts, consumers were exposed to the following information: "Carbon emission equivalents are the amount of Carbon Dioxide (CO2) created by the grocery product and refer to greenhouse gas emissions over the whole life of a product. [For example, from the time an apple was grown and picked from a tree until its presentation at the point of sale, e.g., in a supermarket]. The lower the emissions, the better for the environment." "Water usage refers to the water used to produce, store and distribute a grocery product. [For example, the water used in the orchard to growan apple until it is picked from a tree and then until its presentation at the point of sale, e.g., in a supermarket]. The lower the water usage, the better for the environment." We also note that Upham et al. (2010) used a similar priming approach, providing respondents with a link to a video that "was designed to help elicit opinion, by priming on climate change as a rationale, explaining carbon labelling".

### 4.4. Latent class choice analysis

The basic approach for analyzing our consumer choices in the first stage is the application of a multinomial logit model (Greene et al. 2005). One of the drawbacks of this approach with its underlying random utility model (McFadden 1986) is that it does not account for heterogeneous preferences, but assumes that all respondents have the same preferences, i.e., the probability of individual *i* choosing alternative *j* with a certain set of attributes *x'* at time *t* can be expressed as:

$$Prob_{jit} = \frac{\exp(x'_{it,j}\beta\ )}{\sum_{j=1}^{Ji} \exp(x'_{it,j}\beta\ )} \quad (1)$$

To account for heterogeneous preferences in the sample, we apply latent class choice modeling. Latent class models draw on the assumption of finite mixture modeling, in which it is assumed that a mixture of unobserved segments exists in a population (Wedel and Kamakura 2000). These segments are characterized by segment-specific sets of identifiable parameters, where the segment-specific parameters are determined by the probability of a participant to respond in certain patterns to the given variables. In latent class choice experiments it is assumed that the utility an individual derives from a certain attribute is not individual-specific but depends on the unobservable class membership to one of $q$ = 1,2…$Q$ latent classes. The probability of class membership $q$ depends on individual *i* choosing alternative *j*, which consists of a certain set of observable attributes *x*', at time *t* (Greene and Hensher 2003):

$$Prob_{jit|q} = \frac{\exp(x'_{it,j}\beta_q)}{\sum_{j=1}^{Ji} \exp(x'_{it,j}\beta_q)} \quad (2)$$

It is assumed that there exists a total of $Q$ latent preference classes, which results in the overall log-likelihood:

$$lnL = \sum_{i=1}^{N} ln\left[\sum_{q=1}^{Q} C_{iq}\left(\prod_{t}^{Ti} Prob_{jit|q}\right)\right] \quad (3)$$

where $C_{iq}$ is the probability individual $i$ belongs to class $q$, and $\beta$ refers to the segment-specific utility function parameters. With this approach, a population can be segmented based on their observed response pattern. However, these classes do not explain how consumer groups differ regarding their psychographic and socio-demographic characteristics, i.e., how these classes are characterized. To explain how the segments differ with regard to their characteristics, we follow the Boxall and Adamowicz (2002) framework, which suggests that psychometric and socio-demographic characteristics influence the choices being made.[11] Incorporating further explanatory variables in $C_{iq}$ allows the simultaneous estimation of the choice and the class membership parameters. Consequently, $C_{iq}$ can be further parameterized as:

$$C_{iq} = \frac{\exp(z'_i \gamma_q)}{\sum_{q=1}^{Q} \exp(z'_i \gamma_q)} \tag{4}$$

where $z$*'s* and $\gamma' s$ refer to the class membership explanatory variables and the parameters to be estimated, respectively.

## (5) Empirical results

### 5.1. Descriptive statistics

Considering the main model components as discussed in the previous section, we first present descriptive statistics for individual differences. Regarding *ecological worldview*, we conducted a confirmatory factor analysis with maximum likelihood estimation. Jöreskog's rho as a measure of an unweighted sum score of the NEP items provided an acceptable estimate of construct reliability (0.83; 0.88 for optimally weighted sum score). Cronbach's alpha was at

[11] "A major advantage of this latent segment approach may be its ability to enrich the traditional economic choice model by including psychological factors. This integrated modeling strategy also offers an opportunity to merge various social psychological and economic theories in explaining behavior." (Boxall et al. 2002: 441).

0.82, comparable to the original Dunlap et al. (2000) study. German consumers indicated overall agreement with an ecological worldview (*M* 3.66, *SD* 0.537).

For *involvement,* 80% of the consumers stated to purchase yoghurt weekly or bi-weekly, 17% purchase yoghurt less frequently, 4% never. Toilet paper is purchased less frequently: weekly or bi-weekly by 33% but never by less than 1%. With regard to *lifestyle*, a relatively small share, specifically 8% of the sample, are members of an environmental group, while 18% donate to such groups, and 64% live in an urban area. Approximately 94% of participants indicate that they usually or sometimes read product labels, signaling that *motivation* is significant. Regarding personal *values*, health is most important, followed by societal security and delayed gratification. The following discussion presents the data analysis, following the main model components as presented in previous sections.

