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Food Waste Diversion Programming in Post-Secondary Education

Manar Arica Alattar
Portland State University

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by

Manar Arica Alattar

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Dissertation Committee:
Jennifer L. Morse, Chair
Thomas Kindermann
Max Nielsen-Pincus
Dilafruz Williams

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Abstract

The urgent need for reform of USA and global food systems is evident in the pervasiveness of both food waste (about 40% of food produced nationally) and food insecurity (1 in 6 Americans). Such an inefficient system strains the environmental, social, and economic systems on which it relies. Although policy and infrastructure changes are essential, consumers can play a significant role by decreasing their food waste, given that consumer waste represents 60% of the waste along the food cycle in developed countries. Incorporation of food literacy and food waste education in school curricula may provide a meaningful entry point for promoting food waste reduction skills.

This dissertation presents context on the suitability of food systems for science and climate change education. Practical implementation of this concept is then explored through a survey of 495 students at Portland State University (PSU, Portland, OR) that presents the reported knowledge, attitudes, emotions, and beliefs related to food waste. The underlying factors that influence student food waste behavior and intent to change such behavior are likewise explored. I also provide a description and assessment of a food waste diversion program, *No Scrap Left Behind*, that was developed and piloted at PSU.

I found that knowledge, attitudes, emotions, beliefs, and reported food-related behaviors were generally positive. Students were also interested in taking action and perceived that their food-related actions could make a difference. Intent to change food waste behaviors was influenced by: 1) sustainability actions, 2) food waste diversion

actions, 3) attitudes about composting, 4) composting, 5) reported household food waste, 6) material reuse attitudes. Reported food waste diversion behaviors were related to: 1) intent to reduce food waste, 2) knowledge and attitudes towards composting, and 3) attitudes about reuse.

The measures of reported knowledge, attitudes, emotions, beliefs, and behaviors were not significantly influenced by *No Scrap Left Behind* programming, but actual measured food waste was decreased by one-fourth both over an academic year and within an academic term of programming. This indicates that students are amenable to food waste behavior change when given the encouragement and infrastructure to make that change. Further research may consider opportunities for food waste education beyond the cafeteria setting, particularly as an entry into more complex discussions around environmental, social, and economic systems and concepts.

Dedication

~ O Allah increase me in beneficial knowledge ~ Ameen

I dedicate this work

To my boys, Ibraheem and Yusuf.

Ibraheem, you were and are my happiness throughout this process. Yusuf, your coming motivated me to complete my dissertation. Thank you for waiting until after my dissertation defense to join us in this world.

To my husband and my family

Thank you for supporting me along the way, always being there, and making this journey easier on me.

Thank you all.

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Table of Contents

List of Tables

List of Figures

Glossary of Abbreviations

ANOVA	Analysis of Variance
CBSM	Community Based Social Marketing
CISFS	Committee for Improving Student Food Security
CFC	Chlorofluorocarbon
CO_2	Carbon Dioxide
CSO	Campus Sustainability Office
DEFRA	Department for Environment, Food & Rural Affairs
EE	Environmental Education
EFA	Exploratory Factor Analysis
EPA	Environmental Protection Agency
EVT	Expectancy Value Theory
FAO	Food and Agriculture Organization (of the United Nations)
FDA	(United States) Food and Drug Association
FRN	Food Recovery Network
g	Gram
GHG	Greenhouse Gas
H_2CO_3	Carbonic acid
IRB	Institutional Review Board
lbs	Pounds
NGSS	New Generation Science Standards
NRDC	National Resource Defense Council
PSU	Portland State University
SDT	Self-Determination Theory
SHAC	Student Health and Counseling Center
SPSS	Statistical Package for Social Science
TPB	Theory of Planned Behavior

UC Davis	University of California, Davis (Davis, CA)
UK	United Kingdom
USA	United States of America
USDA	United States Department of Agriculture
VIF	Variance Inflation Factor
WRAP	Waste, Resources and Action Programme
WRI	World Resource Institute
WTP	Willingness to Pay

Chapter 1. The unsustainable food system and potential for changes

Food waste = Lost land, exploited people and money down the drain

> *"...its (food waste's) prevalence throughout the entire food system and its extent are truly astonishing, its perpetuation is among the most offensive demonstrations of human irrationality, and its reduction would obviously go a long way toward improving the productivity of the modern food system while reducing its environmental impacts."*
> (Smil, 2004)

An estimated 40% of the 590 billion pounds of food produced in the United States (and 30% of that produced worldwide) is discarded annually (Bloom, 2011; J. Buzby, Wells, & Aulakh, 2014; FAO, 2013; Lipinski et al., 2013; Neff, Spiker, & Truant, 2015). Annually, 30% of cereals, 40-50% of root crops, fruits and vegetables, and 30% of meat, dairy and fish products are wasted worldwide (Ghosh, Sharma, Haigh, Evers, & Ho, 2015). Nationally, food makes up about 20% of our landfill-bound waste (up from 14% in 1996) (Griffin, Sobal, & Lyson, 2008; Schwab, 2012). The resources used to produce this food—35% of freshwater, 31% of farmland, and 30% of fertilizers—in the United States are thus also wasted (Bloom, 2011; Halloran, Clement, Kornum, Bucatariu, & Magid, 2014; Neff et al., 2015; Poonprasit, Phillips, Smith, Wirojanagud, & Naseby, 2005).

The global food system, including land conversion for agriculture, has a greenhouse gas (GHG) footprint 1.5 times that of the global transportation sector (Benton, 2017). The food wasted globally contributes 3.3 Gigatons of carbon dioxide (CO_2) equivalent emissions, making it the third largest GHG emitter, after the United States of America (USA) and China, if equated to a country (FAO, 2013; Halloran et al., 2014). Furthermore, food production is a major contributor to biodiversity loss (Feldstein,

2017), deforestation (Killeen & Harper, 2016), nitrogen and phosphorus depletion and pollution (Cordell, Drangert, & White, 2009), and many other major negative environmental impacts.

These massive amounts of food waste result in social injustices as well. Low, subsidized food prices lead to markets in which costs are externalized, and farmers are often among the most vulnerable (Pollan, 2015). In fact, farmers in the USA and around the world face some of the largest economic hardships, psychological stress, and, worldwide, some of the highest suicide rates (Patel, 2012; Weingarten, 2015). Food waste and cheap food are in stark contrast with the prevalence of hunger worldwide. Globally, 836 million people (12% of the world population) live in extreme poverty (less than $1.25 a day), and approximately 1 million children die a year from the effects of starvation (Capone, El Bilali, Philipp, Cardone, & Driouech, 2014; UN, 2015). *Food security* is defined as "the physical, social and economic access to sufficient, safe and nutritious food" (Capone et al., 2014). Fifteen percent of Americans (41 million) are food insecure, 20% of whom are children and 10% of whom are elderly (Capone et al., 2014; Feeding America, 2013).

Even countries with improved food access are suffering. Changes in diet, overeating, and increasingly sedentary lifestyles have led to widespread overweightness and obesity (over 2.3 billion people, ~1/3 of the global population). More global citizens, for the first time in history, are overweight than malnourished (Capone et al., 2014). On average 700 kcal per capita of extra food is available in developed countries (Baranowski, Cullen, Nicklas, Thompson, & Baranowski, 2003; Capone et al., 2014;

Smil, 2004). Non-communicable diseases related to excess eating and diets high in meats, fats, and sugars are on the rise worldwide as well (Baranowski et al., 2003; Chang Ma & Contento, 1997).

Estimates from the Food and Agriculture Organization of the United Nations (FAO) value the global economic, social, and environmental impacts of food waste at $2.6 trillion annually (FAO, 2014). Losses due to food waste in the USA alone are estimated at $218 billion (Feldstein, 2017). An average American family wastes between $1,350 and $2,275 a year on food that goes uneaten; per consumer that is about 210-250 pounds (lbs) of food a year (Waters & McNamara, 2015). Beyond the environmental and social impact, these economic wastes are also not justifiable.

Unfortunately, food waste is still on the rise; household waste in developed countries has increased by approximately 50% in the last 10-15 years (Ghosh et al., 2015; Refsgaard & Magnussen, 2009). Although some claim that the demand of a growing world population will further stress the food system, it is clear that the biophysical resources are available but misallocated (Smil, 2004). Improved efficiency along the food cycle and decreased waste and losses can contribute to meeting the needs of growing human populations, especially as agricultural technology continues to improve (Halloran et al., 2014). It is estimated that food waste reduction by one-fourth globally would lead to food savings enough to feed all food insecure people worldwide (Capone et al., 2014; Gunders, 2012b). Availability and accessibility to food are contingent on more equitable and efficient food production, distribution, exchange, affordability, allocation, and

preference (Capone et al., 2014; Smil, 2004). Although some food waste will always be inevitable, a significant amount is avoidable (Thyberg & Tonjes, 2016; WRAP, 2013).

The big wasters – A comparison between the United States and the United Kingdom

Globally, an estimated 30% of food produced, valued at about $2.6 trillion, goes uneaten (FAO, 2014). However, waste generation and its causal factors are not evenly distributed across countries. Developed economies tend to have more stable access to markets and stronger food production, storage, transportation, and cooling infrastructure than do developing countries (Mandyck & Schultz, 2015). Also, citizens in developed countries tend to have access to excess food (1.5 times the estimated daily calorie needs in many developed countries), and utilize a smaller percentage of their income on food (10-15% of income for middle-class Americans) (Capone et al., 2014; Kantor, Lipton, Manchester, & Oliveira, 1997; Smil, 2004). Therefore, about 60% of food waste occurs at the consumer stage in developed countries, as opposed to about 40% in developing countries, which loose more food upstream of the consumer due to infrastructure inefficiencies (FAO, 2015; Lipinski et al., 2013). Although reduction of food losses is essential to improving the efficiency of the global food cycle (Mandyck & Schultz, 2015), this dissertation will focus on food waste specifically at the consumer level.

Two of the most prominent developed countries responsible for food waste are the United Kingdom (UK) and the USA. Although the USA is estimated to waste a greater proportion of food overall (40% as opposed to 30%), both countries provide examples of opportunities that arise for the diversion of this food waste (Lipinski et al., 2013). Both the UK and the USA have overall food waste diversion goals of 50% by 2020 and 2030,

respectively. Food waste diversion efforts in the UK, which began on a national scale in 2007, are a great example for the USA to follow in attempting to meet its more recently established food waste diversion goal (September 2015) (USDA, 2015). The UK efforts are supported through DEFRA (Department for Environment, Food & Rural Affairs) funding of the WRAP (Waste, Resources and Action Programme). Between 2007 and 2010, corresponding with WRAP's *Love Food Hate Waste* programming, the UK saw a 1.1 million ton decrease in food waste (T. E. Quested, Marsh, Stunell, & Parry, 2013). It is estimated that the reduced food waste led to reduction in GHG emissions in 2010 equivalent to seven million tons of CO_2, equal to the emissions of 20% of cars in the UK that year (Papargyropoulou, Lozano, K. Steinberger, Wright, & Ujang, 2014). Although a global economic downturn also occurred at this time, strong evidence suggests at least a partial causal relationship with the programming (T. E. Quested et al., 2013). For the USA to be successful in meeting its food waste diversion goals, it will be essential that political support and funding are invested into making progress toward food waste diversion.

Table 1.1. Comparing food systems and food waste globally, in the USA, and the UK (when data is available).			
	Globally	**USA**	**UK**
Total food wasted	30% (Lipinski et al., 2013)	31-40% (Neff et al., 2015)	~30% (Garnett, 2011; T. E. Quested et al., 2013)
Percent contribution to global food waste		14% (North America and Oceania) (Lipinski et al., 2013)	14% (Europe) (Lipinski et al., 2013)
Percent avoidable food waste		Data lacking (Thyberg & Tonjes, 2016)	~60% (T. E. Quested et al., 2013; WRAP, 2013)
Percent of food waste that enters landfill (not recovered)		90-97% (EPA, 2013)	50% of bio-degradable waste in the European Union (Oliveria, de Moura, & Cunha, 2016)
Economic impact of food waste (annually)	$2.6 trillion (FAO, 2014)	$162-198 billion **over total lifecycle** (J. C. Buzby, Farah-Wells, & Hyman, 2014; Venkat, 2012)	£2.5 billion ($2.8 billion) **food and drink bought and thrown away only** (WRAP, 2013)
Waste reduction target goals	50% reduction by 1985 (established 1974, but no official progress reported on it) (Parfitt et al., 2010)	50% reduction by 2030 (established Sep 2015) (USDA, 2015)	50% reduction by 2020 (European Union Committee, 2014)
Specific national programs		*Food: Too Good to Waste* (EPA, 2014)	*Love Food Hate Waste* (WRAP, 2013)
Household food waste	Varies greatly (Lipinski et al., 2013)	14-25% of bought (Parfitt et al., 2010) 20% of landfill-bound waste (EPA - Schwab, 2012)	12-30% of bought by household (Parfitt et al., 2010; T. E. Quested et al., 2013)
GHG footprint (released from <u>total</u> food cycle unless otherwise noted)	19–29% (Vermeulen, Campbell, & Ingram, 2012). 3% from food waste in landfills only (Papargyropoulou et al., 2014)	13% (US EPA, 2014a) Majority from agriculture ~10-12% (Schwab, 2012)	~ 17 million CO_2 eq tons (Graham-Rowe, Jessop, & Sparks, 2014) 3% from food waste in landfills only (Papargyropoulou et al., 2014)
Percent resources to produce wasted food	12-15% of freshwater globally (Springer, Flaherty, & Robertson, 2013)	30% of the fertilizer, 35% of the freshwater and 31% of the cropland (Desmon, 2015)	4.3% of total water footprint (T. E. Quested et al., 2013)

Notes: It should be noted that estimates are reached through various methods and using differing units and therefore cannot always be directly compared with confidence (Kantor et al., 1997; Parfitt et al., 2010).

Food waste on the home front – focusing on the USA

In the USA, an estimated 40% of the food produced nationally goes uneaten, with 60% of this loss occurring at the end of the food cycle (the consumer, Fig. 1.1), due to various inefficiencies. This is particularly problematic compared to pre-consumer waste, because all of the resources that are needed to process and deliver that food have also already been wasted. In the USA, this includes an estimated 35% of the freshwater, 31% of the cropland and 30% of the fertilizers used nationally (Table 1.1) (Desmon, 2015). Furthermore, once disposed of, this food contributes to the release of 18% of the nation's methane emissions from landfills (US EPA, 2015). Discarded food represents an estimated 20% of landfill-bound municipal waste in the USA (Schwab, 2012). Compared to other waste streams, prevention of food waste is recognized as having the most potential for economic, social, and environmental benefits (Thyberg & Tonjes, 2016).

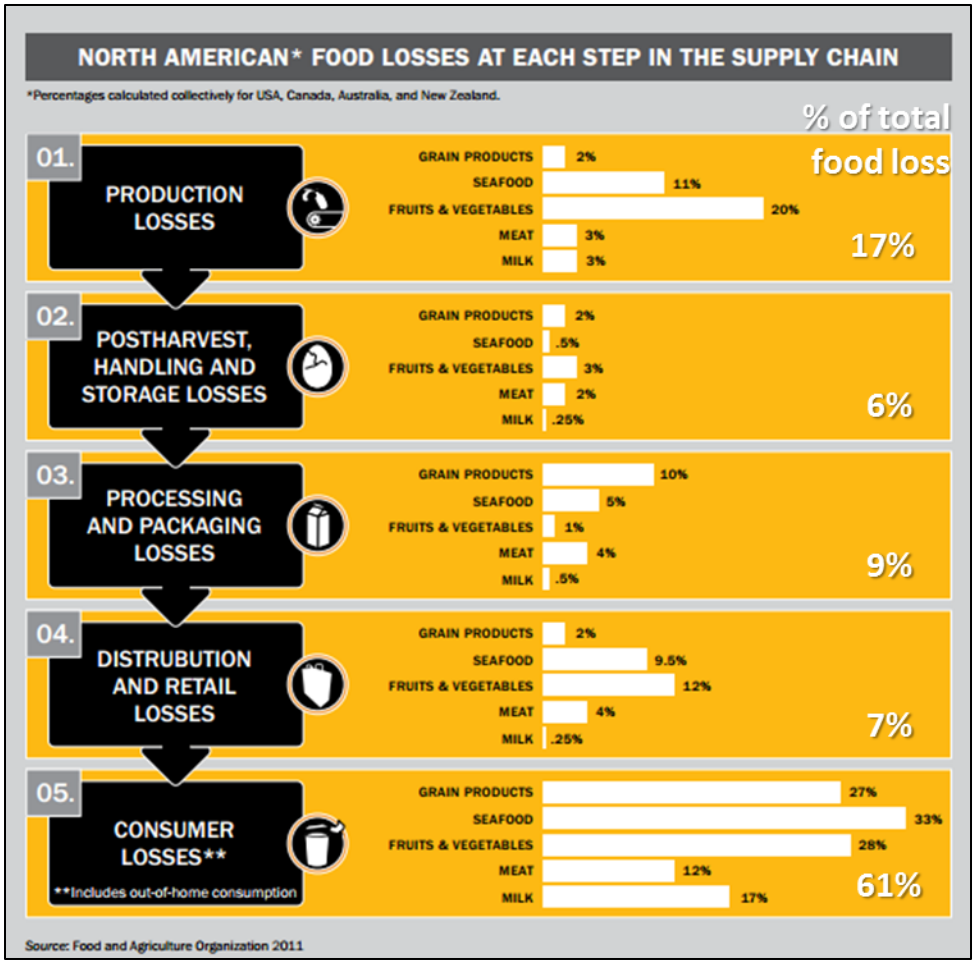

Figure 1.1. Percentage of food lost in North America at each step in the food cycle (% in right side column) and in regards to specific food categories (grain, seafood, fruits and vegetables, meats and milk) within that step. Sources: Diagram modified from Gunders (2012). Percent of total food loss percentages from Lipinski *et al.* (2013).

Besides consumption, the largest portion (17%), of food waste is generated during production (Fig. 1.1). Up to 20.2 billion pounds of produce are left in the field, never harvested due to aesthetic or size standards (Creamer, 2017; Figueiredo, 2013). In the USA and worldwide, agriculture and animal husbandry make up the greatest GHG, water, fertilizer, and land-use impacts throughout the food cycle (Capone et al., 2014; Cordell et al., 2009; Garnett, 2011; Grizzetti, Pretato, Lassaletta, Billen, & Garnier,

2013). Postharvest processing and distribution make up 15% of food waste; fruits and vegetables are lost most readily in transportation (Fig. 1.1) (Gunders, 2012a; Lipinski et al., 2013). Increasing efficiency related to fertilizer use, crop production limits and regulations (excess often produced due to unstable markets), pest control, and relaxing produce size/shape standards (recently done in the UK) can lead to a lower environmental footprint and great improvements in food waste diversion (Baldwin, 2014; Figueiredo, 2016; Ghosh et al., 2015; Grizzetti et al., 2013).

Distribution and retail make up 7% of food losses (about 54 million pounds annually of which are from commercial food service) but also represent a strong opportunity for food waste diversion (Whitehair, Shanklin, & Brannon, 2013). A large portion of food lost in retail is due to: 1) rejection due to *size and aesthetic standards* (an issue pre-retail as well), 2) product *date label confusion*, and 3) over-portioning and bulks sales (J. C. Buzby et al., 2014; Ghosh et al., 2015; Giorgi, Cox, & Fell, 2013; Kantor et al., 1997; Leib et al., 2013; T. E. Quested et al., 2013). The first two can simply be addressed by changing standards around aesthetics and food date labeling. Food date labels are particularly confusing because the only regulated food date label by the US Food and Drug Association (FDA) is that of baby formula. Other labels are developed based on *quality* not *health* standards *by the food industry itself* (Leib et al., 2013). Therefore, in order to promote their product at its best and freshest, and to encourage more frequent purchase through quicker turn-around, food date labels are often more conservative than necessary for health purposes (Baldwin, 2014).

Overstocking and large portion sizes are another major contributor to retail and food service waste. For example, depending on the type, 2-63% of produce is displayed, but never sold (Oliveria et al., 2016; Thyberg & Tonjes, 2016). Improvements to display areas, like narrowing shelving areas or creatively displaying multiple items within the same display case, have allowed for retailers to avoid overstocking and decrease food waste (Hair, 2016). Portion sizes have also increased significantly since the 1970s: research on various food items sold ready-to-eat or as fast-food options shows that portions were between 195% and 700% larger than suggested United States Department of Agriculture (USDA) portion sizes in some cases (Young & Nestle, 2002). Decreasing portion size has been shown to be effective at decreasing food intake and waste (Wansink & van Ittersum, 2013). Consumer behaviors and expectations are a large contributor to this issue; therefore, consumer education is as essential as improvements within the retail and food sectors themselves (Waarts et al., 2011).

Also, the opportunity for *food donation* in retail is significant. All retailers that donate in good faith are protected by law by the Bill Emerson Good Samaritan Act of 1996; unfortunately many are unaware of this (Baldwin, 2014; Kantor et al., 1997). Furthermore, economic and practical challenges exist to getting food to donation locations as it requires transportation, staffing, and time (Baldwin, 2014; Ghosh et al., 2015). Some grass-roots organizations have begun to address this on their own by engaging volunteers in connecting retail food with donation centers: *e.g.*, Fork it Over (forkitover.org), the Food Bus (focuses on waste from grade school cafeterias; foodbus.org), Harvest Share (held at PSU through Committee for Improving Student

Food Security) and others. One particularly successful example is that of the Food Recovery Network (FRN); it started as a college cafeteria donation organization that focused on prepared, but uneaten food at the University of Maryland in 2011. FRN has since become a nation-wide organization that to date has recovered over 2 million pounds of food from college cafeterias around the USA (FRN, 2017). These citizen efforts must be encouraged socially as well as supported by regulation and policy shifts. Food recovery is essential in the food waste diversion narrative as it "can help to reduce hunger; provide tax savings to farmers, food manufacturers, retailers, foodservice operators, and others that donate food; conserve landfill space; and lessen the costs and environmental impact of solid waste disposal" (Kantor et al., 1997).

A number of opportunities for food waste diversion were mentioned above and many more exist, especially in relation to behavior and norm change. Although various stages along the food cycle will require various types of food waste diversion (Poonprasit et al., 2005), programs should strive for *source reduction* first (most cost/environmentally/socially efficient), then *feeding of hungry people or animals* (the purpose of food), then *industrial uses* (such as methane production) and composting, and finally *landfill* disposal (Fig. 1.2). Although landfill disposal is least optimal, it is the most common (96%) final destination of food waste in the USA (Ghosh et al., 2015; US EPA, 2014b).

