Sustainable diets: Studies on German consumers’ intention-behavior gap

Dissertation for the acquisition of the academic degree
Doktor der Agrarwissenschaften (Dr. agr.)

Submitted to the
Faculty of Organic Agricultural Sciences
at
Kassel University, Germany

Submitted by
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Witzenhausen, January 2020
Declaration

I herewith give assurance that I completed this dissertation independently without prohibited assistance of third parties or aids other than those identified in this dissertation. All passages that are drawn from published or unpublished writings, either word-for-word or in paraphrase, have been clearly identified as such. Third parties were not involved in the drafting of the content of this dissertation; most specifically I did not employ the assistance of a dissertation advisor. No part of this thesis has been used in another doctoral or tenure process.

………………………………………

Leonie Fink

Witzenhausen, January 2020
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Date of thesis defense May 26, 2020
Acknowledgements

First of all, I would like to thank my two supervisors Dr. Angelika Ploeger and Dr. Carola Strassner for the continuous support of my PhD study. Thank you for your motivation and valuable expert knowledge, which you have passed on to me. And most of all, thank you for giving me this great opportunity to learn from and with you during this journey.

Then I would like to thank all the people who supported my work by participating in both conducted studies, while dedicating their time and thoughts. In addition, I would like to express my thanks for the various financings during the last four years. These go to a’verdis sustainable foodservice solutions for a great job as a student research assistant, the Software AG Foundation for financing a half-time position as a research assistant at Münster University of Applied Sciences, the Central Equal Opportunities Officer from Münster University of Applied Sciences for a PhD scholarship, Dr. Guido Ritter from Münster University of Applied Sciences for employment as a research assistant and University of Kassel and Münster University of Applied Sciences for funding the first research study. In addition I would like to thank the Open Access Publication Fund of the University of Kassel financed by the German Research Foundation (DFG) and the Library of the University of Kassel for financing the publication of the second and the third paper in open-access journals.

Special thanks go to my older sister Felipa for all the financial support and most importantly for always having my back. Last but definitely not least, I would like to thank my friends and family for their continuous support. Finally, I can answer your annoying question, whether I have submitted my dissertation, with a yes and a big smile on my face.
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<td>FAO</td>
<td>Food and Agriculture Organization of the United Nations</td>
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<td>FBDG</td>
<td>Food-Based Dietary Guidelines</td>
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<td>MD</td>
<td>Mediterranean Diet</td>
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<tr>
<td>NGO</td>
<td>Non-Governmental Organization</td>
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<td>NND</td>
<td>New Nordic Diet</td>
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<td>SDG</td>
<td>Sustainable Development Goal</td>
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<tr>
<td>TPB</td>
<td>Theory of Planned Behavior</td>
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<td>TRA</td>
<td>Theory of Reasoned Action</td>
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<td>UN</td>
<td>United Nations</td>
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<td>WHO</td>
<td>World Health Organization</td>
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Supplementary material

All supplementary material to this doctoral thesis is available electronically on the enclosed CD and will be published later by KOBRA, so that they are accessible to the public (only available in German). The supplementary material refers to the two studies presented in Chapter 4 and 5.

Supplementary material I: Complete Dataset & Coding (Excel Chart) (Paper No. 2, Chapter 4)

Supplementary material II: Demographic Questionnaire (Paper No. 3, Chapter 5)

Supplementary material III: Supplementing Questionnaires for Video Clip 1-4 (Paper No. 3, Chapter 5)

Supplementary material IV: Follow-up Interview Questions (Paper No. 3, Chapter 5)

Supplementary material V: Feedback Questionnaire (Paper No. 3, Chapter 5)

Supplementary material VI: Video Clip 1-4 (Paper No. 3, Chapter 5)

Supplementary material VII: Complete Dataset & Coding (MAXQDA) (Paper No. 3, Chapter 5)
Preface

The basis for this research stemmed from my background and experiences, as a nutrition scientist. During my master’s degree Sustainability in Service Management and Food Industries some of my fellow students constantly complained about not seeing themselves to be able to perform a sustainable diet – mainly because of the higher food prices of sustainable food items. Back then I already thought that this was maybe more like a problem of priorities, at least for most of them.