### 5.2. Latent class analysis

All models and analyses described were estimated using Latent Gold Choice 4.5 software. An aggregated multinomial logit (MNL) model was estimated first to serve as the reference model for each product category. The results are displayed in Table 1. All estimates for attributes in the model were significant, indicating their relevance for choices. The relevance of an attribute for choices, or relative attribute importance, was calculated as the ratio of the utility of an attribute over the sum of the utility of all attributes (Vermunt and Magidson 2005). The relative attribute importance for yoghurt was highest for price, explaining 40 % of variance in choice; water usage explained 35 %, carbon emissions accounted for 15 % of choice variability and the no choice option accounted for 10 %. The pattern was generally similar for toilet paper, however, an even higher level of attribute importance applies to price (57.8 %).

----------Insert Table 1 about here----------

To estimate the optimal number of classes based on the Bayesian information criterion (BIC), we estimated models (with the same specification) for one to four classes for each of the product categories. For yoghurt, the lowest BIC was achieved for a 2-class model. However, the Pseudo-$R^2$-value was considerably higher for the 3-class model. To test whether a 3-class model resulted in an improved model fit, a conditional bootstrap procedure with 500 draws was conducted. The test statistic of the conditional bootstrap is defined as -2 ($LLH_0$-$LLH_1$) where $H_0$ represents the more restricted model with k segments and $H_1$ the more general model with k + 1 segments (Vermunt and Magidson 2005). The p-value for the 3-class bootstrap model was significant, indicating that adding a third latent class to the model improves the overall model fit. In this model, there was no significant difference between classes in terms of utility of carbon emission levels, i.e., preferences did not differ across segments for this attribute, leading us to restrict these parameters to be the same across classes, as recommended by Vermunt and Magidson (2005). This modification improves model fit, because only one aggregate parameter for this attribute needs to be estimated instead of three separate parameters, which resulted in the lowest BIC estimate. We chose the restricted 3-class model as our final model for yoghurt, which fits the data considerably better than the 1-class model in terms of the Log-Likelihood estimate, BIC and Pseudo-$R^2$.

For toilet paper, the best model fit was achieved for a 3-class model, without any further modifications. For this model, the model fit criteria improved considerably relative to the 1-class model.

*Utility estimates of Latent Classes: characterization of sustainable consumers.*

The discussion proceeds by product class, starting with yoghurt, noting that segment-specific parameters in Table 2 are determined by the probability of a participant to respond in certain

patterns to the variables at hand. Yoghurt class 1 represents 43 % of respondents, class 2 represents 34% of respondents, and class 3 represents 23% of respondents. In the following discussion regarding *yoghurt* based on Table 2, we will refer to low (L), medium (M) and high (H) values, as follows for price (L=1.06 €/kg; M=1.24 €/kg; H=1.43 €/kg), carbon footprints (L=0.81 kg; M=0.95 kg; H=1.09 kg) and water footprints (L=733.76 l; M=863.25 l; H=992.74 l). The three classes are similar in that respondents preferred low prices and low carbon and water footprints.

Class 1, which we categorize as *ecologically oriented*, derives highest utility from low prices, low carbon emission equivalent values, and low water usage. Contrary to the other two classes, this segment showed a higher disutility for high water usage (-1.55***), but only slight disutility for high prices (-0.51***). Class 2, *price sensitive*, was characterized by high disutility for high prices (-3.99***). Class 3 derived highest utility from the "*no choice*" option. Utility derived from carbon footprints is diminishing with increasing footprint levels (suggesting that consumers understood the issue, and prefer pro-environmental product choices), yet for each level it was the same for all three segments (L=0.6***, M=-0.12*, H=-0.48***) as only one aggregate parameter was estimated for this attribute.

The *ecologically oriented* class was more likely to score high on the NEP scale relative to the other classes (0.15**), suggesting a strong ecological worldview, and furthermore suggesting that a strong ecological orientation goes along with high involvement in terms of likelihood of purchase frequency (0.34** associated with shopping for yoghurt on a weekly basis), and a high probability to read label information (0.46*** associated with always reading information provided on label). Thus, as expected intuitively and from the literature (e.g., Balasubramanian et al. 2002), consumers in this class associate more value with reading product information, indicating a higher motivation to make informed choices. Regarding lifestyle factors, our estimated classes only differ significantly with regard to donating for an

environmental cause. As expected, consumers in the ecologically oriented class are more likely to engage in donations (0.21**) than the aggregate average. Also, for consumers in this class, the likelihood to care about personal health was low and less important (-0.04*) compared to the average of the sample. Thus, when considering evolved psychological biases to explain these results further, we conclude that these information-driven consumers are less prone to disregard concerns they cannot see or feel (Griskevicius et al. 2012), as they are more likely to choose sustainable products that are accompanied by specific water or carbon footprint information. Since these information-driven consumers were also more likely to donate to an environmental cause, it is notable to compare our results to Steentjes and Van Vugt (2013), who have provided evidence that presenting consumers with video clips of natural scenery leads them to donate more money to environmental causes. Further, the donation behavior of this consumer class suggests that reciprocal altruism is relevant to them and, thus, that social networks matter since these can be understood as support for pro-environmental behavior through reciprocity (van Vugt et al. 2014).