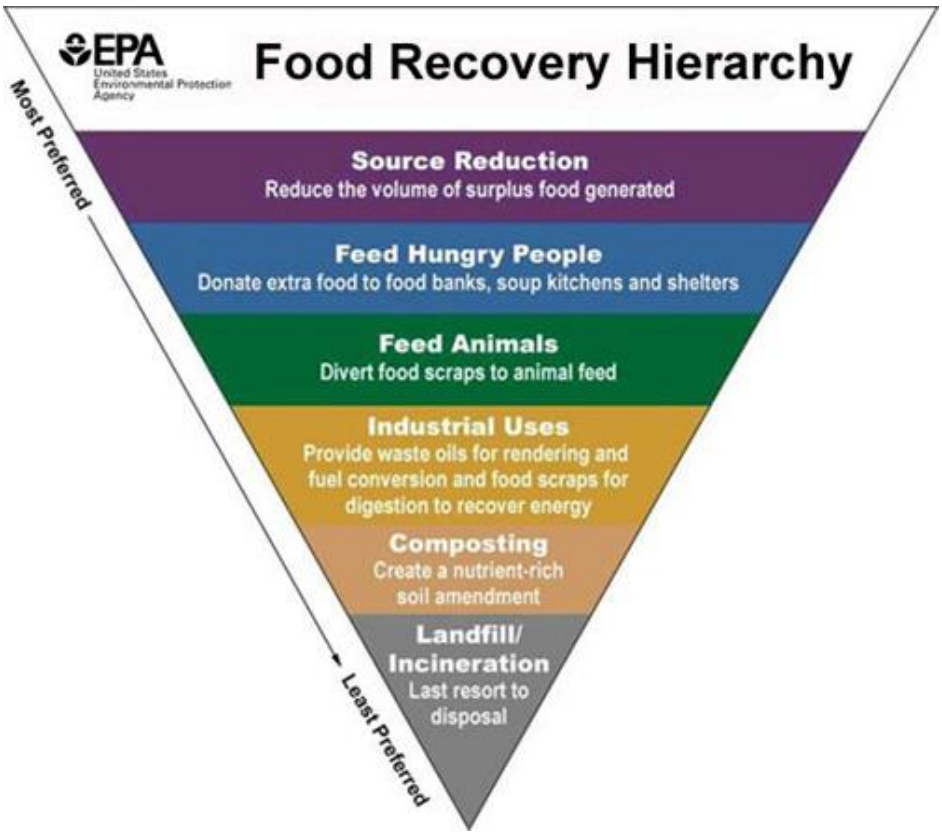

Figure 1.2. Not all food waste diversion methods are equal. The EPA has prioritized actions related to food waste reduction from most preferable (source reduction) to least (landfill). Source: US EPA (2014).

Although small food waste diversion efforts, like FRN and Harvest Share, are essential at the community level, the complex global issues of food waste cannot be solved without political emphasis on food waste and policy change (Ghosh et al., 2015; Thyberg & Tonjes, 2016). Nationally-supported cultural norm-changing programs, like *Love Food Hate Waste* in the UK, can lead to significant measurable change (T. E. Quested et al., 2013).

Thyberg and Tonjes (2016) suggest that national food waste policy target three core concepts: *value improvement* and *skill development* by supporting educational and training initiatives and *logistics* through infrastructure development, regulation and

incentivization of food donation and waste reduction along the food cycle. Food date labeling must also be revisited, standardized, and regulated to reduce the significant waste that label confusion causes (Leib et al., 2013; ReFED, 2016). Beyond national policy changes, it is essential that global initiatives are made to promote a coherent, efficient, just, and sustainable global food system as well (Garnett, 2011; Ghosh et al., 2015; Graham-Rowe et al., 2014; Griffin et al., 2008; Grizzetti et al., 2013; Halloran et al., 2014; Moseley & Stoker, 2013; T. E. Quested et al., 2013; Refsgaard & Magnussen, 2009; Thomas & Sharp, 2013). Balancing policy measures that are well fitted to local systems *and* global in their positive ramifications will be difficult but essential (Thyberg & Tonjes, 2016).

Targeting consumers – changing food waste behaviors

Globally, awareness of food waste is increasing (Creamer, 2017), but solving food waste problems presents many unique challenges. Although national and global policy changes will be optimal in decreasing food waste (T. Quested, Ingle, & Parry, 2013; Thyberg & Tonjes, 2016), such changes are complex and take time. Therefore, consumer behavior also must be targeted in decreasing food waste, especially in developed countries where consumers are responsible for more than half of food wasted along the supply chain (Lipinski et al., 2013). Consumer behavior change is no simple task. Challenges include, but are not limited to: 1) consumers' increasing distance from food cycles, creating an out-of-sight-out-of-mind relationship with food; 2) the multiple, multi-national/institutional players within food cycles; 3) the increasingly mechanized system of food production, requiring less direct human interaction with food and thus lesser

value of food and its preparation; 4) the combination of many factors and behaviors (some in an individual's control, others not) that lead to food waste (Heimlich & Ardoin, 2008; Pollan, 2015; T. E. Quested et al., 2013; Thyberg & Tonjes, 2016). Additionally, many directly conflicting values and attitudes complicate food waste behaviors, including safety versus waste reduction, food versus packaging waste, convenience/habit versus waste reduction, being a good food provider versus food waste reduction (Aschemann-Witzel, de Hooge, Amani, Bech-Larsen, & Gustavsson, 2015). Despite these complicating factors, behavioral interventions and educational programs targeting food waste show potential (T. E. Quested et al., 2013; Whitehair et al., 2013).

In the USA, food waste diversion programming is not as advanced as it is in the UK, but some progress is being made, often at the community level. Efforts such as FRN, Harvest Share, and Fork It Over, tend to be grass-roots in nature and dependent on volunteers for success. In addition, local environmental education efforts are focusing more on garden-learning, reconnection with living soil, and food production as both a means for teaching science and community resilience in the face of climate change (E. A. Skinner, Chi, & The Learning-Gardens Educational Assessment Group 1, 2012; D. Williams & Brown, 2011). Some broader progress has been made in specific municipalities in the USA; for example, the *Portland Composts!* project institutionalized residential composting for single home and small plex units in the Portland area (Planning and Sustainability - The City of Portland, OR, 2011). The newly announced USDA goal of 50% reduction in food waste by 2030 and associated programs like *Food:*

Too Good to Waste through the US EPA could also be promising if supported through policy and funding (USDA, 2015).

Research on the various types of campaigns for food waste is still emerging (much if it from the UK through DEFRA and WRAP efforts), but some information has been published (Eppel, Sharp, & Davies, 2013; T. E. Quested et al., 2013; WRAP, 2013). Furthermore, there is a substantial body of previous research on the promotion of pro-environmental behaviors and in environmental education in general that can inform this discussion. From a general perspective, pro-environmental campaigns can be categorized based on the: 1) techniques employed; and the 2) source of motivation used. Programs can be *informational*, *positive* or *coercive* and they can motivate through *external/tangible* methods (monetary, policy for example) or *internal/intrinsic* (through encouraging a sense of responsibility for example) (Young, 1993).

Extensive research shows that strictly *informative* campaigns and programs do not lead directly to behavior change, food waste diversion related or otherwise (Achterberg & Miller, 2004; Ajzen, 1991; Baranowski et al., 2003; Heimlich & Ardoin, 2008; Kollmuss & Agyeman, 2002; Steg & Vlek, 2009). Behaviors are influenced through both rational processing and sub/unconscious response to surrounding stimuli. Rational processing is based on beliefs, values, attitudes, cost, and circumstance. Sub/unconscious responses are based on following social norms, limited processing time, habitual action, and lack of knowledge of context (Hill & Clifford, 2016; Sunstein, 2008; Whitehair et al., 2013). This balance between rational and irrational decision-making has been called *bounded rationality* and is the focus of the field of behavioral economics and the topic of the

Nudge Theory, which will be discussed later. Therefore, programs related to any pro-environmental behavior must address these many competing preludes to behavior.

Positive encouragement focusing on *internal* motivation (for example garden-learning) can be beneficial in engaging citizens on multiple levels and can lead to long-term benefits, but are also time-consuming and hard to apply to large groups. *Coercive* methods, on the other hand, involve monetary or social disincentive (*e.g.*, higher garbage collection fees compared to compost) and even physical barriers to anti-environmental behaviors (e.g., carpool lanes). These factors are *external* to an individual and can often quickly influence behavior in the short term, although lasting effects are not strong (Young, 1993). The main exception to this is in business, in which the economic gain related to waste reduction in food production sectors has been recognized and leads to a strong business incentive for food waste reduction (Poonprasit et al., 2005). Similar economic motivation has been incorporated into citizen campaigns like *Love Food Hate Waste* (T. E. Quested et al., 2013) and Portland State University's (PSU, Portland, OR) *No Scrap Left Behind* program, which will be discussed in more detail in later chapters.

Nudge Theory, considered by some as *indirect coercion*, suggests that change related to socially important and time-sensitive matters like climate change or health must be through top-down ("*paternal*"), indirect (not forced, only suggested) behavioral *nudges* that quickly alter the status quo. These are often small, artificial constructions within the environment or policy that bias behavior. For example, a nudge in a school cafeteria may involve offering pre-cut fruits and vegetables before processed food options along the lunch buffet. A policy nudge, for example, would be to make a more

sustainable option, like paperless banking, the default. A person could opt out if they chose to, but is more likely just to accept the default option. There is research to suggest the effectiveness of nudges for various pro-environmental behaviors, including food waste diversion (Moseley & Stoker, 2013). Nudge critics take issue with the loss of autonomy presented by this method and point out that since changes are not likely internalized by citizens, they may be more contextual than truly lasting (Lakhani, 2008).

Policy change and regulations of food waste (even less autonomy-supportive and likely more effective) are also essential for behavioral change (Capone et al., 2014; ReFED, 2016). Enforced regulations have been shown to promote both innovation and change at multiple levels within waste systems. Recycling is a prime example of this, as is the change seen through policy initiatives through DEFRA and WRAP in the UK (Kipperberg, 2006; T. E. Quested et al., 2013; Thomas & Sharp, 2013). Due to its complex global nature, food waste must be addressed through collaborative policy change in parallel with grassroots education and programming (Capone et al., 2014; Godfray et al., 2010; Graham-Rowe et al., 2014; T. E. Quested et al., 2013; Refsgaard & Magnussen, 2009; Smil, 2004).

More on education – can people be taught to waste less food?

Education is an essential tool for promoting pro-environmental behavior change (ReFED, 2016). Environmental education, specifically, provides a useful framework for considering food-related educational programming. **Environmental Education** (EE) is defined as the engagement of people/students to make informed decisions about current issues and equipping them with the tools to take the appropriate action within their

specific context (Ardoin, Clark, & Kelsey, 2013). EE emphasizes collaborative, active place-based learning; interaction and feedback between educators, learners and the community; and the communication of objectives and results in multiple ways (Ardoin et al., 2013; Krasny & Roth, 2010). Essentially EE, if implemented correctly and broadly, should eventually lead to social and political structural changes, which in turn would lead to improved institutional and technological sustainability, also known as *Environmentally Sustainable Development* (Scott *et al*. 2013).

Within EE, one of the most common theoretical frameworks for promoting engagement and behavioral change is *Self-Determination Theory* (E. A. Skinner et al., 2012; D. Williams & Brown, 2011). This theory promotes change through autonomy and competence support and seeks to maintain strong relatedness (positive social interactions) between learners and their mentors (Deci & Ryan, 1985). In the next section, I will discuss this and other theories that may be useful for behavior changes related to food waste diversion.

The impossible task – research on behavioral change

Conceptualization of beliefs, values, attitudes, and motivation are essential in order to explain, predict, and ultimately influence human behavior. In psychology, such research began with the very mechanistic view of the human being (driven by biological needs only) and has evolved into a stronger understanding of the organismic and social nature of humans and their interactions. Theories related to behavior and interactions have evolved as well.

Various theories have focused on various constructs in modeling human action. Some focus on identity (*Identity Theory* and *Environmental Identity Theory*) (Sparks & Shepherd, 1992; Stets & Biga, 2003). Others focus on attitudes (*Theory of Planned Behavior*), or motivational aspects of behavior (*Expectancy Value Theory* and *Self Determination Theory*) (Ajzen, 1991; Deci & Ryan, 1985; Wentzel & Wigfield, 2009). Others still focus on specific steps towards action (*Transtheoretical Model*) and how to use campaigns to change such action (*Community Based Social Marketing*) (Baranowski et al., 2003; McKenzie-Mohr, 2000). Others have developed through a marriage of psychology with various fields like economics (*Nudge Theory*) (Thaler & Sunstein, 2009), health and nutrition (*Health Belief Model*) (Baranowski et al., 2003), and even ecology (*Environmental Identity Model*) (Stets & Biga, 2003). A summary of many useful theoretical frameworks is presented at the end of this section (Table 1.2).

Here I focus on the *Theory of Planned Behavior*, *Expectancy Value Theory*, *Self Determination Theory*, and *Community Based Social Marketing* which, along with *Nudge Theory* explained above, were the main influences on my work.

The **Theory of Planned Behavior (TPB)** explains the relation between attitudes and actions. It assumes *reasoned* behavior, but admits that there are some limits or boundaries to reasoned action. The TPB considers attitudes related to the behavior in question, with subjective norms and perceived behavioral control as the drivers of behavior *through the mediating factor of intentions* (Fig. 1.3). Research has suggested strongly the addition of *habits* as a mediating factor between intentions and behavior, as

well as *identity* as a fourth determinant of intention and behavior in the model (Sparks & Shepherd, 1992; Stets & Biga, 2003).

The goal of TPB is not just to predict, but explain behavior (Ajzen 1991). Ajzen suggests that the model be used to affect behavior through the following steps (Fig. 1.3): "1) Identify target determinants to change (given specific behavior and population) and make sure there is room for improvement. 2) Pilot to determine personal accessible or modal accessible (community) related beliefs. 3) Construct TPB questionnaire based on beliefs with direct measures of TPB determinants. 4) Develop intervention specific and appropriate to the behavior and community" (Ajzen, 2006). These steps are functionally similar to those described in Community-Based Social Marketing (McKenzie-Mohr, 2000).

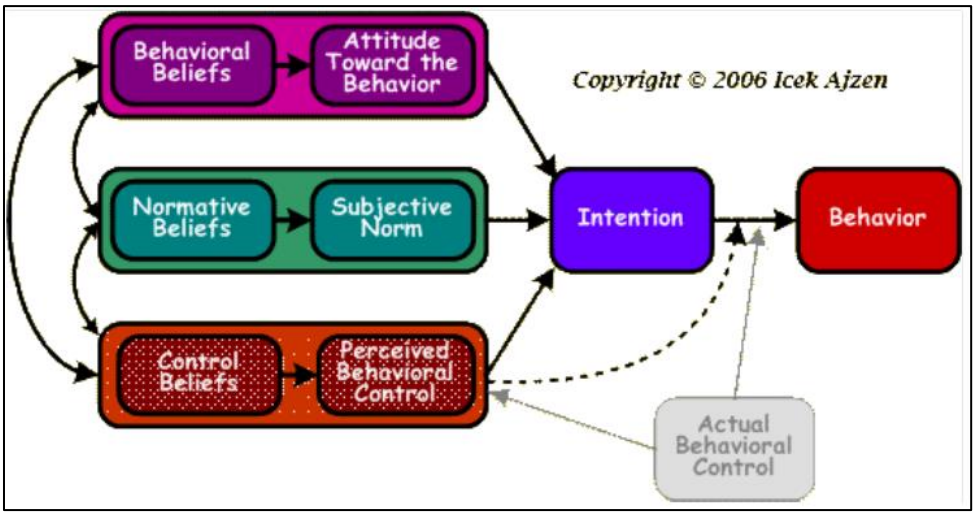

Figure 1.3. The Theory of Planned Behavior model as presented by Ajzen (2006).

Expectancy Value Theory (EVT) considers the effects of many complex constructs on what it postulates as the two direct impacts on behavioral action *expectancy* (expectations of outcomes or success) and *values* (how tasks meet a person's needs). Specifically, a task should have *utility* (usefulness), *intrinsic value*, *attainment value,* and reasonable *cost*. The theory indicates that a person's social context and personal ability, their perception of their context, and the interpretations of their personal ability and experience together influence behavior. These factors interact to create specific self-perceptions (and self-efficacy) in relation to the person's goals and, combined with memories, impact expectancy of success and task values (Fig. 1.4). High expectancy of success and high task value lead to stronger likelihood of action. Research suggests that *Energization Theory* (activation energy needed to attain success) should be included as an influence on expectancy and that *motivational orientation* (extrinsic versus intrinsic) should be included as a factor impacting subjective task value (Gilbert, Susan T. Fiske, & Lindzey, 1998).

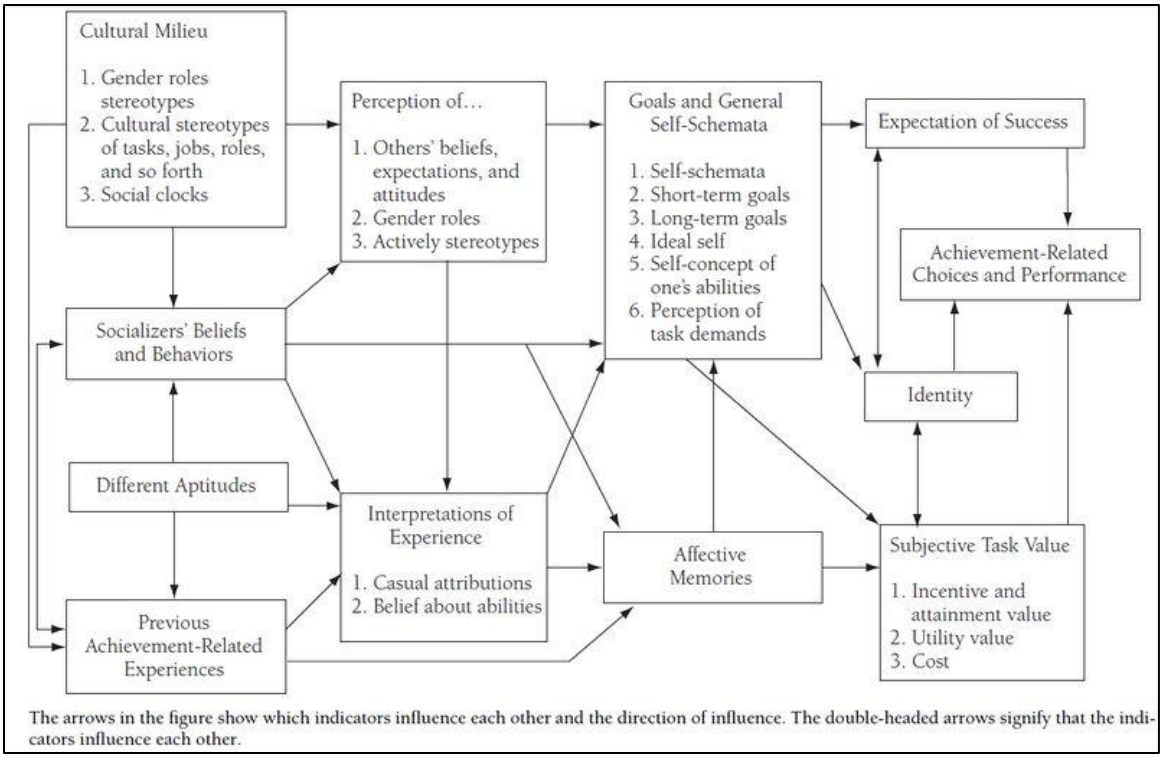

Figure 1.4. Components of Expectancy Value Model by Eccles and Wigfield (2002).

Self-Determination Theory (SDT) focuses on encouraging *autonomy*, *competence*, and *relatedness* (Deci & Ryan, 1985). Such support is postulated to lead to *action* (a reflection of human motivation) and achievement, but they are regulated through *engagement* (behavioral, affective and cognitive involvement) and *disaffection* (behaviors and emotions that reflect maladaptive and un-engaged behavioral states) (E. Skinner, Kindermann, Connell, & Wellborn, 2009). The theoretical model of SDT for motivational development is presented in Fig. 1.5. SDT focuses on the intrinsic integration of motivation in order to promote autonomously functioning individuals, often through educational and mentorship settings (Jones, 2014). SDT also highlights the importance of social partners in meeting these needs (Deci & Ryan, 1985; E. A. Skinner

et al., 2012). Ideally, the goal of sustainability behavioral interventions is to develop behavioral change based on intrinsic motivation and conviction.

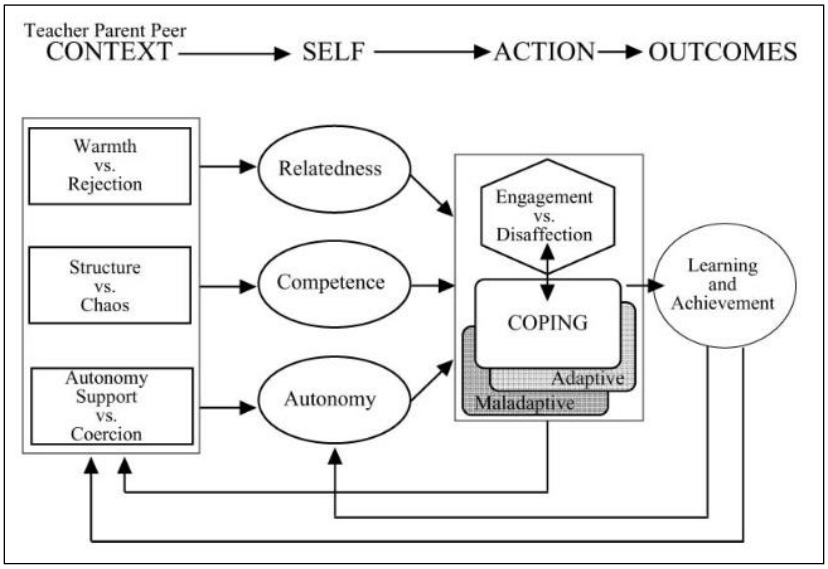

Figure 1.5. Self Determination Theory of Motivational Development, as presented by Skinner et al. (2011), shows the effect of contextual factors on the development of relatedness, competence and autonomy and the regulation of these factors by engagement/disaffection and coping to produce, or inhibit, action.

Community Based Social Marketing (CBSM) expands on previous behavioral models by focusing on the practical implementation of behavioral interventions. CBSM defines a series of steps for developing behavioral change campaigns that go beyond informing and actually influence behavior change. These steps are: 1) defining the target behavior(s); 2) defining the barriers to change these behavior; 3) designing a program that targets these barriers to encourage the behavior of interest; 4) piloting the program; and 5) evaluating the program for broad implementation (McKenzie-Mohr, 2000). CBSM is often used in the context of sustainability programming. The framework stresses the

importance of assessment and modification of intervention design. Vidgen (2015) developed an online forum for reporting on and sharing CBSM-based research results. My research benefited strongly from the CBSM model, especially in the development and assessment of the *No Scrap Left Behind* food waste intervention and related programming.

Table 1.2. A summary of select behavioral change models that explain behavior and inform behavioral modification efforts.

Theory	Summary	Motivation for change	Influencing change	Notes
Knowledge-Attitude-Behavior (KAB) Model (Baranowski et al., 2003)	New information accumulates to change attitudes and those attitudes directly influence behavior in a *rational* reasoned way. Assumes behavior is rational.	Accumulation of knowledge which influences attitudes	Provision of information	Knowledge important to behavior, but not in a direct way (Heimlich & Ardoin, 2008; Kollmuss & Agyeman, 2002; Pelletier, Dion, Tuson, & Green-Demers, 1999).
Identity Theory (Baranowski et al., 2003)	Early model that proposes that *identity* ("a set of meanings attached to the self that serve as a standard reference that guides behavior in situations") are important influences on behaviors (Stets and Biga 20003). Many later models borrow from these ideas.	Identity	Influencing and changing meanings attached to self.	The *Environmental Identity Model* specifies how identity specifically impacts environmental behaviors (Stets & Biga, 2003).

