

# **Predicting Household Food Waste Reduction**

**An exploratory study comparing and contrasting the Theory of Planned Behavior and  
Value Belief Norm theory**

Sólrún Sigurðardóttir

**Lokaverkefni til MS-gráðu í umhverfis- og auðlindafræði**

**Sálfræðideild**

**Heilbrigðisvísindasvið**

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## **Preface**

This master's thesis is a collaboration between the psychology department and the environment and natural resources graduate programme at the University of Iceland.

This thesis is comprised of two parts. The first part, Part A, is a literature review and a detailed explanations of the methods used for data collection for the study which is presented in the second part. The second part, Part B, consists of a manuscript, intended for publication, which reports a study with the aims to compare and contrast the Theory of Planned Behavior (TPB) and Value Belief Norm (VBN) theory as predictors of household food waste. These two different theoretical approaches were chosen because of their differences and because they have been prominent in research of environmentally friendly behavior. The TPB assesses the intention of the individual to act, and the VBN theory moral obligation to act. Each theory consists of measureable sub-constructs, and by assessing how each of them relates to household food waste, it is possible to create programs that reduce such behavior. Since there has been little-to-no peer-reviewed research on the topic, the study was explorative in nature.

## **PART A. Literature Review:**

### **Predicting household food waste reduction: An exploratory study comparing and contrasting the Theory of Planned Behavior and Value Belief Norm theory**

## **1. Introduction**

### *1.1. Introduction to food waste*

There are various environmental problems that pose a threat to environmental sustainability, such as global warming, water shortage, loss of biodiversity and urban air pollution. Many of these are rooted in human behavior and can be managed by changing the relevant behavior, thus reducing its environmental impact (e.g. Vlek & Steg, 2007).

Food waste is a global and complex problem that affects each of the three pillars of sustainable development: environment, economic and social (FAO, 2013). It is hard to estimate how much food is wasted and/or lost each year in the world or how it can be prevented. Food loss refers to the decrease of edible food at the production, post-harvest, and processing stages of the food supply chain. Food waste, on the other hand, refers to food losses occurring at the retail and consumption end of the food supply chain. This measurement excludes the inedible portions of food products, and focuses on the portions intended for human consumption. Food waste therefore relates to retailers' and consumers' behavior (Parfitt, Barthel, & Macnaughton, 2010).

The Food and Agriculture Organization of the United Nations (FAO) estimates that around one-third of edible parts of the food produced for human consumption in the world gets lost or wasted globally: about 1.3 billion tons of food per year (Gustavsson, Cederberg, & Sonesson, 2011). Food is lost and wasted throughout the whole food supply chain, from agricultural production to final household consumption. In low income countries, most food is wasted and lost in the early stages of the food supply chain, though in medium and high income countries, it mostly occurs at the retail and consumption level (Gustavsson et al., 2011). The FAO estimates that, in North America and Europe, food waste per capita is 95-115 kg/year, while it is only 6-11 kg/year in sub-Saharan Africa and South/Southeast Asia. A possible reason for these differences could be that rich countries can simply afford to waste food. Therefore, one of the prevention strategies proposed by the FAO to the current massive food waste problem

is raising public awareness and thereby changing people's attitude toward food waste (Gustavsson et al., 2011). While changing public's attitude would not be enough to solve all of the problems related to food waste, it would be impactful.

Economically speaking, avoidable food wastage has a negative and direct impact on income, both for farmers, who pay upfront costs in the form of resources and labor, and consumers, who purchase food that gets thrown away before being used (Gustavsson et al., 2011). The cost of food waste has been estimated in some countries. The Waste and Resources Action Programme (WRAP), an organization located in the United Kingdom, estimates that the cost of food waste for the average household (2.4 persons) is 700 pounds per year (approximately 130.000 ISK) (WRAP, 2013). Results from a pre-study on household food waste in 17 homes in Reykjavík, Iceland, indicated that the cost of food waste for a four-person household would be at least 150.000 ISK a year (Burgherr, Sigurðardóttir, Magnúsdóttir & Guðbrandsson, 2015).

Food waste is not strictly bound to losses in financial value, but extends further due to the hidden costs of food waste. Food that is produced but never consumed has a negative impact on the environment (FAO, 2013). The FAO (2013) conducted a global study focusing on the impact food waste has on climate change, water, land and biodiversity. Their main results estimated that the carbon footprint from greenhouse gas emission of food that was produced but not eaten was around 3.3 Gtons of CO<sub>2</sub> per year. If food waste were to be regarded as a nation, this number places it as the third highest CO<sub>2</sub> emitter after USA and China. The blue water footprint, which refers to the consumption of groundwater and surface resources, of unconsumed food is about 250 km<sup>3</sup>, or a volume equivalent to the annual water discharge of Volga River, the largest river in Europe in terms of discharge. Furthermore, food that is produced and thrown away uneaten occupies 1.4 billion hectares of land, an area close to 30% of all agricultural land in the world (FAO, 2013). The environmental impact of food waste on biodiversity at a global level is difficult to estimate, but monocropping and agricultural expansions into wild areas only serve to compound the negative externalities (FAO, 2013).

Food security is one of the major concerns in large parts of the developing world, but still a massive amount of food is thrown away annually. Some world population forecasts estimate that the human population could reach 9 billion by 2050 (United Nations, 2013), and food production must therefore increase significantly in order to meet future global demands.

Some estimations have predicted that a 50% reduction in food waste by 2050 could provide one-quarter of global food needs and demands (Lipinski et al., 2013). Based on these figures, it appears very possible that the continuation of food waste at the current rate will pose a serious threat for food security in the near future (Gustavsson et al., 2011).

Since 2007, WRAP has been running a consumer food waste prevention program and a campaign called Love Food Hate Waste (LFHW) (WRAP, 2013). Through this program, WRAP has gathered research on the types and amounts of food and drinks that are being wasted, why they are wasted, and what behaviors have led to that waste. These things are critical in raising awareness on the issue of food waste and encourage people to make changes that will reduce food waste (WRAP, 2013). The cause of food waste is not due to a single behavior, but rather a combination of multiple behaviors that can increase or decrease the likelihood of food being wasted. These behaviors are by no means exhaustive, and many other influencing factors could lead to food waste reduction (Quested, Marsh, Stunnell, & Parry, 2013). The WRAP (2013) findings revealed that food waste had decreased by 21% between 2007 and 2012, although the cause is hard to estimate, as if whether or not the LFHW campaign had an impact. The work does however demonstrate that households can reduce the amount of food and drink they waste considerably (WRAP, 2013).

### *1.2. The role of psychology in understanding pro-environmental behavior*

Psychology can play an important role in the management of environmental problems, e.g. food waste, by promoting behavioral change. Psychologists and sociologists have, over the last 40 years or so, been exploring the roots of direct and indirect environmental actions by trying to understand why people act in an environmentally friendly manner and what kind of barriers to prevent such behavior are (Kollmuss & Agyeman, 2002). Behavior that benefit the environment or aims to harm the environment as little as possible is called pro-environmental behavior. When acting in a pro-environmental manner, one seeks to minimize the negative impacts of one's actions, such as by minimizing energy- and resource consumption, or recycling (Kollmuss & Agyeman, 2002). Some behaviors are a direct or proximal cause of environmental change (Stern, Young, & Druckman, 1992). Household food waste reduction is an example of a direct cause of environmental change, as it is performed in the private sphere of the household (Stern, 2000). Other behaviors might be indirectly environmentally significant, but have a greater environmental impact in the long run when compared to direct or proximal causes of

environmental change. International development policies are an example of these indirect and significant behavior (Stern, 2000). It is therefore important to understand the cognitive, motivational and structural factors and processes that facilitate or are barriers to pro-environmental behavior (Steg & Vlek, 2009).

By adopting pro-environmental behavior patterns, an individual can contribute significantly to environmental sustainability (Steg & Vlek, 2009). Numerous theoretical frameworks have been developed to try to understand what leads to pro-environmental behavior, but no definitive answers has been found (Kollmuss & Agyeman, 2002). Behavioral interventions are generally more effective if they are systematically implemented, planned and evaluated (Steg & Vlek, 2009). Interventions are unlikely to be effective if they do not target the key psychological mechanisms that underpin barriers and/or motivations. For this reason, people are unlikely to reduce food waste if they are not motivated to do so (Graham-Rowe, Jessop, & Sparks, 2015). Although it is widely acknowledged that the best way to reduce the negative impact of food waste is to minimize food waste in households, minimization is made difficult due to the multiple, interacting behaviors that can influence the likelihood of wasted food (Quested et al., 2013). Investigations into household food waste reduction should therefore be theory-driven to reveal the determinants that can potentially modify behavior. A theory can provide a framework for causal processes to be identified, and guide the development of effective and replicable intervention (Steg & Vlek, 2009).

### *1.3. Past research*

There has been little peer-reviewed research focusing on identifying key motivations and/or barriers to reduce household food waste. The research that does exist has mostly been qualitative, and is important in identifying key factors and potential barriers to waste reduction in households (Graham-Rowe, Jessop, & Sparks, 2014). To our knowledge, only three published studies have used a well-established model called The Theory of Planned Behavior (TPB) (Ajzen, 1991) as a potential framework for an effective intervention, which specifies the cognitive antecedents of behavior (Graham-Rowe et al., 2015; Stefan, Herpen, Tudoran, & Lähteenmäki, 2013; Mondéjar-Jiménez, Ferrari, Secondi, & Principato, 2016). It appears that no one has used the Value Belief Norm Theory (Stern, 2000) to explain food waste reduction in households, at least to the best of our knowledge.

## 2. Literature review

### 2.1. *The Theory of Planned Behavior*

The Theory of Planned Behavior (TPB) provides a theoretical framework for systematically investigating the factors that may influence behavioral choices (Tonglet, Phillips, & Read, 2004). The TPB is a general theory of behavior and can be used to explain a variety of intentional behaviors (Ajzen, 1991). The TPB is one of the most commonly used and influential psychological theories for explaining pro-environmental behaviors (Botetzagias, Dima, & Malesios, 2015).

The central factor in the TPB is the individual's intention to perform or not to perform a given behavior, based on the assumption that behavioral intention captures motivational factors that influence behavior. Intentions are indicators of effort, or how hard people are willing to try in order to perform the behavior (Ajzen, 1991). Intention is influenced by three factors. First is the attitude towards the behavior, and that is the favorable or unfavorable evaluation by an individual to perform or not to perform the behavior. The second factor is subjective norm, which is the perceived pressure and/or influence by the individual's social surroundings to perform or not perform the behavior. The third factor is perceived behavioral control (PBC), which is the perception of the individual's ability to perform the behavior (Ajzen, 1991). As the intention to perform the behavior gets stronger, the likelihood of the behavior to be performed increases (see Figure 1) (Ajzen, 1991).

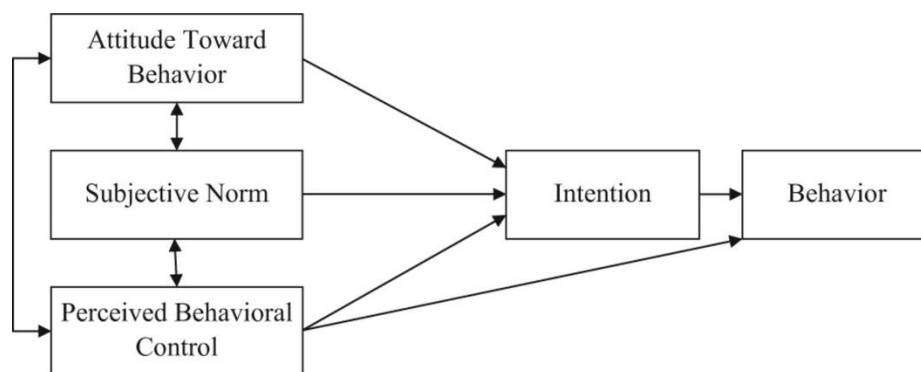


Figure 1. The Theory of Planned Behavior (Ajzen, 1991).

Behavioral intentions are only expressions of volitional behavior. If the person can decide to perform or not to perform the behavior, the intention is the immediate determinant of the behavior. The performance of most behavior is however at least to some degree dependent

on non-motivational external factors, e.g. money, time, resources and societal structures. These factors collectively represent people's actual control over the behavior (Ajzen, 1991). The actual behavioral control is crucial, and the opportunities and resources available to a person must, to some extent, increase the likelihood of behavioral achievement. Perception of behavioral control and its impact on intention and behavior is, however, more interesting. The PBC plays an important part in the TPB, and is the factor that distinguishes between TPB and the Theory of Reasoned Action (TRA), the predecessor of the TPB (Ajzen, 1991). The concept of PBC is compatible with Bandura's concept of perceived self-efficacy (Bandura, 1982). Self-efficacy is "concerned with judgments of how well one can execute courses of action required to deal with prospective situations" (Bandura, 1982, p. 182). In other words, PBC states that people's behavior is influenced by their confidence in the ability to perform the behavior. According to TPB, PBC can be used directly to predict behavior (Ajzen, 1991). External factors, such as personality, demographic characteristics and past experience, may influence the behavior, but it is argued that these influences are mediated indirectly through all the other components of the model (Ajzen, 1991).

The TPB has been used and applied across a variety of environmental behaviors, such as recycling behavior (e.g. Boldero, 1995; Taylor & Todd, 1995; Cheung, Chan, & Wong, 1999; Tonglet et al., 2004) and travel mode choices (e.g. Bamberg, Ajzen, & Schmidt, 2003; Gardner & Abraham, 2010). However, the TPB has only been implemented in three other studies to our knowledge to understand psychological predictors to household food waste (Stefan et al., 2013; Graham-Rowe et al., 2015; Mondéjar-Jiménez et al., 2016). Research findings have usually supported the use and utility of TPB constructs in predicting intentions and in a meta-analysis it was found that on average, intention accounted for 27% of the variance of pro-environmental behavior (Bamberg & Möser, 2007). Some studies have raised concern that the explanatory power of the TPB is lacking, and that when additional variables are included the percentage of variance explained increases (e.g. Tonglet et al., 2004; Boldero, 1995; Davies, Foxall, & Pallister, 2002). According to Ajzen (1991), the TPB allows for additional variables to be incorporated into the model as those variables might make a significant contribution to the explanation of behavior, although, doing so is a deviation from the original theory. Research in the field of environmental behavior has found that moral norm is a useful addition to the TPB. As moral norm was not an original component of the theory, the original TPB may be insufficient to explain environmental behavior. Research has shown that moral norm increases

the predictions, such as the intention to recycle significantly (e.g. Chan & Bishop, 2013; Largo-Wight, Bian, & Lange, 2012). Therefore, a smarter alternative may be a model of behavior that incorporates moral norms as a core predictor of behavior.