The above findings suggest therefore that psychographic characteristics (including altruism and environmental concern: Straugham & Roberts 1999) are highly relevant for our understanding of environmentally friendly behavior with regard to carbon and water footprints, while they complement a significant literature stream that has highlighted the positive correlation between environmental concern and environmentally friendly behavior (e.g., Dunlap et al. 2000; Straugham & Roberts, 1999; Roberts & Bacon 1997; van Liere & Dunlap 1980). For this class of *ecologically oriented* consumers, we also conclude that the ability of footprint labels to act as an information (statistics) carrier likely helps to overcome some ancestral tendency with regard to concerns consumers cannot see or feel. We thereby provide evidence that such information strategies can likely work for sub-sections of the population, reducing the mismatch of strategies aimed to change behavior with evolutionary biases (van

Vugt et al. 2014), since the label can present a distant environmental problem by integrating statistical information (Griskevicius et al. 2012).[12]

The *price sensitive class* was more likely to score low on the NEP scale (-0.12*) and shows thereby little concern for the environment in terms of a general ecological worldview. This class was not as much driven by high involvement compared to the ecologically oriented class, as consumers in this class tend to be less likely to shop weekly for yoghurt (0.28* and 0.34**, respectively), and similarly consumers were not motivated to consider product label information compared to the ecologically oriented class (-0.20* associated with always reading information provided on label). In contrast to the ecologically-oriented class, consumers in this class are also less likely to donate to an environmental cause (-0.17*). As expected from the literature (Griskevicius et al. 2012; Daly and Wilson 2005), male consumers in the price-sensitive class receive a greater utility from being price-sensitive than female consumers (-0.18** for female). Contrary to the ecologically oriented class, the price sensitive class was more likely to value personal health highly (0.06**), but societal security less so (-0.06**), signaling a more self-centered consumer class that trades off personal (health-related) expenditure with expenditure on distant environmental problems. This observation, together with the finding that members of this class are unlikely to attend to product label information suggests that footprint labeling is not sufficient for such consumers to help reducing the mismatch of strategies aimed to change behavior with evolutionary biases, as far as people's disregard of problems is concerned which they cannot see or feel (Griskevicius et al. 2012).

Class 3 is the class of infrequent yoghurt shoppers. Females who are not motivated to read product labels dominate this class (0.19***), which contrasts with the dominance of male

[12] With regard to mismatch, the evolutionary perspective argues that information strategies such as those built on guilt to change behavior may be suboptimal, because they work against our evolved psychological tendencies (van Vugt et al. 2014).

consumers in the price-sensitive class (-0.18**). Class members tend to be indifferent with regard to societal-security and score low on personal health values.

In the following discussion regarding *toilet paper* based on Table 2, we will refer to low (L), medium (M) and high (H) values, as follows for price (L=3.54 €; M=4.17 €/kg; H=4.79 €/kg), carbon footprints (L=2.55 kg; M=3.00 kg; H=3.45 kg) and water footprints (L=140.25 l; M=165.00 l; H=189.75l). Consumers obtained greater utility from products with low prices and low carbon and water footprints, but the extent differed between classes. The *price sensitive* class was larger (accounting for 46 % of all respondents) compared to the price sensitive class for yoghurt choices (34%), but the general structure of segments prevailed across products, suggesting that there is some cross-product category robustness, and that our results for a staple food and non-food product could be transferrable to other related product classes. The larger size of the price sensitive segment could be attributed to the greater attribute importance of price as also observable in the MNL model. This could be considered alongside with previous research on German consumers, which found that consumers were more knowledgeable regarding prices for toilet paper than for yoghurt (Evanschitzky, 2004), suggesting greater price awareness among toilet paper consumers.

An *ecologically oriented* class, comprising 30 % of all respondents and a "*no choice*" class (accounting for 24 % of respondents) emerged. Interestingly, significant disutility was observed for high water footprint levels in both the price-sensitive and the ecologically oriented class, though as expected predominantly for the latter class (-1.37*** and -1.55***, respectively). The price sensitive segment gained utility from both low and medium carbon footprint emissions (0.37** and 1.06**, respectively). This differs from the other two segments which did not derive utility from medium carbon emission values, as the insignificant parameter estimates suggest. High and medium prices resulted in strong disutility across all classes, although it is striking that the disutility for high prices in the price sensitive class is almost triple

for toilet paper relative to yoghurt (-9.29*** and -3.99***, respectively), whereas the disutility for high prices in the ecologically oriented class is only about twice as high for toilet paper relative to yoghurt (-1.04*** and -0.51***, respectively). Respondents in the ecologically oriented segment derived highest utility from low water footprints, almost twice as high compared to utility from low carbon footprints (1.49*** and 0.88***, respectively).