Theory	Summary	Motivation for change	Influencing change	Notes
Behavioral learning theories	Many different theories in this category. Focus on *Operant conditioning* –"behaviors are performed in response to stimuli and the frequency of occurrence of the behavior after a stimulus increases if the behavior is reinforced" (Baranowski et al., 2003). Behavior is considered *irrational*.	Reduction of physiological need. Reinforcement of behavior	Reinforce desired behavior through rewards and punishments	Can work, but requires specific attention from well-trained professional. Difficult to do in large scale intervention
Behavioral Economics Model (Hill & Clifford, 2016)	As with economics behaviors are considered tradeoffs between costs and benefits. Behavior a result of *bounded rationality* in which behavior is not fully rational and is influenced by amount of information, perceptions, loss aversion and other barriers or costs to action.	Reinforcing nature of benefits resulting from behavior	Understand the costs and benefits of behaviors to people (groups of people) Use that to reinforce behaviors leading to positive change. Specifically: **framing effect**, **psychological pricing, nudging** and **loss aversion** are considered (Hill & Clifford, 2016; Moseley & Stoker, 2013).	Has been shown to work/be relevant to obesity and environmental behavior (Diekmann 1998, 2003).

Theory	Summary	Motivation for change	Influencing change	Notes
Nudge Theory (Hill & Clifford, 2016; Lehner, Mont, & Heiskanen, 2015; Moseley & Stoker, 2013; Sunstein, 2008)	Developed from behavioral economics. Includes "choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives... Nudges are not mandates. Putting fruit at eye level counts as a nudge. Banning junk food does not" (Thaler & Sunstein, 2009). Behavior through *bounded rationality.*	The *nudge* (architectural alteration that biases behavior without forcing a specific choice).	Developing nudges through: "1) simplification and framing of information, 2) changes to the physical environment, 3) changes to the default policy, and 4) the use of social norms." (p 3 Lehner et al., 2015)	Effective in a number of settings, including consumption, food and food-waste related
Health Belief Model (Baranowski et al., 2003; Chang Ma & Contento, 1997)	People's beliefs about health problems, perceived benefits of action, barriers to action and self-efficacy explain engagement in health promoting behaviors. Developed based on operant and cognitive behavioral theories (Rhodes 2013) and similar to Knowledge, Attitude, Behavior Model.	Information and perceptions about risk. Level of perceived threat – *readiness to act.* Action selected to minimize threat.	*Risk communication* (not as affective). *Fear-based communication* has been shown sometimes effective, but based on both efficacy of response and self-efficacy of person.	Research shows weak links between perceived risk and health action and weak correlation between aspects of model generally.

Theory	Summary	Motivation for change	Influencing change	Notes
Social Cognitive Theory (SCT) (Bandura, 1991; Baranowski et al., 2003)	SCT suggests that behavior is a function of both the social environment and the person, which are in constant and dynamic relation/interaction.	**Self-efficacy**: *Self-efficacy* is a person's perceived capability for learning or preforming specific actions	Precedence of positive aspects of new idea over negative ones (may be a threshold). Success, self-efficacy and rewards encourage the person to continue to behavior. Skill development important.	Some (weak) correlation, especially when skill development included, with action in programs targeting dieting and exercise specifically.
Self Determination Theory (SDT) (Deci and Ryan 1985; Skinner et al 2012; Jones 2014; Ryan and Deci 2013)	Marks a change in psychological understanding of behavior focusing on internal, *organismic*, rather than external influence, *mechanistic*, drivers of behavior. Focuses on encouraging *autonomy*, *competence* and *relatedness*.	*Autonomy support*, *structure*, and *involvement.*	Developing *autonomy*, *competence* and *relatedness* through *autonomy support*, *structure*, and *involvement.*	Research supports effectiveness, but is time consuming, specific to an individual and can be difficult to apply to large, group settings.
Expectancy Value Theory (Ajzen, 1991; Wentzel & Wigfield, 2009)	Postulates that people form beliefs by associating it with other certain attributes (positive or negative) which influences attitudes, and hence behavior, towards that behavior.	***Expectancies*** are "our beliefs about the future." ***Subjective task values***: 1) *attainment value* (importance of doing well on task). 2) *Intrinsic value* (part of/benefit future plans?). 3) *Utility value* (enjoy it?). 4) *Cost*	"cognitive information-processing approach to attitude formation" (Ajzen 1991)	More practical for achievement specifically than behavioral change generally.

Theory	Summary	Motivation for change	Influencing change	Notes
Theory of Reasoned Action (TRA) then **Theory of Planned Behavior (TPB)** (Ajzen, 1991; Baranowski et al., 2003; Stets & Biga, 2003)	Behavior is predicted by *intentions*, which are influenced by one's *attitudes towards a behavior*, *subjective norms* and *perceived/actual behavioral control*.	Positive and negative outcomes. Desire to please others. Perceived control/actual control over success	1) Identify specific determinants of behavior to change. 2) Pilot. 3) Construct TPB questionnaire based on beliefs and with direct measures. 4) Develop appropriate intervention. (Ajzen, 2006) (similar to CBSM)	Research suggests the addition of moral beliefs, positive and negative emotions, and past experience.
Transtheoretical Model and Stages of Change	Focuses on describing stages of change. Specifies the following stages: pre-contemplation (not ready), contemplation (getting ready), preparation (ready), action, maintenance.	Decisional balancing of pros and cons of behavior (similar to SCT and TPB's attitude to act) Self-efficacy (confidence to change, similar to SCT) Processes of change (factors that facilitate behavioral change)	Sometimes through *tailoring* in which initial perceptions of pros, cons and self-efficacy are measured and a specific behavioral change plan is developed.	Stages of change still being developed. *Tailoring* difficult for large scale, although the process is similar to that of CBSM which is developed for large scale marketing.

Theory	Summary	Motivation for change	Influencing change	Notes
Ecological and social ecological models (Baranowski et al., 2003; Stets & Biga, 2003)	Various models that ecological, social and political models affect human behavior and vice versa. Locations in which people live are called *ecologies* and the social environmental, *social ecologies.*	Various factors including: legislation, policy change, ecological and social design, change to physical environmental.	Not always clearly defined. Could include: prompting and facilitating, manipulating access, increasing or decreasing the attractiveness of a choice/behavior.	Allows for better consideration of environmental and social justice within behavioral framework.
Community Based Social Marketing (CBSM) (McKenzie-Mohr, 2000; McKenzie-Mohr, Nemiroff, Beers, & Desmarais, 1995)	Focuses on a defined procedure for promoting health change in a community, rather than just understanding behavioral change.	Programming developed using model	Campaign designed to emphasize value, address barriers, increases, and promote the behavior in a way best understood by the audience. Monitoring of audience participation before and after campaign essential.	Research shows effectiveness in various situations.

Even within these well-established theoretical frameworks, food waste presents a unique challenge. As mentioned before, the complexity of food waste behaviors makes them difficult to fit into one behavioral model or framework. Therefore, my research drew from the various models described in detail here as well as research on other aspects of food waste diversion. Although more research is emerging on food waste behaviors, the focus is often on food waste quantification or life cycle waste assessment. Research

on the factors that influence food waste behaviors and how to target those factors effectively with policy, education, and interventions is still emerging.

Purpose of dissertation

The overall objective of this dissertation is to understand the factors that influence food waste behavior and the opportunities for improving such behavior within an educational setting. I first explain the importance of introducing food more intentionally into general and scientific educational settings. Then, I present an assessment of university students' understanding of food waste. In the same university setting, a food waste intervention called *No Scrap Left Behind* was piloted. I present an assessment of that program. Finally, I discuss the overall implications of my work. Chapters Two, Three, and Four are written as separate manuscripts. Therefore, there is some redundancy in their content.

Specific research objectives and questions

Objective 1: To present the importance of food education as a broad theme for connecting personal experience to science curricula and climate change.

Objective 2: To assess the knowledge, attitudes, emotions, beliefs, and reported behaviors of university students around food systems and food waste.

> **Research question 2.1**. What are the knowledge, attitudes, emotions, beliefs, and reported behaviors of university students towards food waste?
>
> **Research question 2.2**. How do these knowledge, attitudes, emotions, beliefs, and reported behaviors compare to the national results on similar measures?
>
> **Research question 2.3**. What underlying factors influence food waste behaviors?

Objective 3: To pilot and assess the effectiveness of *No Scrap Left Behind* food waste diversion programming.

Research question 3.1. Are student knowledge, attitudes, emotions, beliefs, and reported behaviors towards food waste improved by the intervention? If so, how?

Research question 3.2. Is actual average lunch food waste (in grams per student) decreased during the intervention? If so, by how much?

Research question 3.3. How can the pilot inform improvements to *No Scrap Left Behind Programming* as it continues to be implemented on campus?

Chapter summaries

Chapter 1. The unsustainable food system and potential for changes

Unsustainable food systems pose a significant threat to environmental, social and economic systems globally. This chapter presents the environmental, social and economic impacts of food systems and waste and discusses the importance of developing policy, behavior change, and educational programs to improve the efficiency of food systems, especially at the consumer level.

Chapter 2. Food in science education: A better way to fry the big fish

Food has a central place in individual lives and community culture. The strong identification that people have to food provides an excellent opportunity for environmental educators to make abstract environmental issues like climate change more relevant through their connection to food systems. This chapter presents the conceptual framework for the research presented in the following chapters.

Chapter 3. Trends and underlying factors in reported food waste knowledge, attitudes, emotions, and behaviors in university students

In order to influence students in regards to food decisions, their current knowledge of and actions related to food and food waste must be understood. This chapter presents an exploratory analysis of self-reported knowledge, attitudes, emotions, beliefs, and behaviors regarding food systems and food waste in university students. This baseline data provides the reference point for the research in the subsequent chapter in which a program on behavior change related to food waste diversion is presented and assessed.

Chapter 4. Impact of food waste diversion programming on university student food waste and measures of related knowledge, attitudes, emotions and reported behavior

No Scrap Left Behind programming is aimed at increasing student knowledge and improving their attitudes, emotions, and behaviors around food waste. The program was developed and tested in a university cafeteria over an academic year (2015/2016). Both direct (food waste audits) and indirect (survey) measures of behavior were collected and tracked over the year to determine if and to what extent the program was successful in influencing students' actual food waste diversion and their knowledge, attitudes, emotions and beliefs related to food waste.

Chapter 5. Implications and conclusions

This chapter revisits the research objective and questions. Implications and improvements of the programs developed for this dissertation are presented. I also suggest future research which can improve curricula and programming around food waste diversion.

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Chapter 2. Food in science education: A better way to fry the big fish

Authors: Manar A. Alattar, Amy Y. Benfield, Jennifer L. Morse

Introduction

Increasingly, the environmental and social impacts of the global food system are being recognized. Agriculture is the primary driver of land conversion, habitat destruction, and pollution worldwide (Feldstein, 2017). The greenhouse gas (GHG) footprint of the global food system is 1.5 times that of the global transportation sector (Benton, 2017). At a time characterized by an increased awareness of human impact on the environment, massive amounts of food waste make these impacts even more inexcusable. An estimated 40% of food produced nationally, and 30% of available food globally, goes uneaten (Lipinski et al., 2013). In startling contrast is the looming effect of hunger and food insecurity in communities nationally (50 million Americans) and globally (815 million), further highlighting the extreme inefficiencies of our global food system (FAO, 2013; Feeding America, 2013). With such a rich topic on environmental impact, why are we not focusing more specifically on food systems as a vehicle for teaching about climate change?

When asked "How can you decrease your own environmental footprint?", many students will immediately think about biking to school, adding a faucet attachment to decrease water use, or using less electricity at home. These are all essential to improving human interactions with nature, but we'll get more bang for our GHG buck by changing the way we interact with food. Food is also essential to life, health, identity, and

community (Barton, Koch, Contento, & Hagiwara, 2005; Pliner & Mann, 2004; Waters & McNamara, 2015). As such, food is a cultural and personal signifier that is relevant, sometimes critically, to students' lives outside the classroom. Educators can, and in many cases do, use food both as a more impactful and more personal connection with climate change.

Taking advantage of the fad

Increased interest in food makes this an opportune time for incorporation of food throughout science and environmental science curricula. Demand for organic food has more than doubled since 2005 (USDA, 2017). Vegetarianism has almost doubled since the turn of the century, due mainly to ethical and health concerns (American Dietetic Association, 2003; Leitzmann, 2014). Food-related television programming continues to increase in popularity, even as actual time spent preparing, eating, and cleaning up after meals is declining dramatically (Matwick & Matwick, 2015; Monsivais, Aggarwal, & Drewnowski, 2014). Despite increased interest in food issues, one aspect of food that is less commonly understood is that of its environmental impact (Brook Lyndhurst, 2007; Halloran, Clement, Kornum, Bucatariu, & Magid, 2014). Awareness of the impacts of food waste is beginning to increase, as books like Bloom's *American Wasteland* (2010) and documentaries like *Just Eat It* (2014) are taking on the topic.

Changes within national science curricula, especially those related to the Next Generation Science Standards (NGSS), also lend themselves well to a broader and more intentional incorporation of food throughout scientific curricula. NGSS seeks to incorporate cross-cutting themes with relevance to practical implementation that touch on

core scientific concepts across the science curriculum in an interactive, hands-on, solution-driven manner. Nothing fits this bill like food. Food is, by definition, "cross-cutting," as it is a driver of historical development, geographical expansion and settlement, technological advancement, and global interconnection, making it optimal for cross-disciplinary curricular linkages. Food connects strongly to core content throughout academia, and is broadly applicable and deeply rooted in students' life and community, regardless of educational level or background. Finally, food production is cyclical and increasingly dependent on technological systems. Therefore, concepts of systems thinking, engineering solutions, and modeling are integral to food-related education (Lederman & Abell, 2014).

Beyond the classroom – developing skillsets for improved health

Environmental sustainability and sustainability education are increasingly focusing on the importance of human health as well, a concept often termed "ecological public health" (Filho, Azeiteiro, & Alves, 2016; Lang & Heasman, 2015). Trends in diet-related diseases in children are particularly concerning and, sadly, allow educators yet another food-connection to the lives of the students they teach. An estimated 17% of American children are obese (CDC, 2017), contributing to an increase in type-2 diabetes and other diet-related diseases in children, especially those from racial minorities (Pulgaron & Delamater, 2014). We are essentially "feeding (our children) to death" argues Ann Cooper, author of *Lunch Lessons: Changing the way we feed our children* (Cooper, 2012). Food-related science curricula and health science programs enhance students understanding of food systems and their personal options within them (Barton et al.,

2005; Pollan, 2015), specifically improving their dietary behaviors and food choice habits, and engagement with and knowledge of science overall (Barton et al., 2005; Brooks & Begley, 2014; Liquori, Koch, Contento, & Castle, 1998; Vaitkeviciute, Ball, & Harris, 2014; Vidgen & Gallegos, 2014).

What's already happening?

The power of food in school has not been lost on most educators. Any teacher can attest to the impact of even a single drowsy or hungry student on the whole classroom. Schools and educators have been increasingly pushing for more healthful school lunches and incorporation of school gardens, and related lessons, into school curricula. Nationally, schools participating in farm-to-school lunch programs increased from 400 in 2004 to 2,300 in 2014 (Berlow & Randall, 2015). School gardens have also become increasingly common nationwide. Programs like Berkeley's Edible Schoolyard initiative and Portland's Learning Gardens Laboratory have successfully incorporated gardening, food, and hands on learning into school curricula for years, even decades. These and other programs have been shown to improve both direct and indirect measures of student success and improve academic success in science, math, and other subjects (Williams & Dixon, 2013). Curricula that incorporate food systems into science and math also improve students interest in and reception of science curricula (Duffrin et al., 2010), and increase engagement in both science and school generally (Skinner, Chi, & The Learning-Gardens Educational Assessment Group 1, 2012; Williams & Brown, 2011). Furthermore, students who experience gardening and farming have a stronger awareness of systemic relationships within living and environmental systems. They may also be

more aware of the personal impact they can and do have on their surroundings (Ableman, 2005). Even at the university level, instructors are increasingly incorporating food modules into their writing, chemistry, social science, and even art classes in order to draw students into the topic at hand and encourage meaningful discussion.

What more can be done?

First, it is essential that, as a society, we acknowledge the overwhelming impacts of food on the environment and climate. This needs to occur at both the citizen and policy level to be most effective at mitigating the impacts of food production on environmental, social, and economic systems. As science educators, we can be on the front lines of this change. Taking on food as a tool, not only to connect students to living soil or the chemical reactions in baking bread, but to make complex concepts directly relevant and clearly understandable.

Since food and agriculture are primary drivers of climate change, we need to rethink our connection to them and how we teach about them. We can explain ozone depletion by talking about the global cold-food chain and the role of refrigerants within it, instead of starting with chlorofluorocarbons (CFCs) (what a mouthful). We can explain biodiversity degradation through the lens of its primary cause: land conversion for agriculture. We can talk about the GHG emissions of thousands of heads of lettuce trapped, for potentially decades, in a landfill. We can bring the big issues to the table, so to speak. Instead of starting with CFCs, GHGs, H_2CO_3 (carbonic acid), WTP (willingness to pay), and other servings of alphabet soup, we can speak a language that students understand well. The language of "bread and butter" (grain is the second-most wasted

food worldwide; livestock and dairy are the biggest contributors to GHG emissions within the food cycle); “eat your veggies” (fruits/vegetables are the most wasted foods). We can talk about “morning coffee” (coffee plantations are a major contributor to deforestation, nonnative monoculture, and social injustice) and “fast food” versus “slow food” values. I’m hungry for this new science curriculum already!

In conclusion

The opportunity for science education to utilize food more broadly throughout scientific and related curricula cannot be overlooked. Food is a universal linkage between the individual, any individual, and the environment. Complex global concepts can be brought into plain language by using food as a direct conduit for thinking, talking, learning and building skillsets for a sustainable future. As educators, let’s fry the big fish, so to speak, by using student-friendly lingo and the familiar flavors of food.

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Chapter 3. Trends and underlying factors in reported food waste knowledge, attitudes, emotions, and behaviors in university students

Authors: Manar A. Alattar, James DeLaney, Jennifer L. Morse, Max Nielsen-Pincus

Abstract

Food waste is a pervasive social, economic, and environmental issue, yet most people are unaware of its impacts and underestimate their contribution to it. Recent work nationally has begun to explore knowledge, attitudes, and behaviors related to food and food waste. In order to deliver targeted interventions, it is important to understand the underlying factors which influence food waste behaviors. Four hundred and ninety-five individuals were surveyed at Portland State University, Portland, OR, USA. Our objectives were to: 1) identify how university students' self-report knowledge, attitudes, emotions, and behaviors related to food waste; 2) explore underlying factors driving food-related behaviors; and 3) develop a model for assessing food waste diversion programs. The participants underestimated their contributions, individually and that of consumers generally, to food waste. They reported that they most often left food on their plate because it did not taste good or they had overestimated portion size. A majority of participants already preformed many food waste reduction behaviors, and were both interested in taking action and aware that their efforts could make a difference. An exploratory factor analysis on the 24 Likert-scale items in our questionnaire returned a five-factor structure that explained about 55% of the variance. Indexes of these factors and household food waste were modeled to determine their relation to "intent to reduce food waste" and "food waste diversion behaviors". Intent to decrease food waste was

correlated with food management skills, attitudes and knowledge of compost systems, sustainability actions and attitudes, and reported household waste. Reports of actual food waste diversion behaviors were related to intent to reduce food waste, knowledge and attitudes towards composting, and attitudes about reuse. Addressing these constructs in multifaceted food waste diversion programming will be important to influencing food waste norms within and beyond university settings.

Introduction

Pro-environmental behaviors are complex and a result of many underlying factors. Knowledge, skill to implement knowledge, intent to make change, belief that one's actions will make a difference, personal identity, and social support for change are examples of important factors related to environmental behavior (Ajzen, 1991; Eilam & Trop, 2012; McKenzie-Mohr et al., 1995; Stets & Biga, 2003). Although some overlap has been shown, research indicates that underlying factors driving environmental behavior are generally unique for each type of environmental behavior. Factors that influence one behavior, like recycling, may not be predictive of other behaviors, like composting (McKenzie-Mohr et al., 1995; Thomas & Sharp, 2013). Furthermore, the factors that motivate environmental action can differ from those that inhibit or amotivate such behavior (Pelletier et al., 1999).

Sustainability efforts have often focused on behaviors like the "three Rs;" reduce, reuse, and recycle; with respect to material waste and reducing transportation emissions. Despite these efforts, the food cycle, including wasted food, has one and a half the

greenhouse gas (GHG) footprint of the global transportation sector (Benton, 2017). Not only does the food cycle have significant environmental impacts, it is also grossly inefficient. Forty percent of the total edible food in the USA and 30% worldwide is wasted (Lipinski et al., 2013; Neff et al., 2015). Yet 41 million Americans, and 815 million globally, are food insecure (unable to reliably find their next meal) (FAO, 2013; Feeding America, 2013). Loss of edible food occurs at each stage within the food cycle from production to consumption, but consumers are responsible for the bulk (60%) of food waste in developed countries (Lipinski et al., 2013). Although consumer behaviors are related to broader aspects of the food cycle, like presence (or absence in most cases) of city composting systems, many individual actions can be taken to divert food waste. Optimally, food waste diversion actions reduce food waste before it occurs, like planning meals, buying and storing food more efficiently, portioning, and eating leftovers. If food does become inedible, scraps can be composted (US EPA, 2014). To increase the prevalence of food waste diversion actions, it is essential to understand the factors that specifically influence food waste and food waste diversion behaviors and to be able to measure them for intervention purposes. Work in this area has shown the complexity of food waste behaviors specifically.

Food waste behaviors are influenced by many, often competing, factors (Benítez, Lozano-Olvera, Morelos, & Vega, 2008; Evans, 2012; Graham-Rowe et al., 2014). Cost and convenience, including accessible infrastructure (like city composting), are strong determinants of food waste diversion behaviors (Graham-Rowe et al., 2014; Neff et al., 2015; Pelletier et al., 1999; Refsgaard & Magnussen, 2009). The role of cost and

convenience, in general, to behavior determination is well established in many behavioral and motivational theories, including Expectancy Value Theory and the Energization Theory of Motivation, in which cost is a determinant of value and the value of a task is inversely related to perceived cost (Eccles & Wigfield, 2002; Fiske, Gilbert, & Lindzey, 2010). Knowledge and skills specific to food waste and food management are also essential to food waste diversion (Graham-Rowe et al., 2014; Pelletier et al., 1999; Whitehair et al., 2013). Food management skills have been the focus of various food waste diversion campaigns and interventions (Oliver, 2010; Pollan, 2008; T. Quested et al., 2013). Presumably, having specific food-related knowledge and food management skills decreases the actual and perceived costs of food and waste management. Food date labeling is also a major driver of food waste, causing up to 20% of household food waste (Leib et al., 2013; Neff et al., 2015; WRAP UK, 2017). The vagueness of food date labels and the lack of regulated standards lead to a considerable amount of consumer confusion about how food date labels translate to food safety, thus resulting in significant amounts of food waste worldwide (Leib et al., 2013; WRAP UK, 2017).