## 2.2. *Norm Activation Model*

The Norm Activation Model was developed by Schwartz (1977) and is used to explain behavior in terms of interrelationships amongst four main constructs: personal norms, social norms, awareness of consequences (AC) and ascription of responsibility (AR). The NAM model was developed to explain pro-social and altruistic behavior. Altruistic behavior or motivation is, according to Schwartz, the purpose or intention to benefit another as an expression of internal values. Common labels for altruistically motivated behavior are “sharing”, “helping”, and “pro-social behavior” (Schwartz, 1977).

The central idea of the NAM model is that the influence of social norms on the behavior of the individual is not direct, but mediated by personal norms. Personal norms reflect the idea that a person behaves in a certain manner because they feel like it is the right thing to do. Personal norms are conceptualized by the feeling of moral obligations that individuals hold for themselves (Schwartz, 1977). Social norms, on the other hand, consist of obligations and expectations towards how they as an individual should behave, which are anchored in social groups (e.g. family members or friends) (Schwartz, 1977). According to Schwartz (1977), personal norms are the only direct determinants of pro-social behavior and will only respond if the individual is both aware of the consequences (AC) and feels some responsibility for these consequences (AR) (see Figure 2). The relationship between personal norms and taking action is stronger when the individual is aware of his/her responsibility and of the negative or positive consequences of his/her action. This leads to the presumption that the associations between norms and behavior is negligible amongst those that are low in AC and AR, compared with those that are high in AC and AR (Schwartz, 1977).

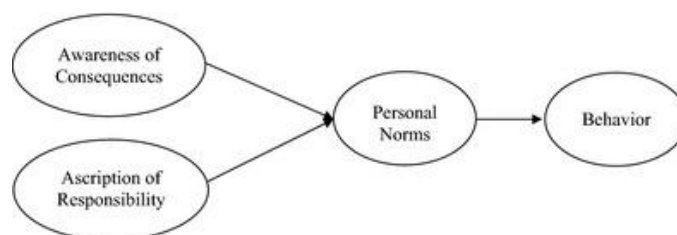


Figure 2. The Norm activation model, proposed by Schwartz (1977).



Some researchers have combined and integrated the TPB and NAM for better explanatory power of behavior. Bamberg and Schmidt (2003) pointed out that the theories focus on different aspects of social behavior and were also developed in different contexts so they should be combined because of their differences, not because of their similarities. Ajzen (1991) himself also suggested that an addition of personal norm could increase the explanatory power of the TPB, as none of the TPB constructs captures the influence of moral considerations, and would therefore bring the moral aspect to the intention of the behavior. He did not, however, revise his theory to include this construct. According to Thøgersen (1996), pro-environmental behavior is not based on cost and benefit analysis of the individual but on a person's moral belief, so the personal norm should add to the explanatory power when the two theories are combined. To our knowledge, NAM has not been implemented to understand psychological predictors to household food waste, but has shown promising results in explaining other environmental behaviors, such as transportation behavior (e.g. Wall, Devine-Wright, & Mill, 2007).

### 2.3. *Value Theory*

One of the most widely used and empirically grounded theories of basic values is the Schwartz value theory (Cieciuch, Schwartz, & Vecchione, 2013). Values have not been defined in an unanimous way, but the most agreed upon definition is that values are “desirable trans-situational goals varying in importance, which serve as a guiding principle in the life of a person or other social entity” (Schwartz, 1992, p. 21). First, values reflect a belief of a certain end-state that is desired. Second, values are abstract in nature and therefore transcend specific situations. Thirdly, values usually serve as a guiding principle for evaluating or selecting behavior, events and people. Finally, values can be ordered in a system of value priorities. This implies that the choice to act will be based on the value that is considered to be most relevant to the act (Schwartz 1992; 1994)

In the original Schwartz's value theory, 10 different values of different motivational goals were proposed. It was based on the assumption that values are cognitive representations of universal human necessities (Schwartz & Bilsky, 1987). However, Schwartz et al. (2012) redefined this theory, proposing a set of 19 conceptually distinct values. The 19 latent values of the theory can be measured and plotted in a two-dimensional space that consists of four separate value clusters (Schwartz et al., 2012). The structure of the values in the theory is a

continuous spectrum, but can be grouped into wedge-shaped categories. Therefore, opposing values express dissimilar motivations, attitudes and behaviors, whereas adjacent values express similar motivations. The distance between items can be regarded as the degree to which they are correlated, and adjacent values are therefore more likely to correlate with each other (McQuilkin, Garðarsdóttir, Thorsteinsson, & Schwartz, 2016). The first dimension is “Openness to change” versus “Conservation”. This dimension distinguishes values that stress independence, like self-direction and stimulation from values that emphasize greater conformity and tradition. The second dimension is “Self-transcendence” versus “Self-enhancement”, which distinguish social values like benevolence and universalism from those values that pursue personal interest such as achievement and power (Schwartz; 1992, 1994) (see Figure 3).

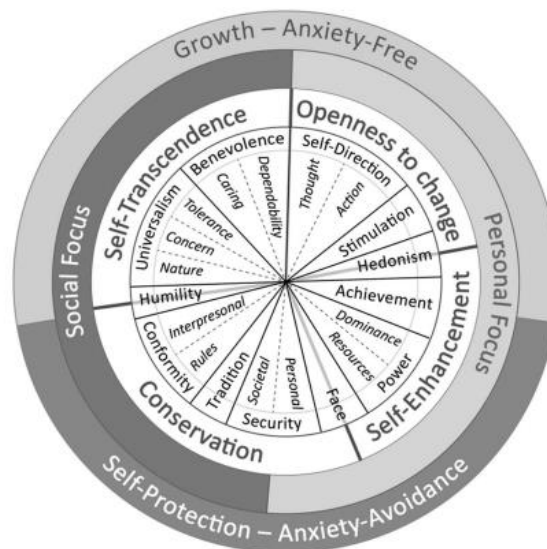


Figure 3. The 19-value model, proposed by Schwartz et al. (2012)

From these values, three general value orientations are typically distinguished within the eco-literature; egoistic, altruistic and biospheric (or ecocentric). Egoistic value orientation is characterized by individuals that try to maximize their personal outcomes, altruistic value orientation usually reflects concern for the welfare of other human beings and biospheric value orientation reflects concerns with non-human species or the biosphere (Stern, Dietz, & Kalof, 1993). Values placed on different targets, (e.g. humanity, the biosphere or the individual’s self), directs attentions toward value-congruent information that will in return affect, in this case, pro-environmental behavior (Stern & Dietz, 1994; Nordlund & Garvill; 2002, 2003). Egoistic value orientation is thought to be part of the self-enhancement dimension, as the motivational goals

are either power (e.g. gaining control over resources or people) or achievement (e.g. focusing on gaining personal success and ambition) (e.g. van Lange, De Bruin, Otten, & Joireman, 1997; Schwartz, 1992). The two main focuses in the self-transcendence dimension are universalism and benevolence. Benevolence is considered to be a broader form of altruism, and therefore altruistic value orientation, and welfare of the biosphere is one of the motivational goal in universalism, and therefore biospheric value orientation (e.g. Schwartz, 1992; Stern & Dietz, 1994). Therefore, altruistic and biospheric values could be regarded as a part of the self-transcendence dimension.

Value orientation has been widely studied within social and environmental psychology. The difference between self-transcendence versus self-enhancement dimension has been shown to embody itself in different kinds of beliefs and pro-environmental behavior (e.g. Stern, 2000; Nordlund & Garvill, 2002). People who value concerns beyond themselves (self-transcendent with altruistic or biospheric values), are more likely to engage in pro-environmental behavior (Steg, Dreijerink, & Abrahamse, 2005). Environmental behavior and environmental attitudes are thought to be related to peoples values (e.g. Stern, 2000) and because values are thought to conceptualize important life goals or standards as a guiding principle in life (e.g. Rokeach, 1973), they might provide a basis for the formation of attitudes that would act as guidance for behavior. Values may therefore play an important role in regard to environmental problems: as pro-environmental behavior transcends self-interest, issues often arise from conflict between collective and individual interest (e.g. Axelrod, 1994; Karp, 1996). Values have been correlated with various self-reported behaviors such as consumer behavior, recycling, policy acceptance and political behavior to protect the environment (e.g. Karp, 1996; Stern & Dietz, 1994; Stern, Dietz, Abel, Guagnano & Kalof, 1999). In general, however, values are not thought to have a strong direct effect on behavior. The relationship between behavior and general values are usually mediated by other factors like personal norms or behavior specific beliefs (e.g. Poortinga, Steg, & Vlek, 2004; Nordlund & Garvill, 2003). To our knowledge, values have not been used in practice to explain household food waste. The comparison between people that are high or low on self-enhancement or self-transcendence dimensions in regard to household food waste could shed light on the behaviors that could change food waste behavior.

#### 2.4. *New Ecological Paradigm (NEP)*

In the 1970's, environmental issues started to receive the public's attention, among them is air and water pollution, loss of resources and conservation. Attempts were made to measure the public's concern of environmental quality, often called "environmental concern" (Weigel & Weigel, 1978). Many environmental problems today are more ambiguous in origin, less observable and more geographically dispersed than localized air and water pollution. Problems such as climate change, loss of biodiversity and even food waste are global problems but their causes are both complex and synergistic. Therefore tackling these environmental problems is complicated (Stern et al., 1992). It involves recognizing that human activities are altering ecosystems and that all living species, including people, are dependent on it. Acknowledging what is required for sustainable development also means reevaluating our underlying worldviews regarding our relationship with our physical environment (e.g. Dunlap, van Liere, Mertig, & Jones, 2000).

The New Environmental Paradigm scale was published in 1978 by Dunlap and Van Liere. The scale assesses beliefs about humanity's ability to upset the balance of nature, humanity's right to dominate over nature and limits to growth for human societies (Dunlap & van Liere, 1978). The NEP scale was widely used as a measure of pro-environmental orientation. The name was changed to a seemingly more appropriate label, "ecological" worldview later on, to the New Ecological Paradigm (NEP) (Dunlap et al., 2000). The NEP scale is thought to tap into "primitive beliefs" about the relationship between humanity and nature, as it constitutes a fundamental component of people's belief systems about social reality, physical reality and nature itself (Dunlap et al., 2000).

The difference between worldview and values is that values are situation transcending beliefs about what the individual perceives as important in life whereas worldviews are general beliefs that relate to a specific domain in life (Poortinga et al., 2004). The NEP scale is aimed to measure the view people have on the human-environment relationship, and can therefore be seen as the environment's vulnerability to human interference (Poortinga, Steg, & Vlek, 2002). In the literature of environmental psychology, the NEP has been measured in terms of general environmental concern (Poortinga et al., 2004). General beliefs or worldviews are less stable than values and the relationship between worldviews and behavior is generally not strong. This is because behavior-specific beliefs mediate the relationship between worldview and behavior

(e.g. Poortinga et al., 2004; Nordlund & Garvill, 2003). Since food waste has not been studied widely, nor psychological predictors used to explain what causes people to waste food, it is hard to measure the association between NEP and food waste. However, it is likely that individuals that have higher environmental concern might be less likely to waste food.

## 2.5. Value Belief Norm Theory

The Value Belief Norm (VBN) theory of environmentalism was developed by Stern (Stern et al., 1999; Stern, 2000). The theory joins value theory (Schwartz, 1992; 1994), the NEP (Dunlap & van Liere, 1978) and NAM (Schwartz, 1977) through a causal chain that leads to behavior (Stern, 2000). The premises of the theory are that each variable in the chain has a direct effect on the next variable but can also indirectly affect variables further down the chain. The causal chain moves from relatively stable, central elements of personality and belief structures, towards more focused beliefs about the human-environment relationship (the NEP). As the general human-environment relationship beliefs are rooted deeper in the individual, people have more awareness of consequences (AC) about their behavior toward the environment and their responsibility (AR). That in turn results in a sense of moral obligation towards the environment and activates the personal norm for an action. The personal norm directly determines whether the behavior in question is performed or not (see Figure 4) (Stern, 2000). Personal norms therefore create a general tendency that influences different kinds of behaviors taken with pro-environmental intent (Stern, 2000; Nordlund & Garvill, 2002). The VBN theory, like the NAM, proposes that environmental behavior results from the personal norm, that is, an individual feels morally obliged to act pro-environmentally (Stern, 2000).

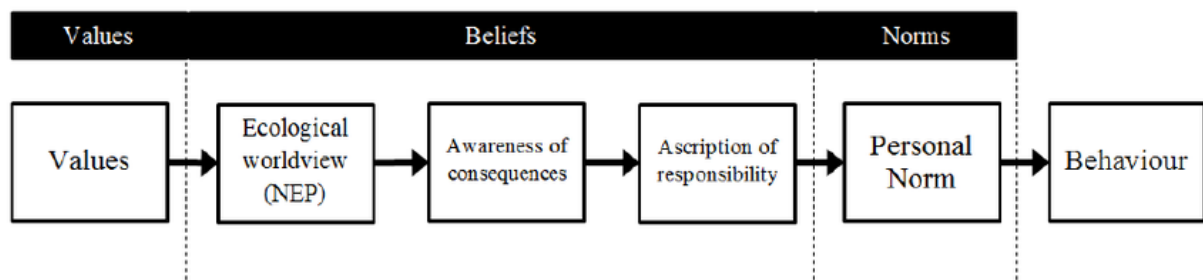


Figure 4. The causal link between value, beliefs and norms in the VBN theory (adapted by Stern (2000)).