As the world moves further into a time, where our environment is exposed to great threats like loss of biodiversity, pollution of waters and climate change, we cannot just stand by and watch, while knowing one major reason causing this misery: our current practiced food systems including our practiced diets who play a crucial role as causer. We urgently need to shift our food systems towards sustainability and one by one start to practice sustainable diets. I see it as my duty as a researcher to not only get to the bottom of this problem, but to contribute to the development of solutions that can be applied to support environmental and human health by practicing sustainable diets and provide a livable future for next generations.

This cumulative dissertation comprises of two published papers and one submitted paper in international peer-reviewed journals:


The papers have been inserted in this dissertation in their original published or submitted version (Chapter 3, 4 and 5). Only the font and font size was adapted to those used in the dissertation. In addition, the name of the journal, the date of submission and the date of publication have been added to provide more detailed information.
Summary

Globally our practiced food systems are causing great harm to our environment including contributions to biodiversity loss, soil degradation, water pollution, and climate change, as well as to human health. Sustainable diets are crucial for solving those global diet-related problems because they are credited with a key role in the transformation of our currently practiced food systems into more sustainable ones. Increasing the practice of sustainable diets can be a starting point for initiating the needed change. People who are already trying to adopt sustainable diets are often confronted with the intention-behavior gap, caused by a range of barriers that influence their behavior. These barriers are internal (e.g. knowledge, skills) and external factors (e.g. dependence on other, food availability) that interfere with people’s behavioral control, when they want to translate their intentions into behavior. It becomes obvious, that people need support for closing the intention-behavior gap and be able to practice sustainable diets. The overall research aim of this doctoral research is to develop solutions for closing consumers intention-behavior gap and gain a better understanding of the barriers interfering. To understand people’s needs and what could support them during the processes of practicing a sustainable diet, it stands to reason that they can be directly involved in the development processes for ideas that solve the addressed problem. In search of an appropriate methodology, we examined the concept and especially the methods of open innovation, commonly applied in modern product and service development. We have worked out that a participative workshop for idea generation can be a suitable approach to involve people in the development process. On that account, we conducted six workshops in different German cities from September to December 2016 with 82 participants in total. We collected data by letting participants generate ideas to bridge the intention-behavior gap. Analyzing the result it could be shown that they don’t provide directly applicable ideas that will help people to overcome emerging barriers. They rather refer to external factors, that have to be changed, to be able to practice sustainable diets. The high number of external factors offers a range of barriers that contribute to causing the intention-behavior gap. Eliminating these barriers requires a deeper and more comprehensive understanding of these factors and their interplay. Therefore, we conducted a think aloud study in January and February 2019 with 20 participants, to explore the four most relevant external factors availability, education, advertising, and price. Furthermore, questionnaires for all four factors were handed out and a follow-up interview was conducted to gain additional qualitative data. Results showed that these four external factors alone seem to have a significant impact on the intention-behavior relation. Further data analysis showed that all factors interact in some way with other internal and external factors. That makes practicing sustainable diets a complex activity. In order to move forward in the process of making sustainable diets practicable and develop sustainable food
systems as an ideal nutrition environment, the external factors need to be addressed by policy, various stakeholders, and consumers. This doctoral research provides insight on what needs to be changed to shape external and internal factors in a way that people can practice sustainable diets without barriers interfering, and finally gives recommendations for policy, stakeholder and consumer action.
1 General Introduction