Factors related to identity, such as the desire to be a "good provider" and personal satisfaction with acting environmentally, also influence food waste behaviors (Graham-Rowe et al., 2014; McKenzie-Mohr et al., 1995; Visschers, Wickli, & Siegrist, 2016). Work on environmental identity shows that the prominence of and commitment to one's environmental identity is an integral determinant of pro-environmental behaviors generally (Stets & Biga, 2003). In the absence of community or city infrastructure for food waste diversion, the component acts of food waste diversion are often private

(portioning, eating leftovers, backyard compost, *etc*.). Therefore, food waste diversion seems less related to social identity than other pro-environmental behaviors like recycling (Lehner et al., 2015; Thomas & Sharp, 2013). Social factors would likely become more significant where food waste diversion was emphasized in a public setting like a neighborhood (curbside or community garden compost) or cafeteria. General sustainability beliefs and beliefs specific to food waste have both been shown to influence plate waste (Whitehair et al., 2013). Emotions such as guilt are also important to food waste diversion (Graham-Rowe et al., 2014; Leigh Gibson, 2006).

Many factors, including habit and simple environmental cues, affect food waste behaviors subtly as well. For example, plate size and visual signals for how much food has been eaten have been shown to have considerable influence on eating and waste behavior (Freedman & Brochado, 2010; Wansink, 2010; Wansink & van Ittersum, 2013). Work on behavioral economics and nudging has shown that simple changes in food-related environments, like removal of cafeteria trays, decreasing plate sizes, displaying more healthful options before less healthful ones, and pre-cutting fruits instead of serving them whole, can encourage food waste diversion and healthier eating habits (Lehner et al., 2015; Moseley & Stoker, 2013). Although these more subtle factors were not measured here, they are important and the focus of many behavior economics studies (Lehner et al., 2015; Moseley & Stoker, 2013; Thaler & Sunstein, 2009; Wansink & van Ittersum, 2013).

Exact measurements of individual food waste to determine the effects of various factors on food waste habits can be difficult, however. Reasons for this difficulty include

that waste behaviors are highly dependent on one's circumstance, waste itself is often an aggregate of various materials from multiple individuals, and many disposal receptacles are generally available to a person throughout the day (Beigl et al., 2008). Cities in which pay-as-you-throw food waste systems have been established may provide a unique exception (Beigl et al., 2008; Chrobog, 2015). Such systems, developed as part of rigorous city-wide food waste diversion efforts in parts of South Korea and some other countries, have led to 30% and 40% reduction of food waste in households and restaurants respectively (Chrobog, 2015).

Understanding the impacts of these factors on food waste behaviors and determining how to influence them through targeted interventions are necessary to promote food waste diversion efforts. Consumer and food-service employee educational programming has been suggested as the second most impactful and economically feasible solution to food waste reduction (second only to standardizing food date labeling) (ReFED, 2016; Thyberg & Tonjes, 2016; Waarts et al., 2011). Educational programs in the United Kingdom (UK) and elsewhere have shown considerable success in addressing food waste behaviors (T. Quested et al., 2013). The most notable of these is the *Love Food Hate Waste* campaign funded through the Waste and Resources Action Programme (WRAP) in the UK. The program is unique in that both significant funding and research efforts are combined to engage consumers in food waste diversion skills. Rather than focusing on the environmental impact of food waste, the program emphasizes the financial benefits resulting from food waste diversion and the development of skills to enable such diversion (T. E. Quested et al., 2013; WRAP UK, 2017). A 1.1 million ton (13%)

reduction in annual household food waste in the UK between 2007 and 2010 is partially attributed to this programming (T. E. Quested et al., 2013). In September 2015, the US Department of Agriculture (USDA) and Environmental Protect Agency (EPA) announced the nation's first food diversion goal of 50% food waste reduction by 2030. As food waste diversion efforts in the USA unfold, it will become more clear how much financial, political, and intellectual support and traction this goal will have and whether consumer programing like *Love Food Hate Waste* can be developed and implemented effectively on the national scale (USDA, 2015).

To aid in the development and assessment of programs on food waste diversion, researchers and planners have created an array of useful tools, including mathematical models. Many such models have been developed to predict general household waste generation for planning purposes in city waste management (Beigl, Lebersorger, & Salhofer, 2008). Predictor variables within these waste generation models include household density (members/household), level of education, income, and other variables related to socio-economic status (Benítez et al., 2008). More research is necessary, however, to develop models that explain food-waste related behaviors specifically.

To understand factors related to food waste reduction behaviors, we developed a short survey instrument that was administered to university students. We focused on reported food waste diversion behaviors, knowledge of food waste, intent and interest in food waste reduction, attitudes and emotions towards food and composting, perceived cost of food waste, and general sustainability beliefs. University students are well-suited for such a study, as they are a diverse yet accessible population and represent a likely

audience for targeted educational programming. A simplified conceptual model of the factors that guided our study and analysis is presented in Figure 3.1.

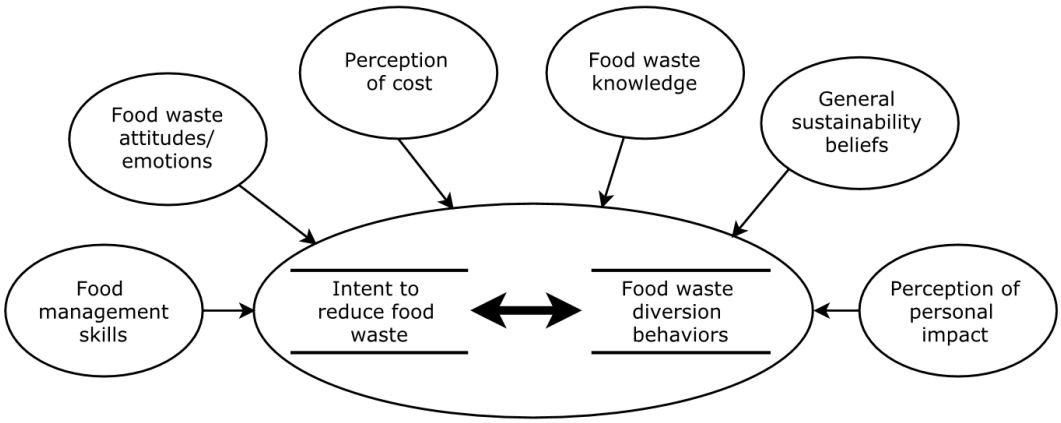

Figure 3.1. A simplified conceptual figure of various underlying factors that influence food waste diversion behaviors. This model informed our data analysis.

Our research objectives were to: 1) understand university students' food waste attitudes, emotions, knowledge, intent, and reported behaviors compared to those reported nationally; 2) determine the underlying factors that influence reported food waste diversion behaviors; and 3) develop a model for assessing food waste diversion programs.

Methods

Setting and participants

Our study took place at Portland State University (PSU; Portland, OR, USA), where an average of 25% of landfill-bound waste is food scraps (and 36% compostable in general) (Doherty et al., 2013). This includes more than 500 tons per year of valuable food scraps that could be diverted (Hair, 2013). As an institution, PSU is working towards 25%

reduction of overall waste generation and 10% reduction of landfill-bound waste by 2030 (PSU Climate Action Plan) (CSO, 2010).

A total of 495 surveys were collected through convenience sampling in the school cafeteria, three freshman classes, and online throughout campus. At the cafeteria, students were given the survey while waiting to pay for food or while eating, and returned their completed questionnaires after their meal. Students in freshman courses were given questionnaires during a Campus Sustainability Office presentation in those classes. The online survey was set up in Qualtrics (Qualtrics, Provo, UT) and distributed by email to students by various instructors and departments throughout the university.

Data Collection

The survey instrument (Appendix B.4) was designed to measure attitudes, emotions, knowledge, intent, and reported behaviors related to food waste as well as general sustainability beliefs. Questions (Table 3.1) were modeled from previous food waste literature, but refined further based on input from the campus sustainability office and knowledge of the PSU student population (Graham-Rowe et al., 2014; Lipinski et al., 2013; Neff et al., 2015; Refsgaard & Magnussen, 2009).

Respondents were asked to report on attitudes, emotions, knowledge, intent, and reported behaviors related to food waste in 24 Likert item questions and three written-answer questions. All Likert-type questions were given a five-point response scale that ranged from “Strongly agree” to “Strongly disagree,” with “Neutral” as the middle anchor point. A 5-point scale allows for sufficient variation within the scale without risking participant reluctance to choose extreme answers on a wider scale (Boslaugh,

2013). Questions were asked in both pro-food waste diversion form (e.g. "I eat leftovers") and anti-food waste diversion form ("Food waste doesn't bother me") to diversify and capture a broader range of responses. Questions written in anti-food waste diversion form were reverse-coded for analysis. Cognitive interviews were conducted with a number of potential respondents and survey experts to establish the content validity of the instrument.

Food waste knowledge and knowledge of resources was measured with questions that have been used in other food waste studies (Leib et al., 2013; T. Quested et al., 2013) and questions on specific campus-related food waste diversion knowledge (Pelletier et al., 1999; Whitehair et al., 2013). "I understand food freshness labels (sell by, best by, use by, expiration date, *etc*.)," and "I know about the campus composting program" are examples of Likert item general and specific food waste knowledge items. Knowledge was also probed by asking respondents to estimate the percent of food waste at various consumer levels: average American household, the campus community, and the USA as a nation, and along the food cycle from production to consumption.

Intent and interest in food waste reduction was measured with questions including "I put effort into reducing food waste" and "I am interested in taking action to prevent food waste," as done in or suggested by other work (Eilam & Trop, 2012; Hebrok & Boks, 2017; Neff et al., 2015). Food management skills have been cited as important to food waste generation (Graham-Rowe et al., 2014; Neff et al., 2015; Vidgen & Gallegos, 2014) and were measured using a series of questions similar to those in a recent national survey (Neff et al., 2015): *e.g.*, "I eat leftovers," "I check the refrigerator before

shopping," and "I compost my food scraps."

Attitudes towards food waste were measured with both cognitive and affective statements. Cognitive statements included items such as "Food waste does not bother me" and "My individual actions towards food waste do not make a difference" that are similar to questions posed in other studies (Brook Lyndhurst, 2007; McKenzie-Mohr et al., 1995; Neff et al., 2015). The affective component was measured with three additional items: "I dislike composting," "When I compost I feel like I'm contributing to the greater good," and "Composting stinks and is gross." The perceived cost of food waste was measured through one question: "I don't think the food I throw away costs much money".

Broader sustainability beliefs were probed indirectly with the following questions: "I believe that many materials can be reused or recycled into something new," "I believe proper waste disposal makes a positive environmental impact," "I would like to see more programs that help reduce food waste," and "I would enroll in a course with a sustainability theme." Participants were also asked directly about the amount of food they wasted (as a percentage of total food) and the reasons for that food waste ("I generally leave food on my plate because?" with multiple potential answers). Basic, university-related demographic data were also collected, including age, gender, academic level, and whether students lived on-campus.

Data analysis

Demographics and national comparisons

To understand student knowledge, attitudes, emotions, intent and interest, perceived cost, and reported behavior (Objective 1), we used frequency analysis to report percentages.

Specifically, when participants "agreed" with a statement, the results presented are a sum of "agree" and "strongly agree" responses. Similarly, if participants "disagreed," the "disagree" and "strongly disagree" responses were combined. Where appropriate, frequencies were compared to those reported as national data (Objective 2) (Lipinski et al., 2013; Neff et al., 2015).

Factor analysis

We conducted an exploratory factor analysis (EFA) to explore the underlying factor structure of the 24 Likert items and generate response variables for the regression analysis. As opposed to a hypothesis-driven endeavor, we chose an exploratory method to explore which factors were present, but we maintained methodological flexibility to better understand and utilize potential unexpected correlations among items (Bartholomew, Steele, Galbraith, & Moustaki, 2008).

Following the data screening, the EFA was conducted using a multi-step process and clear set of decision rules (B. Williams, Onsman, & Brown, 2010). First, a principal axis extraction method was used, because it is robust against non-normally distributed variables (Fabrigar, Wegener, MacCallum, & Strahan, 1999; Lorenzo-Seva & Ferrando, 2015). The analysis was performed on a polychoric correlation matrix, which is a modified version of Pearson's correlation more appropriate for ordinal data, using oblique rotation to allow for some correlation between factors (Browne, 2001; Lorenzo-Seva & Ferrando, 2015). Second, we examined the item-loadings and cross-loadings and retained only those with eigenvalues greater than one (Anna Costello & Osborne, 2005). Finally, we retained factors if: a) they contained at least three items with loadings greater

than 0.32, and b) no cross-loadings of 0.32 or above (Yong & Pearce, 2013). Multi-item indexes were generated for each factor by averaging the responses to questions within each factor. All indexes were evaluated for internal correlation using Cronbach's alpha (Boslaugh, 2013). Pairwise deletion, which leaves all available cases without removing all data from a given respondent (Schafer & Graham, 2002), was used for all steps in the analysis.

Regression analysis

The relationship of the measured factors and reported individual food waste to both "intent" and "food waste diversion behaviors" (Fig. 3.1) were explored using linear regression (Objective 3). The factor indexes for these two concepts were used as the dependent variable in separate models. This was done to get a more complete understanding of the impact of the factors on both intending to and actually participating in food waste diversion behaviors. Food waste diversion behaviors have an interesting relationship to the measured factors as they can be considered an outcome (Fig. 3.1; "Food waste diversion behaviors"), but these behaviors are also skills which are predictors of food waste intent and behavior. Specifically, they relate to perception of cost and personal impact and therefore, can be considered predators as well (Fig. 3.1; "Food management skills"). Furthermore, many food waste diversion/management skills are influenced by external factors unrelated to food waste diversion specifically. For example, someone on a budget would be more likely to make a shopping list or eat leftovers to save money, with little regard for food waste specifically. Intent to reduce food waste, on the other hand, is specific to food waste, but does not always translate

directly into action. Therefore, in order to more fully understand the drivers of food waste reduction, we present two models, one in which "Food waste diversion behaviors" are the dependent variable and a second in which they are considered "Food management skills" and a predictor of "Intent to reduce food waste."

Although there are obvious limitations to using indexes based on self-reported behavior, this is appropriate due to the difficulty of obtaining accurate individual food waste measures from a large sample, which is common for this type of research (Barr, 2007). Predictor variables were tested for multicollinearity within the regression model using a Variance Inflation Factor (VIF); no multicollinearity was detected below three. The original model was reduced based on predictor significance (<0.05) in a stepwise fashion to obtain the final model. Data analysis was done in IBM Statistical Package for Social Science (SPSS) for Windows, Version 24.0 (IBM, Armonk, NY) and R 3.2.4 (R Core Team, Vienna, Austria).

Results and discussion

Sample characteristics and demographics

A total of 495 surveys were collected across all sampling occasions. Of those, 332 were collected in the cafeteria, 99 in freshman inquiry classes, and 64 online from various courses and programs throughout the university. The average age of respondents was 21 years old, with a range of 18 to 58 years. Of participants, 54% were female and 42% male (3% other or undefined). These percentages match those of the university as a whole in the same year (53% female; 44% male) (University Communications, 2017). A majority (n = 490, 94% of respondents) were undergraduate students, and 3 (<1%) were post-

bachelor students. A majority (n = 377, 76%) lived in residence halls on campus. On average, participants ate at the residence hall cafeteria eight times a week, and at the general school cafeteria once a week. On average, the house/dorm of participants had two members.

Responses compared to national data

Participants reported that they wasted 18% of the food they bought, on average, but perceived that average Americans were more wasteful, reporting an average of 35% food waste (Fig. 3.2). Other research shows that Americans do indeed waste between 15% to 30% of the food they buy (Parfitt et al., 2010; H. Williams, Wikström, Otterbring, Löfgren, & Gustafsson, 2012) and that most underestimate their own contribution to food waste compared to others (Neff et al., 2015; T. E. Quested et al., 2013; Refsgaard & Magnussen, 2009). Students estimated that 50% of food was wasted nationally; research indicates that national food waste is between 30-40% (Buzby et al., 2014; Neff et al., 2015). Thirty percent (n = 150) of the students in our study reported that national food waste was within the 30-40% range.

In regard to food waste that occurs along different stages of the supply chain (Fig. 3.2), responses were compared to percent averages for "North America and Oceania" reported by Lipinski *et al.* (2013). On average, participant estimates for "Production" waste were consistent with published values (17%) (Lipinski et al., 2013). Average reported waste values associated with "Handling and storage" (15%), "Processing" (16%), and "Distribution" (20%) were overestimated compared to published percentages, 6%, 9%, and 7%, respectively (Lipinski et al., 2013). As in other studies (Neff et al.,

2015; Refsgaard & Magnussen, 2009; Thomas & Sharp, 2013), participants in our study underestimated consumer waste, with the reported average almost half (35%) of the published estimate (61%) (Lipinski et al., 2013).

When asked why they left food on their plate, 55% said because it "doesn't taste good," 31% because they "overestimated the portion size," 9% because they "don't have time to eat it," 6% because they are "being aware of their caloric intake," 3% didn't know or declined to answer (participants were directed to choose all that applied, therefore the total exceeds 100%). Portion size, low appetite, and disliking the taste of food were the most commonly cited reasons for not finishing food in a study of Korean elementary students (Kim, Ko, Kim, & Kim, 2000). In studies of meals eaten outside the home in Europe, portion size and ordering too much were cited as the main reasons for plate waste. Being full, dislike of the taste/smell/preparation of the food, identity-related factors, and social influence were also cited as reasons for plate waste (Betz, Buchli, Göbel, & Müller, 2015; Giorgi et al., 2013). Respondents who preferred the "full meal experience" (appetizers, sides, drinks, *etc*.) and/or ate out as a social engagement rather than for nourishment, were also more likely to waste food (Giorgi et al., 2013). Plate waste was also perceived as not the customer's responsibility or out of their control (Oliveria et al., 2016).

In regard to food waste diversion thoughts and behaviors, 71% of participants in our study agreed that they thought about the food waste they generated; 70% put effort into food waste reduction; 65% were interested in taking action; and only 23% talked to others about food waste. Thirty-six percent composted their own food scraps. Residence

hall dwellers reported composting slightly more (41%) than non-residents (34%), presumably due to the ease of access to resident composting, but the difference was not statistically significant (one-tailed t-test, $p = 0.46$). Eighty-two percent ate leftovers; 77% checked the refrigerator before shopping; 62% made shopping lists; and 38% prepared or cooked some of their meals. This was similar to the national population as reported by Neff *et al.* (2015), in which~75% of respondents used leftovers in future meals (sometimes or often), ~90% checked fridge and cupboards before shopping (sometimes-always), and ~85% made shopping lists (sometimes-always).

With respect to emotions and attitudes, only 5% reported that "food waste doesn't bother them;" 4% "dislike compost and composting;" and 4% agreed that food waste does not bother them because it breaks down in the landfill. Similarly, only 9% of the participants in the Neff *et al*. study said that food waste did not bother them at all. In our study, 7% of participants agreed that they "don't need to worry about source reduction (buying /preparing less food to avoid waste)," whereas in the Neff *et al*. study (2015), 40% were not bothered by food waste when they composted.

Also, in regard to affective questions, 44% of our survey participants felt like composting "contributed to the greater good." Only 10% agreed that "composting stinks and is gross" and only 11% agreed that their "actions towards food waste do not make much of a difference." In terms of general sustainability beliefs, 84% agreed that "materials can be reused or recycled into something new," 89% agreed that "proper waste disposal makes a positive environmental impact" and 64% agreed that they "would like to see more programs on campus that help reduce food waste."

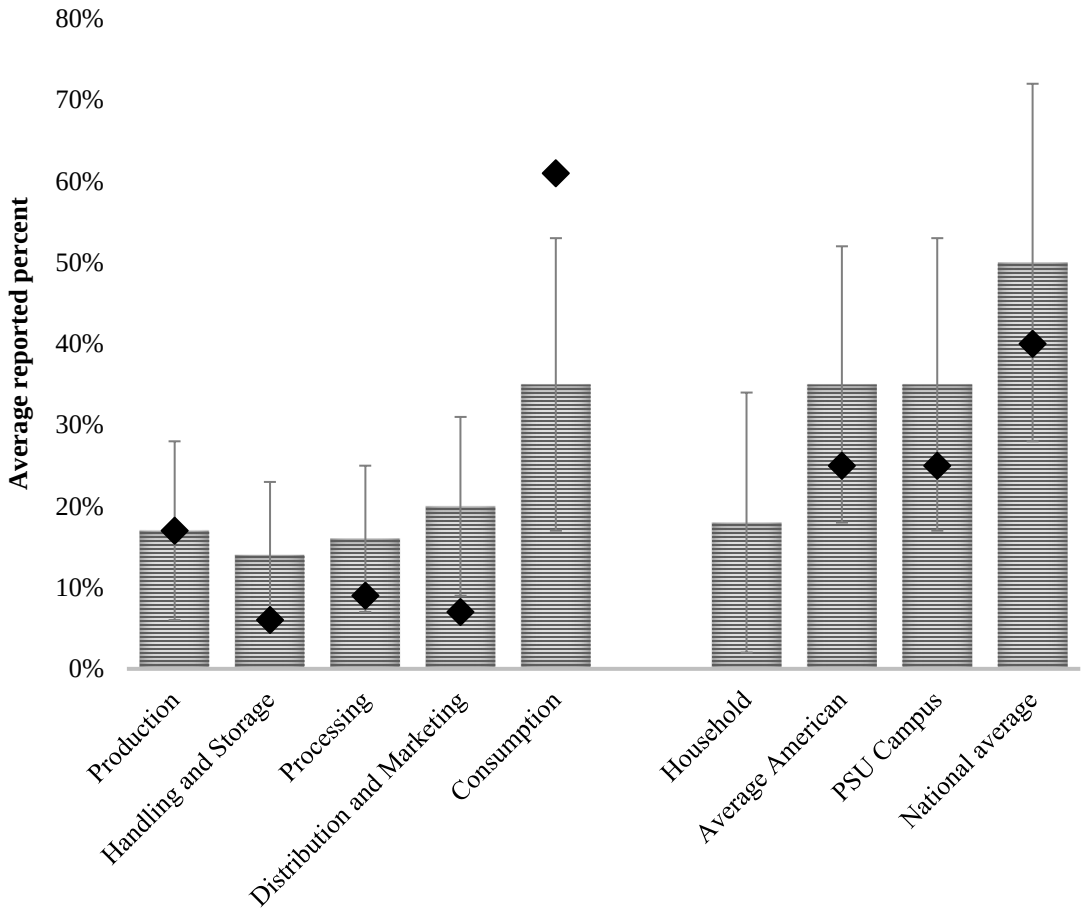

Figure 3.2. **Average perceived percent food waste** along the food cycle and at various consumer levels. Black diamonds (♦) represent the estimated "true" values of food waste for each level as reported in the literature (Doherty et al., 2013; Gunders, 2012a; Lipinski et al., 2013; Parfitt et al., 2010). Percent average household can be compared to the food waste of an average American. Standard deviations of responses are represented with error bars.

Exploratory factor analysis and regression models

The EFA resulted in five factors based on our selection criteria. The items factored into categories (Table 3.1) similar to those that we attempted to measure (Fig. 3.1), including clear factors for "Intent to decrease food waste" and "Food waste diversion behaviors." Factors represented about 55% of the variances in survey responses. The questions in

each factor were averaged to produce factor indexes for the regression model. The factor indexes for intent and food waste behaviors were used as dependent variables to determine how the other factors and reported household food waste interacted with these constructs.

Table 3.1. Summary of Likert items and factor indexes.