According to Stern and colleagues (Stern et al., 1999; Stern, 2000), personal norms can have an influence on different kinds of behaviors taken with pro-environmental intent. They

identify four types of behavior. The first is *environmental activism*, where the focus is mostly on social movement participation, e.g. active involvement in environmental demonstration or organization. The second is *non-activist behaviors in the public sphere*, which involves both environmental citizenship and support for acceptance of public policies. The third is *private-sphere environmentalism*, which has a direct environmental impact based on personal decisions, such as the purchase, use and disposal of household and personal products. The environmental impact of each individual's personal behavior might be rather small, but when many people do the same thing, they have a significant impact in the aggregate. The fourth behavior is *behaviors in organizations*, which could be the effect of individuals on the environment through other behaviors, such as designing manufactured products in more environmentally benign ways (Stern et al., 1999; Stern, 2000). As has been mentioned, household food waste reduction would be classified as a private-sphere behavior as it takes place in the household. Additionally, although each individual contribution might be rather small, the collective impact of household food waste is significant.

In some studies, AC and AR have been defined differently and focus on general environmental conditions (e.g. Stern et al., 1999; Gärling, Fujii, Gärling, & Jakobsson, 2003) while others define AC and AR as specific beliefs (e.g. Steg et al., 2005; Nordlund & Garvill, 2003). Generally, specific beliefs are more strongly related to behaviors and intention than general beliefs (e.g. Nordlund & Garvill, 2003; Ajzen, 1985). The predictive power of the VBN theory could be enhanced if the measurement of AC and AR beliefs, as well as personal norms, would be directed at a specific behavior. The causal chain of the VBN theory would move from general beliefs to specific beliefs (Steg et al., 2005). Thus, the predictive power of the VBN theory in explaining causes of food waste should be enhanced by asking the individual about food waste in their own household in comparison to food waste in general and by asking about specific types of food that is being wasted.

The VBN theory has been tested and has successfully explained various environmental acts like environmental citizenship, willingness to reduce car use, acceptability of energy policies and consumer behavior (e.g. Kaiser et al., 2005; Nordlund & Garvill, 2003; Steg et al., 2005). While some studies did not test the full VBN theory (e.g. Kaiser, Hübner, & Bogner, 2005; Nordlund & Garvill, 2003), others have tested the theory as a whole (Steg et al., 2005). To our knowledge, the VBN theory has not been used to explain household food waste reduction.

## 2.6. *Historical background of the two theories*

The first and most significant difference between TPB and VBN theory is the emphasis on altruism in the latter. As has been pointed out, the TPB stresses personal utility and the individual's cost versus benefit analysis (Ajzen, 1991), while in the VBN theory benefits to others have priorities over self-interest (Schwartz, 1977). The second difference is that VBN theory focuses on internal norms (personal norms) while TPB focuses on external norms (subjective norm). Thirdly, TPB captures perceived control over behavior while VBN theory does not. The fourth difference between the two models is that TPB includes intentions whereas VBN theory does not (Wall et al., 2007).

The TPB model stresses the importance of cost-benefit arguments and views the individual as maximizing their utility while in the VBN theory, personal norms (or moral) are possible behavioral determinants (Bamberg & Schmidt, 2003). The TPB assumes that when an individual is confronted with choice between two behavioral alternatives, the one that is associated with most positive behavioral consequences will be chosen. The processes that are underlying the performance of the behavior are mostly controlled (Ajzen, 1991). Therefore, one can argue that the TPB is in line with what has been called the "naïve scientist" approach while the VBN theory, which holds belief that moral obligations influences behavior, is more in line with the "cognitive miser" approach.

The predominant model of social cognition was the "naïve scientist" approach, proposed by Fritz Heider (1958). According to the model, humans think and act in a rational way in making a scientific cause-effect analysis. The individual is believed to think like a scientist by analyzing and measuring the world around them. This desire for consistency and stability, and the ability to predict and control makes us behave like a "naïve scientist" by logically and rationally testing hypothesis about the behaviors of others (Heider, 1958). However, Fiske and Taylor (1991) argued that in ideal circumstances, people are not very careful scientists, as the capacity of the individual to process information is limited, and the individual is therefore in fact a "cognitive miser". According to this model, individuals use the least complex and demanding cognition, e.g. heuristics or mental short cuts, and use any opportunity to avoid engaging in effortful thoughts. Various errors and biases that are associated with an individual's social thinking are not departures from the ideal form of information processing but intrinsic to social thinking. The cognitive misers do therefore, act rationally due to the intensity of stimuli

and information intake (Fiske & Taylor, 1991). Later models of social cognition suggest that the two poles of cognition, the naïve scientist and cognitive miser approach, are too monolithic. In the cognitive miser approach, motivation had almost disappeared, but as the importance of motivation became evident again, the social thinker approach moved to the “motivated tactician”. In this approach, an individual chooses between multiple strategies based on motives, needs and goals, and is therefore a flexible social thinker that has multiple cognitive strategies available (e.g. Fiske & Taylor, 1991). Therefore, the individual sometimes chooses through the interest of adaptability and accuracy, like the naïve scientist, and sometimes chooses in the interest of speed or self-esteem, like the cognitive miser and is thus both (Crisp & Turner, 2014). The TPB and VBN theory could represent two different approaches and ends of social cognition, and the comparison between them could give an interesting idea of how the individual thinks and acts in regard to household food waste reduction.

## *2.7. Other influential factors that could affect food waste reduction in the household*

Apart from psychological predictors to food waste reduction in the households, other factors have been identified as influential. In the next section a few will be described.

### *2.7.1. Demographical factors*

Demographical factors have been found to correlate with the amount of food wasted in households. For example, household size has been shown to be an influencing factor on the amount of food that is wasted, and unsurprisingly, the amount of food waste increases with growing household size (e.g. Koivupuro et al., 2012). However, other studies have shown that people who live by themselves tend to generate most food waste “per person” (e.g. Baker, Fear, & Denniss, 2009; WRAP, 2008), and others have shown that gender might be an influencing factor in food waste, as women, tend to generate the most waste when responsible for grocery shopping (e.g. Koivupuro et al., 2012). Age has also been shown to be an influential factor on food waste in the household, and according to WRAP (2008), people over the age of 65 generate approximately 25% less household food waste than the rest of the population. Interestingly, those over 65 were found to be more disengaged with global environmental concern than the rest of the population but are more likely to hold the view that food waste is wrong. This is possibly due to differences in life experiences, such as austerity and poverty during and after



World War II (Quested et al., 2013). Although these factors undoubtedly are influential to food waste reduction in households, demographics are not the main emphasis of this study.

### *2.7.2. Political Orientation*

The left-right distinction has been equated with the liberalism-conservatism division due to historical roots. The right-wingers tend to believe in the wisdom of the ages and that social changes should happen slowly, as new ideas should be viewed with skepticism until their merits have been proven. Right wingers are also more likely to support the prevailing social order (Jost, Glaser, Kruglanski, & Sulloway, 2003). After the Industrial Revolution in the West, capitalism became, in many ways, the prevailing social order due to its inevitable economic inequality, and those on the right tended to defend it. Those who wanted more redistribution of wealth and involvement of the state in order to guarantee the welfare of the citizens have been more associated with the left (Thorisdottir, 2012).

Research within political psychology has focused on the differences in attitudes, goals, motives, values and personalities of left- and right-wing ideologies, and therefore validates the soundness of the left-right dimension. A meta-analysis found that both dispositional and situational variables were related to left-right political orientation, and were especially associated with management of threat and uncertainties. Intolerance of ambiguity, need for structure and closure, and fear of threat and loss were positively related to right-wing whereas openness to new experiences, preference of cognitive complexities and tolerance of uncertainty were negatively related to attitudes of right-wing people (Jost et al., 2003). It is therefore clear that there is a difference between individuals with left- or right-wing political orientation, but the cause for this is more difficult to analyze.

A large cross-cultural analysis on self-reported political orientation of individual's was analyzed using the World and European Values Survey data (Neumayer, 2004). The findings showed that left-oriented individuals were more willing to prioritize environmental protection over economic growth, had greater confidence in green movements, and were more likely to engage in pro-environmental political behavior. However, left-oriented individuals were not more likely than right-oriented individuals to choose environmentally friendly products or recycle or reuse products (Neumayer, 2004). Policy support to improve the environment has also been more associated with left-oriented individuals like pro-environmental behavior and

intentions (e.g. Dietz, Stern, & Guagnano, 1998). On the other hand, fiscal conservatism has been positively correlated with the tendency to place more emphasis on the economy than environmental concern. Right-oriented individuals accept human dominance over nature, and that humans have no altruistic responsibilities to non-humans (Allen & Castano, 2007). Although no evidence has shown that political orientation could be an influential factor in household food waste reduction, it may prove interesting if there are demonstrable differences<sup>1</sup>.

### 2.7.3. *Habits*

Habits are regarded as learned sequences of acts that are triggered automatically by specific environmental cues as a result of frequent performance in the same or similar social and physical environment (e.g. James, 1890). Habits enable the individual to perform an particular action in a rather mindless fashion, suggesting that habitual behavior may be regarded as automatic, as it is done efficiently, effortlessly and unconsciously (Aarts, Verplanken, & van Knippenberg, 1998). As the behavior is repeated and reinforced by satisfactory experiences, the habit strength increases (Aarts et al., 1998). The two elements of habits, automaticity and being environmentally cued makes habit particularly hard to change (e.g. Maio et al., 2007). Most people eat every day in the same places at the same times. Therefore, it could be assumed that eating behavior is habitual to a large extent (Conner, Norman, & Bell, 2002). Studies have also shown that most food choices are habitual (Carrasco, Labeaga, & López-Salido, 2005; Naik & Moore, 1996). However, food waste reduction is not a single act but a series of multiple behaviors and practices. The individual actions and effectiveness to reduce household food waste could therefore vary between context of the performed behavior in question (Quested et al., 2013).

In contrast to constructs like intention, personal norms and attitude, which are a conscious part of human cognition, habit is unconscious. Therefore it can prove difficult to ask individuals to report on the strength of their habits (Klöckner, Matthies, & Hunecke, 2003). Traditional theories like the TPB and theories focusing on moral obligations, like VBN theory, have proven their strengths in multiple applications on pro-environmental behavior, but are weak in that they lack the conceptual integration of repeated actions and habitual patterns of

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<sup>1</sup> Political Orientation was tested in the current study (Part B), but was not found to be a significant predictor of either intention to reduce household food waste or self-reported food waste behavior, and was therefore omitted from further analysis.

the behavior (Klöckner et al., 2003). Due to the complexity of food waste reduction behavior and difficulty in measuring the habitual part of behavior, it was decided to exclude habits from the study.

### **3. Methods used in the current study**

The issue of missing data has been a common source of difficulty in statistical analysis, challenging academics since the beginning of field research (Graham, 2009). In order to understand this difficulty, missing data has been categorized based on type: missing completely at random (MCAR), missing at random (MAR), and missing not at random (MNAR). With MAR, the missingness (that is, whether the data is missing or not) may depend on the observed data, but not on unobserved data. If data is MCAR, the missingness does not depend on the observed data, as MCAR is a special case of MAR. However, with MNAR, the missingness depends on unobserved data (Schafer & Graham, 2002).

#### *3.1. Missing data and planned missing data design*

In the current study, planned missing data design was applied to the questionnaire, which allows incomplete data to be collected from participants by randomly assigning them questionnaires with missing items. The main benefit of the method is a shortened questionnaire, thereby reducing the burden on the participants, leading to increased validity and potentially higher quality of data (Little & Rhemtulla, 2013).

The missing data design method used in this study was the three-form design of planned missing data. Each item on the questionnaire was allocated to one of four blocks; X, A, B and C. X stands for items everyone responded to. Each questionnaire form was composed of the X block plus two out of the three remaining blocks, resulting in full participation in X block items, and two-third participation in A-C block items (Graham, Hofer, & MacKinnon, 1996). The planned missing design conforms with the MCAR assumption, because participants are randomly assigned to a missing data pattern. Even though planned missing design is not commonly used, the recognition of its usefulness is increasing and becoming more common as the modern methods of analysis and imputation on missing data are becoming more accessible (Little & Rhemtulla, 2013).

### 3.2. *Multiple Imputation (MI) and Multivariate Imputation in Chained Equation: MICE*

One method used to deal with complex and incomplete data sets is the Multiple Imputation (MI) method. The MI method is a general framework that uses imputed versions of the data by replacing the values that are missing with plausible data values. The values that are imputed to the data are drawn from a distribution specifically modeled for each missing entity (van Buuren & Groothuis-Oudshoorn, 2011). The MI method provides valid statistical inference under MCAR and MAR conditions (Little & Rubin, 2002). There are three main steps used in the MI method. In step 1, a number of imputation,  $m$ , is used. The MI method acknowledges the uncertainty that is associated with the imputed values from each  $m$  imputation, that in turn will lead to an uncertainty by generating a  $m$  imputed complete data sets (Little & Rubin, 2002). Each  $m$  set of complete data set has one unique estimate of the missing values. The  $m$  complete data sets are then analyzed individually at step 2, resulting in  $m$  different estimates for each parameter. Therefore, each imputed data  $m$  has a unique estimation, resulting in  $m$  analysis. At the last step, the  $m$  estimations are pooled together and estimated, thus yielding a single estimate of the parameter with a corresponding standard error (Figure 4) (Little & Rubin, 2002; van Buuren & Groothuis-Oudshoorn, 2011).

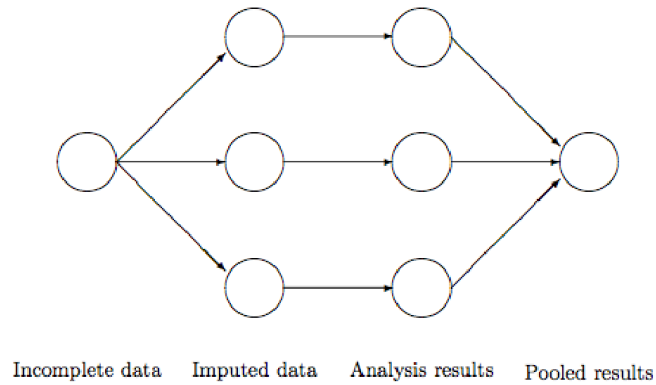


Figure 4. The three main steps in multiple imputation, with  $m = 3$  in the figure.