Attitudes in terms of *global worldview* (Dunlap et al. 2000) and *involvement* performed poorly in explaining segment membership for toilet paper (the NEP coefficient is zero across segments, because the segments did not differ on this attribute), yet *motivation* with regard to reading label information had some explanatory power, with consumers in the ecologically-oriented class more likely to be characterized by those claiming to always read label information (0.24*), compared to consumers in the price-sensitive class to be more likely characterized by less motivated information processors, claiming to only sometimes read label information (0.16*). Strikingly, lifestyle explained sustainable choices well only for the ecologically-oriented class and for those opting out with respect to those who make a *donation*, signaling that consumers in the ecologically-oriented class are more likely to make donations (0.28***) relative to consumers opting out, as these are less likely to donate (-0.17*). Furthermore, consumers in the no choice segment were more likely to live in urban areas than average (0.09*). Also, consumers in the ecologically-oriented class were less likely to live in urban areas (-0.11*), which goes against our expectations when considering our rationale regarding imitation of social norms among urban consumers (section 2) as well as based on previous evidence (Steentjes and van Vugt 2013). Taking into account that the segments for yoghurt did not differ with respect to the urban-rural divide, we conclude from the above results (-0.11*) that the propensity to socially imitate among ecologically-oriented consumers is in some ways higher for consumers in rural areas. This may, perhaps, be explained through a social network

perspective, since rural communities were elsewhere found to be characterized by higher levels of social capital compared to urban communities (Onyx et al. 2000).

Striking and yet anticipated are also the toilet paper choice results for socio-demographics, in that consumers in the price sensitive class are less likely to be characterized by female consumers (-0.17***) (e.g. Loureio et al. 2002 for similar evidence regarding females from eco-labelled apples in the US), whereas the reverse is the case for consumers opting out (0.08*).

Considering personal values (Rokeach 1973) in the context of toilet paper choices, consumers in the ecologically-oriented class are less likely to be concerned about p*ersonal health*, compared to consumers in the price-sensitive segment (-0.04** and 0.02*, respectively). This finding is consistent with and can be rationalized through a well-known evolved bias, that of self-interest (Appendix I), in that a focus on personal health with its self- rather than communal focus receives support from natural selection logic (Dawkins 1976, in van Vugt et al. 2014: 10), while ecologically-oriented consumers are predicted to be less prone to such an evolved self-interest bias (Griskevicius et al. 2012).

Further, consumers in the price-sensitive class are also less likely to be concerned about social security and delayed gratification (-0.04* -0.03*, respectively), thereby suggesting that such consumers place little value on altruism and on self-control, and are less likely to tend to discount the future (Griskevicius et al. 2012). This result is therefore in line with our above hypothesis that people who value the future less than the present by scoring low in terms of delayed gratification are less likely to choose sustainable products, while this finding also conforms with previous work (van der Wal et al. 2013).

In light of the above results for both product classes, we receive support for taking an approach that encompasses a broader range of psychographics when describing consumer segments associated with pro-environmental choices. More specifically, when we consider our

empirical results for the Dunlap et al (2000) NEP construct, our results for yoghurt choices provide some additional construct validity, beyond Pierce et al. (1987), Stern et al. (1995), and others (e.g. Dunlap 2008; van Riper et al. 2014; Biasutti et al. 2017), yet in relative terms, Rokeach's (1973) personal values have overall contributed with greater class explanatory power.[13]

*Summary of attribute importance by class (carbon, water, price).*

For yoghurt and its ecologically-oriented class, water usage and carbon emissions accounted for 50 % of explained variance (Table 3). For toilet paper, this was lower at 41 %. In the price-sensitive classes, price explained around 60 % of choices for both product categories. Class 3 is the segment without distinguishable preferences for either product; members chose the no-choice option in most cases, and no-choice explains 36 % of variance in this class for yoghurt. The variance explained for toilet paper is considerably lower for this class, indicating that even though this was the only class to gain utility from the no choice option, price was still the most decisive factor. Overall, carbon emission equivalents contributed least to explained variance, which could be due to the fact that the underlying metric is less familiar to consumers compared to the metric underlying water footprints, since this the latter corresponds to a unit that consumers are familiar from their daily life. This is accompanied, in ascending order, by water usage, the no-choice option and price.