Item (nested within factor)	Item loading	Cronbach's alpha	% Agree	% Neutral	% Disagree
Food waste diversion behaviors		0.648			
I eat leftovers	0.476		82.4	10.7	5.7
I check the refrigerator before shopping	0.77		77	13.3	8.7
I don't make lists/or plan meals before shopping	0.655		18.2	19.6	61.2
I think about the portions of food that I take or cook	0.44		75.6	17.2	6.1
I prepare/cook some of my meals	0.21*		69.1	17.1	12.3
Intent to decrease food waste		0.752			
I think about the food waste I generate	0.944		70.7	20.2	8.3
I put effort into reducing food waste	0.711		70.1	21.2	7.9
I am interested in taking action to prevent food waste	0.545		64.8	28.1	6.7
Composting		0.813			
I know about the residence hall compost program	0.747		36.8	20.7	39.5
When I compost, I feel like I'm contributing to the greater good	0.881		81.8	13	1.9
Composting stinks and is gross	0.881		18.6	31.6	46.5
Sustainability actions		0.621			
I would be interested in attending a workshop on portioning or cooking for one person	0.709		33.5	36	29.3
I talk to other people about food waste	0.322		23.2	31.1	41.8
I would enroll in a course with a sustainability theme	0.523		44.6	30.7	21.6
Material reuse attitudes		0.709			
I understand food freshness labels (sell by, best by, use by, expiration date, *etc*.)	0.542		71.1	18	7.3
I believe that many materials can be reused or recycling into something new	0.731		84	10.7	2.2
I believe that proper waste disposal makes a positive environmental impact	0.736		88.5	6.7	1.8
Attitudes about compost		0.638			
I compost my food scraps	0.324		35.8	22	39.4
If I compost, I don't need to worry about source reduction (buying/preparing less food to avoid waste)	0.592		6.5	29.1	62
I dislike compost and composting	0.666		4.2	24.4	68.7
Food breaks down in the landfill, so it doesn't bother me	0.946		3.8	21.6	71.5

**Item was removed from its original factor without significantly affecting its Cronbach's alpha and improving both the logical and correlational strength of factor "Food waste diversion actions."*

The food waste diversion behavior model (n = 495) indicated that three variables were most significantly related to this variable (after model reduction): intent to decrease food waste ($p < 0.01$), composting ($p < 0.001$), and material reuse attitudes ($p < 0.001$). The model was highly significant as assessed by an Analysis of Variance (ANOVA) ($p < 0.001$, $R^2 = 0.242$; Table 3.2). Interestingly, food waste diversion actions were negatively correlated with the composting index with food waste diversion, but still positively correlated with attitudes towards composting. This may indicate that those who divert food waste worry less about composting. Due to the complexity of factors that influence human psychology and behavior, statistical models that explain 20% to 30% of the variance in a data set are considered beneficial and useful (Bartholomew et al., 2008).

The model for intent to decrease food waste (n = 495) showed a significant relationship to all six input variables: sustainability actions ($p < 0.001$), food waste diversion actions ($p < 0.001$), attitudes about composting ($p < 0.001$), composting ($p < 0.001$), reported household food waste ($p < 0.001$), material reuse attitudes ($p < 0.01$). The model was significant as assessed by an ANOVA ($p < 0.001$, $R^2 = 0.368$; Table 3.2). Interestingly, household waste was positively correlated with intent to decrease waste. This may indicate that people who waste more feel guilty and intend to decrease food waste without acting upon it. Guilt has been shown to influence attitudes and intentions towards food waste (Graham-Rowe et al., 2014).

However, it should be noted that reported household waste is a complex construct and often does not represent a true value. A large number of studies have shown that people consistently underestimate their food waste. In fact, in multiple studies, between

45-70% of respondents indicate that they waste "very little," "hardly any," "no food" or "0-10% of food" (Neff et al., 2015; T. E. Quested et al., 2013; Refsgaard & Magnussen, 2009; Thyberg & Tonjes, 2016). In our study, 50% of respondents indicated that they wasted 0-10% of their food. Higher reported food waste percentages may actually indicate a more informed participant and may, therefore, correlate with higher intent to decrease food waste.

Table 3.2. Linear regression models indicating relationships between measured factors and both "intent to decrease food waste" and "reported food waste diversion behaviors."

Factor index/item	Predictors of **Intent to decrease food waste**	Predictors of **Food waste diversion behaviors**
y-intercept	0.288	0.889
Food waste diversion behaviors index	0.224***	--
Intent to decrease food waste index	--	0.296***
Composting index	- 0.174***	0.324***
Sustainability actions index	0.312***	NS
Material reuse attitudes index	0.104**	0.115**
Attitudes about compost index	0.184***	NS
Your household waste (%)	0.159***	NS
(n = 495)	*R^2 = 0.368*	*R^2= 0.242*

*Significance levels: NS (not significant), **(<.01), ***(<.001). Adjusted R^2 and standardized Beta presented. All models were significant predictors of the dependent variable based on Analysis of Variance (ANOVA) ($p < 0.001$). Variance Inflation Factors (VIF) for all predictors in all models indicated no multicollinearity (VIF < 3). Factor correlation matrix included in Appendix A, Table A.1.*

Implications and limitations

Similar to nationally reported trends, we found that students underestimated their own food waste (compared to their reported and actual estimates of average Americans) and the contribution of consumers generally to food waste along the food cycle. They also overestimated pre-consumer waste. But students in our sample, as in the national sample, were interested in taking action (65%), perceived that they put effort into food waste

diversion (71%), and thought about the food waste they generated (72%). Although attitudes do not necessarily translate directly into behavior (Shrum, Lowrey, & McCarty, 1995), 36% of participants still composted their food waste to some extent, 83% ate leftovers, 77% checked their refrigerator before shopping, and 62% made shopping lists.

We also explored interactions between the measured factors in our model (Fig. 3.1) using both of the following as outcomes: 1) reported food waste diversion behaviors, and 2) intent to decrease food waste. Food waste diversion behaviors can be strongly influenced by factors unrelated to intentions regarding food waste reduction (T. E. Quested et al., 2013). For example, students are likely to consider portioning, eating leftovers and preparing their own meals as budget management options, regardless of their attitudes or intentions towards food waste. Intentions to reduce food waste are more specific, but may or may not translate directly into behavior (Eilam & Trop, 2012). Therefore, measuring both aspects allowed for a fuller understanding of the factors influencing food waste behaviors. Food waste diversion and food management skills could be predicted using indexes of intent, composting awareness and attitudes about material reuse. Intent to decrease food waste was related to sustainability actions, food management skills, attitudes about composting and composting behavior, reported household food waste, and material reuse attitudes.

Results of this research are promising. They indicate that students have some skills and knowledge related to food waste reduction, generally positive attitudes, and the intent and interest to make change. Students also provide an optimal population for targeted food waste interventions. The school environment lends itself well to both in and

out of classroom food system and food waste curricular development (Waters & McNamara, 2015). This opportunity has been recognized by researchers in nutrition education, science education, motivational sciences, and others (Liquori, Koch, Contento, & Castle, 1998; E. A. Skinner et al., 2012; Whitehair, 2011). University of California for example, started its Global Food Initiative in 2015 with the goal of "weav(ing) food and agriculture into every course", changing the university's buying practices, and being a model of the best food and sustainability practices to the world (Napolitano, 2015; Waters & McNamara, 2015). This program continues to provide examples of food education through its food-targeted courses, food waste buffets, and educational programming in its cafeterias. Other models include food science curricula that has been infused into environmental education programs, like LiFE (Linking Food and the Environment), the Cookshop Program and others (Barton, Koch, Contento, & Hagiwara, 2005; "Linking Food & the Environment (LiFE)," 2005; Liquori et al., 1998).

Our results provide important insight into factors that play a role in food waste diversion behavior. The EFA and regression modeling show that our survey instrument was well-suited for predicting intent to reduce food waste. It would be beneficial to consider additional items relating to cost and perception of personal impact, as those did not appear as significant factors in our EFA. More items on barriers generally and social influence would strengthen the survey tool as well. Measuring individual student food waste in a method that could be linked and compared to survey responses would also be a powerful approach. Although this is challenging, some successful models exist (Whitehair et al., 2013). A confirmatory factor analysis on a survey instrument, improved

based on these results, could continue to strengthen the survey instrument for purposes of intervention success assessment.

Conclusion

Food waste must be addressed, but ours and previous research indicate the complexity of such a task. People are thinking about food waste, interested in taking action, and aware that they can make a difference, yet food waste per household continues to increase worldwide (Refsgaard & Magnussen, 2009). In order to change consumer behavior related to food waste, we must understand and be able to measure the factors that underlie such behavior. In this study, we explored the knowledge, attitudes, emotions, beliefs, and reported behaviors of university students in relation to food waste. Students were shown to be similar in many ways to the national population in terms of their responses about food waste. However, university students in a campus setting provide an opportunity for targeted interventions and campaigns that can lead to broader change related to food waste. Through modeling the interactions between various measured factors, we found that intent to change food waste practices is related to food management skills, attitudes and knowledge of compost systems, sustainability actions and attitudes, and reported household waste. Reports of actual food waste diversion behaviors was related most strongly to intent to change, knowledge and attitudes towards composting, and attitudes about reuse. Addressing these constructs in food waste diversion programming will be important to educational food waste interventions.

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Chapter 4: Impact of food waste diversion programming on university student food waste and measures of related knowledge, attitudes, emotions, and reported behavior

Authors: Manar A. Alattar, Jennifer L. Morse

Abstract

University cafeterias contribute an estimated 3.6 million tons to food waste in the USA. As significant waste generators and centers of research and education, universities also serve as excellent controlled environments for food waste diversion training and assessment. We developed a university cafeteria food waste diversion program and assessed the program's impact on both direct and indirect measures of food waste behavior, as well as on attitudes, knowledge, and emotions related to food waste. We found that students had overall positive attitudes, knowledge, and emotions related to food waste diversion, with little change over the year. Actual (measured) food waste was decreased by 28% within the program year. This indicates the potential for food waste diversion programming to impact student behavior in the short term and potentially allow students to develop skills for long-term change as well.

Introduction

Schools around the world have recognized the economic, social, and environmental value of addressing cafeteria food waste (Abdelaal, 2017; Al-Domi et al., 2011; J. Buzby & Guthrie, 2002; Smyth, Fredeen, & Booth, 2010). In university cafeterias in the USA, 3.6 million tons of food are wasted annually (Luecke, 2015). Most often, plate waste includes starch components, fruits and vegetables, and other side dishes (Oliveria et al., 2016).

Waste audits of university campuses identify food, representing one-fourth or more of all campus solid waste in some cases, as a primary opportunity for solid waste reduction (Doherty et al., 2013; Smyth et al., 2010). This waste is due to both inefficiencies within the food preparation and service as well as consumer behavior.

The issue of food waste is not unique to higher education. An estimated 26% of food offered through federally funded national school lunch programs is wasted. This results in an estimated loss of $1.2 billion annually (Cohen, Richardson, Austin, Economos, & Rimm, 2013), double the estimate in 2002 (J. Buzby & Guthrie, 2002). Research on school cafeteria food waste from around the world has shown that students produce between 51.3 g to 121.9 g of food waste per meal (usually lunch) (Table 4.1) (Al-Domi et al., 2011; J. Buzby & Guthrie, 2002; Merrow, Penzien, & Dubats, 2012; Sarjahani, Serrano, & Johnson, 2009; UC Davis Dining Services, 2015; Whitehair et al., 2013; Wilkie, Graunke, & Cornejo, 2015). Plate waste is particularly concerning in the case of school children who have been frequently shown to consume insufficient amounts of calories, fiber, vitamins, and minerals from school lunches (Cohen et al., 2013).

Table 4.1. Food waste per student as reported from various cafeteria food waste studies. Studies organized from most recent.

	Average waste (g/student)	Waste after intervention (g/student)	Percent change	Time of waste collection
Florida (3 grade schools - public and private) (Wilkie et al., 2015)	52.2 (13% of total waste)	No intervention	N/A	Waste per school day
UC Davis (UC Davis Dining Services, 2015)	102.06 (year 2009)	51.31 (year 2016)	-50%	Lunch
Kansas State University (Whitehair et al., 2013)	57	(15% reduction after informative campaign)	-15%	Lunch (per tray)
Western Michigan University (Merrow et al., 2012)	121.90	104.90 (item-by-item sale) 82.21 (trayless)	-14% (item-by-item) -33% (trayless)	All day (breakfast, lunch and dinner)
University of Jordan (Al-Domi et al., 2011)	70	No intervention	N/A	Lunch
Virginia Polytechnic Institute and State University (Sarjahani et al., 2009)	117.03 (with tray)	88.90 (trayless)	-24%	Food collected the whole week (average of all meals)
Various Boston Middle Schools (Cohen et al., 2013)	(26.1% of total food)	No intervention	N/A	Lunch
Nationally representative school data (1991-2) (J. Buzby & Guthrie, 2002)	(various studies report 10% to 37%, but 12% most reliable)	No intervention	N/A	Breakfast and lunch

Research on methods for decreasing food waste in schools is emerging, but needs to be improved on (Hebrok & Boks, 2017). Cafeterias that have implemented trayless dining decreased their food waste generation by approximately 30% (Gunders, 2012b).

Item-by-item sale (as opposed to open buffet) decreased waste by 14% (Merrow et al., 2012). Plate size has also been shown to correlate positively with food waste (Wansink & van Ittersum, 2013); as a result, many cafeterias have decreased the size of plates offered at buffets. These are all examples of behavioral *nudges*, in which behavior is influenced through subtle changes to the environment, rather than direct behavior intervention (Moseley & Stoker, 2013; Thaler & Sunstein, 2009).

Interventions that target attitude and behavior change directly have also been shown to decrease food waste. Simple, informative campaigns achieved a 15% reduction in food waste over one academic term (Whitehair et al., 2013). A program including interactive food waste messaging, both in and out of the cafeteria, and food waste buffets, to display the accumulation of student food waste, at University of California, Davis (UC Davis, Davis, CA) even achieved a 50% reduction in food waste after seven years of programming (UC Davis, Dining Services, 2015) (Table 4.1).

In addition to reducing overall campus waste, efforts in school cafeterias can influence long-term food waste behavior of students. Firstly, due to the number of meals many students eat in school cafeterias, this environment has lasting effects on their eating and health behaviors (French, Story, Fulkerson, & Hannan, 2004). Secondly, secondary and post-secondary education often are times of identity development and formation, which impacts behaviors throughout life (Berman, Kennerley, & Kennerley, 2008). Finally, cafeterias, like laboratories, allow for experimental manipulation that can encourage learning and behavior change in students, such as in the example of behavioral nudges.

Our research was conducted at Portland State University (PSU, Portland, OR, USA). Food waste represents 25% of PSU's campus waste stream (Doherty et al., 2013). As an institution, PSU is working towards 25% waste generation reduction and 10% landfill-bound waste reduction by 2030 (PSU Climate Action Plan). Nationally, as of September 2015, goals for 50% food waste reduction by 2030 have been set by U.S. Environmental Protection Agency (EPA) and United States Department of Agriculture (USDA) (USDA, 2015). To help contribute to these goals and impact student food waste behaviors, a food waste diversion program was developed and piloted through the Campus Sustainability Office (CSO) in partnership with PSU Dining and the Student Health and Counseling Center (SHAC).

The program, *No Scrap Left Behind*, was modeled after various food waste diversion programs including *Love Food, Don't Waste* at UC Davis, the *Love Food Hate Waste* program in the United Kingdom (UK), and others. The characteristic feature of the UC Davis program was their collection of student food waste for display in a food waste buffet throughout lunch. Although there were other components to the program, this visually compelling experience opens the door to a variety of rich discussions around food waste and its impact. Research on pro-environmental behaviors has suggested that increased visibility of the issue or related action is more likely to lead to pro-environmental action (Thomas & Sharp, 2013). The UK's *Love Food Hate Waste* program focuses on personal (especially economic) impacts of food waste and skill development to decrease waste (T. E. Quested et al., 2013). *No Scrap Left Behind* was also developed to include these components.

Community Based Social Marketing (CBSM) was the main theoretical framework that contributed to program development (McKenzie-Mohr, 2000). In CBSM, behavior is influenced through identifying barriers to change, implementing a program to address such barriers, assessing the program, and improving the intervention based on assessment (McKenzie-Mohr, 2000). Barriers to food waste reduction were identified through literature reviews and consultation with university staff. This study presents an assessment of the effects of *No Scrap Left Behind* programming on measures of food waste behaviors as well as reported knowledge, attitudes, emotions, and beliefs related to food waste.

No Scrap Left Behind programming included informational discussion tabling, a food waste buffet, incentives (small prizes) for students who return clean plates and surveys, educational signage throughout the cafeteria, and a "taste, not waste" (taste food before taking) system (see Appendix B for all program materials). In order to assess the program, food waste behaviors were measured directly by weighing food waste and indirectly through surveying. Surveys also measured knowledge, attitudes, emotions, and beliefs related to food waste diversion and sustainability. The objective of the program was to decrease food waste production per student in the cafeteria and improve students' knowledge, attitudes, emotions, and behaviors toward food waste. We hypothesized that, after programming, food waste production per student per lunch would decrease, and student knowledge, attitudes, emotions, and reported behaviors related to food waste would improve from the beginning of the program to the end.

Methods

Study location and sample population

Our study took place at PSU in the residence hall cafeteria. The cafeteria hosts an average of 175 people at breakfast (7am-8:30am), 400 people at lunch (11-1:30am), and 500-600 people at dinner (5-6:30pm) each day (Wapelhorst, 2015). Most of the students served in this cafeteria are first- and second-year university students living in residence halls on campus. A total of 174 surveys were collected through convenience sampling in the school cafeteria throughout the duration of programing. Students were given surveys while waiting in line to pay for food or while eating, and they returned their completed surveys after their meal.

Survey

Respondents were asked to report on knowledge, attitudes, emotions, beliefs, and behaviors related to food waste in 30 Likert-type questions and three written-answer questions (Appendix B.4). All Likert-type questions were given a five-point response scale that ranged from “Strongly agree” to “Strongly disagree”, with “Neutral” as the middle anchor point. A 5-point scale allows for sufficient variation within the scale without risking participant reluctance to choose extreme answers on a wider scale (Boslaugh, 2013). Questions were asked in both pro-food waste diversion form (e.g. “I eat leftovers”) and anti-food waste diversion (“Food waste doesn’t bother me”) to diversify and capture a broader range of responses. Questions written in anti-food waste diversion form were reverse-coded for analysis, which is common in such survey analysis (E. A. Skinner et al., 2012; Visschers et al., 2016). Cognitive interviews were conducted

with a number of potential respondents and survey experts to establish the content validity of the instrument.

Food waste knowledge was measured with questions that have been used in other food waste studies (Leib et al., 2013; T. Quested et al., 2013) and questions on specific campus-related food waste diversion knowledge (Pelletier et al., 1999; Whitehair et al., 2013). "I understand food freshness labels (sell by, best by, use by, expiration date, *etc*.)", and "I know about the campus composting program" are examples of general and specific food waste knowledge items. Knowledge was also probed by asking respondents to estimate the percent of food waste at various consumer levels: average American household, the campus community, and the USA as a nation, and along the food cycle from production to consumption. Direct questions about the amount of food participants wasted (as a percentage of total food) and the reasons for that food waste ("I generally leave food on my plate because?", with multiple potential answers) were also asked.

Intent and interest in food waste reduction was measured with questions including "I put effort into reducing food waste" and "I am interested in taking action to prevent food waste," as done in or suggested by other work (Eilam & Trop, 2012; Hebrok & Boks, 2017; Neff et al., 2015). Food management skills have been cited as important to food waste generation (Graham-Rowe et al., 2014; Neff et al., 2015; Vidgen & Gallegos, 2014) and were measured using a series of questions similar to those in a recent national survey (Neff et al., 2015) like "I eat leftovers", "I check the refrigerator before shopping" and "I compost my food scraps." Attitudes towards food waste were measured with both cognitive and affective statements, including "Food waste does not bother me," "My

individual actions towards food waste do not make a difference," "Composting stinks and is gross," and "When I compost I feel like I'm contributing to the greater good" (Brook Lyndhurst, 2007; McKenzie-Mohr et al., 1995; Neff et al., 2015). Perceived cost of food waste was measured with two items, "I don't think the food I throw away costs much money" and "When I go to a buffet restaurant, I take more than I can eat to get my money's worth."

Broader sustainability beliefs were probed indirectly with the following questions: "I believe that many materials can be reused or recycled into something new," "I believe proper waste disposal makes a positive environmental impact," "I would like to see more programs that help reduce food waste," and "I would enroll in a course with a sustainability theme." Questions specific to the university cafeteria were asked as well; one asked about satisfaction with the food served by the dining hall, and the other three were related to knowledge and usage of cafeteria composting and reuse options. Basic, university-related demographics were also collected, including age, gender, academic level, and whether students lived on-campus.

Food waste buffets and compost audits (direct measurement of behavior)

This study combines both direct (food waste buffet and compost audits) and indirect (surveys) measures of behavior in response to the intervention. Other studies have tended to focus on either directly quantifying food waste (Al-Domi et al., 2011; Wilkie et al., 2015) or surveying (Neff et al., 2015), although some have done both (Poonprasit et al., 2005; Whitehair et al., 2013). The combination of direct behavior measurements with survey data provides evidence of whether behavior is actually being affected, rather than

relying on self-report data (Dietz, Fitzgerald, & Shwom, 2005; Graham-Rowe et al., 2014).

Student food-waste behavior was measured directly in two ways:

1) *Food waste buffets* - During the *No Scrap Left Behind* programming, food scraps were collected from all students for two hours during lunch. The cafeteria does not have any disposal containers available to the students; rather it has a single revolving tray return at the exit. Food was collected at the tray return, curated by volunteers into a food waste buffet, and weighed at the end of lunch. Students did not have access to eat any of the displayed food; it was intended to display the accumulation of food waste over lunch. The cafeteria provided the transaction numbers for each program period. Food scraps were collected and weighed separately from napkins, fruit rinds, and other inedible compostables. Liquid volumes were not collected.
2) *Kitchen audits* - The possibility of social desirability bias in the measured food waste was significant (Griffin et al., 2008). In other words, students could be wasting less food because of the presence of the *No Scrap Left Behind* volunteers and social pressure from the programming. Therefore, food waste weights were measured in the kitchen (where students could not see that it was being done) in a single week following the intervention. These weights included inedible compostables, which were later subtracted based on the average percentage of inedible compostables from the program weeks. In the Winter of 2017, these weights were measured in both the week before and the week after programming for comparison.

In order to control for student acclimation to the cafeteria system and its food options, which may inherently decrease amounts of food waste over time, we compared changes in food waste both over an academic year and within an academic term. This allowed us to confirm that changes in food waste were seen both within the short term (directly after the intervention) and in the long term (over an academic year of programming). Parallel changes in both timeframes would point to the intervention as the main contributor to such change, whereas changes over the year and not directly after programing within a term would indicate that other factors may have contributed to the changes in food waste behavior.

Data Analysis

Survey responses from the students at the beginning of the intervention (Fall 2015) were compared to responses at the end of the year (Spring 2016). Additional data was also collected during the Winter 2017 program to confirm decreases in food waste weights. Although Likert items may not meet t-test assumptions of normality and are not continuous, research has shown that t-tests are acceptable and appropriate for comparing Likert items (Winter & Dodou, 2010). For direct measures of behavior (food waste buffet and kitchen weights), average food waste per student was calculated based on customer transaction numbers for the intervention period. These values were compared from the beginning of the intervention to the end with a significance threshold of 0.10

Results

Sample characteristics and demographics

A total of 174 surveys were collected from students through convenience sampling at the beginning (Fall 2015; n = 88) and end (Spring 2016; n = 86). The average age of respondents was 20 years old, with a range of 18 to 38 years. Of participants, 47% were female and 49% male (4% other or undefined). A majority (91%) lived in residence halls on campus. On average, participants ate at the cafeteria 10 times a week. Participants lived in dorms/houses with an average of two residents per household.