One method used for addressing missing data and has emerged in statistical literature is the Multivariate Imputation by Chained Equations (MICE) (van Buuren & Groothuis-Oudshoorn, 2011). The MICE software package first appeared in 2001 as an R package, and included functions such as predictor selections, passive imputation and automatic pooling. The pooling is done under the Rubin's Rule (1987) (van Buuren & Groothuis-Oudshoorn, 2011). The method that was used in the study was predictive mean matching (PMM). The method

draws imputations only from observed data and within the range of the observed data. Therefore, the distribution of the imputed and observed values should be similar. Although it was once thought that 3-5 imputations  $m$  were sufficient (Rubin, 1987), researchers now recommend using a much higher  $m$  than was previously considered (Graham, Olchowski, & Gilreath, 2007). Setting  $m$  imputations that are too low might result in large simulation error, especially if the fraction of missing information (fmi) is high (van Buuren & Groothuis-Oudshoorn, 2011).

## **PART B. Research Report:**

### **Predicting household food waste reduction: An exploratory study comparing and contrasting the Theory of Planned Behavior and Value Belief Norm theory**

#### **Abstract**

Food waste is a global and complex environmental problem that affects all three pillars of sustainable development: environment, economic and social. Food waste has gathered much attention in research, albeit mostly in the macro context, such as measuring its global volume. Research focusing on food waste at the consumer level is fairly recent. Food waste is rooted in human behavior, and in order for effective and efficient interventions, it is important to identify the psychological antecedents of household food waste reduction. This exploratory study aims to investigate whether components of the Theory of Planned Behavior (TPB) and Value Belief Norm (VBN) theory are predictors of household food waste. Using an online questionnaire among university students ( $N = 391$ ) we explored whether constructs of TPB and VBN theory could predict intention to reduce household food waste and self-reported food waste behavior. Results support the utility of the TPB model, but not the VBN theory, in predicting intention to reduce household food waste ( $R^2 = 52.3\%$ ), with all core constructs of the TPB; attitude, subjective norm and perceived behavioral control, being significant predictors. When the two theories were combined to predict self-reported household food waste behavior, the VBN theory added significantly to the variance explained ( $R^2 = 16.2\%$ ), due to self-transcendence and self-enhancement being significant predictors of behavior. This results demonstrate the utility of applying the TPB model as an intervention to reduce household food waste.

**Keywords:** Household food waste; Theory of Planned Behavior; Value Belief Norm theory; Multiple Imputation (MI); Planned missing data design.

#### **1. Introduction**

Environmental problems that pose a threat to environmental sustainability are oftentimes rooted in human behavior and can only be managed by changing the relevant behavior, thus reducing its environmental impact (e.g. Vlek & Steg, 2007). However, in order to design appropriate interventions to modify such behavior, research is needed in order to pinpoint its determinants.

Food waste is one such environmental problem. It is global and complex and affects each of the three pillars of sustainable development: environmental, economic and social (FAO, 2013). The Food and Agriculture Organization of the United Nations (FAO) estimates that around one-third of edible parts of the food produced for human consumption in the world gets lost or wasted globally, adding up to about 1.3 billion tons of food per year (Gustavsson et al., 2011). Food is lost and wasted throughout the whole food supply chain, from agricultural

production to final household consumption. In low income countries food is mostly lost in the early stages of the food supply chain, while in medium and high income countries food loss occurs mostly at the retail and consumption level (Gustavsson et al., 2011). The term *food waste* refers to food losses occurring at the retail and consumption end of the food supply chain. This concept excludes the inedible portions of food products, and focuses on the portions intended for human consumption (Parfitt et al., 2010).

Food waste has negative consequences for the economy and personal finances (Gustavsson et al., 2011) as well as the environment (FAO, 2013). The FAO (2013) conducted a global study focusing on the impact of food waste on environmental concerns such as climate change, water, land cultivation and biodiversity. This study estimated that the carbon footprint from greenhouse gas emissions of food produced but not eaten was around 3.3 Gtons of CO<sub>2</sub> per year. If food waste were to be regarded as a nation, this number places it as the third highest CO<sub>2</sub> emitter after the USA and China (FAO, 2013).

### *1.2. The role of psychology in understanding pro-environmental behavior*

Behavior that directly benefits the environment or aims to minimize harm to the environment is called pro-environmental behavior. When acting in a pro-environmental manner, one seeks to minimize the negative impact of one's actions, such as by minimizing energy- and resource consumption, or recycling (Kollmuss & Agyeman, 2002). By adopting pro-environmental behavior patterns, an individual can contribute significantly to environmental sustainability (Steg & Vlek, 2009). Numerous theoretical frameworks have been developed to try to understand what leads to pro-environmental behavior but no definitive answers have been found (Kollmuss & Agyeman, 2002). Psychological research may aid in the understanding of cognitive, motivational and structural factors and processes that facilitate or hinder pro-environmental behaviors (Steg & Vlek, 2009). Psychological insight can thereby play an important role in the management of environmental problems, such as food waste, by pinpointing precursors to pro-environmental behavior. Behavioral interventions are more effective in general if they are systematically implemented, planned and evaluated (Steg & Vlek, 2009), and are unlikely to be effective unless they target the key psychological mechanisms that underpin barriers and/or motivations. For this reason, people are unlikely to reduce food waste if they are not motivated to do so (Graham-Rowe et al., 2015). Investigations into household food waste reduction should therefore be theory-driven to reveal the

determinants that can potentially modify behavior and guide the development of effective and replicable interventions (Steg & Vlek, 2009).

Over the last couple of decades, food waste has gathered much attention in research, though the focus has mostly been on the amount of food waste generated in industrialized countries, clean energy for production, management innovations and treatment of waste (Chen, Jiang, Yang, Yang, & Man, 2016). Research on food waste at a consumer level using behavioral theories is only fairly recent, and the factors underlying the behavior of food waste are still under analysis and discussion (Papargyropoulou et al., 2016; Secondi, Principato, & Laureti, 2015). There can be multiple complex reasons and actions which cause the individual to waste food (Quested et al., 2013). It has therefore been suggested that any model for analyzing food waste should bear in mind the context in which the behavior occurs, and take into account e.g. the individuals' attitudes, values, motivations and perceived behavioral control of food wastage (Mondéjar-Jiménez et al., 2016).

Since there has been little peer-reviewed research focusing on identifying key motivations and/or barriers to reduce household food waste, we decided to compare and contrast two theoretical frameworks, the Theory of Planned Behavior (TPB) and Value Belief Norm (VBN) theory as predictors of household food waste. To our best knowledge, only three published studies have used the TPB (Ajzen, 1991) as a potential framework for effective intervention of household food wastage, which specifies the cognitive antecedents of behavior (Graham-Rowe et al., 2015; Mondéjar-Jiménez et al., 2016; Stefan et al., 2013). No published studies exist on the VBN theory (Stern, 2000) to explain food waste reduction in households.

## **2. Theoretical framework**

### *2.1. The Theory of Planned Behavior*

The Theory of Planned Behavior (TPB) is one of the most commonly used and influential psychological theories for explaining pro-environmental behaviors (Botetzagias et al., 2015). It provides a theoretical framework for systematically investigating the factors that may influence behavioral choices (Tonglet et al., 2004) and can be used to explain a variety of intentional behaviors (Ajzen, 1991). The central factor in the TPB is the individual's *intention* to perform or not to perform a given behavior, based on the assumption that behavioral intention captures



motivational factors that influence behavior. Intentions are indicators of effort, or how hard people are willing to try in order to perform the behavior (Ajzen, 1991). In the theory, intention is influenced by three factors. The first factor is the *attitude towards the behavior*, and that is the favorable or unfavorable evaluation of an individual to perform or not to perform the behavior. The second factor is *subjective norm*, which is the perceived pressure and/or influence by the individual's social surroundings to perform or not to perform the behavior. The third factor is *perceived behavioral control* (PBC), which is the perception of the individual's ability to perform the behavior (Ajzen, 1991). As the intentions to perform the behavior get stronger, the likelihood of the behavior to be performed increases (Ajzen, 1991).

The TPB has been used and applied across a variety of environmental behaviors, such as recycling behavior (e.g. Boldero, 1995; Taylor & Todd, 1995; Cheung et al., 1999; Tonglet et al., 2004), travel mode choices (e.g. Bamberg et al., 2003; Gardner & Abraham, 2010) and household food waste (Stefan et al., 2013; Graham-Rowe et al., 2015; Mondéjar-Jiménez et al., 2016). Research findings have usually supported the utility of TPB constructs in predicting intentions, and a meta-analysis found that on average, intention accounted for 27% of the variance of pro-environmental behavior (Bamberg & Möser, 2007).

Some studies have raised concern that the explanatory power of the TPB is lacking, and that when additional variables are included as predictors, the percentage of variance explained increases (e.g. Tonglet et al., 2004; Boldero, 1995; Davies et al., 2002). According to Ajzen (1991), the TPB allows for additional variables to be incorporated into the model as those variables make a significant contribution to the explanation of behavior, although, doing so is a deviation from the original theory.

## 2.2. Value Belief Norm Theory

The Value-Belief-Norm Theory (VBN) of environmentalism was developed by Stern (Stern et al., 1999; Stern, 2000). VBN theory has been widely tested and has been successful in explaining various environmental acts, such as environmental citizenship, willingness to reduce car use, acceptability of energy policies and consumer behavior (e.g. Kaiser et al., 2005; Nordlund & Garvill, 2003; Steg et al., 2005). The VBN theory combines value theory (e.g. Schwartz, 1992, 1994), the New Ecological Paradigm (NEP) (Dunlap & van Liere, 1978) and the Norm Activation Model (NAM) (Schwartz, 1977) through a causal chain in which all are

believed to be a determinant of behavior (Stern, 2000). Each of these determinants is described below.

### *2.2.1. Values*

It is thought that people's values are related to their environmental behavior and attitudes (e.g. Stern, 2000). Since values are thought to conceptualize important life goals or standards as guiding principles in life (e.g. Rokeach, 1973), they might provide a basis for the formation of attitudes that would act as guidance for behavior.

Values reflect a belief of a certain desirable end-state, are abstract in nature, can be ordered in a system of value priorities and usually serve as guiding principles for evaluating behavior, events and people. This implies that the choice to act will be based on the value that is considered to be most relevant to the act (Schwartz 1992; 1994). In one of the most widely used and empirically grounded theories of basic values, the Schwartz Value Theory, values are measured and plotted in a two-dimensional space that consists of four separate value clusters (Cieciuch et al., 2013). The first dimension is "Openness to change" versus "Conservation". This dimension distinguishes values that stress independence, like self-direction and stimulation from values that emphasize greater conformity and tradition. The second dimension is "Self-transcendence" versus "Self-enhancement", which distinguishes social values, like benevolence and universalism, from those values that pursue personal interest, such as achievement and power (Schwartz, 1992, 1994).

Within eco-literature, a distinction has been made between egoistic, altruistic and biospheric (or ecocentric) values. The self-enhancement dimension is made up of egoistic values, where motivational goals are either power (e.g. gaining control over resources or people) or achievement (e.g. focusing on gaining personal success and ambition) (e.g. van Lange et al., 1997; Schwartz, 1992). In contrast, the self-transcendence values, where the motivational goals are universalism and benevolence, could be regarded as altruistic and biospheric value orientation (e.g. Schwartz, 1992; Stern & Dietz, 1994)

Value orientation has been widely studied within social and environmental psychology, including the difference between self-transcendence and self-enhancement dimensions in the context of differing beliefs and pro-environmental behavior (e.g. Stern, 2000; Nordlund & Garvill, 2002). As pro-environmental behavior transcends self-interest, issues often arise from

conflict between collective and individual interest (e.g. Axelrod, 1994; Karp, 1996). People who value concerns beyond themselves (self-transcendent with altruistic or biospheric values), are more likely to engage in pro-environmental behavior (Steg et al., 2005). Values have been found to correlate with various self-reported behaviors, such as consumer behavior, recycling, policy acceptance and political behavior to protect the environment (e.g. Karp, 1996; Stern & Dietz, 1994; Stern et al., 1999).

#### *2.2.2. Beliefs - New Ecological Paradigm (NEP)*

The New Ecological Paradigm (NEP) scale was published in 1978 by Dunlap and Van Liere (Dunlap & van Liere, 1978). The NEP scale is thought to tap into “primitive beliefs” about the relationship between humanity and nature, as it constitutes a fundamental component of people’s belief systems about social reality, physical reality and nature itself (Dunlap et al., 2000). The NEP scale aims to measure how people view the human-environment relationship, and can be utilized to assess the environment’s vulnerability to human interference (Poortinga et al., 2002). In the literature of environmental psychology, the NEP has been found to measure general environmental concern (Poortinga et al., 2004). General beliefs or worldviews are less stable than values and the relationship between worldviews and behavior is generally not strong. This is because behavior-specific beliefs or personal norms mediate the relationship between worldview and behavior (e.g. Poortinga et al., 2004; Nordlund & Garvill, 2003).

#### *2.2.3. Norms*

The Norm Activation Model (NAM) was developed by Schwartz (1977) and has been used to explain behavior in terms of interrelationships amongst four main constructs: personal norms, social norms, awareness of consequences (AC) and ascription of responsibility (AR). The NAM model was developed to explain pro-social and altruistic behavior. The central idea of the NAM model is that the influence of social norms on the behavior of the individual is not direct, but mediated instead by personal norms. Personal norms reflect the idea that a person behaves in a certain manner because he/she feel like it is the right thing to do. Personal norms are conceptualized by the feeling of moral obligations that individuals hold for themselves (Schwartz, 1977). According to Schwartz (1977), personal norms are the only direct determinants of pro-social behavior and will only activate if the individual is both aware of the consequences (AC beliefs) and feels some responsibility for these consequences (AR beliefs).

Some researchers have combined and integrated NAM with the TPB for better explanatory power of behavior. Ajzen (1991) himself suggested that the addition of personal norms could increase the explanatory power of the TPB, as none of the original TPB constructs captures the influence of moral consideration. The NAM model has shown promising results in explaining environmental behaviors, such as transportation behavior (e.g. Wall et al., 2007). According to Thøgersen (1996), pro-environmental behavior is not based on cost-benefit analysis of the individual, like the TPB assumes, but on a person's moral belief, as the NAM asserts. Therefore, the NAM should add to the explanatory power when the two theories are combined.