1.1 Background of the study

Our daily practiced diets base on an individual selection of foods we make every day. Together we create a global demand on food (Meybeck and Gitz, 2017). That in turn has an influence on our food systems, meaning for example where and how food is produced, processed, packaged, distributed, consumed, and disposed. Besides, the way in which we eat has a significant impact on our own health and on natural resources as well as on biodiversity (WHO, 2003; Tilman and Clark, 2014; Meybeck, 2015; FAO, 2016). Currently, especially our western diets practiced within the corresponding food systems are neither sustainable nor health-promoting for humans and our environment. It is indisputable that by practicing our current food systems, we are placing a heavy burden on our environment and endanger all living beings (Meybeck and Gitz, 2017; Durazzo, 2019; Willett et al., 2019). The impact on the world’s climate, water quality, soil conditions, and biodiversity has reached a critical level (FAO, 2019). According to research, our global food system causes up to 30% of human-made greenhouse gas emissions (Vermeulen, Campbell and Ingram, 2012; Johnston, Fanzo and Cogill, 2014; Garnett et al., 2016). With biodiversity loss, we are facing extinction of animals, plants, and crop varieties that cannot be brought back into this world. Today, as humanity, we are at a point where this problem is becoming more urgent with every day that passes. Already ten years ago, the concept of planetary boundaries was launched, for exploring a safe operating space for human activity on a global scale. Nine boundaries, including climate change, ocean acidification, stratospheric ozone depletion, biogeochemical nitrogen and phosphorus cycle, global freshwater use, land system change, biodiversity loss, atmospheric aerosol loading, and chemical pollution, were introduced (Rockström et al., 2009). The safe operating space has already been exceeded for the boundaries of climate change, biogeochemical nitrogen and phosphorus cycle, land system change, and biodiversity loss (Steffen et al., 2015). Taking into account that even two boundaries (chemical pollution and the release of novel entities and atmospheric aerosol loading) couldn’t be quantified yet, these results are more than alarming. In the context of nourishing our growing world population, expected to reach around 10 billion by 2050 (United Nations, 2019), we need to shift our food systems and practiced diets towards more sustainability (Fitch Bowdren and Santo, 2019; Irz et al., 2019; Willett et al., 2019). In other words, we need a great transformation of our global food system (Willett et al., 2019). Otherwise, future generations will struggle more than present generations already do with establishing food security for all people equally and live in a healthy environment (Simões-Wüst and Dagnelie, 2019; FAO, 2014). This would also mean that, without a corresponding change or transformation, it will not be possible to achieve the 17 UN Sustainable Development Goals (SDG; United Nations, 2015). In order to enable sustainable and health-promoting diets,
it is one of the highest priorities to protect biodiversity and the variety of foods and their nutritional value (Toledo and Burlingame, 2006; Institute of Medicine, 2014; Johnston, Fanzo and Cogill, 2014). Therefore, we need to produce food within sustainable food systems “(...) that ensure[s] food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised” (HLPE, 2014, p. 31). It becomes clear that diets are the result of our food systems and are, at the same time, a key driver for shaping our food systems (Meybeck, 2015). This becomes an important determinant when talking about a change towards more sustainability (Mason and Lang, 2017; Meybeck and Gitz, 2017). Moreover, diets can act as a causer or preventer of human and environmental health (Serafini and Toti, 2016). Although all actors in a food system affect the overall sustainability, we as consumers play a key role in shaping the type of food system by practicing sustainable diets (Grunert, 2011). Sustainable food consumption is a complex decision-making process (Vermeir and Verbeke, 2006). These everyday choices, which are frequent, multifaceted and dynamic, are affected by a whole range of individual (age, taste, habits, knowledge, emotions, income, values, abilities, perceived behavioral control) and situational factors (food trends, food prices and availability, accessibility, social norms, household practices, and cultural traditions; Asp, 1999; Vermeir and Verbeke, 2006; Sobal and Bisogni, 2009; Kearney, 2010; Oosterveer and Sonnenfeld, 2012; Reisch, Eberle and Lorek, 2013; Joshi and Rahman, 2015; Kreuzer et al., 2019; Nguyen, Morrison and Neven, 2019). Therefore, it can be said that food consumption is always influenced by such determinants (Oosterveer and Sonnenfeld, 2012).