Survey data

Student responses were compared from the beginning of the programming year (Fall 2015) to the end of the year (Spring 2016). Overall, students began with positive knowledge, attitudes, emotions, and beliefs related to food waste diversion. A detailed analysis of the overall trends in these data is presented in Chapter 3. Yet, when survey data was compared between the beginning and end of the program, there were few questions in which significant differences were detected. Students were 11% and 10%, respectively, more likely to agree with the questions "I think about the food waste I generate" and "I put effort into reducing food waste" by the end of the year (one-tailed ttest, p-value < 0.05). No other significant differences were detected in survey responses.

Food waste buffet and kitchen audit data (direct behavior measurements)

As predicted, student food waste based on kitchen audits (out of student sight) decreased significantly by 28% within one academic year (Fall 2015 to Spring 2016; one-tailed t-test, $p < 0.10$) and 26% within one term (Winter 2017; one-tailed t-test, $p < 0.10$) of programming. Food waste buffet measurements, though, were significantly lower than compost audit measurements at the beginning of the year, and increased by 36% over the

year of programming (one-tailed t-test, p-value < 0.10). At the end of the year, kitchen audit data nearly matched data collected at the food waste buffet (Fig 4.1).

Table 4.2. Comparison of average food waste per student over an academic year of programming and within a single term. Data collection and comparison occurred within the week of programming as well as in the kitchen (out of sight of the students) the week before and/or after programming. Results suggest an effect of social desirability bias on student behavior.

		Initial	Final	% change	p-value
Year (2015-2016)	Intervention	37.29 ± 11.19	50.81 ± 14.09	36%	0.07
	Kitchen	68.78 ± 6.65	49.72 ± 6.68	-28%	0.00
Term (Winter 2016)	Intervention	40.97 ± 7.09			
	Kitchen	87.03 ± 14.39	64.27 ± 13.31	-26%	0.02

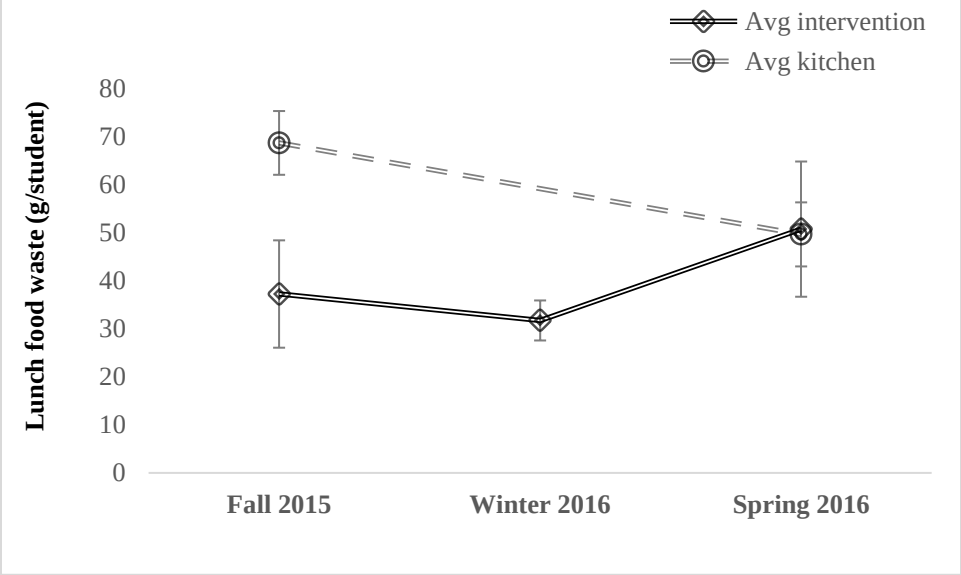

Figure 4.1. **Evolution of student food waste (g/lunch)** as measured at the food waste buffet and compost audits in the kitchen (out of sight of students) over the year of programming (Spring 2015 to Fall 2016). Standard deviation indicated with error bars.

Discussion

Respondents' attitudes, knowledge, emotions, beliefs, and reported behaviors related to food waste were initially positive, and changed little over the year of *No Scrap Left Behind* programming. Actual food waste behaviors, though, did improve over the

programming period, with food waste decreasing by more than one-fourth (Table 4.2 and Fig. 4.1). A similar outcome was found by Whitehair *et al.* (2013) in a study of the impact of general versus specific food-waste messaging during a cafeteria intervention. They also found little change in knowledge, attitudes, and beliefs as measured through surveying, but saw a 15% decrease in actual food waste. One explanation is that, since students already have generally positive attitudes and emotions towards food waste reduction (see more details in Chapter 3), they are ready to make behavioral changes with the correct encouragement. Research also indicates that behavioral change in adults (particularly in the short term) can often be easier than changing attitudes (Eilam & Trop, 2012). At least in the short term, social pressure from programming also likely affected food waste behaviors (Thomas & Sharp, 2013).

We were aware that the decrease in food waste could also be related to students' increasing familiarity with the food and cafeteria over the year of programming. Since PSU only has one residence hall cafeteria, we could not run a parallel control for this, but instead confirmed that food waste behavior was also influenced within one academic term in the year following the initial pilot. It can be assumed that if food waste decreases in the week directly after programming compared to the week directly before, then the program is more likely the cause then gradual acclimation to the cafeteria system. Student familiarity can be assumed to be relatively similar within those couple of weeks. Therefore, the significant (26%) decrease in food waste within a single term (Table 4.2) suggests that the program is effective regardless of acclimation to the cafeteria.

Food waste as measured during programming, in front of the students, was initially lower than weights measured behind the scenes, in the kitchen. Results from the two measurement approaches became similar by the end of the year. These results suggest that social desirability bias likely impacted student food waste behavior when they were first introduced to the *No Scrap Left Behind* program and volunteers (Fisher & Katz, 2008). Since kitchen weights and program weights were essentially the same by the end of the year, it can be assumed that the effects of social desirability bias tapered off as students became more familiar with the program and its volunteers. Anecdotally, volunteers also reported that students were being more cautious of their waste during the intervention days, especially at the beginning of the year. It was noted that some students brought food to the tray return that seemed to be intended for waste and finished it quickly before turning in their plate to volunteers.

High turnover in cafeteria staff and management personnel was a notable challenge, especially in food waste measurements in the kitchen (conducted by cafeteria staff). This is a ubiquitous issue for most food programming, as hospitality industries, including hotel and restaurant employees, have some of the highest turnover rates of all industry categories (highest of all measured industries in 2016; 28.6%) (Compensation Force, 2017). In order to compensate for such turnover, aspects of the program should be incorporated into the food service company's sustainability practices, and more frequent trainings should occur with cafeteria staff and management personnel about the programming. In fact, research shows that, although the contracting body (the university in this case), can include sustainability practices within the contract with the food service

agency, such practices are more likely to succeed when they are already built into the policies of the food service agency itself (Oliveria et al., 2016; Parfitt et al., 2010). *No Scrap Left Behind* programing efforts were subsequently incorporated into the waste reduction and sustainability practices found in the new dining service contract of 2017.

Going forward, the *No Scrap Left Behind* program design is continuously being improved, as it is now annual programming in the cafeteria. Enhancements include more social media connections, a food waste pledge to encourage student commitment to food waste reduction, more interactive programming including film screenings, panels and other out-of-cafeteria events, and more student feedback and discussions related to food waste.

Conclusion

Student food waste generation decreased by around one-fourth both within one term and over one year of *No Scrap Left Behind* programming. Students' knowledge, attitudes, emotions, and reported behaviors related to food waste reduction were relatively positive at the onset (see Chapter 3) based on survey data, and did not change significantly over the programming period. This may indicate that students are ready for change related to food waste and only require the correct encouragement. These findings are encouraging and have resulted in the establishment of *No Scrap Left Behind* programming every term at the residence hall cafeteria on campus since the pilot. The results of this study and others suggest the great potential of university food waste diversion programming for impacting student (and hence more generally, citizen) food waste behaviors.

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Chapter 5. Implications and conclusions

Overview of dissertation and results

Food production and food waste have disproportionate impacts on environmental, social, and economic systems worldwide. The topic also provides an ideal entry point for educating students at all educational levels about the systems that food impact. In this dissertation, I examine the theoretical and practical implications of food in science education generally and food waste diversion programming specifically. I conclude by reviewing the objectives and research questions and discussing implications and future directions.

Objective 1: To present the importance of food education as a broad theme for connecting personal experience to science curricula and climate change.

In Chapter Two, I argued from a theoretical perspective for better incorporation of food systems into science education. Food education is well-positioned to be effective due to the direct link it provides between individual- and large-scale global issues. Food provides a familiar language for educators on which to build an understanding of complex environmental issues rather than beginning with abstract and complex concepts.

Objective 2: To assess the knowledge, attitudes, emotions, beliefs, and reported behaviors of university students around food systems and food waste.

Research question 2.1. *What are the knowledge, attitudes, emotions, beliefs, and reported behaviors of university students towards food waste?*

Research question 2.2. *How do these knowledge, attitudes, emotions, beliefs, and reported behaviors compare to the national results on similar measures?*

Research question 2.3. *What underlying factors influence food waste behaviors?*

Chapters Two and Three focused on food waste diversion programming in the university setting. Chapter Three focused on university students' reported knowledge, attitudes, emotions, beliefs, and reported behaviors related to food waste, compared to national results and factors that influence food waste behaviors. I found that students generally underestimated their food waste and that of consumers generally. As with national samples (Neff et al., 2015; Thyberg & Tonjes, 2016), students had positive attitudes, emotions, and reported behaviors towards food waste diversion and sustainability generally, and reported intent and interest to decrease food waste. They also tended to believe that their actions towards food waste reduction would make a difference. The factors that influence intent to decrease food waste and actual food waste behaviors were also analyzed from survey results. I found that intent to decrease food waste was correlated with food management skills, attitudes and knowledge of compost systems, sustainability actions and attitudes, and reported household waste. Reports of actual food waste diversion behaviors were related to intent to reduce food waste, knowledge and attitudes towards composting, and attitudes about reuse.

Objective 3: To pilot and assess the effectiveness of **No Scrap Left Behind** *food waste diversion programming.*

Research question 3.1. Are students' knowledge, attitudes, emotions, beliefs, and reported behaviors towards food waste improved by the intervention? If so, how?

Research question 3.2. Is actual average lunch food waste (in grams per student) decreased during the intervention? If so, by how much?

Research question 3.3. How can the pilot inform improvements to *No Scrap Left Behind Programming* as it continues to be implemented on campus?

In an attempt to positively influence food waste attitudes, knowledge, emotions, beliefs, and behaviors, we developed a food waste diversion program called *No Scrap Left Behind* (Appendix B). The program borrowed from various food waste diversion programs worldwide, specifically the University of California, Davis (UC Davis)'s cafeteria food waste intervention and the United Kingdom's (UK) national *Love Food Hate Waste* program. Theoretically, the program drew mainly from Community Based Social Marketing (CBSM). It included discussion tables and messaging around budgeting, portioning and impacts of food waste. It also included a food waste buffet in which all lunch food waste was displayed for students to see over the course of lunch. Changes in survey responses and actual food waste weights were compared from the beginning and end of the intervention. Knowledge, attitudes, emotions, beliefs, and reported behaviors remained positive and were generally unaffected by the intervention. Actual food waste per student, though, was reduced by one-fourth or more over both an academic year and within one academic term of programming. This suggests that

students' positive outlook on food waste diversion and interest in changing their food waste can easily be translated into at least short-term actions. Other research also supports this conclusion, showing that consumers are willing and interested in avoiding food waste, but are often generally unaware of their food waste and the impact of food waste generally, and may lack skills related to food waste reduction (Aschemann-Witzel, de Hooge, Amani, Bech-Larsen, & Oostindjer, 2015; Neff et al., 2015; T. E. Quested et al., 2013). Whether these changes in behavior are internalized and lead to a reduction of food waste beyond the cafeteria context or in the long term was not studied here. It is important that long term effects of programming be measured in future research. Recommendations for improvement of the *No Scrap Left Behind* program are included in the discussion that follows.

Implications and limitations

University cafeterias nationally generate 3.6 million tons of food waste (Luecke, 2015), an opportunity for both food waste reduction and behavior change. My research confirms this potential, showing that student attitudes towards food waste reduction are positive and that food waste reduction is achieved after programming. Using the most modest waste generation numbers from our study, we estimated annual food waste reduction for the residence hall cafeteria, for both lunch and dinner, at 4.75 tons. The estimate is based off of food waste weights per student after programming and an eight-month year, which is likely an underestimate. Such reductions throughout the campus would contribute significantly to PSU's Climate Action Plan to reduce overall waste generation by 10% by 2030 (CSO, 2010). More generally, "(e)very school meal served is a chance to teach and

an opportunity for learning" (Berlow & Randall, 2015). It is not just kilograms of food waste; it also opens up an important discussion on campuses about food, food culture, waste, consumerism, *etc*. Through such programs, the cafeteria can become a community dining-table, so-to-speak.

Even with its success, *No Scrap Left Behind* can benefit from various improvements. Some changes that have already been implemented include a food-waste pledge, more informed dining service practice, and more diverse food waste-related events outside of the cafeteria. Research on sustainability behaviors shows that commitment-making can influence both short- and long-term behavior change (Lokhorst, Werner, Staats, van Dijk, & Gale, 2013). In relation to dining practices, the program helped informed new food waste diversion and sustainability initiatives in dining services practices. Finally, additional food waste-related events are being held on campus beyond the cafeteria. These include informative food-waste events and movie screenings, and upcoming online student cooking and portioning classes. The goal is to develop a campus culture that is both informed about food waste and actively involved in decreasing it, personally and collectively. These efforts are a collaboration between the sustainability office, dining services, health services, and campus groups focused on food security and justice efforts.

There is still significant potential for *No Scrap Left Behind* to engage students directly with local stakeholders within our food cycle. This includes farmers and farm workers, food service workers, nutritionists, grocers, food donation volunteers, gardeners, and even actual livestock and plants. Food-management skills workshops on meal

planning, portioning, food storage, cooking quickly and on a budget, and other topics would provide students with practical hands-on experience and engagement with the topic. Events can be organized in the cafeteria as a means of bringing different perspectives to the table, both figuratively and literally. The Park Blocks area of the campus also provides an opportunity for outdoor events.

Continued data collection is also essential to the success of the program. The survey instrument could be improved by including more questions related to both the economic and overall cost of reducing food waste. Cost of food in relation to overall income has historically and geographically had a strong impact on food waste. Scarcity and high costs tend to quickly lead to food waste reduction, whereas low prices and perceived abundance lead to increased food waste (Thyberg & Tonjes, 2016; Waters & McNamara, 2015). Educating consumers on the true costs of food and food waste is essential to programming on food waste diversion. Emphasizing the economic benefits of food waste reduction has been shown to greatly encourage food waste reduction both at the retail and consumer levels (Papargyropoulou et al., 2014; Poonprasit et al., 2005).

Costs related to increased input of effort are also barriers to food waste reduction (T. E. Quested et al., 2013; Refsgaard & Magnussen, 2009). Consumers are increasingly becoming distant from food production systems, and increasingly less skilled at food management (Thyberg & Tonjes, 2016). Therefore, the real and perceived effort required for food management and waste reduction are increasing and must be addressed in food waste diversion programming through skill development and education. More questions

related to such perceived costs have been included in other food waste research and can add to our survey as well (Neff et al., 2015; Refsgaard & Magnussen, 2009).

Furthermore, decreased connection with food and food cycles not only leads to increased barriers to food management skills, but also to a devaluation of food generally (Thyberg & Tonjes, 2016). Re-establishing the value of food is also an important goal of food waste reduction programming. Such values were not probed by our survey instrument, but could provide an important addition. Finally, using the survey to solicit more specific program feedback from the student participants could help improve the program.

Although many items could be added to the survey, it would also be beneficial to have a shortened version. Anecdotally, students seemed fatigued from the survey length at times. A briefer survey could include one representative survey item from each of the five factors discussed in Chapter Three, plus additional items on barriers, costs, and values. The ability to directly link food waste production to survey results is important. Although some programs have done this successfully (Whitehair et al., 2013), it remains difficult.

A common limitation of food waste diversion programming and interventions is that short term, external effects are more easily measured than long-term internalization (Aschemann-Witzel, de Hooge, Amani, Bech-Larsen, & Oostindjer, 2015). This dissertation presents only a pilot of the first year and a half of programming. As the *No Scrap Left Behind* program continues to be implemented on campus, it is my hope that

continued assessments and improvements will be reported in order to contribute more broadly to food waste diversion efforts nationally and worldwide.

But really, there's a bigger problem

The unsustainability of food production is not innate to food; it is a problem we've created, and relatively recently. In the last 200 years, the way food is produced and valued has changed dramatically. Farming historically was usually small-scale, solar-based, and functioned as a feedback of locally managed inputs and outputs. In the 1900s one fuel calorie produced 2.3 calories of food (due to solar input) (Pollan, 2015). With the industrial age and migration into urban areas, the new challenges of feeding dense populations of city dwellers in convenient ways, led to a growing separation between urban and rural realities. In terms of food, this meant coercing natural systems to produce under increasingly unnatural, un-diverse, and often unhealthy growing conditions. The resulting "food" must now last longer and survive extended commutes and stringent aesthetic standards, with less regard for its quality, taste, and the health of the people and systems that produced it. Then the "food", often processed until it is relatively unrecognizable (soda is a corn product; think about that), is fed to urban consumers. This disconnect is a real and growing problem. Rural communities are suffering also, as machines replace human labor and subsidies restrict the types of foods they can profit from growing (Nestle, 2015).

Within this unhealthy cycle, those closest to the food are the most vulnerable; farm laborers that can't afford the produce they pick, minorities living in food deserts, and children. Children are fed both unhealthy foods and an unhealthy set of food values

and skills. Alice Waters, a prominent chef and food activist, calls these values “fast food values": uniformity, speed, constant availability, cheapness, deception, work as drudgery, more/bigger is better, and dishonesty. The decreasing value and sanctity of food creates a feedback cycle that allows for the food system to continue to devalue food and its producers. Even the use of the word “scrap” in our program name, shows evidence of this devaluation of leftover food as scraps, rather than a lost gift or resource. Food viewed as a commodity is managed as such rather than a sacred building block of the human body, community, and natural systems.

Our generations are also uprooted as humanity transitions to a largely urban lifestyle, filled with technological distractions. Individuals have little connection to the local, to living soil, even to the people around us (Ardoin, 2006; D. Williams & Brown, 2011). In fact, it is farming that allowed humans to move away from hunting/gathering and into a settled, local-based lifestyle in the first place. Reconnecting with food allows us to reconnect with ourselves, our communities, and our natural world.

Many cultures are transitioning to a more Western style, meaty, fatty, and sugary diet, and leaving behind strong wisdoms about the importance of food and the importance of being intentional about how we interact with food. Wisdom on the value of food is essential to maintain and teach.

> "The whole world (the sun, water, soil, nutrients, people, *etc*.) conspired to bring you that grain of rice,” my aunt recalls being told as a child, when she left a grain of rice in her bowl.

Also, wisdoms against gluttony, overeating and wastefulness, for example:

> "The human does not fill any container that is worse than his stomach. It is sufficient for the son of Adam to eat what will support his back. If this is not possible, then a third for food, a third for drink, and third for his breath." (Prophet Mohammed PBUH as reported in AtTirmidthi).

We must reclaim wisdom around food as an essential step to rebuilding our food system. Sustainable eating would be such that urban and rural communities would support each other, social justice would be considered, and both environmental and human health would be integral to the overall system (Berlow & Randall, 2015).

A sustainable food system, though, will not result from only community efforts. Political and economic structures must be reorganized to support the health and success of farmers, eaters, and the environment rather than companies and corporations. Nationally, this means reassessing subsidies on large monoculture crops like corn and soy and the unhealthy food products that are generated from them (Nestle, 2015). The US Farm Bill subsidizes these crops, while considering many fresh fruits and vegetables as "specialty crops". Instead, healthy food and healthy farming should be supported through governmental funding. Furthermore, food justice and food infrastructure must be brought to the forefront in international discussions. Food-related issues contribute to many of the conflicts we see internationally.

Policy change will also mean governments taking an active approach in promoting health through healthy eating, rather than a passive or by-stander approach. In relation to food, consumers see food as very personal and want to be "in control" of their food choices (Mandyck & Schultz, 2015). The reality is that external influences over our

food choices are prolific. Even the ways items are arranged and displayed in markets influence our choices without us knowing (Moseley & Stoker, 2013). This influence is perpetuated further by our distance from food production and our ignorance of the social, environmental, and economic systems that bring us that food. An alternative approach where policy regulation discourages biased influence from business monopolies and lobbies, and instead subsidizes healthy food, farmers, and laborers, is essential.

My research focuses on impacting consumer food waste behaviors, specifically in educational settings, but food waste occurs throughout the food cycle and throughout the society. Educators can use these and other tools within their niche to begin important discussions around food. Although these conversations are essential, citizens should also support policy change that improves the sustainability of our food system.

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Appendix A. Correlation matrix

Table A.1. Correlation matrix for factors.

	Intent to change	Food waste diversion behaviors	Sustainability actions	Material reuse attitudes	Composting	Attitudes about composting
Intent to change	1	.393**	.482**	.346**	.020	.438**
Food waste diversion behaviors	.393**	1	.266**	.295**	.073	.310**
Sustainability actions	.482**	.266**	1	.370**	.189**	.524**
Materials reuse attitudes	.346**	.295**	.370**	1	.184**	.430**
Composting	.020	.073	.189**	.184**	1	.196**
Attitudes about compost	.438**	.310**	.524**	.430**	.196**	1

**. Correlation is significant at the 0.01 level (1-tailed).

Appendix B: *No Scrap Left Behind* toolkit

Appendix B.1. *No Scrap Left Behind* Toolkit Guide

Introduction:
No Scrap Left Behind is a food waste diversion program designed and piloted at Portland State University (Portland, OR) based on programs at other universities including the University of California, Davis *Love Food, Don't Waste* program. *No Scrap Left Behind* is designed to engage students in active learning around food waste and food waste diversion skills. The programs seek to engage students in food waste diversion in relation to the economic, social, environmental and health impacts that it has. The program also seeks to help students develop some basic skill around food portioning and food waste diversion. Students participating in the program are surveyed (convenience/snowball sampling) about knowledge and behaviors around food waste, both to open the discussion and assess the program. The program success is further measured by measuring the amount of student generated food scraps composted during the same lunch period (11am-1pm) the week prior to and after the week of the intervention each term. This allows us to determine the effect of the program/volunteer presence in the cafeteria and whether students change their behavior in response to us or intrinsically, long-term.

Objectives:
1. To engage students in **food waste/portioning awareness educational programming** as they pass through the cafeteria and dispose of their waste.
2. To **assess student change in knowledge and behavior related to food waste/portioning** by comparing pre-and post-participation survey results and food scrap weights.
3. To help inform catering services about **potential opportunities for economic savings by encouraging student food waste reduction**.