### *2.3. Comparing the two theoretical frameworks*

The first and most significant difference between TPB and VBN theory is the emphasis on altruism in the latter. As has been pointed out, the TPB stresses personal utility and the individual's cost-benefit analysis (Ajzen, 1991), while in the VBN theory, benefits to others have priorities over self-interest (Schwartz, 1977). The second difference is that VBN theory focuses on internal norms (personal norms) while TPB focuses on external norms (subjective norms). Thirdly, TPB captures perceived control over behavior while VBN theory does not. The fourth difference between the theoretical frameworks is that TPB includes intention to act whereas VBN theory does not (Wall et al., 2007). The TPB model stresses the importance of cost-benefit arguments and views the individual as maximizing their utility while in the VBN theory, personal norms (or moral) as possible behavioral determinants (Bamberg & Schmidt, 2003). The TPB assumes that when an individual is confronted with a choice between two behavioral alternatives, the one that is associated with the most positive behavioral consequences will be chosen. Therefore, the processes underlying the performance of the behavior are mostly controlled (Ajzen, 1991).

### *2.4. The present study*

Few studies on food waste have focused on psychological factors behind the behavior relating to household food waste. Rather, most studies have researched food waste in a macro context, such as the environmental impact of food waste (FAO, 2013), or food waste volume (e.g. WRAP, 2008, 2013). Since there has been little peer-reviewed research focusing on the behavior of the individual in regard to household food waste, this study is exploratory in nature.

The main objective of this study was to compare and contrast the TPB and VBN theory as predictors of household food waste. This was done by exploring whether the TPB and VBN could predict both a) *intention* to reduce household food waste and b) participants' *self-reported food waste behavior*.

First, the two theoretical frameworks were tested separately by examining whether the core predictors of the TPB model or the VBN theory would predict intention to reduce household food waste. Then the same theoretical constructs were used to predict self-reported food waste behavior of the participants. Secondly, the two theoretical frameworks were tested jointly, for both intention to reduce household food waste and participants' self-reported food waste behavior. The results of these two analyses were used to assess whether the two theories combined, could explain more variance in the outcome variables than each theory could on its own.

### **3. Method**

#### *3.1. Design and procedure*

The current study employed a web-based questionnaire that was sent out to undergraduate students of the University of Iceland. Participants were sent an email which explained the study, asked for their participation, and provided a link to the questionnaire on the QuestionPro website (QuestionPro, 2016)

To be eligible for the study, participants had to be eighteen years or older and understand Icelandic. The questionnaire was open on QuestionPro from September to October, 2016. Participation was voluntary and anonymous. In order to incentivize participation, those who completed the survey were entered into a lottery for a chance to win a restaurant voucher.

#### *3.2. Participants*

In total, 405 participants completed the questionnaire. Participants who indicated that they had not wasted any food in their household in the past 7 days ( $n = 14$ ) were omitted from further analyses, as it would not have been possible for these individuals to reduce their household food

waste<sup>2</sup>. All analyses reported below are thus conducted on data from the remaining 391 participants. Ages ranged from 18 to 69 ( $M = 27.12$ ,  $SD = 9.07$ ), where 62.3% were aged between 20-25 years old. The majority of participants were female (83.6%), educated up to undergraduate level (73.7%), with no children under the age of eighteen living in their household (62.1%) and lived in the capital region (87.2%). For more details on participants' demographics, see Table 1. All participants were residents of Iceland at the time of the study.

**Table 1.**  
Participant demographics.

	<i>N</i>	%		<i>N</i>	%
Gender			Household location		
Female	327	83.6	Capital region	341	87.2
Male	64	16.4	Countryside	42	10.7
Household size			No. of children in household		
1	56	14.3	0	243	62.1
2	112	28.6	1	72	18.4
3	77	19.7	2	46	11.8
4	66	16.9	3	20	5.1
5	55	14.1	4	2	.5
6	19	4.9	5	0	0
Over 6	5	1.3	Over 5	0	0
Education			Household income (ISK)		
Elementary school	3	.8	Under 250.000	81	20.7
College	288	73.7	250.-449.999	67	17.1
Apprenticeship or vocational school	11	2.8	450.-649.999	53	13.6
Vocational training	11	2.8	650.-849.999	43	11
Undergraduate degree	49	12.5	850.-1.499.999	57	14.6
Postgraduate degree	27	6.9	1500.-3.500.000	22	5.6
			Over 3.500.000	6	1.5
			Don't want to answer	60	15.3

<sup>2</sup> A supplementary analysis including these 14 participants showed nearly identical results. Inkeeping with the analysis by Graham-Rowe et al. (2015), we therefore omitted them from further analysis.

### *3.3. Analysis*

The Multiple Imputation (MI) method was used in the data analysis in the current study and was conducted in the statistical software R through MICE, and in SPSS (20.0).

Due to length of the questionnaire, this study utilized the three-form design of planned missing data (see chapter 3.4.1). The method of planned missing data allows incomplete data to be collected from participants by randomly assigning missing items to their questionnaire. The main benefit of this method is a shortening of the questionnaire, thereby reducing the burden on participants. This can yield increased validity and may lead to a higher quality of data. One can administer 33% more items in total by shortening the survey for each participant, yet allowing more items, increasing the breath of constructs tested (Little & Rhemtulla, 2013). At least one-third of participants provide data for each pair of questions, so all correlations are estimable (Graham, 2009). The drawback is that in the three-form design some correlations are tested with lower power because they are based on only one-third of the sample, however that is not considered to be out of the researcher's control and could be avoided (Graham, 2009). The main focus of the current study was not to test the methodological power of the three-form design of planned missing data, but to test the constructs of the two theories in predicting intention to reduce household food waste and self-reported food waste behavior.

Data can be missing completely at random (MCAR), missing at random (MAR), and missing not at random (MNAR). With MAR, the missingness (that is, whether the data is missing or not) may depend on the observed data, but not on unobserved data. If data is MCAR, which is a special case of MAR, the missingness does not depend on the observed data. However, with MNAR, the missingness depends on unobserved data (Schafer & Graham, 2002). The planned missing data design conforms with the MCAR assumption, because participants are randomly assigned to a missing data pattern (Little & Rhemtulla, 2013).

Since the planned missing data design was applied to the questionnaire, the fraction of missing information (fmi) was rather high. When the proportion of fmi is high, it is recommended to assess convergence on the imputed data. According to van Buuren & Groothuis-Oudshoorn (2011), there is no clear-cut method for determining if the MICE algorithm has converged, but the most common method is to plot one or more parameters against the iteration number. As can be seen in Appendix D, there is no definite trend and the different stream freely intermingle with each other. It was therefore concluded that convergence

was met, since the difference between different variance was not larger than the variance within each individual sequence (van Buuren & Groothuis-Oudshoorn, 2011).

The fmi for each predictor variable and the proportion of total variance that is attributed to the missing data (lambda) was calculated in R (Rubin, 1987). According to Rubin (1987), fmi is used to define the relative efficiency of the MI. When applying the MI method on data, one must make a decision on how many  $m$  imputations should be considered sufficient for the data. According to Graham et al. (2007), when missing data is 50%, it is recommended to use at least  $m = 40$  to guarantee less than 1% power fallout. The fmi and lambda for both hierarchical multiple regression models of intention to reduce household food waste and self-reported food waste behavior is presented in Appendix C. Since the fmi was rather high in the current study, ranging from .04 for attitude and subjective norm to .36 for NEP, due to planned missing data design, it was decided to use the number of imputations  $m = 50$  (Rubin, 1987).

In the MI method,  $m$  imputations are created from the data set that contains  $m$  completed data, and each statistical procedure has to be done  $m$  times. As both R and SPSS could not give a pooled estimate of Cronbach's alpha ( $\alpha$ ) or standard deviation ( $SD$ ), rules suggested by Rubin (1987) were used through the formula  $\bar{D} = \frac{\sum_{i=1}^m \hat{D}_i}{m}$  to calculate the average for each data for the final estimation (Sinharay, Stern, & Russell, 2001).

To test the two theoretical frameworks, hierarchical multiple regression was used to compare and contrast the TPB and VBN theory on both intention to reduce household food waste and self-reported food waste behavior.

### *3.4.Measures*

The questionnaire was set up using the QuestionPro software. The questionnaire consisted of three parts, assessing the theoretical frameworks, evaluation of respondents on the food waste reduction behavior and demographics (see Appendix A).

*Demographic information.* Participants were asked to identify their gender, age, level of education, household size, number of children living in their household (under the age of 18 years old), household income and household location.

*Responsibility for household food cooking and household food shopping.* Responsibility for household food cooking and food shopping were assessed by the following



items: “To what extent are you responsible for cooking and preparing food in your household?” and “To what extent are you responsible for food shopping in your household?” ranging from 1 = not at all responsible to 4 = responsible for all or almost all.

*Self-reported food waste behavior.* Participants’ food waste behavior was modified from the measures used by WRAP (2007) questionnaire to estimate the amount of food participant’s perceived they threw away within the last 7 days. Participants had to estimate the amount that was thrown away (1 = none/not applicable to 6 = quite a lot) for various food types (e.g. fruit and vegetables, dairy products, bread, fish and meat, unfinished food on plates). The decision to group food waste by category was based on the assertions of WRAP (2007), which found that participants provided a more realistic estimation of food waste when they considered different food types separately, as opposed to estimating food waste volume in total. These questions have been proven a reliable measure of food waste, and when this quantification of food waste is combined with behavior data, the validity of responses can typically be confirmed (e.g. participants who say they waste less do waste less and vice versa) (WRAP, 2007).

*The theory of planned behavior (TPB).* Participants completed a series of items assessing the cognitive constructs in the TPB model. Responses were given on 7-point Likert scales and ranged from strongly disagree (1) to strongly agree (7), unless otherwise indicated. Items used in this study were obtained from Graham-Rowe et al. (2015) but were adapted to the current study and parallel translated into Icelandic. Internal reliability was calculated for each iteration of each construct, although, pooled Cronbach’s alpha ( $\alpha$ ) is not accessible through the MI method. The mean of the Cronbach’s alpha for each of the 50 imputations is therefore presented. The composite scores were calculated from the means of the constituent items.

*Intention.* Participants’ intentions to reduce household food waste was assessed through three items, e.g. “I plan to reduce the amount of food that gets thrown away from my household over the next seven days”. The mean of Cronbach’s alpha over the 50 imputed samples was  $\alpha = .92$ .

*Attitude.* Attitudes toward reducing household food waste was assessed using a seven point semantic differential scale with six pairs of adjectives, rating the statement “For me to reduce the amount of food that gets thrown away from my household over the next seven days would be...” extremely bad (1) / extremely good (7), extremely pointless / extremely worthwhile, extremely unenjoyable / extremely enjoyable, extremely foolish / extremely wise,

extremely unpleasant / extremely pleasant, and extremely harmful / extremely beneficial. The mean of Cronbach's alpha over the 50 imputed samples was  $\alpha = .86$ .

*Subjective norm.* Two items were used to measure subjective norm, “most people who are important to me probably think that I should reduce the amount of food that gets thrown away from my household over the next seven days” and “most people who are important to me would probably approve of me reducing the amount of food that gets thrown away from my household over the next seven days,”  $r(391) = .75, p < .001$ .

*Perceived behavioral control (PBC).* Four items were used to assess PBC, e.g. “If I wanted to I could reduce the amount of food that gets thrown away from my household over the next seven days.” The mean of Cronbach's alpha over the 50 imputed samples was  $\alpha = .64$ .

*Values.* Eight subscales from the latest version of the Portrait Values Questionnaire (PVQ-RR) by Schwartz's (Schwartz et al., 2012; Icelandic translation by McQuilkin et al., 2016) were used to assess participants' values. As we were particularly interested in altruistic, biospheric and egoistic values, items assessing only the self-transcendence versus self-enhancement dimensions were used (e.g. Nordlund & Garvill, 2003). Three values, each represented by three items (nine in total), measured the self-enhancement dimension (achievement, power dominance and power resources) and five values, represented by three items (15 items in total), measured the self-transcendence dimension (universalism-nature, universalism-conservation, universalism-tolerance, benevolence-care and benevolence-dependability). Each item described a person (e.g. “It is important for him/her to be tolerant towards all kinds of people and groups”) and respondents were asked to rate their similarity to that using a 6-point scale (1 = not like me at all to 6 = very much like me). Two versions were used in the questionnaire (female and male), and participants responded to their self-identified gendered version. The mean of Cronbach's alpha over the 50 imputed samples was  $\alpha = .86$  for self-transcendence values and  $\alpha = .76$  for self-enhancement values.

*Beliefs* were assessed using the revised New Ecological Paradigm Scale (Dunlap et al., 2000; Icelandic translation by Ragna B. Garðarsdóttir). Participants completed 6 items from the shortened NEP scale regarding anthropocentric items, ranging from 1 = fully disagree to 7 = fully agree. Items from the shortened list were e.g. “Humans were meant to rule over the rest

of nature” and “Plants and animals have as much right as humans to exist.” The mean of Cronbach’s alpha over the 50 imputed samples was  $\alpha = .67$ .

*Beliefs* were also assessed through awareness of consequences (AC) and ascription of responsibility (AR). Respondents indicated to what extent they fully disagreed (1) or fully agreed (7) to 11 items reflecting awareness of consequences (AC; 6 items) and ascription of responsibility (AR; 5 items). The items on the questionnaire were adopted from Steg et al. (2005). The mean of Cronbach’s alpha over the 50 imputed samples was  $\alpha = .80$  for AC beliefs and  $\alpha = .66$  for AR beliefs.

*Norms* were assessed using personal norms. The items on the questionnaire were adopted from Steg et al. (2005), e.g. “I feel guilty when I waste food.” The mean of Cronbach’s alpha over the 50 imputed samples was  $\alpha = .73$ .

#### *3.4.1. Three-form design of planned missing data on the questionnaire*

In the current study, three-form design of planned missing data was applied to the questionnaire. Different blocks of questions were used and participants received random sets of blocks, according to the three-form design; AB-X, AC-X or BC-X. The X blocks consisted of demographics and household food waste behavior. Using the three-form design for questions measuring the TPB model and VBN theory shortened the questionnaire by 27.4%. Table 2 describes how the constructs of the TPB model and VBN theory were split into 4 blocks in the questionnaire.