----------Insert Table 3 about here----------

[13] Dunlap et al. (2000: 430) suggest that "the most important evidence of the NEP Scale's construct validity comes from studies that have theorized that the NEP forms a primary component, along with fundamental values, of environmental belief systems and then have found this expectation empirically confirmed (Pierce et al., 1987; Stern, Dietz & Guagnano, 1995)."

## (6) Conclusions

Research on sustainable consumption has sought to find more effective interventions to facilitate changes in individual consumption behavior toward ecologically-sustainable products (McDonagh and Prothero 2014 ). Psychographics and especially socio-demographics have been at the center of such analyses. This paper suggests to also include a somewhat neglected perspective, that of evolutionary psychological biases, which has suggested to distinguish between proximate behavioral causes (Ajzen 1991) and ultimate behavioral causes which influence environmental outcomes (Kenrick et al. 2010), so as to improve the effectiveness of targeted and market-segmented interventions.

This paper applies a segmentation approach, to provide evidence from latent class choice modeling that interventions to facilitate changes in consumption behavior of footprint labeled products likely vary in their effectiveness with distinct consumer segments for which consumer heterogeneity is taken into account. Using a large-scale consumer survey, we apply latent class choice analysis to two products from different product categories labeled for carbon and water footprints (a staple food, yoghurt, and a staple non-food product, toilet paper).

The latent class model suggests to distinguish three classes, ecologically-oriented consumers, price-sensitive consumers and abstainers. In this regard, the size of the ecologically-oriented consumer segment is appreciably larger for the food-staple product investigated. About one third of respondents made their food-staple choices mostly based on price, while preferring the sustainable alternative if price was low. For both product categories, we observe that consumers in the ecologically-oriented class are more likely to be characterized by female consumers. This is consistent with previous work that has identified a predisposition of female consumers for pro-environmental choices (e.g., Jones et al. 2017; Lee 2009; Diamantopoulos

et al. 2003; Jain and Kaur 2006). Nevertheless, this has been found to vary as a function of female consumers' perceived identity, self- versus group-based identity (Pinto et al. 2014).

More generally, for the non-food staple, toilet paper, consumers associate significant and similar disutility for high water footprint levels in both the price-sensitive and the ecologically-oriented class. This contrasts with results for yoghurt, where consumers associate high disutility for high water footprint levels, but only in the ecologically-oriented class. For both toilet paper and yoghurt, we find that consumers in both the ecologically-oriented and the price-sensitive segment derive highest utility from low water footprints, almost twice as much compared with utility from low carbon footprints. This finding of a relatively higher utility from responsible water compared to carbon usage is also of interest in light of earlier latent class evidence, which suggests that consumers associate low utility with carbon footprint labeling (Koistinen et al. 2013). The general predisposition of ecologically-oriented consumers for less wasteful water usage has also been confirmed in an earlier study from Brazil, which found that responsible water consumers tend to be older and have lower levels of education (Pinto et al. 2011).

The results for water versus carbon footprint identify significant differences in behavioral intentions and underlying motivations. The most important factors to describe sustainable behavioral intentions, contributing to profiling the segments, were found to be motivation in terms of reported attention to product label information, several lifestyle attributes, ecological attitude, involvement with the product, as well as personal values. More specifically, our profiling of segments has accounted for several of Rokeach's (1973) personal values and for the role of an 'ecological worldview' (Dunlap et al. 2000). Overall, the results suggest that personal values rather than Dunlap's (2000) 'new environmental paradigm' question set provide a more effective means to characterize consumer classes in their pro-environmental choice behavior involving footprint labeling. Furthermore, considering those

personal values (Rokeach 1973) investigated and their explanatory power, we find that personal health is most important, followed by societal security and delayed gratification. Except for the muted importance of the value of societal security, our results support consumer profiling described by Straughan and Roberts (1999), who have previously combined demographic and psychometric variables to predict self-reported ecologically conscious behavior. We find, however, that respondents with a higher valuation of personal health are represented less in the ecologically-oriented segment. This supports the view that consumers' lower focus on a self-related goal like personal health goes along with consumers' inclination to behave responsibly and in altruistic ways with regard to resource use and pro-environmental commitment (van Vugt et al. 2014).

The latent class results further suggest that consumers' support for environmental groups through membership has little explanatory power for predicting class membership (irrespective of product class), supporting an elsewhere observed limited tendency for consumers to become active citizens in dealing with climate change issues (Prothero et al. 2011). This result of an insignificant contribution of environmental group membership to explain ecologically-oriented classes goes against our initial expectation, as we anticipated that social imitation and conformity with respect to copying others to spur green behavior and foster pro-environmental social norms (van Vugt et al. 2014) would likely be more prevalent among ecologically-oriented consumers. Our results regarding environmental group membership is also diverging from evidence on sustainable water consumption in Brazil, where Pinto et al. (2011) found that consumers with greater environmental awareness attach more importance to values such as conformity. However, the significant explanatory power of donation propensity for the ecologically-oriented consumer class (in both product categories) suggests that fostering network support through donations and reciprocal altruism matters significantly for this consumer group. This finding is of interest in that the role of reciprocal altruism could be

understood through the lens of evolved psychological biases, as dense social networks are more inclined to support pro-environmental behavior through reciprocal altruism (van Vugt et al. 2014).