Process:
The *No Scrap Left Behind* cafeteria intervention was run once a week each term of the academic school year. The cafeteria (wall posters, service stations, tray return, napkin holders, *etc*.) were re-signed for the intervention to promote and inform around food waste diversion. Volunteers tabled to discuss and interact with students about food waste and portioning. As students came through to the tray return area their food waste was collected and curated into a food waste buffet.

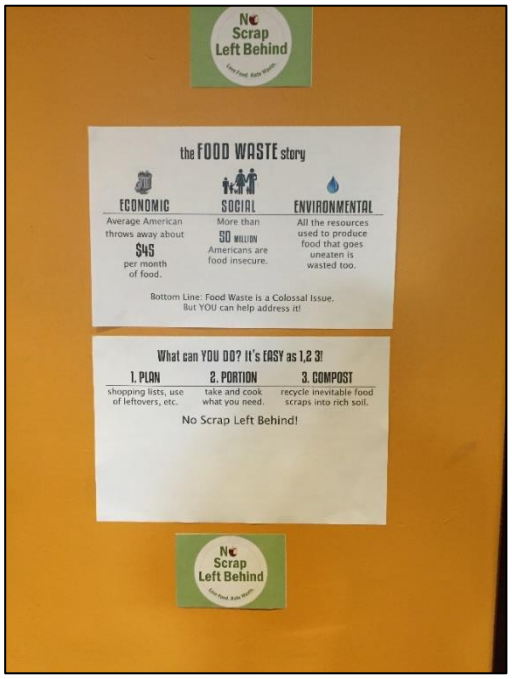
Program materials:
Program materials may be shared upon request to specific institutions. These materials were developed in collaborating offices at Portland State University, including the Campus Sustainability Office (CSO), PSU Dining, and the Center for Student Health and Counseling (SHAC). These contributors reserve the rights to grant access to their materials selectively to specific institutions. We also request that the program be cited in

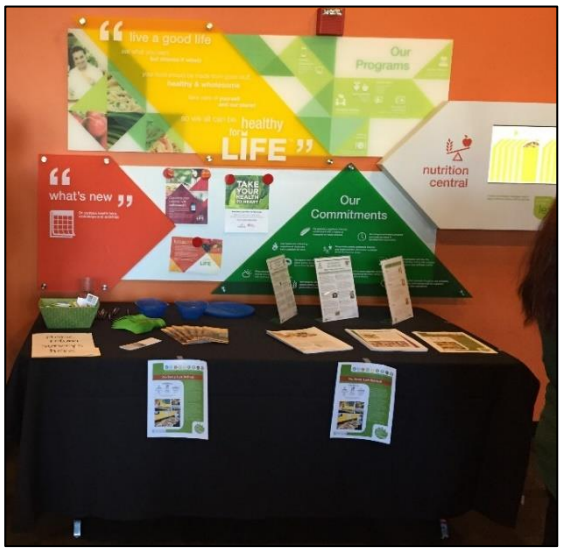
any formal or informal publications about the program. All marketing material file names in this toolkit are labeled with the office in which they were developed.
Molly Bressers (Program & Outreach Coordinator at CSO), Holly Carman-Fujioka (PSU Dining Marketing Coordinator), and Hannah Heller (SHAC) developed marketing materials. Manar Alattar (CSO) supervised the program and material development overall. Anthony Hair (CSO) along with many dedicated volunteers also helped support and implement the program.

Note: The crying food images on the medium sized posters are by the Love Food Hate Waste campaign (LoveFoodHateWaste.com) and are cited directly to them.

For questions, comments or material requests, please contact Manar Alattar at manar@pdx.edu.

Photo Gallery





Sources:

UC Davis Love Food, Don't Waste Program: http://dining.ucdavis.edu/sus-recycling.html

UK Love Food Hate Waste Program: http://www.lovefoodhatewaste.com/

Program in the press:

Campus Sustainability Office. (2016, January 29). Portland State Inside PSU | News. Green Campus Spotlight. Portland State University, Portland, OR. Retrieved from https://www.pdx.edu/insidepsu/news/green-campus-spotlight-tackling-food-waste-one-lunch-time

Kennedy, M. (2016, February 17). Program shows Portland State students how much food they waste. Sustainability Initiatives. American School and University, Overland Park, KS. Retrieved from http://asumag.com/sustainability-initiatives/program-shows-portland-state-students-how-much-food-they-waste

Appendix B.2. Program signage

Appendix B.2.1. Wall signage

Resources developed by:

Crying food posters – Modified from *Love Food Hate Waste* program (permission to use images from program; information updated for USA)

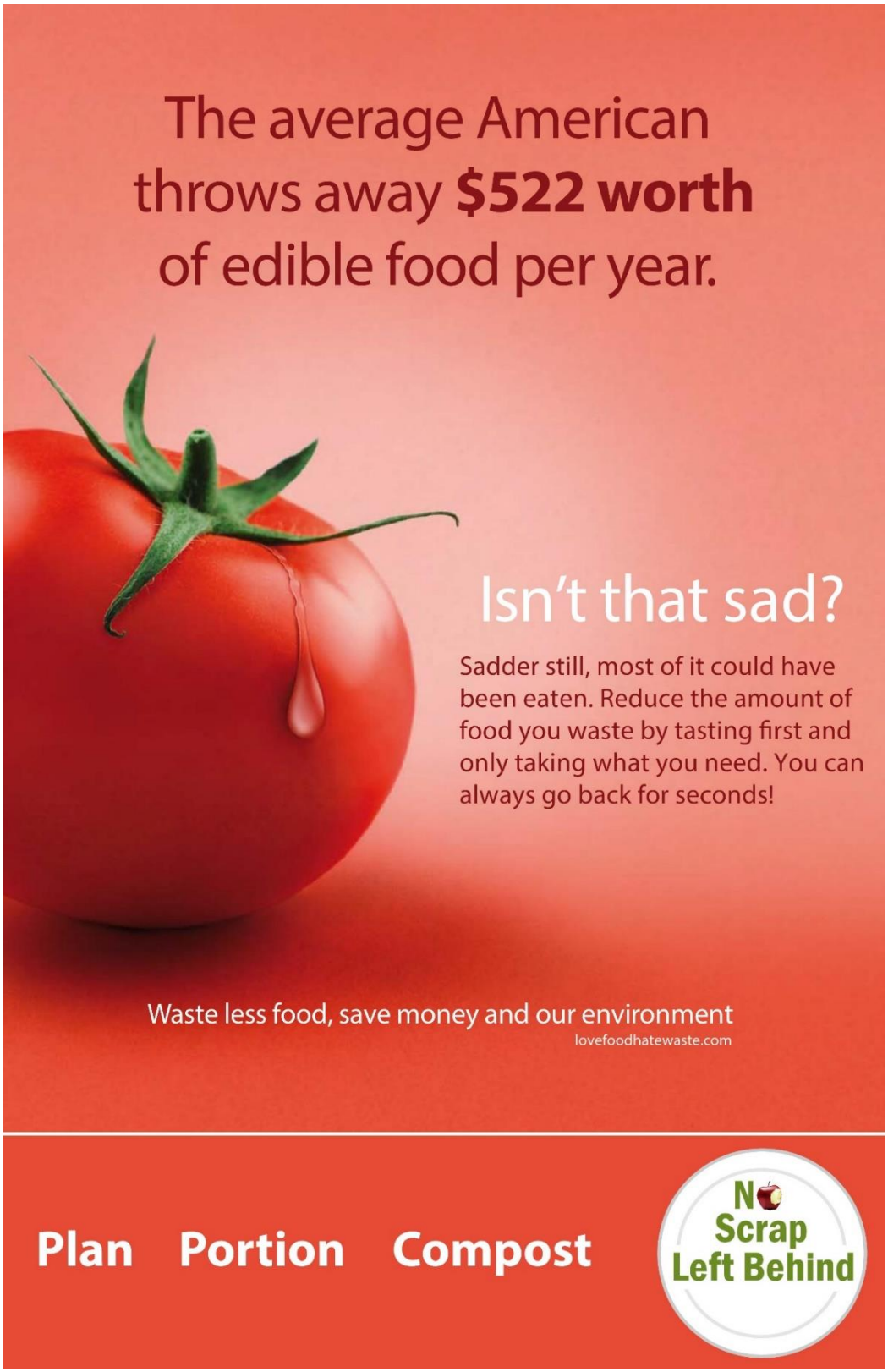
The Food Waste Story – Developed by PSU Dining

Total Food Waste $162 Billion – Developed by PSU Dining

We're weighing the waste – Developed by PSU Dining


Wasting food wastes the
resources used to produce it.
In the U.S. that is 35% of our fresh
water and 31% of our farmland.
Isn't that sad?
Sadder still, most of it could have
been eaten. Reduce food waste
by planning meals, making a list,
and buying only what you need.
Waste less food, save money and our environment
lovefoodhatewaste.com
Plan Portion Compost
No
Scrap
Left Behind


While America wastes 160 billion pounds of food each year, over 50 million Americans are food insecure.
Isn't that sad?
If we reduce food waste by only 15%, we could feed more than half of food insecure Americans.
Waste less food, save money and our environment
lovefoodhatewaste.com
Plan Portion Compost
No Scrap Left Behind


The average American throws away $522 worth of edible food per year.
Isn't that sad?
Sadder still, most of it could have been eaten. Reduce the amount of food you waste by tasting first and only taking what you need. You can always go back for seconds!
Waste less food, save money and our environment
lovefoodhatewaste.com
Plan Portion Compost
No Scrap Left Behind

the FOOD WASTE story

ECONOMIC

Average American throws away about

$45

per month of food.

SOCIAL

More than

50 MILLION

Americans are food insecure.

ENVIRONMENTAL

All the resources used to produce food that goes uneaten is wasted too.

Bottom Line: Food Waste is a Colossal Issue.
But YOU can help address it!

What can YOU DO? It's EASY as 1,2 3!

1. PLAN	2. PORTION	3. COMPOST
shopping lists, use of leftovers, etc.	take and cook what you need.	recycle inevitable food scraps into rich soil.

No Scrap Left Behind!


TOTAL FOOD WASTE $162 BILLION
ANNUAL U.S.
FOOD
WASTE
VEGETABLES $30B
DAIRY..... $29B
MEAT..... $ 23B
POULTRY..... $ 20B
FATS / OILS..... $ 13B
GRAIN..... $ 11B
FRUITS.....$10B
EGGS.....$3B

We're weighing the waste this week!

Appendix B.2.2. Napkin holder signage

Resources developed by:

Green napkin holders – Developed by Campus Sustainability Office

Food Waste Quizzes – Developed through coordinated efforts with all partners (Campus Sustainability Office (CSO), PSU Dining, Student Health and Counseling (SHAC), and Committee for Improving Student Food Security (CISFS))


No
Scrap
Left Behind
NOT


No
Scrap
Left Behind
Plan. Portion. Compost.


No
Scrap
Left Behind
Love Food. Hate Waste.


No
Scrap
Left Behind
Plan. Portion.Compost.


No
Scrap
Left Behind
Taste before you take.


No
Scrap
Left Behind
Think before you take.

No Scrap Left Behind

FOOD WASTE QUIZ

Grab a napkin, jot down some quick answers and get a prize as you leave today!

1. What types of food are the most wasted?
2. How many Americans are food insecure (do not know where their next meal is coming from)?
3. How many items can students receive (for free) by showing their PSU ID from the Student Food Pantry – now in the basement of SMSU?

No Scrap Left Behind

FOOD WASTE QUIZ

Grab a napkin, jot down some quick answers and get a prize as you leave today!

1. Per month, how much MONEY does the average American waste on food that goes uneaten?
2. What percentage of the food produced worldwide is estimated to go uneaten? TAKE A GUESS!
3. In just a few words, what is the meaning of "Food Security"?

No Scrap Left Behind

FOOD WASTE QUIZ

Grab a napkin, jot down some quick answers and get a prize as you leave today!

1. On average, how much food does ONE person waste in a month (pounds)? Just guess….
2. What material makes up the largest fraction of our total waste in the United States? (hint above)
3. Name one way YOU can cut down on food waste.

No Scrap Left Behind

FOOD WASTE QUIZ

Grab a napkin, jot down some quick answers and get a prize as you leave today!

1. What percentage of the food produced worldwide is estimated to go uneaten? It'll surprise you.
2. What is the name of the once a month opportunity for students to receive free fresh fruits & vegetables outside Shattuck Hall on the Park Blocks on the second Monday of every month at noon?

Quiz Key:

Yellow quiz

1. Fruits and veggies

2. About 50 million

3. Five per day

Green quiz

1. About $45

2. ~30%

3. Unsure if they will find their next meal

Blue quiz

1. ~20 lbs

2. Food

3. Many including: shop in bulk, eat/reuse leftovers, meal planning, portion correctly.

Purple quiz

1. ~30%

2. Harvest Share Free Market

Appendix B.3. Student handouts

Resources developed by:

Food Facts - Natural Resources Defense Council (NRDC) – Source: nrdc.org/policy

No Scrap Behind Tips! – Developed by Student Health and Counseling Center at Portland State University (SHAC)

FOOD FACTS

Your Scraps Add Up: Reducing food waste can save money and resources

Feeding the U.S. population requires an enormous amount of land and resources. Yet, 40 percent of food in the U.S. goes to waste. When the resources to grow that food are considered, this amounts to approximately 25 percent of all freshwater, 4 percent of the oil we consume, and more than $165 billion dollars all dedicated to producing food that never gets eaten. Reducing your own food waste is an easy way to trim down your bills and your environmental footprint.

HOW MUCH DO WE WASTE?

In the U.S., we waste around 40 percent[2] of all edible food. A large portion of that waste is caused by consumers. The average American throws away between $28-43[3] in the form of about 20 pounds[4] of food each month.If we wasted just 15 percent less food, it would be enough to feed 25 million Americans.[5]

Feeding the planet is already a struggle, and will only become more difficult with 9-10 billion people expected on the planet in 2050. This makes food conservation all the more important. The United Nations has predicted that we'll need up to 70 percent more food to feed that projected population.[6] Developing habits to save food now could dramatically reduce the need for increased food production in the future.

WHAT DOES WASTING FOOD COST US?

The cost of wasted food is staggering. In addition to the wasting of water, energy, chemicals, and global warming pollution that goes into producing, packaging, and transporting discarded food, nearly all of the food waste ends up in landfills where it decomposes and releases methane, a heat-trapping greenhouse gas that is 21 times more potent than carbon dioxide. Consider these cost estimates of all the food that never gets eaten in the U.S., and imagine just how much we can save by wasting less food:

- 25 percent of all freshwater used in U.S.[7]
- 4 percent of total U.S. oil consumption[7]
- $165 billion per year[8] (more than $40 billion from households)[9]
- $750 million per year just to dispose of the food[10]
- 33 million tons of landfill waste (leading to greenhouse gas emissions)[11]

NRDC
THE EARTH'S BEST DEFENSE

For more information, please contact:
Dana Gunders
dgunders@nrdc.org
(415) 875-6100
switchboard.nrdc.org/blogs/dgunders/
Twitter: dgunders

www.nrdc.org/policy
www.facebook.com/nrdc.org
www.twitter.com/nrdc

25 million people could be fed if we reduced food waste by 15 percent

WHERE DOES FOOD WASTE COME FROM?

Food waste is a complex problem with losses occurring throughout the supply chain from "farm to fork." Crops are sometimes left unharvested because their appearance does not meet strict quality standards imposed by supermarkets. Food can be mishandled or stored improperly during transport. Large portions, large menus, and poor training for food handlers contribute to food waste in restaurants.

In households, fresh products make up most of the wasted food. The U.S. Department of Agriculture reports that a typical American throws out 40 percent of fresh fish, 23 percent of eggs, and 20 percent of milk. Citrus fruits and cherries top the list for fruits, and sweet potatoes, onions, and greens are commonly wasted vegetables.[12]

Much of household waste is due to overpurchasing, food spoilage, and plate waste. About 2/3 of household waste is due to food spoilage from not being used in time, whereas the other 1/3 is caused by people cooking or serving too much.[13] Single households produce proportionately more waste per person than multiple occupancy situations with more than one adult. Children, however, can add to the waste tally too. In fact, in a study of British households, those with children produced 41 percent more food waste than similarly sized households without children.[14]

The good news is we can reverse this costly food waste trend. Follow these tips and you'll finish your plate feeling satisfied in a whole new way.

EASY STEPS TO REDUCING YOUR FOOD WASTE

Follow these tips to keep your food bill and "food-print" down at the same time:

- **Shop Wisely**—Plan meals, use shopping lists, buy from bulk bins, and avoid impulse buys. Don't succumb to marketing tricks that lead you to buy more food than you need, particularly for perishable items. Though these may be less expensive per ounce, they can be more expensive overall if much of that food is discarded.
- **Buy Funny Fruit**—Many fruits and vegetables are thrown out because their size, shape, or color are not "right". Buying these perfectly good funny fruit, at the farmer's market or elsewhere, utilizes food that might otherwise go to waste.
- **Learn When Food Goes Bad**—"Sell-by" and "use-by" dates are not federally regulated and do not indicate safety, except on certain baby foods. Rather, they are manufacturer suggestions for peak quality. Most foods can be safely consumed well after their use-by dates.[15]
- **Mine Your Fridge**—Websites such as www.lovefoodhatewaste.com can help you get creative with recipes to use up anything that might go bad soon.
- **Use Your Freezer**—Frozen foods remain safe indefinitely. Freeze fresh produce and leftovers if you won't have the chance to eat them before they go bad.
- **Request Smaller Portions**—Restaurants will often provide half-portions upon request at reduced prices.
- **Eat Leftovers**—Ask your restaurant to pack up your extras so you can eat them later. Freeze them if you don't want to eat immediately. Only about half of Americans take leftovers home from restaurants.
- **Compost**—Composting food scraps can reduce their climate impact while also recycling their nutrients. Food makes up almost 13 percent of the U.S. waste stream, but a much higher percent of landfill-caused methane.[16]
- **Donate**—Non-perishable and unspoiled perishable food can be donated to local food banks, soup kitchens, pantries, and shelters. Local and national programs frequently offer free pick-up and provide reusable containers to donors.

1 Buzby, et al. The Value of Retail- and Consumer-Level Fruit and Vegetable Losses in the United States. Journal of Consumer Affairs, Fall 2011: 492-515.
2 Hall KD, Guo J, Dore M, Chow CC (2009) The Progressive Increase of Food Waste in America and Its Environmental Impact. National Institute of Diabetes and Digestive and Kidney Diseases. PLoS ONE 4(11):e7940.
3 Jonathan Bloom, *American Wasteland* (Cambridge: Da Capo Press, 2010).
4 Food and Agriculture Organization of the United Nations, *Global Food Losses and Food Waste*. http://www.fao.org/ag/ags/ags-division/publications/publication/en/?dyna_fef%5Buid%5D=74045.
5 This calculation assumes 2,500 kcal/capita/day and an annual total of 150 trillion calories in losses, as reported in K.D. Hall, J. Guo, M. Dore, C.C. Chow, National Institute of Diabetes and Digestive and Kidney Diseases, "The Progressive Increase of Food Waste in America and Its Environmental Impact," PLoS ONE 4(11):e7940, 2009.
6 Food and Agriculture Organization (FAO) http://www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf.
7 See Hall 2009 above.
8 J. Buzby, and J. Hyman. "Total and per capita value of food loss in the United States", Food Policy, 37(2012):561-570.
9 Jones, Timothy. Corner on Food Loss. Biocycle, July 2005. p25.
10 USDA and US EPA. Waste Not, Want Not. Feeding the Hungry and Reducing Solid Waste Through Food Recovery. EPA 530-R-99-040. See vii above.
11 http://www.epa.gov/osw/conserve/materials/organics/food/fd-basic.htm.
12 http://www.ers.usda.gov/Publications/TB1927/TB1927.pdf.
13 http://www.wrap.org.uk/downloads/Household_Food_and_Drink_Waste_in_the_UK_Nov_2011.da3b238f.8048.pdf p27.
14 ibid.
15 http://www.fsis.usda.gov/factsheets/food_product_dating/index.asp.
16 See USDA/EPA above.

www.nrdc.org/policy

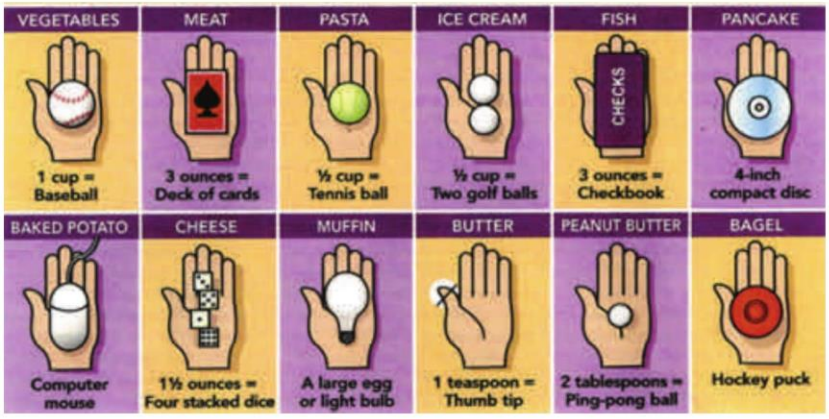
NRDC

NO SCRAP BEHIND TIPS!

What Should I Eat?

- Look for staple items in the **bulk section** like oatmeal, grains, and beans.
- **Frozen** veggies and fruits last longer and are nutritious.
- Check the **"day old"** bread section.
- **Re-use** yogurt , cottage cheese, & glass containers to store leftovers.
- Plan meals and make a grocery list – don't buy items you won't eat that week!

How much is one portion?



Learn more about portion sizes and how to reuse leftovers:

http://www.lovefoodhatewaste.com/recipes

Portland State UNIVERSITY

SHAC | Center for Student Health & Counseling
Medical | Dental | Counseling | Testing | Health Promotion

Peanut Butter and Jelly Granola Bars

Makes 12. Heat the oven to 350 °F. Butter or oil an 8" x 11" baking pan.

If you have a different size pan, that's fine—it'll just change how thick the bars are.

Pour the oats into a large bowl. You can use quick oats if they're all you have, but I prefer the bite and chew of rolled oats. For a different texture, you can also substitute a cup of oats with a cup of Rice Krispies, but the bars are great either way. Add the peanut butter, half the jelly, the water, and the salt to a small pan. Stir over low heat until it's smooth. Mix the peanut butter and jelly concoction into the oats until all the oats are coated and you have a sticky mass. Dump the mixture into the oiled pan and press it into an even layer. Spread the remaining jelly over the top. Pop the pan into the oven for 25 minutes, until it's toasty and brown around the edges. Mmm. Crunchy. Leave the bars in the pan until they cool completely, about an hour, then slice into 12 bars.

3 cups rolled oats (or 2 cups oats and 1 cup Rice Krispies)

½ cup peanut butter

½ cup jelly or jam

¼ cup hot water

¼ tsp salt butter or vegetable oil

Additions: nuts coconut dried fruit honey

EAT WELL ON $4/ DAY
GOOD AND CHEAP
To Download a Free PDF visit
ww.leannebrown.com

Check Out These Free Smartphone Apps!

Fridge Pal— helps you track what items are left in your fridge and expiration dates.

Food Planner—create your weekly shopping list, keep track of items, and build recipes.