In the TPB model, three items measured intentions, so each participant answered two out of three. All participants answered the two questions regarding subjective norm, since all three groups needed to have items that tested that construct. There were 4 items, in total, that measured PBC, meaning that all participants answered the item “I believe I have complete control over reducing the amount of household food waste that gets thrown away from my household over the next seven days,” as well as two out of three remaining PBC questions. Attitude was measured on a semantic differential scale, not Likert-scale, so participants answered all six items regarding attitude. Regarding values, three questions measured each of the eight values on the self-enhancement and self-transcendence dimension. Therefore, the questionnaire was split equally into three groups which each consisted of eight items, one of each value, and participants answered two out of three of these subsets. The NEP, AC and

personal norms were all measured by six items, so each group answered four out of six. Since only 5 items were used to assess AR, all participants answered two items, e.g. “My household food waste has little impact on food waste in general” and two out of three of the remaining items. More information on each item of the questionnaire can be seen in Appendix A.

**Table 2.**

Outline of how the three-form design of planned missing data was applied to the questionnaire.

<b>Blocks</b>				
	<b>A</b>	<b>B</b>	<b>C</b>	<b>X</b>
<u>TPB model</u>				
PBC	Q1	Q2	Q3	Q4
Subjective Norm				Q1, Q2
Intention	Q1	Q2	Q3	
Attitude				Q1, Q2, Q3, Q4, Q5, Q6
<u>Values</u>				
Self-enhancement	S1	S2	S3	
Self-transcendence	S1	S2	S3	
<u>Beliefs</u>				
NEP	Q1, Q4	Q2, Q5	Q3, Q6	
AC	Q3, Q4	Q1, Q5	Q2, Q6	
AR	Q1	Q2	Q4	Q3, Q5
<u>Norms</u>				
Personal norms	Q1, Q5	Q2, Q4	Q3, Q6	

*Note: Q1 – Q6 represent individual question for each scale. S1 – S3 represent subsets of values, where e.g. S1 refers to the first question for each value (see Appendix A).*

## 4. Results

Respondents did not report a large amount of food waste on average (Table 3), however, they reported on average high levels of intentions to reduce food waste. Other descriptive statistics are reported in Table 3 and Pearson correlation coefficients ( $r$ ) between constructs measuring TPB and VBN theory are given in Table 4.

### *4.1. Predicting intention to reduce household food waste and self-reported food waste behavior by contrasting the two theoretical frameworks*

A hierarchical multiple regression analysis was conducted to determine whether the TPB or the VBN theory constructs could significantly predict intention to reduce food waste or self-reported food waste behavior of participants. Demographic and background variables were controlled for in this analysis, specifically, gender, age, income, household size, number of children in household, responsibility for household food shopping and responsibility for household food cooking.

#### *4.1.1. Intention to reduce household food waste*

First, the core constructs of the TPB; attitude, subjective norm and PBC, and VBN theory; self-transcendence, self-enhancement, NEP, AC, AR, and PN, were compared to see if either theory could predict the intention of participants to reduce their household food waste.

The core TPB predictors accounted for 52.3% of the variance in intention to reduce food waste,  $F(3, 6847) = 104.8, p < .001$ , with all three of the TPB predictors being significant; attitude ( $\beta = .41, p < .001$ ), subjective norm ( $\beta = .32, p < .001$ ) and PBC ( $\beta = .55, p < .001$ ).

The VBN predictors accounted for 16.7% of the variance in intention to reduce food waste,  $F(6, 8731) = 6.34, p < .001$ , with AC ( $\beta = .25, p < .021$ ) and personal norms ( $\beta = .26, p < .028$ ) being significant predictors.

#### *4.1.2. Self-reported food waste behavior*

The same core constructs of the TPB and VBN theory were also compared to see whether either theory could predict or were influential determinants on self-reported food waste behavior of participants.

The core TPB predictors accounted for 10.9% of the variance in the self-reported food waste behavior,  $F(3, 57244) = 9.85, p < .001$ , with attitude ( $\beta = -.10, p < .027$ ), subjective norm ( $\beta = .10, p < .007$ ) and PBC ( $\beta = .10, p < .016$ ) all being significant predictors.

The VBN predictors accounted for 9.1% of the variance in the self-reported food waste behavior,  $F(6, 14899) = 3.12, p < .015$ , with self-enhancement ( $\beta = .19, p < .002$ ) being the only significant predictors.

**Table 4**  
Descriptive statistics for the key study variables.

	<b>Min.</b>	<b>Max.</b>	<b><i>M</i></b>	<b><i>SD</i></b>
Age	18	69	27.06	9.04
Household size	1	7	3.07	1.50
Number of children in household	1	5	1.61	.93
Responsibility for food shopping	1	4	1.83	.93
Responsibility for cooking	1	4	1.91	.91
Intention	1	7	5.15	1.52
Attitude	1	7	6.21	.82
Subjective Norm	1	7	5.06	1.17
Perceived behavioral control (PBC)	1	7	5.10	1.20
Self-enhancement	1	6	3.14	.71
Self-transcendence	1	6	4.95	.62
New Ecological paradigm (NEP)	1	7	2.81	.97
Awareness of consequences (AC)	1	7	5.60	1.01
Ascription of Responsibility (AR)	1	7	5.53	.98
Personal Norm	1	7	5.31	.94
Self-reported food waste behavior	1	6	2.09	.85

**Table 5.**Pearson's correlation coefficients (*r*) between the TPB, VBN theory predictors, intention and self-reported food waste behavior (SRFWB)

	1	2	3	4	5	6	7	8	9	10	11
1 Intention	-										
2 SRFWB	.70	-									
3 Attitude	.43**	-.04	-								
4 Subjective norm	.55**	.22**	.28**	-							
5 PBC	.64**	.15**	.32**	.56**	-						
6 Self-enhancement	-.00	.18**	-.06	.07	-.03	-					
7 Self-transcendence	.26**	-.09	.41**	.18**	.24**	.05	-				
8 NEP	-.16**	.10	-.19**	-.03	-.20**	.16**	-.34**	-			
9 AC	.31**	-.04	.38**	.16**	.28**	.01	.50**	-.37**	-		
10 AR	.23**	.01	.35**	.15**	.26**	-.05	.48**	-.37**	.54**	-	
11 PN	.31**	-.12*	.43**	.09	.26**	-.12*	.51**	-.37**	.51**	.53**	-

\*Correlation is significant at  $p < .05$ \*\*Correlation is significant at  $p < .01$

#### *4.2. Predicting intention to reduce household food waste by combining both theoretical frameworks*

A hierarchical multiple regression analysis was conducted to determine whether the TPB model as well as its expanded version including the VBN theory, could significantly predict intention to reduce household food waste. The analysis is summarized in Table 5. As before, demographic and background variables were controlled for in step 1 in this analysis. The same core TPB constructs were entered at step 2 to see if they contributed significantly to the prediction of intention. In step 3, the same VBN theory constructs were entered to explore whether they contributed further to the prediction of intention over and above the core TPB constructs.

The step 1 predictors accounted for 6.12% of the variance in the intention to reduce household food waste,  $F(7, 127953) = 3.34, p < .001$ .

As before, and can be seen in Table 5, the TPB accounted for additional 52.3% explained variance in step 2. When the constructs of the VBN theory, were entered in step 3 there was no increase in the explained variance in intention,  $F(6, 5121) = 1.13, p = .34; \Delta R^2 = 0.01$ . Inspection of the beta weights revealed that none of the VBN constructs were significant linear predictors. In total, the final model accounted for 53.6% of the variance in intention to reduce household food waste: attitude ( $\beta = .35, p < .001$ ), subjective norm ( $\beta = .34, p < .001$ ) and PBC ( $\beta = .53, p < .001$ ) all remained significant positive linear predictors.



**Table 6.**

Hierarchical multiple regression of intention to reduce household food waste.

Step	Predictors	<i>B</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>R</i> <sup>2</sup>	Adj. <i>R</i> <sup>2</sup>	$\Delta F$	$\Delta R^2$
1	Gender <sup>a</sup>	-.51	.21	-2.45	.014				
	Age	-.01	.01	-1.21	.225				
	Income	-.01	.04	-.18	.855				
	Household size	-.12	.09	-1.34	.181				
	No. of children in household	.09	.12	.73	.467				
	Responsibility of cooking	.08	.15	.53	.596				
	Responsibility of shopping	-.31	.14	-2.18	.029				
						.06	.04	3.34**	
2	Gender	-.27	.16	-1.71	.087				
	Age	-.06	.01	-.74	.460				
	Income	-.00	.03	-.06	.953				
	Household size	.03	.07	.37	.716				
	No. of children in household	.02	.09	.16	.872				
	Responsibility of cooking	.19	.11	1.69	.091				
	Responsibility of shopping	-.24	.11	-2.24	.025				
	Attitude	.41	.07	5.61	.000				
	Subjective Norm	.32	.06	5.16	.000				
	Perceived behavioral control	.55	.07	7.76	.000				
						.52	.51	104.8***	.46
3	Gender	-.27	.16	-1.69	.091				
	Age	-.01	.01	-.76	.450				
	Income	.01	.03	.15	.878				
	Household size	.02	.07	.32	.749				
	No. of children in household	.02	.09	.21	.831				
	Responsibility of cooking	.17	.11	1.47	.142				
	Responsibility of shopping	-.20	.11	-1.87	.061				
	Attitude	.35	.08	4.18	.000				
	Subjective norm	.34	.06	5.36	.000				
	Perceived behavioral control	.53	.07	7.47	.000				
	Self-enhancement	.02	.09	.19	.850				
	Self-transcendence	-.08	.13	-.59	.558				
	New Ecological Paradigm	-.01	.08	-.06	.952				
	Awareness of consequences	.11	.08	1.38	.169				
	Ascription of responsibility	-.10	.08	-1.22	.222				
	Personal norm	.16	.09	1.83	.068				
						.54	.52	1.13	.01

\*Significant at  $p < .05$ \*\* Significant at  $p < .01$ \*\*\* Significant at  $p < .001$ <sup>a</sup> Females = 1, Males = 2

#### *4.3. Predicting self-reported food waste behavior by combining both theoretical frameworks*

A hierarchical multiple regression analysis was also conducted to determine whether the TPB model and the extended version including the VBN theory could significantly predict self-reported food waste behavior. The same constructs, in each step, were entered into the hierarchical multiple regression model. The analysis is summarized in Table 6.

The step 1 predictors accounted for 3.6% of the variance in self-reported household food waste,  $F(7, 2968204) = 2.02, p = .049$ .

As before, and can be seen in Table 6, the TPB accounted for 10.9% of the variance explained when entered at step 2. When VBN theory constructs were entered at step 3, the explained variance of food waste reduction behavior increased significantly ( $\Delta F(6, 14606) = 3.26, p = .003; \Delta R^2 = .05$ ). Inspection of the beta weights revealed that only self-enhancement ( $\beta = 0.18, p < 0.02$ ) and self-transcendence ( $\beta = -.18, p < .002$ ) emerged as significant linear predictors, though self-transcendence was negative. In total, the predictors in the final model accounted for 16.2% of the variance of self-reported food waste reduction behavior; subjective norm ( $\beta = .09, p < .017$ ) and perceived behavioral control ( $\beta = .12, p < .017$ ) remained significant positive linear predictors, but attitude did however not.

**Table 7.**

Hierarchical multiple regression of the TPB and VBN on self-reported food waste behavior.

Step	Predictors	B	SE	<i>t</i>	<i>p</i>	<i>R</i> <sup>2</sup>	Adj. <i>R</i> <sup>2</sup>	$\Delta F$	$\Delta R^2$
1	Gender <sup>a</sup>	-.05	.10	-.54	.589				
	Age	-.00	.01	-.18	.857				
	Income	.03	.02	1.34	.181				
	Household size	-.05	.04	-1.13	.260				
	No. of children in household	.09	.06	1.59	.111				
	Responsibility of cooking	.08	.07	1.08	.282				
	Responsibility of shopping	.05	.07	.70	.487				
						.04	.02	2.02*	
2	Gender	-.04	.10	-.44	.662				
	Age	.00	.01	.26	.793				
	Income	.03	.02	1.32	.189				
	Household size	-.02	.04	-.48	.631				
	No. of children in household	.07	.06	1.19	.233				
	Responsibility of cooking	.10	.07	1.45	.148				
	Responsibility of shopping	.05	.07	.80	.422				
	Attitude	-.10	.05	-2.21	.027				
	Subjective Norm	.10	.04	2.70	.007				
	Perceived behavioral control	.10	.04	2.41	.016				
						10.9	.09	9.85***	.07
3	Gender	-.04	.10	-.40	.688				
	Age	.01	.01	.99	.323				
	Income	.02	.02	1.02	.306				
	Household size	-.03	.04	-.71	.478				
	No. of children in household	.08	.06	1.43	.153				
	Responsibility of cooking	.13	.07	1.88	.061				
	Responsibility of shopping	.04	.07	.54	.586				
	Attitude	-.04	.05	-.79	.431				
	Subjective norm	.09	.04	2.38	.017				
	Perceived behavioral control	.12	.04	2.74	.006				
	Self-enhancement	.18	.06	3.13	.002				
	Self-transcendence	-.18	.08	-2.25	.024				
	New Ecological Paradigm	.03	.05	.58	.563				
	Awareness of consequences	-.01	.05	-.13	.899				
	Ascription of responsibility	.08	.05	1.54	.125				
	Personal norm	-.05	.06	-.85	.396				
						.16	.13	3.26**	.05

\*Significant at  $p < .05$ \*\*Significant at  $p < .01$ \*\*\*Significant at  $p < .001$ <sup>a</sup> Females = 1, Males = 2

## 5. Discussion

The findings of the current study support the utility of the TPB model, but not the VBN theory, in predicting intention to reduce food waste. Intention to reduce household food waste was predicted by attitude, subjective norm and perceived behavioral control. These findings are in line with Graham-Rowe et al. (2015) who found that all core predictors of the TPB model were significant predictors. These results indicate that participants who felt more favorable about reducing their food waste, felt that they had the approval of those who are important to them to reduce their household food waste and also felt confident that they could reduce their household food waste, were more likely to intend to reduce their household food waste. The core constructs of the TPB model were also found to be significant predictors of self-reported food waste behavior of the participants, however when VBN theory constructs were combined, only PBC and subjective norm were found to be significant.