Considering that climate change is a problem which is not experienced fully today, our results could be further rationalized with predictions from evolutionary psychology (e.g., Griskevicius et al. 2012; McDonagh and Prothero 2014), in that consumers with a higher ecological orientation tend to be less affected by evolutionary biases with regard to individuals' tendency to disregard concerns which they cannot feel or see, and with regard to future discounting (Appendix I). Especially for highly ecologically-oriented consumers (43 % and 30 % of our respondents for yoghurt and toilet paper, respectively), our results suggest that information labeling, in terms of a label presenting a distant environmental problem by integrating statistical information, can help with raising the effectiveness of interventions to advocate pro-environmental behavior (Griskevicius et al. 2012).

In terms of implications for marketers and public policy, we conclude therefore, and in line with recent work (e.g., Castka and Corbett 2016; de Andrade et al. 2017), that sustainability labels are likely providing valuable and interpretable information to consumers. Further, it likely proves valuable to go beyond socio-demographic differences, and account for psychographics as well as underlying evolutionary adaptive psychological biases in order to better understand and achieve more effective interventions that include more accurate profiling of consumers focused on sustainable consumption.

However, raising awareness towards environmental issues through labeling schemes is expected to be only one step toward influencing attitudes and motivations of consumers to make more sustainable choices. Yet our results seem to concur with previous work in that this has highlighted footprint labeling as an effective means to nudge particular consumer segments towards more sustainable consumption practices and a more responsible consumer-citizenship

(e.g., Thøgersen 2005). Increased involvement of consumer segments that are already prone toward pro-environmental choices – such as reflected in their donation behavior to environmental groups – may contribute to greater participatory consumer citizenship (McGregor 1999) in support of pro-environmental behavior. In today's age of social media, such participatory consumer citizenship could manifest itself in terms of "small virtual social networks to help spread good environmental practices" (van Vugt et al. 2014: 12).

From a public policy perspective, knowledge of what differentiates particular consumer segments could be used for the development of targeted public policies that promote the consumption of sustainable products from the vantage point of global warming. Such targeted public policy initiatives may be in the form of public informational campaigns, thereby complementing product-based carbon labels at the point of sales. In light of the significant and consistent higher utility (across product categories) that consumers associate with lower water footprints relative to carbon footprints, the question arises of whether such information campaigns are first and foremost needed with regard to carbon footprints.

Naturally, our paper faces a number of limitations that warrant further analysis. First, as a function of the very design of the experiments, the analysis has provided a limited view into consumers' attribute valuation with a focus on footprint attributes, omitting other attributes that have proved valuable in previous studies on carbon footprints, such as location in terms of locale of production and country-of-origin (e.g., Onozaka et al. 2011; Schnettler et al. 2015). A similar limitation by design constitutes the labeling relied upon, as a faceless commitment and information provision, relative to face-to-face commitments with vendors that have proved relevant in the context of food trust and credence attributes (de Krom et al. 2010). In light of the stated preference analysis of this paper, a further limitation applies to the potential hypothetical bias, although the meta-analysis of Murphy et al. (2005) has highlighted that a choice-based elicitation mechanism is important in reducing bias, which was found with a

median ratio of hypothetical to actual value of 1.35. Although consumers were provided with a basic definition of carbon and water footprints before proceeding to the choice experiments, a possible further limitation of this study could be that we did not control sufficiently for whether consumers knew the meaning of carbon and water footprints. One indication of this possible limitation is the fact that carbon emission equivalents contributed less to explained variance in the latent class models compared to water equivalents, suggesting that the relatively greater familiarity of consumers with water metrics might be part of the explanation.

Related footprint work on potatoes and minced beef (Peschel et al. 2016) has tried to explore how well-informed respondents consider themselves to be about ways to reduce carbon emissions and water usage. Other work has highlighted the importance of educating consumers with regard to carbon footprints (Wikoff, Rainbolt, & Wakeland, 2012; Upham et al. 2010). However, these analyses are still leaving scope for further analyses on consumer knowledge and understanding of footprints, in particular with regard to the issue of normalization or frame of reference to aid comprehension of carbon labeling (Upham et al. 2010), related to the relationship between knowledge and personal values (Rokeach 1973), as well as concerning other psychological biases only introduced in our paper (Appendix I).

Building on evolutionary psychology insights (e.g. Griskevicius et al. 2012; van Vugt et al. 2014), is likely valuable to further explore incentives which reduce mismatches between strategies that are aimed at changing environmentally unsustainable behavior with ancestral motives, as the latter can drive environmentally unsustainable behavior. Last but not least, scope for further analysis relates also to further exploring the transferability of our results to other products and product classes, in different regional and cultural contexts. Taking the above limitations and possible extensions into account could further aid the empowerment of policymakers and citizens to deal with climate issues.