Appendix B.4. Surveys

Resources developed by:

Short and long survey – Manar Alattar while employed with Campus Sustainability Office (CSO)

Appendix B.4.1. Short survey (half page)

Food Diversion Survey

Please rate the following based on how strongly you agree or disagree with each statement:	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I think about the food waste I generate (Circle one)	1	2	3	4	5
My individual actions towards food waste do not make much of a difference	1	2	3	4	5
I put effort into reducing food waste	1	2	3	4	5
Food waste doesn't bother me	1	2	3	4	5
I eat leftovers	1	2	3	4	5
I check the refrigerator before shopping	1	2	3	4	5
I don't make lists and/or plan meals before shopping	1	2	3	4	5
I think about the portions of food that I take or cook	1	2	3	4	5
Composting contributes to the greater good	1	2	3	4	5
I compost my foodscraps	1	2	3	4	5
If I compost, I don't need to worry about source reduction (buying /preparing less food to avoid waste)	1	2	3	4	5
Composting stinks and is gross	1	2	3	4	5
Food breaks down in the landfill, so it doesn't bother me	1	2	3	4	5
I talk to other people about food waste	1	2	3	4	5
I understand food freshness labels (sell by, best by, use by, expiration date, etc.)	1	2	3	4	5

Food Diversion Survey

Please rate the following based on how strongly you agree or disagree with each statement:	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I think about the food waste I generate (Circle one)	1	2	3	4	5
My individual actions towards food waste do not make much of a difference	1	2	3	4	5
I put effort into reducing food waste	1	2	3	4	5
Food waste doesn't bother me	1	2	3	4	5
I eat leftovers	1	2	3	4	5
I check the refrigerator before shopping	1	2	3	4	5
I don't make lists and/or plan meals before shopping	1	2	3	4	5
I think about the portions of food that I take or cook	1	2	3	4	5
Composting contributes to the greater good	1	2	3	4	5
I compost my foodscraps	1	2	3	4	5
If I compost, I don't need to worry about source reduction (buying /preparing less food to avoid waste)	1	2	3	4	5
Composting stinks and is gross	1	2	3	4	5
Food breaks down in the landfill, so it doesn't bother me	1	2	3	4	5
I talk to other people about food waste	1	2	3	4	5
I understand food freshness labels (sell by, best by, use by, expiration date, etc.)	1	2	3	4	5

1. If I leave food on my plate the main reason is usually (choose one):
    a. It doesn't taste good
    b. I overestimated the portion size
    c. I'm being aware of caloric intake
    d. I don't have time to eat it
    e. I don't know
    f. Other _____

2. Each year in the USA, over 160 billion pounds of food is wasted from production to consumption. What percentage of food do you think is lost at each step in the food-cycle? (Use table to answer)

Production	**Handling and Storage**	**Processing**	**Distribution and Market**	**Consumption**	Note: percentages should add up to 100%
%	%	%	%	%	

1. Everyone generates at least some waste. What *percentage* of food do you think is wasted by each of the following: (fill in below)

1. If I leave food on my plate the main reason is usually (choose one):
    a. It doesn't taste good
    b. I overestimated the portion size
    c. I'm being aware of caloric intake
    d. I don't have time to eat it
    e. I don't know
    f. Other _____

2. Each year in the USA, over 160 billion pounds of food is wasted from production to consumption. What percentage of food do you think is lost at each step in the food-cycle? (Use table to answer)

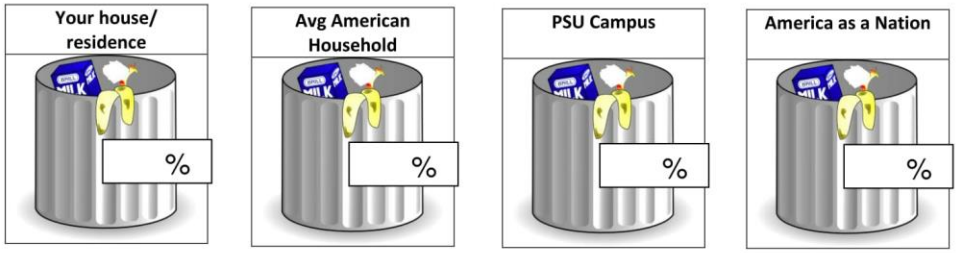
Production	**Handling and Storage**	**Processing**	**Distribution and Market**	**Consumption**	Note: percentages should add up to 100%
%	%	%	%	%	

2. Everyone generates at least some waste. What *percentage* of food do you think is wasted by each of the following: (Fill in the below)

Appendix B.4.2. Full survey

Food Diversion Survey

1. Age: ____
2. Gender: ____
3. I am a (circle one): Student / Faculty / Employee
4. Do you live in a residence hall on campus? (Circle one) Yes / No
5. Are you enrolled in a freshman inquiry class that does waste audits? Yes / No
6. How many times have you taken this survey? _____
7. Do you participate in residence hall composting? Yes / No
8. How many times a week, on average, do you eat at PSU cafeterias, specifically:
    a. Victor's (Ondine)? _____
    b. Viking's (Smith)? ____
9. How many people (including yourself) live in your house, apartment or dorm-room? ____
10. Everyone generates at least some waste. What *percentage* of food do you think is wasted by each of the following: (Fill in the table)



Please rate the following based on how strongly you agree or disagree with each statement:	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I think about the food waste I generate (Circle one)	1	2	3	4	5
I enjoy the food offered at Victor's dining hall	1	2	3	4	5
My individual actions towards food waste do not make much of a difference	1	2	3	4	5
I put effort into reducing food waste	1	2	3	4	5
I am interested in taking action to prevent food waste	1	2	3	4	5
Food waste doesn't bother me	1	2	3	4	5
I eat leftovers	1	2	3	4	5
I don't think the food I throw away costs much money	1	2	3	4	5
When I go to a buffet restaurant I take more than I can eat to get my money's worth	1	2	3	4	5
I check the refrigerator before shopping	1	2	3	4	5
I don't make lists and/or plan meals before shopping	1	2	3	4	5
I prepare/cook some of my meals	1	2	3	4	5
I think about the portions of food that I take or cook	1	2	3	4	5
I would be interested in attending a workshop on portioning or cooking for one person	1	2	3	4	5

Please rate the following based on how strongly you agree or disagree with each statement:	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I know about the residence hall compost program	1	2	3	4	5
Composting contributes to the greater good	1	2	3	4	5
I compost my foodscraps	1	2	3	4	5
If I compost, I don't need to worry about source reduction (buying /preparing less food to avoid waste)	1	2	3	4	5
I dislike compost and composting	1	2	3	4	5
Composting stinks and is gross	1	2	3	4	5
Food breaks down in the landfill, so it doesn't bother me	1	2	3	4	5
I talk to other people about foodwaste	1	2	3	4	5
I understand food freshness labels (sell by, best by, use by, expiration date, etc.)	1	2	3	4	5
I know about reusable to-go container options at Victor's	1	2	3	4	5
I use reusable to-go containers at Victor's	1	2	3	4	5
I believe that many materials can be reused or recycled into something new	1	2	3	4	5
I believe proper waste disposal makes a positive environmental impact	1	2	3	4	5
I believe that waste reduction and management is a potential career path or academic pursuit	1	2	3	4	5
I would enroll in a PSU course with a sustainability theme	1	2	3	4	5
I would like to see more programs at PSU that help reduce food waste.	1	2	3	4	5

11. If I leave food on my plate the main reason is usually (choose one):
    a. It doesn't taste good
    b. I overestimated the portion size
    c. I'm being aware of caloric intake
    d. I don't have time to eat it
    e. I don't know
    f. Other _____

12. Each year in the USA, over 160 billion pounds of food is wasted from production to consumption. What percentage of food do you think is lost at each step in the food-cycle? (Use table to answer)

Production	**Handling and Storage**	**Processing**	**Distribution and Market**	**Consumption**	Note: percentages should add up to 100%
%	%	%	%	%	

13. What is your feedback on the cafeteria intervention program? Your feedback might say how the program affected you, what you learned or took away from it, or even how to improve it.

Appendix C. Food waste photo gallery program

Food Left Behind Art Gallery Project

Background:
The *Food Left Behind* art gallery project was generated from ideas from various programs and student discussions about food waste. Specifically, in Portland State University's *No Scrap Left Behind* food waste diversion campaign it became obvious that images of food waste had an influence on students. On behalf of the Campus Sustainability Office along with other instructors and staff on campus, we connected with various food waste specialists (including Jordan Figueiredo, Dana Gunders, and Tristram Stuart) and it seems the idea is new and could be developed upon beyond this program.

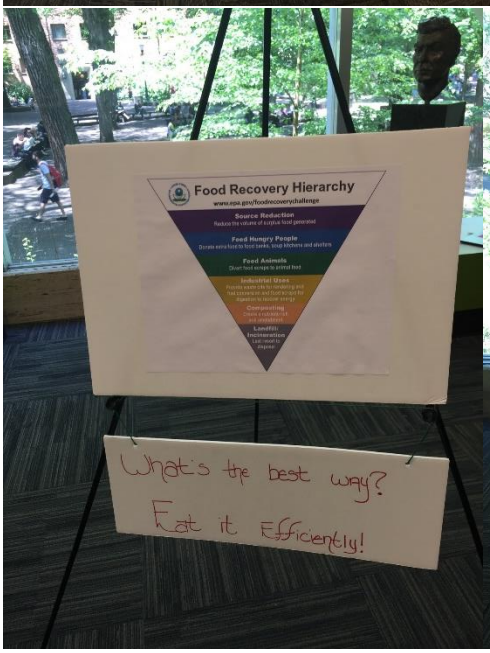
Introduction:
The food waste art show will be developed from the available photo resources as well as student work from WALL-E classes to highlight the issue of food waste. The photos will be displayed as it fits in the food cycle from production to consumption and waste.

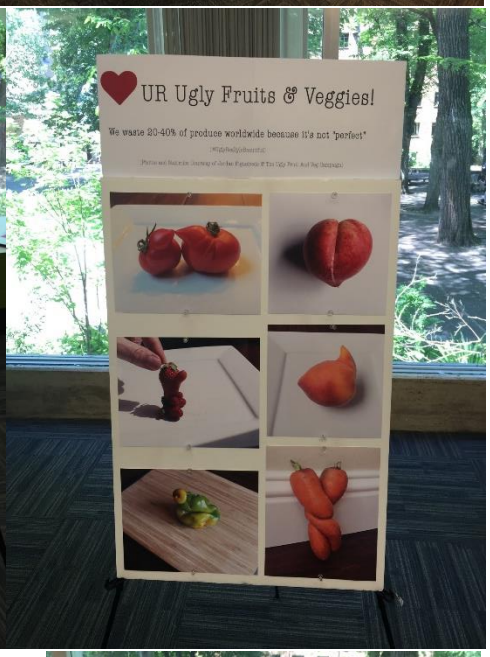
Objectives:

4. To have students **reflect** on the process of wasting food and how it fits into the greater process
5. To **engage** the campus in food and food waste
6. To eventually produce a large, shareable **food waste art gallery** for universities.

Images of gallery May 31, 2016 Gallery

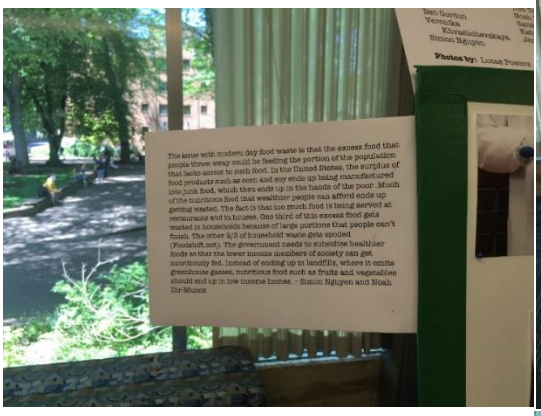
Photo credits: Lucas Powers, Jensine Tirado, and students. Images also provided by Ugly Fruits & Veg campaign.

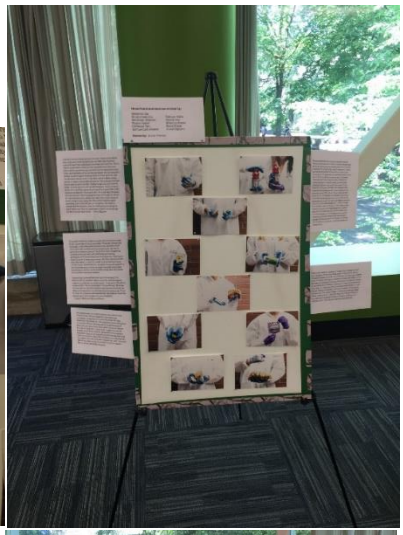

Food Recovery Hierarchy
What's the best way?
Eat it Efficiently!

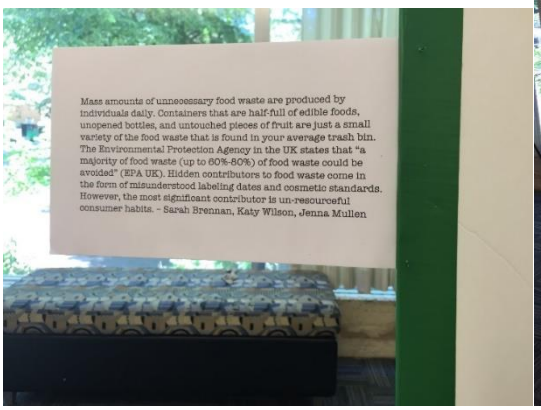

UR Ugly Fruits & Veggies!
We waste 20-40% of produce worldwide because it's not "perfect"

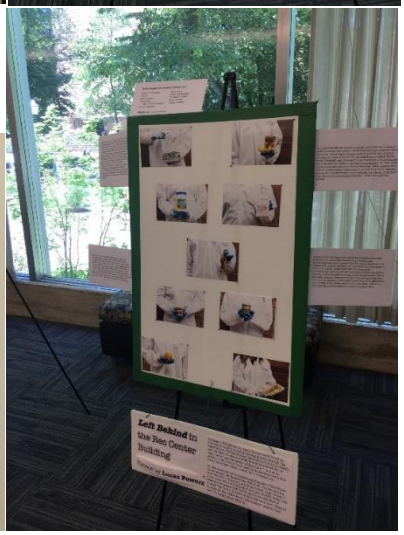

No Scrap Left Behind

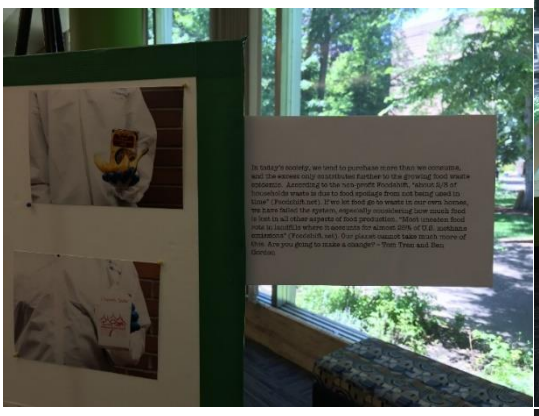

Come Join the Oregon Food Bank's
Harvest share
Free, Fresh & Local Produce
Happening the Second Monday of every month
Outside Shattuck Hall in the Park Blocks

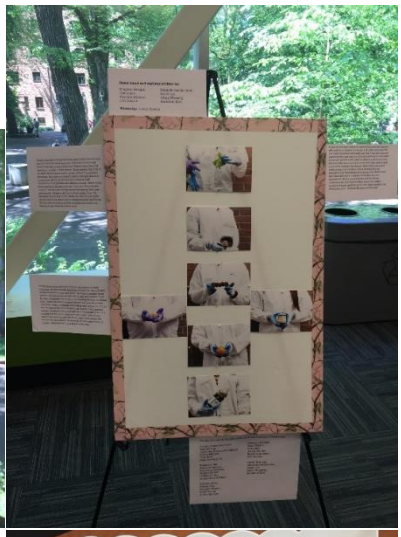

Photos by: Lucas Powers
The issue with modern day food waste is that the excess food that people throw away could be feeding the portion of the population that lacks access to such food. In the United States, the surplus of food products such as corn and soy ends up being manufactured into junk food, which then ends up in the hands of the poor. Much of the nutritious food that wealthier people can afford ends up getting wasted. The fact is that too much food is being served at restaurants and in houses. One third of this excess food gets wasted in households because of large portions that people can't finish. The other 2/3 of household waste gets spoiled (Foodshift.net). The government needs to subsidize healthier foods so that the lower income members of society can get nutritiously fed. Instead of ending up in landfills, where it emits greenhouse gasses, nutritious food such as fruits and vegetables should end up in low income homes. - Simon Nguyen and Noah Di-Munos

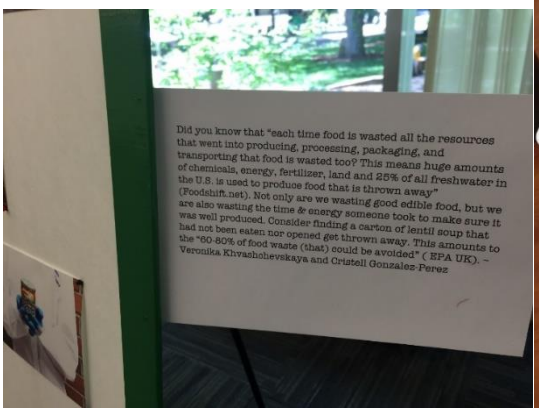



Mass amounts of unnecessary food waste are produced by individuals daily. Containers that are half-full of edible foods, unopened bottles, and untouched pieces of fruit are just a small variety of the food waste that is found in your average trash bin. The Environmental Protection Agency in the UK states that "a majority of food waste (up to 60%-80%) of food waste could be avoided" (EPA UK). Hidden contributors to food waste come in the form of misunderstood labeling dates and cosmetic standards. However, the most significant contributor is un-resourceful consumer habits. - Sarah Brennan, Katy Wilson, Jenna Mullen


Left Behind in the Rec Center Building
Photos by Lucas Powers


In today's society, we tend to purchase more than we consume,
and the excess only contributes further to the growing food waste
epidemic. According to the non-profit Foodshift, "about 2/3 of
household waste is due to food spoilage from not being used in
time" (Foodshift.net). If we let food go to waste in our own homes,
we have failed the system, especially considering how much food
is lost in all other aspects of food production. "Most uneaten food
now in landfills where it accounts for almost 25% of U.S. methane
emissions" (Foodshift.net). Our planet cannot take much more of
this. Are you going to make a change? - Tom Tran and Ben
Gordon




Did you know that "each time food is wasted all the resources
that went into producing, processing, packaging, and
transporting that food is wasted too? This means huge amounts
of chemicals, energy, fertilizer, land and 25% of all freshwater in
the U.S. is used to produce food that is thrown away"
(Foodshift.net). Not only are we wasting good edible food, but we
are also wasting the time & energy someone took to make sure it
was well produced. Consider finding a carton of lentil soup that
had not been eaten nor opened get thrown away. This amounts to
the "60-80% of food waste (that) could be avoided" (EPA UK). -
Veronika Khvashchevskaya and Cristell Gonzalez-Perez


Did you know that meat production
has the highest GHG, water
Nitrogen and phosphorus
footprint of all foods?!
Campus Sustainability
Office
greencampus@pdx.edu
pdx.edu/sustainability

Appendix D. Food waste mindful cook-off activity

Food Waste Mindful Cook-off Activity

Name: *Cooking to Save the Planet!* OR *Cook Off the Scraps!*
(Other names may be appropriate as well depending on the venue)

Educational goal: To promote efficient kitchen and cooking habits that decrease food waste. The focus is on portioning, eating foods before they lose their shelf life, and utilization of left overs.

Overview of activity: Participants will cook a dish based on the following process and share it with the group. Dishes will be judged, by the audience, based on taste and display. Participants should be aware of the food waste associated with each dish. You can focus more or less on food preparation, food storage or food waste depending on the event.

Guidelines:

1. Think of the top three kitchen ingredients that you often have trouble putting to use before they pass their optimal shelf life, be specific.
2. Use lovefoodhatewaste.com, www.bigoven.com/recipes/leftover or other resources to find a recipe that utilizes most of those items.
3. Cook and bring it to the event to be judged by the participants (based on taste and presentation).
4. You'll be asked to present your dish to the group.
5. Prizes for the top voted entree and dessert!

Note: cooking will be done at home and brought in potluck style.

Promotion: This activity is associated with a flier as well. See below for generic.

Campus Sustainability Office
Portland State University, Portland OR
Developed March 14, 2016

Image sources: www.taste.com.au/gallery/12+perfect+pizza+toppings,454; www.gimmesomeoven.com/slow-cooker-root-vegetable-stew/;www.budgetbytes.com/2010/02/roast-beef-quesadillas/;www.twopeasandtheirpod.com/asparagus-spinach-feta-quiche/

DATE
COOK OFF
THE SCRAPS!!

Time – Location

SAVING FOOD SCRAPS ONE DISH AT A TIME

How can I compete?

1. Think of the top three ingredients that you often have trouble using before their optimal shelf life. Be specific.
2. Use lovefoodhatewaste.com, bigoven.com/recipes/leftover or other resources to find a recipe that utilizes most of those items.
3. Cook 'em up and bring your dish to the potluck to be judged by your colleagues. Judging criteria:
   - Taste; yay or nay?
   - Presentation; hot or not?
4. You'll also be asked to present your dish to the group.
5. **Prizes** will be awarded to the top voted *entree* and *dessert*!

Can I just come to eat?!

I'll be pretty hungry, but too busy to cook; can I still come?

Are you kidding me?! OF COURSE! The more voters and eaters, the less food waste! YAY!

Save the planet one pizza, stew, quesadilla, casserole, or quiche dish at a time!

Learn more about food storage and recipes that are amazing, easy and allow us to use up food before it loses its shelf life @ lovefoodhatewaste.com.

Image sources:
www.taste.com.au/gallery/12+perfect+pizza+toppings,454;
www.gimmesomeoven.com/slow-cooker-root-vegetable-stew/;www.budgetbytes.com/2010/02/roast-beef-quesadillas/;www.twopeasandtheirpod.com/asparagus-spinach-feta-quiche/

INSTRUCTIONS
HOW DOES THIS WORK??

1. Put a card near your dish with its name and a short description.
2. Taste and enjoy.
3. Read about the other dishes.
4. Write the number of the dish you like best (orange for sweet/green for salty) on a sticky, fold and insert it into the voting box.

Save the planet one pizza, stew, quesadilla, casserole, or quiche dish at a time!

Learn more about food storage and recipes that are amazing, easy and allow us to use up food before it loses its shelf life @ lovefoodhatewaste.com.

Appendix E. Institutional Review Board (IRB) approval

Human Subjects Research Review Committee
Post Office Box 751
Portland, Oregon 97207-0751
503-725-4288 tel
503-725-8170 fax
hsrrc@pdx.edu

To: Jennifer Morse / Manar Alattar

From: PSU Human Subjects Research Review Committee

Date: May 26, 2016

Re: HSRRC waived review of your application titled, "Educating on Food Diversion: Assessment of Food Diversion Related Educational Programs." IRB# 163833

The Human Subjects Research Review Committee has waived further review of your proposal as we have determined that the project does not fall under the federal regulations pertaining to research with human subjects. The project involves the analysis of secondary, de-identified data.

Regardless of this waiver, PSU faculty, staff and students are still responsible for maintaining the highest ethical standards when conducting any projects or studies on behalf of PSU.

Thank you for informing the committee, and we appreciate your timely attention to this matter. If you make changes in the proposed project, the Committee must be notified in writing as further review may be required.

If you have questions or concerns, please contact the Office of Research Integrity, (503) 725-2227, Market Center Building, 6th floor.