The findings did not provide support for the inclusion of the construct of the VBN theory when predicting intention to reduce household food waste, as none of the VBN constructs were significant predictors and did not increase the variance explained. These findings contradict a growing literature which suggests that the utility of the TPB model might be increased with inclusion of additional predictor variables (e.g. Tonglet et al., 2004; Boldero, 1995; Davies et al., 2002). However, when the two theories were combined to predict self-reported food waste behavior, the inclusion of the VBN construct did significantly increase explained variance.

The two theories that were compared in this study are very different in nature and level of specificity. The TPB model stresses the importance of cost-benefit arguments and the function on the belief that the individual maximizes their utility. Therefore, it assumes that when an individual is confronted with a choice between two behavioral alternatives, the one that is associated with most positive behavioral consequences will be chosen and the processes that are underlying the performance of the behavior are mostly controlled (Ajzen, 1991). It is therefore likely that a very specific behavior, such as household food waste reduction, is better explained by control and “cost-benefit”, rather than the sense of moral obligation, beliefs or values held by the individual in regard to a particular behavior. Even though there are many reasons and multiple types of behavior that lead to food being wasted (Quested et al., 2013), food waste reduction could be regarded as rather a specific behavior. VBN theory is therefore possibly weak in explaining household food waste reduction, regardless of the individual’s

values, beliefs and norms, towards household food waste reduction. Though moral and personal norms have been used to explain various pro-environmental behaviors, such as recycling, it is perhaps not surprising that a more general theory as VBN is not well-suited to explain specific behavior, such as food waste. A more specific theory, in this case the TPB, should be used to explain more specific behavior, whereas a more global theory, the VBN theory, should be used to explain behavior at a global level. One limitation to the current study is that we did not test the causal chain of the VBN theory, as suggested by Steg et al. (2005). In future research it would be beneficial to test the full causal chain of the VBN theory and test mediation effects, that is, if the constructs of the VBN theory mediate the relationship between constructs.

The results have both theoretical and practical implications. The results may aid in creating an evidence-based intervention for household food waste reduction. Previous studies (Graham-Rowe et al., 2015; Stefan et al., 2013; Mondéjar-Jiménez et al., 2016) have also shown that behavioral models, such as TPB, are appropriate for explaining food waste behavior, and can therefore be utilized to motivate people to engage in household food waste reduction. Perceived behavioral control was a strong significant predictor of both intention to reduce household food waste, as well as self-reported food waste behavior. Such information can be applied in educational programs or campaigns with the aim of explaining personal volitional control over food waste, and the capacity for the individual to willingly act on the behavior. One way this education could be conveyed is by informing the individual how they can reduce their household food waste. This study found that more favorable attitude towards food waste reduction are associated with greater intention to reduce food waste. With this in mind, emphasizing the positive outcome of reduced food waste could work as an effective determinant of behavior, and eventually work to change attitudes towards food waste. Subjective norms were also found to be a significant predictor of both intention to reduce household food waste and self-reported food waste behavior. In terms of practical implications, social groups that the individual perceives as important to them could positively influence the individual to reduce their household food waste. This could prove impactful in terms of campaigns aiming to reduce food waste, to have a public figure in the community to positively influence the attitude of individuals to reduce their household food waste.

Participants were asked about their self-reported food waste behavior through the question “*Please estimate how much household food waste... got thrown away in the last seven days*”. Fourteen participants indicated they had not thrown away *any* food for the last seven

days, and the total food waste mean was only about 2.09 (1 = none, 6 = quite a lot), which is rather low, compared to the FAO estimation that around one-third of all edible food is thrown away in the world (FAO, 2013). Asking participants to estimate their food waste retrospectively has its limits, so it is likely that participants underestimated their household food waste, for reasons such as being unable to estimate their waste accurately or lacking the motivation to do so. This could possibly be improved by focusing on one food category, as was done in the Graham-Rowe et al. (2015) study, or by utilizing a more objective measure of waste, even though there are no available standard methods for food waste evaluation (Sharp, Giorgi, & Wilson, 2010). In the current study, results imply that it might be more realistic to ask participants about their future intention to reduce food waste, as there was almost no correlation between self-reported food waste behavior and intention, but a strong correlation between intentions to reduce food waste and core constructs of the TPB model. Therefore, reliance upon self-reported food waste behavior may not be ideal in food waste research, in contradiction to the WRAP methodology.

There were some methodological limitations to the current study, which warrant mentioning, and the findings should be interpreted with these limitations in mind. The first limitation was the sample of the study, as the questionnaire was sent out only to university students from the University of Iceland. The sample was very homogeneous, with an overrepresentation of females, as is expected when participation is voluntarily (Singer, van Hoewyk, & Maher, 2000; Curtin, Presser, & Singer, 2000). Most respondents had reached a similar education level, lived in the capital region of Iceland and were mostly aged from 20-25 years old (although age ranged from 18-69 years old). The fact that most respondents were the same age could prove problematic for the sample, as it might be likely that values depend in part on age. Perhaps the uniform nature of the sample may reduce the explanatory power of the VBN theory. It is therefore not likely that the sample was a true representation of Icelandic households, but can without a doubt give insight into how the two theoretical frameworks are associated to household food waste behavior.

The Cronbach's alpha reliability for some items was lower than .70, which according to common criteria, means that the reliability of these items are not acceptable (Nunnally, 1978). However, some researchers have raised doubts about the methodological "urban legends" of widely cited and reported cutoff criteria (Lance, Butts, & Michels, 2006). Nonetheless, if conventional criteria are adhered to, the results of those scales need to be interpreted with care.

One of the strengths of the current study is the use of planned missing data design, which allows researchers to administer long questionnaires in a shortened form without losing data. This approach allows researchers to accurately predict missing data since the missing data is missing completely at random, by design. However, there are some limits to using the multiple imputation technique, as the statistical power of some of the software only implements pooled results for some statistical procedures: this was the case for the Cronbach's alpha, as pooled estimation was not possible, and for standard deviation. However, as the field of planned missing data design is growing and developing fast, the method is very promising for future research.

In summary, the findings of this study supported the utility of the core TPB construct at predicting intention to reduce household food waste, as well for self-reported household food waste behavior. Additional constructs from the VBN did not increase the explained variance of intention to reduce household food waste, but the inclusion did increase the variance explained in predicting self-reported food waste behavior. The results of the study provided some evidence that the TPB model could be a useful framework for future interventions, with the motivation to increase intention to reduce household food waste and household food waste reduction behavior.

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## Appendix A. The Theory of Planned behavior questionnaire (Icelandic)

	Mjög ósammála	Nokkuð ósammála	Svolítið ósammála	Hvorki ósammála né sammála	Svolítið sammála	Nokkuð sammála	Mjög sammála
<i>Intention:</i>							
Q1. Ég ætla að minnka matarsóun heimilis míns næstu sjö daga	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q2. Ég hyggst minnka matarsóun heimilis míns næstu sjö daga	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q3. Ég mun reyna að minnka matarsóun heimilis míns næstu sjö daga	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Subjective norms:</i>							
Q1. Flestir sem eru mér mikilvægir myndu að öllum líkindum styðja það ef ég minnkaði matarsóun heimilis míns næstu sjö daga	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q2. Flestum sem eru mér mikilvægir myndu að öllum líkindum finnast að ég ætti að minnka matarsóun heimilis míns næstu sjö daga	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Perceived behavioral control (PBC):</i>							
Q1. Ég gæti minnkað matarsóun heimilis míns næstu sjö daga ef ég vildi	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q2. Það er að mestu undir mér komið hvort að ég minnki matarsóun heimilis míns næstu sjö daga	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q3. Það væri mögulegt fyrir mig að minnka matarsóun heimilis míns næstu sjö daga	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q4. Ég trúir því að ég hafi fullkomna stjórn á því að minnka matarsóun heimilis míns næstu sjö daga	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

*Attitude:*

Q1. Að minnka það magn matar sem hent er af heimili mínu næstu sjö daga þykir mér..

- ☐ Mjög tilgangslaust
- ☐ Nokkuð tilgangslaust
- ☐ Svolítið tilgangslaust
- ☐ Hvorki tilgangslaust né verðugt viðfangsefni
- ☐ Svolítið verðugt viðfangsefni
- ☐ Nokkuð verðugt viðfangsefni
- ☐ Mjög verðugt viðfangsefni

Q2. Að minnka það magn matar sem hent er af heimili mínu næstu sjö daga þykir mér..

- ☐ Mjög óánægjulegt
- ☐ Nokkuð óánægjulegt
- ☐ Svolítið óánægjulegt
- ☐ Hvorki óánægjulegt né ánægjulegt
- ☐ Svolítið ánægjulegt
- ☐ Nokkuð ánægjulegt
- ☐ Mjög ánægjulegt

Q3. Að minnka það magn matar sem hent er af heimili mínu næstu sjö daga þykir mér..

- ☐ Mjög óskynsamlegt
- ☐ Nokkuð óskynsamlegt
- ☐ Svolítið óskynsamlegt
- ☐ Hvorki óskynsamlegt né skynsamlegt
- ☐ Svolítið skynsamlegt
- ☐ Nokkuð skynsamlegt
- ☐ Mjög skynsamlegt

Q4. Að minnka það magn matar sem hent er af heimili mínu næstu sjö daga þykir mér..

- ☐ Mjög slæmt
- ☐ Nokkuð slæmt
- ☐ Svolítið slæmt
- ☐ Hvorki slæmt né gott
- ☐ Svolítið gott
- ☐ Nokkuð gott
- ☐ Mjög gott

Q5. Að minnka það magn matar sem hent er af heimili mínu næstu sjö daga þykir mér..

- ☐ Mjög óþægilegt
- ☐ Nokkuð óþægilegt
- ☐ Svolítið óþægilegt
- ☐ Hvorki óþægilegt né þægilegt
- ☐ Svolítið þægilegt
- ☐ Nokkuð þægilegt
- ☐ Mjög þægilegt

Q6. Að minnka það magn matar sem hent er af heimili mínu næstu sjö daga þykir mér..

- ☐ Mjög skaðlegt
- ☐ Nokkuð skaðlegt
- ☐ Svolítið skaðlegt
- ☐ Hvorki skaðlegt né gagnlegt
- ☐ Svolítið gagnlegt
- ☐ Nokkuð gagnlegt
- ☐ Mjög gagnlegt

### Portrait values Values Questionnaire-RR (Icelandic/Female)

	Ekkert líkt mér	Ekki líkt mér	Nokkuð líkt mér	Svolítið líkt mér	Líkt mér	Mjög líkt mér
S1:						
Það er mikilvægt fyrir hana að þeir sem minna mega sín í samfélaginu séu verndaðir	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Það er mikilvægt fyrir hana að aðrir geri það sem hún segir þeim að gera	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Það er mikilvægt fyrir hana að láta sér annst um náttúruna	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Það er mikilvægt fyrir hana að annast þá sem standa henni nærri	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Það er mikilvægt fyrir hana að hafa valdið sem getur fylgt peningum	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Það er mikilvægt fyrir hana að vera umburðarlynd gagnvart allskyns fólki og samfélagshópum	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Það er mikilvægt fyrir hana að hafa metnað	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Það er mikilvægt fyrir hana að þeir sem hún þekkir beri fullt traust til hennar	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S2:						
Það er mikilvægt fyrir hana að vera rík	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Það er mikilvægt fyrir hana að taka þátt í aðgerðum til að verja náttúruna	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Það er mjög mikilvægt fyrir hana að hjálpa þeim sem henni þykir vænt um	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Það er mikilvægt fyrir hana að vera áreiðanlegur og traustur vinur	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Það er mikilvægt fyrir hana að hafa vald til að láta aðra gera það sem hún vill	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Það er mikilvægt fyrir hana að ná miklum árangri	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Það er mikilvægt fyrir hana að hlusta á og skilja fólk sem er ólíkt henni	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Það er mikilvægt fyrir hana að allir í heiminum hafi jöfn tækifæri í lífinu	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Ekkert líkt mér	Ekki líkt mér	Nokkuð líkt mér	Svolítið líkt mér	Líkt mér	Mjög líkt mér
S3:						
Það er mikilvægt fyrir hana að vera sú sem segir öðrum hvað á að gera	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Það er mikilvægt fyrir hana að eiga dýra hluti sem sýna auðæfi hennar	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Það er mikilvægt fyrir hana að verja náttúrulegt umhverfi gegn eyðileggingu eða mengun	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Það er mikilvægt fyrir hana að láta sig varða allar þarfir þeirra sem henni þykir vænt um	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Það er mikilvægt fyrir hana að aðrir taki eftir hennar afrekum	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Það er mikilvægt fyrir hana að allir njóti réttlætis, jafnvel þeir sem hún ekki þekkir	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Það er mikilvægt fyrir hana að allir vinir hennar og fjölskylda geti algerlega reitt sig á hana	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Það er mikilvægt fyrir hana að taka annað fólk gott og gilt, jafnvel þótt hún sé ekki sammála því	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Questionnaire for the NEP, AC, AR and personal norm (Icelandic)

*The NEP revised scale:*

	Mjög ósammála	Nokkuð ósammála	Svolítið ósammála	Hvorki ósammála né sammála	Svolítið sammála	Nokkuð sammála	Mjög sammála
Q1. Menn hafa rétt á því að móta náttúruna svo hún mæti þörfum þeirra	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q2. Plöntur og dýr hafa sama tilvistunarrétt og menn*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q3. Mannkyni var ætlað að stjórna náttúrunni	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q4. Hugvitssemi mannkyns mun tryggja að við gerum jörðina EKKI óvishæfa	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q5. Þrátt fyrir sérgáfu okkar þarf mannkyn engu að síður að lúta náttúrulegum* lögum	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q6. Menn munu á endanum læra nægjanlega mikið um náttúruna til þess að geta stjórnað henni	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