**Acknowledgements**

Funding from the Canadian Consumer and Market Demand Network

(http://www.consumerdemand.rees.ualberta.ca/) is gratefully acknowledged. Sub-grant

Number: CMD-548.

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## Tables

**Table 1.** *Aggregated MNL choice model*

| | ***Yoghurt*** | | | ***Toilet paper*** | | |
|---|---|---|---|---|---|---|
| Pseudo-$R^2$ | .17 | | | .21 | | |
| | *β* | *Wald stat.* | *Relative attribute importance* | *β* | *Wald stat.* | *Relative attribute importance* |
| **Carbon footprint** | | | | | | |
| 0.81 kg / 2.55 kg | .47*** | 122.82*** | 15 % | .50*** | 154.21*** | 8.8 % |
| 0.95 kg / 3.00 kg | - .22*** | | | -.10* | | |
| 1.09 kg / 3.45 kg | - .25*** | | | -.39*** | | |
| **Water footprint** | | | | | | |
| 733.76 l / 140.25 l | .91*** | 327.76*** | 35 % | .86*** | 282.13*** | 15.4 % |
| 863.25 l / 165.00 l | - .15*** | | | -.17*** | | |
| 992.74 l / 189.75 l | - .76*** | | | -.69*** | | |
| **Price** | | | | | | |
| 1.06 € / 3.54 € | 1.08*** | 596.16*** | 40 % | 3.65*** | 690.56*** | 57.8 % |
| 1.24 € / 4.17 € | - .23*** | | | -1.46*** | | |
| 1.43 € / 4.79 € | - .85*** | | | -2.20*** | | |
| **No-Choice** | | | | | | |
| No choice | - .24*** | 104.04*** | 10 % | -.91*** | 885.82*** | 18.0 % |
| | LL-value = -2884.81, BIC (LL) =5821.17 | | | LL-value = -2738.85, BIC (LL) =5529.24 | | |

Note: *p<0.05; **p<0.01; ***p<0.001

The MNL coefficients can be interpreted in terms of positive or negative probability of choosing alternative levels (as a function of the coefficient sign), while recognizing that we are referring to different levels of utility/ dis-utility (Hensher et al. 2015).

**Table 2.** *Latent class model for choices with three classes*

| | | | ***Yoghurt*** | | | | ***Toilet paper*** | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | *Ecologically oriented* [a] | *Price sensitive* | *No choice* | *Overall* | *Price sensitive* | *Ecologically oriented* | *No choice* | *Overall* |
| Relative size (N) | | | 43% (679) | 34% (537) | 23% (363) | (1579) | 46% (726) | 30% (474) | 24% (379) | (1579) |
| $R^2$ | | | .30 | .75 | .04 | .65 | .72 | .35 | .13 | .66 |
| | | | **β** | **β** | **β** | **Wald stat.** | **β** | **β** | **β** | **Wald stat.** |
| **Carbon footprint** | 0.81 kg / 2.55 kg♣ | | | .60*** | | 113.12*** | .37** | .88*** | .34* | 143.86*** |
| | 0.95 kg / 3.00 kg | | | - .12* | | | 1.06** | - .04 | .19 | |
| | 1.09 kg / 3.45 kg | | | - .48*** | | | -1.43*** | - .84*** | - .53** | |
| **Water footprint** | 733.76 l / 140.25 l | | 1.45*** | 1.16*** | .96*** | 258.95*** | 1.69*** | 1.49*** | .74*** | 128.43*** |
| | 863.25 l / 165.00 l | | .10 | - .51** | - .14 | | - .32** | .07 | .19 | |
| | 992.74 l / 189.75 l | | -1.55*** | - .65* | - .82** | | - 1.37*** | - 1.55*** | - .93*** | |
| **Price** € | 1.06 € / 3.54 € | | .68*** | 5.36** | .91*** | 95.73*** | 14.55*** | 1.46*** | 3.59*** | 101.13*** |
| | 1.24 € / 4.17 € | | - .18* | -1.37 | - .08 | | - 5.27*** | - .41* | - 1.96*** | |
| | 1.43 € / 4.79 € | | - .51*** | -3.99*** | - .84*** | | - 9.29*** | - 1.04*** | - 1.63*** | |
| **No-Choice** | No choice | | -1.40*** | - 2.00*** | 1.32*** | 524.06*** | - 4.72*** | - 2.17*** | .44*** | 116.83*** |
| | | Intercept | - .25 | - .23 | .74 | 1.19 | .34 | - .44 | .10 | .02 |
| **Ecological Attitude** | | NEP | .15** | - .12* | - .04 | 7.17* | .00 | .00 | .00 | .01 |
| **Involvement** | Purchase frequency | *Never* | - .48 | - .85* | 1.33*** | 69.58*** | 1.16 | - 3.40 | 2.24 | 7.44 |
| | | *Less than monthly* | - .04 | .12 | - .08 | | - .40 | .85 | - .45 | |
| | | *Monthly* | .07 | .15 | - .22* | | - .27 | .89 | - .62 | |
| | | *Bi-weekly* | .11 | .30* | - .41*** | | - .28 | .73 | - .45 | |
| | | *Weekly* | .34** | .28* | - .62*** | | - .21 | .94 | - .73 | |
| **Motivation** | Read info | *Always* | .46*** | - .20* | - .25** | 26.64*** | - .13 | .24* | - .12 | 10.82* |
| | | *Sometimes* | - .14 | .07 | .07 | | .16* | - .12 | - .04 | |
| | | *Never* | - .32* | .14 | .18 | | - .03 | - .13 | .16 | |
| **Lifestyle** | Environmental group member | | - .14 | .05 | .09 | 1.75 | - .18 | .05 | .13 | 2.70 |
| | Make donation | | .21** | - .17* | - .04 | 6.82* | - .12 | .28*** | - .17* | 13.51*** |
| | Urban living | | - .05 | - .06 | -.01 | 1.20 | .03 | - .11* | .09* | 4.24 |
| **Socio-demographics** | Female | | - .01 | - .18** | .19*** | 16.25*** | - .17*** | .09 | .08* | 11.10*** |
| | Age *(omitted due to non-significance)* | | | | | | | | | |
| **Values** | Health | | - .04* | .06** | - .02* | 8.49** | .02* | - .04** | .01 | 6.00* |
| | Social security | | .04 | - .06** | .02 | 6.13* | - .04* | .01 | .02 | 4.24 |
| | Delayed gratification | | .02 | - .02 | .00 | 1.19 | - .03* | .03 | .00 | 3.63 |
| | | | LL-value = -2367.2, BIC (LL) = 5183.53, Class. Err. = .18 | | | | LL-value = -2324.05, BIC (LL) = 5126.67, Class. Err. = .16 | | | |