Overall, the importance of sustainable food consumption and the associated environmental connection is getting more and more acknowledged (Auestad and Fulgoni, 2015; Gustafson et al., 2019; Sarlio, 2018). While there is evidence that consumer behavior is changing towards the purchase of sustainable food products (Salem et al., 2015; Loy et al., 2016), other sources state that people lack knowledge, practical skills, willingness, and competence to practice sustainable diets (Vermeir and Verbeke, 2006; Carlsson, Mehta and Pettinger, 2019). Besides, especially young adults are struggling with laziness to prepare their own meals or following desires and habits from childhood (Kreuzer et al., 2019). People choose sustainable diets because of health and environmental reasons, as well as taste, ethics, or losing weight (Lehikoinen and Salonen, 2019). Nevertheless, the majority of our population fail to act on their intentions and is struggling most of the time with consistent implementation of a sustainable diet (Schwarzer, 2008; Oosterveer and Sonnenfeld, 2012; Ajzen, 2015; Alsaffar, 2016; Kreuzer et al., 2019).

This discrepancy between having a positive intention but failing acting on it is called the intention-behavior gap (Orbell and Sheeran, 1998; Sheeran and Webb, 2016). In general, only half of the time our intentions are translated into the desired behavioral action, which demonstrates the significance of the gap (Sheeran and Webb, 2016). The intention-behavior gap is caused by various
factors influencing our intention-behavior relation (Schwarzer, 2008; Ajzen, 2015; Fishbein and Ajzen, 2015). In the case of not practicing sustainable diets, these factors, also known as barriers, can be for example high food prices, poor presentation, the amount of packaging, lack of food availability, time, information, trust or knowledge, media and advertising, social influences and habits (Nestle et al., 1998; Padel and Foster, 2007; Aertsens et al., 2009; Dixon and Isaacs, 2013; Van Doorn and Verhoef, 2015; von Koerber, Bader and Leitzmann, 2017; Kreuzer et al., 2019).

What becomes evident is, that individuals need some kind of support to close the intention-behavior gap and establish a far-reaching practice of sustainable diets. In order to develop and provide support, we need to understand these behavioral influences and consider a wide range of individual needs during the process of diet adoption. Only then we are able to initiate an effective change that after all requires a long-term period of interventions (Nestle et al., 1998). Since nutritional recommendations like food-based dietary guidelines (FBDG) coming from the scientific domain are usually not perceived as practicable in everyday life and their success remains off (Brown et al., 2011; Bechthold et al., 2017), it is time for leaving traditional research paths and seek for innovation towards solutions for overcoming the intention-behavior gap. Thus, a comprehensive study to find solutions that help people to close the intention-behavior gap and to examine the factors that cause the intention-behavior gap when trying to practice sustainable diets is needed.

1.2 Theoretical framework – the theory of planned behavior

One widely used social-psychological model for understanding human behavior including consumer decision making is the theory of planned behavior (Ajzen, 1985, 2015).

The theory of planned behavior (TPB; Figure 1) implies that fundamentally the immediate precursor of a particular behavior is the previously formed intention to perform the particular behavior. The formed intention bases on the influence of three considerations (attitude toward the behavior, subjective norm, and perceived behavioral control) and their beliefs (behavioral beliefs, normative beliefs, and control beliefs; Ajzen, 2015). What is not shown in Figure 1 are the feedback loops. Once a behavior has been performed, the gained experience in the form of information will in turn have an influence on a person’s behavioral, normative, and control beliefs and through that on future intentions and behavior (Ajzen, 2015). Also relevant are potential background factors like age, values, knowledge, culture, or media. They are expected to have effects on behavioral, normative, and control beliefs and can thereby influence people’s intentions and behavior (Ajzen, 2015). The TPB allows investigations to determine the extent to which a particular background factor influences the intention through one of the three beliefs (Ajzen and Albarracin, 2007). The crucial factor determining, if the formed intention is translated into the
corresponding behavior, is the one of actual behavioral control. Actual behavioral control refers to the ability of people to have full control over their behavior. Both, perceived behavioral control and actual behavioral control have two dimensions of control factors – internal (e.g. skills, abilities, willpower, emotions, knowledge, and compulsions) and external factors (e.g. living conditions, dependence on others, availability, time, money; Ajzen, 1985, 2002; Kidwell and Jewell, 2003).