*Awareness of Consequences (AC):*

	Mjög ósammála	Nokkuð ósammála	Svolítið ósammála	Hvorki ósammála né sammála	Svolítið sammála	Nokkuð sammála	Mjög sammála
Q1. Matarsóun flýtir fyrir hlýnun jarðar	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q2. Matarsóun í vestrænum ríkjum hefur áhrif á matarskort annars staðar í heiminum, t.d. í þróunarríkjum Afríku	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q3. Matarsóun mín hefur hnattrænar afleiðingar	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q4. Matarsóun eykur á ójöfnuð í heiminum	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q5. Lífstíll manna veldur sóun matvæla	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q6. Það er vert að hafa áhyggjur af matarsóun	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

*Ascription of Responsibility (AR):*

	Mjög ósammála	Nokkuð ósammála	Svolítið ósammála	Hvorki ósammála	Svolítið sammála	Nokkuð sammála	Mjög sammála
	né sammála						
Q1. Ég ber sameiginlega ábyrgð með öðrum á matarsóun í heiminum	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q2. Mér finnst ég bera sameiginlega ábyrgð með öðrum á matarsóun í heiminum	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q3. Matarsóun á heimili mínu hefur lítil áhrif á heildarmatarsóun í heiminum*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q4. Stjórnvöld og matvælaðnaðurinn bera ekki aðeins ábyrgð á matarsóun í heiminum, heldur ég líka	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q5. Í raun getur hver einstaklingur lítið gert til að draga úr matarsóun í heiminum*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

*Personal norms:*

	Mjög ósammála	Nokkuð ósammála	Svolítið ósammála	Hvorki ósammála	Svolítið sammála	Nokkuð sammála	Mjög sammála
	né sammála						
Q1. Mér finnst ég bera skyldu til að sóa sem minnst af matvælum	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q2. Mér finnst ég bera siðferðislega skyldu til þess að sóa sem minnst af matvælum, jafnvel þótt aðrir geri það ekki	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q3. Ég fæ samviskubit þegar ég sóa matvælum	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q4. Ég fæ ekki samviskubit þegar ég kaupí matvæli sem eru innflutt*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q5. Ég væri betri manneskja ef ég sóaði minna af mat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q6. Fólk í svipaðri stöðu og ég ætti að beita sér meira fyrir því að sóa sem minnst af matvælum	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Questions regarding food waste behavior and demographics

Að hve miklu eða litlu leyti sérð þú um matarinnkaup á þínu heimili?

- ☐ Að öllu eða mestu leyti
- ☐ Að þó nokkru leyti (um helming þeirra)
- ☐ Að litlu leyti
- ☐ Að engu leyti

Að hve miklu eða litlu leyti sérð þú um matseld á þínu heimili?

- ☐ Að öllu eða mestu leyti
- ☐ Að þó nokkru leyti (um helming hennar)
- ☐ Að litlu leyti
- ☐ Að engu leyti

Hversu miklum mat og drykk hentir þú síðastliðna sjö daga? (í moltugerð, ruslatunnuna, niður vaskinn, gefið dýrum o.s.frv.)

Vinsamlegast merktu við eitt svar við hvern flokk

	Mjög miklu	Nokkuð miklu	Einhverju	Litlum hluta	Nánast engu	Engu	Á ekki við
Matur og drykkur í heild	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Brauð og bakkelsi	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ávextir	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Grænmeti	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Kjöt og fiskur	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mjólkurafurðir og egg	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Þurrvörur og dósamatur	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Drykkjarvörur	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Matur sem fór til spillis því of mikið var eldað	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Matur sem varð eftir á disknum	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Matur úr pakkningum sem voru opnar en kláraðist ekki úr (t.d. skinkubrét)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Matur sem var útrunninn eða var byrjaður að mygla	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Matur sem var kominn fram yfir síðasta neysludag	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Hugsaðu um það magn sem var hent af heimili þínu í síðustu viku. Ef tekið er tillit til atburða sem eiga sér að jöfnu ekki stað í venjulegri viku, að hve miklu eða litlu leyti endurspeglar það magn matar sem var hent í síðustu viku því magni sem venjulega er hent á heimili þínu?

- ☐ Var minna en fjórðungur af því sem er venjulega hent
- ☐ Var um fjórðungur af því sem er venjulega hent
- ☐ Var um helmingur þess sem er venjulega hent
- ☐ Var um þrír-fjórðu þess sem venjulega er hent
- ☐ Endurspeglar það sem er venjulega hent
- ☐ Örlítið meira en er venjulega hent
- ☐ Töluvert meira en er venjulega hent
- ☐ Mun meira en er venjulega hent
- ☐ Ég veit það ekki

Hvaða ár ertu fædd/ur?

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Í hvaða pósthúsnúmeri býrðu?

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Hvert er hæsta stig menntunar sem þú hefur lokið?

- ☐ Hef ekki lokið grunnskólaprófi
- ☐ Grunnskólapróf
- ☐ Bóklegt nám á framhaldsskólastigi
- ☐ Iðnám - verklegt nám á framhaldsskólasviði
- ☐ Starfsnám (t.d. sjúkraliða-, lögreglu-, húsmæðra- eða ritaranám)
- ☐ Grunnám í háskóla (t.d. BA, B.Ed eða BS)
- ☐ Framhaldsnám á háskólastigi (t.d. MS, MA eða Ph.D)

Hversu margir búa á heimili þínu? (að þér meðtöldum)

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ Fleiri en 6

Hversu mörg börn (0-18 ára) búa að jafnaði á heimili þínu?

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ Fleiri en 6



Hverjar eru heildartekjur heimilis þíns á mánuði fyrir skatt? (Athugið að með heildartekjum er átt við allt samanlagt, öll laun, aukavinnu, yfirborganir og einnig námslán, tryggingabætur, lífeyristekjur, húsaleigubætur o.þ.h. fyrir alla á heimilinu).

- ☐ Undir 250.000 kr
- ☐ 250-449.999 kr
- ☐ 450-649.999 kr
- ☐ 650-849.999 kr
- ☐ 850-1.499.999 kr
- ☐ 1.500-3.500.000 kr
- ☐ Yfir 3.500.000 kr
- ☐ Ég vil ekki svara

Í pólitískri umræðu er oft talað um „vinstri“ og „hægri“. Hvar myndir þú staðsetja sjálfa/n þig á þessum kvarða almennt? (1 = vinstri, 10 = hægri)

1 \_\_\_\_\_ 10

Í pólitískri umræðu er oft talað um „frjálslyndi“ og „íhaldssemi“. Hvar myndir þú staðsetja sjálfa/n þig á þessum kvarða almennt?

- ☐ Mjög frjálslynd/-ur
- ☐ Nokkuð frjálslynd/-ur
- ☐ Svolítið frjálslynd/-ur
- ☐ Mitt á milli
- ☐ Svolítið íhaldssamur/-söm
- ☐ Nokkuð íhaldssamur/-söm
- ☐ Mjög íhaldssamur/-söm

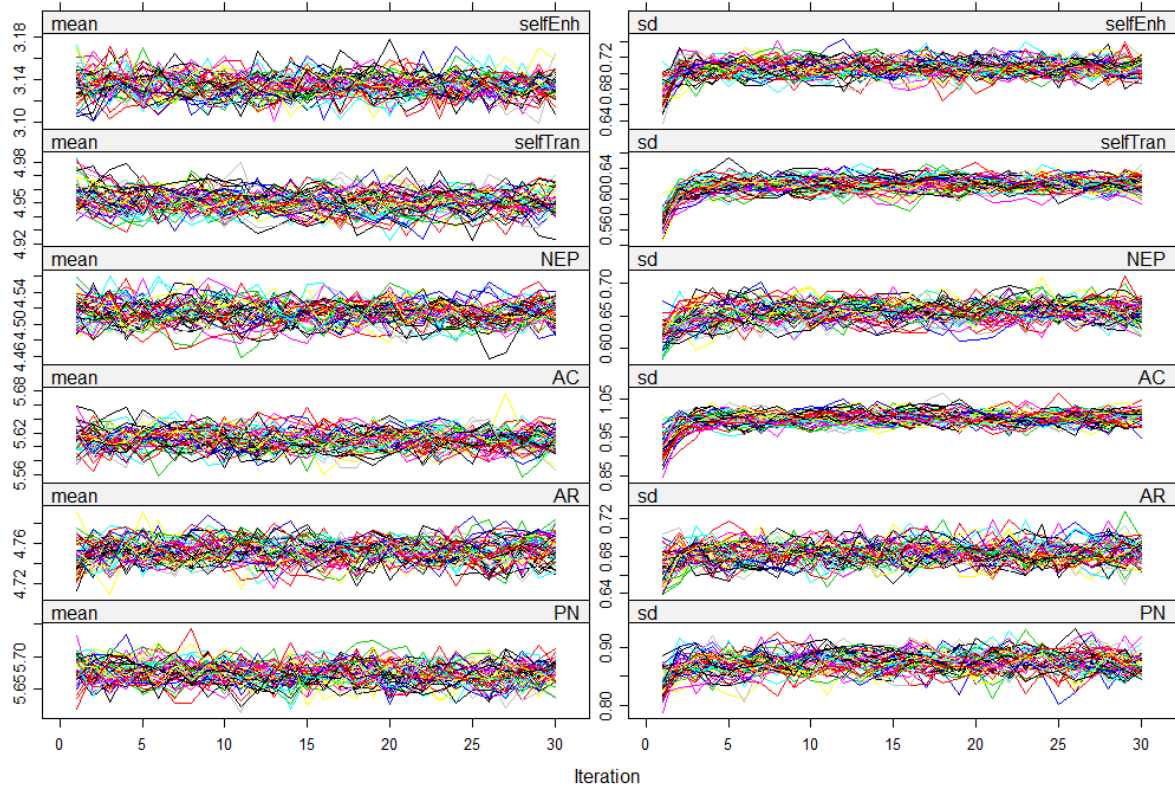
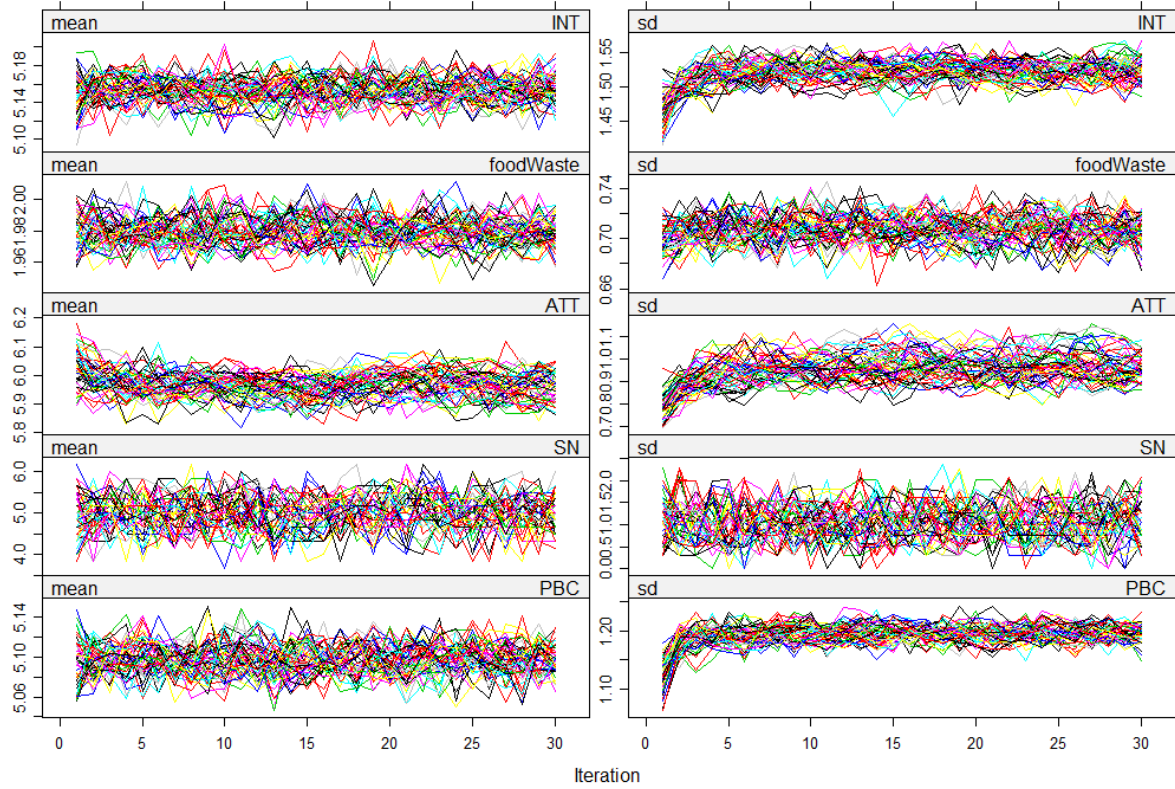
Ef kosið yrði til Alþingis á morgun, hvaða flokk myndir þú kjósa?

\_\_\_\_\_

Hvernig skilgreinir þú kyn þitt?

- ☐ Kona
- ☐ Karl

## Appendix B. Convergence of constructs of the two theoretical frameworks



### Appendix C. Fraction of missing information (fmi) and lambda

Fraction of missing information (fmi) was calculated for each predictor and the proportion of total variance that is attributed to the missing data (lambda). In Table 1, information about missing data of the predictors for intention to reduce household food waste is shown, and the same in Table 2 for self-reported food waste behavior.

**Table 1**

Fraction of missing information (fmi) and lambda of predictors for intention to reduce household food waste.

<b>Predictor</b>	<b>fmi</b>	<b>Lambda</b>
Attitude	.12	.11
Subjective norm	.15	.14
Perceived behavioral norm	.25	.24
Self-enhancement	.23	.22
Self-transcendence	.24	.23
New Ecological Paradigm	.36	.35
Awareness of consequences	.24	.24
Ascription of responsibility	.23	.22
Personal norm	.24	.24

**Table 2**

Fraction of missing information (fmi) and lambda of predictors for self-reported food waste behavior.

<b>Predictor</b>	<b>fmi</b>	<b>Lambda</b>
Attitude	.05	.04
Subjective norm	.05	.04
Perceived behavioral norm	.12	.11
Self-enhancement	.14	.13
Self-transcendence	.12	.12
New Ecological Paradigm	.20	.19
Awareness of consequences	.18	.17
Ascription of responsibility	.13	.13
Personal norm	.18	.17