Note: [a] Classes are ordered by class size; *p<0.05; **p<0.01; ***p<0.001. ♣ In each case (for footprints and price) the first value refers to yogurt, the second to toilet paper (12 rolls).

**Table 3.** *Relative attribute importance*

| | ***Yoghurt*** | | | | ***Toilet paper*** | | | |
|---|---|---|---|---|---|---|---|---|
| | *Ecologically oriented* [a] | *Price sensitive* | *No choice* | Weighted average | *Price sensitive* | *Ecologically oriented* | *No choice* | Weighted average |
| Relative size | 43% | 34% | 22% | | 46% | 30% | 24% | |
| CO2 | 13% | 7% | 15% | 11.4% | 6% | 15% | 10% | 9.7% |
| H2O | 37% | 11% | 24% | 25.4% | 8% | 26% | 19% | 15.9% |
| Price | 15% | 58% | 24% | 31.5% | 61% | 22% | 62% | 49.8% |
| No choice | 35% | 25% | 36% | 31.6% | 24% | 38% | 10% | 24.7% |
| | | | | 100% | | | | 100% |

Note: [a] Classes are ordered by class size

## Appendix I

Van Vugt et al. (2014: 9) suggest that environmental problems are caused or exacerbated by five key evolved psychological biases that aided the survival and reproductive interests of our human ancestors:

| **Evolved psychological biases** | | **Opportunities for intervention (marketing, public policy)** |
|---|---|---|
| *Self-interest*: | Proclivity for self-interest | People cooperate with kin and in reciprocal social relationships |
| *Shortsightedness*: | Preference for immediate over delayed rewards (temporal discounting) | People discount the future less in safe and predictable environments |
| *Status*: | Concerns about relative rather than absolute status | People value environmental behaviors if they come with a status increase |
| *Social imitating*: | Propensity to socially imitate | People copy sustainable behaviors if they are performed by the majority |
| *Sensing*: | Tendency to disregard impalpable consequences | People respond to environmental threats that they can sense, and there is an innate love for nature |

Source: adapted from Table 1, van Vugt et al. (2014)

## Appendix II

**Figure 1**. *Example choice set for yoghurt*

Imagine you are in your usual grocery store and you would like to purchase a 750g tub of yoghurt you usually buy: Do you choose Alternative A, Alternative B or Alternative C?

| **750 g tub of yoghurt** | **Alternative A**  | **Alternative B**  | **Alternative C** |
|---|---|---|---|
| Carbon ($CO_2$) emission equivalents | 0.81 kg | 1.09 kg | None of these |
| Water usage | 863.25 l | 733.76 l | |
| Price | 1.06 € | 1.43 € | |
| I would choose: | A___ | B___ | C___ |