Figure 1. Ajzen’s model of the Theory of Planned Behavior (Ajzen, 2019).

The TPB model has been applied in a large number of studies examining food choice and consumption behavior (fair trade products, animal welfare, organic food products, environmental and sustainability-related behaviors; Gorton and Barjolle, 2013; Hassan, Shiu and Shaw, 2016). By not only considering various beliefs and determinants that precede the formation of intentions but also internal and external control factors who can be responsible for creating the intention-behavior gap, it provides our research with a framework for examining and understanding dietary behavior.

1.3 Sustainable diets – state of research

By claiming a far-reaching adoption and practice of sustainable diets, it begs the question what exactly is a sustainable diet? What can be said is that the concept of sustainable diets is complex and there is currently a lot of movement in the development of a common consensus on what constitutes a sustainable diet. This is why, in the past years, more and more researchers have focused on sustainable nutrition and diets (Sarlio, 2018).

The term sustainable diets has been already phrased in 1986 by Gussow and Clancy when they attempt the first call for dietary guidelines for sustainability (Gussow and Clancy, 1986). More than 30 years ago, they stated that nutritionists should begin to address issues of sustainability and that consumers need to make
food choices that contribute to the protection of our environment (Gussow and Clancy, 1986). By making rough suggestions for dietary guidelines they intended to commence a discussion about incorporating sustainability into food guides. Their suggestions include the recommendations to (1) eat a variety of foods, (2) maintain ideal weight, (3) avoid too much fat, saturated fat, and cholesterol, (4) eat foods with adequate fiber and starch, (5) avoid too much sugar, (6) avoid too much sodium and (7) drink alcoholic beverages only in moderation (Gussow and Clancy, 1986).

Since this doctoral research was conducted in Germany, it needs to be mentioned that nutrition research and concepts that include the idea of sustainable nutrition (e.g. biodynamic agriculture by Demeter, organic food culture, nutrition ecology, wholesome nutrition) already exist in Germany for a long time and received scientific attention starting in the 1980s, due to environmental and food security policy debates. Many of the aspects included in these concepts correspond to the concept of sustainability (Rückert-John, 2011). Wholesome Nutrition, for example, is a concept of a mainly plant-based diet, where minimally processed foods are preferred. It was developed at the University of Giessen in the 1980s. The concept includes health, ecologic, economic, and social aspects and was later enhanced by the aspect of culture and seven principles of sustainable nutrition. The main food groups consumed are vegetables and fruits, whole-grain products, potatoes, legumes, and dairy products. Native cold-drawn plant oils, nuts, oleaginous seeds, and fruits should be consumed in moderate quantities. If desired, small amounts of meat, fish, and eggs can be consumed as well (von Koerber, Männle and Leitzmann, 2012). Research and publication activity was intensified in the 1990s and since the turn of the millennium (Herde, 2005; Rückert-John, 2011; Erdmann et al., 2003). Hofer (1999) described that the general principle for a sustainable nutrition needs to include aspects of health, social, and the environment as value dimensions. The Öko-Institut (1999) also demanded that a debate about sustainable nutrition should include the human right to food and to what extent production, trade relations, and consumption patterns support, enhance or prevent this right. Food safety and food security must also be included in this discussion. Jungbluth (2000) gave instructions for reducing the environmental impact of food consumption. These include avoiding fresh overseas products imported by air freight, vegetables from the greenhouse, and conserved products in glass packaging (if these cannot be refilled or recycled). In addition, consumers should reduce their meat consumption, due to the high environmental impact and food losses during processing. Purchased should be products that are produced locally or organic and are fresh or chilled (rather than frozen).

Summarizing these conducted studies’ recommendations for a sustainable food product selection, it can be said that consumers should consume fresh, organic, local, seasonal, fair trade, and low processed food products with environmentally packaging. Meat (e.g. 40 kg instead of 60 kg per capita), milk (e.g. 315 l instead of
360 l per capita), and eggs (e.g. 9 kg instead of 11.5 kg per capita) should be consumed less within a year (Erdmann et al., 2003).

The debate on sustainable nutrition in Germany has been revived by research projects like Ernährungswende in which strategies for social-ecological transformations were developed in the societal field of action environment-nutrition-health (Rückert-John, 2011). At the same time, scientists from various institutions worked on the concretion and definition of a sustainable diet. For example, the following approach, taken from the Ernährungswende project: “Sustainable nutrition is therefore environmentally friendly and healthy. Offers and supply structures, information and communication are designed on a daily basis and enable socio-cultural diversity. Sustainable nutrition contributes to a long-term satisfaction of nutritional needs and thus to a better quality of life.” (translated from German into English; Eberle et al., 2006, p. 54). Until then, it was not possible to agree on a definition of sustainable nutrition within Germany. Therefore, the criteria for sustainable nutrition were further specified. Herde (2005), for example, defined criteria for general principles (social justice, preservation of cultural diversity and gender equality), food characteristics (fresh, regional, seasonal, organic and genetically unmodified), the composition of the food (varied, adequate nutrition, plenty plant-based foods and drinks, moderately animal foods, sparingly fat and sugary foods, several small meals a day), pre-preparation (fair prices for food, go groceries shopping by foot, by bicycle or by public transport, proper storage of food), preparation (energy-conscious cooking behavior, aspects of nutritional culture, a balance between ready meals and home-cooked meals) and post-preparation (waste prevention before waste recycling, returnable or cardboard packaging).

For a long time, the concept of sustainable nutrition has not really been pursued on an international level, until 2010, when a milestone was reached. The Food and Agriculture Organization of the United Nations (FAO) and Bioversity International organized an international scientific symposium on Biodiversity and Sustainable Diets: United Against Hunger (FAO, 2012). One of the purposes was to reach a consensus on a definition of sustainable diets, which has been achieved: “Sustainable Diets are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources.” (FAO, 2012, p. 7). In addition to the definition, FAO published a schematic representation of the key components of a sustainable diet, that includes (1) well-being, health, (2) biodiversity, environment, climate, (3) equity, fair trade, (4) eco-friendly, local, seasonal foods, (5) cultural heritage, skills and (6) food and nutrient needs, food security, accessibility (Figure 2).
Both, the definition and the schematic representation make it clear that all included attributes are interdependent (FAO, 2012). To get to a broader understanding of sustainable diets, Johnston, Fanzo and Cogill (2014) examined determinants, factors, and processes that influence the key components of a sustainable diet. It can be seen in Figure 3, that the key components and their contained factors and processes are building a complex construct behind the term sustainable diets.
Figure 3. The key components, determinants, factors and processes of a sustainable diet (Johnston, Fanzo and Cogill, 2014).

In 2017, Mason and Lang have also published a schematic representation of issues, which come into play with sustainable diets (Figure 4). Again, the complex interdependency is represented by an overlapping of the key features (of health, social values, quality, environment, governance, and economy) and their determinants (Mason and Lang, 2017).
Meanwhile, researchers also worked on the perspective of dimensions of sustainable diets and nutrition. For example, von Koerber published a refined version of his workgroup’s concept of sustainable nutrition in 2014 (von Koerber, 2014). It includes health, society, economy, environment, and culture as the five dimensions of sustainable nutrition (Figure 5).
Published in 2018, Sarlio has also included dimensions in her concept of a sustainable and healthy diet. Within her work, a sustainable and healthy diet consists of people, plates and the planet, surrounded by the chosen conditions that the production and supply of sustainable food should be practiced within planetary boundaries and consider global justice and food security, health and well-being, food’s nutritional quality and safety as well as food’s social and cultural acceptability (Sarlio, 2018).
Although publishing all these different illustrations over the last years, there is a consensus, that there cannot be just one sustainable diet. Sustainable diets show variations in their compositions that are for example environment- or culture-related (Lang, 2014). Yet, it is still not clear what exactly constitutes a sustainable diet and how it looks like in real life. Therefore, Garnett named a number of issues within the fields of nutrition, environment, economy & food supply, society & ethics, and other food related health, that need to be considered when a sustainable diet is defined (Figure 7; Garnett, 2014b).
In general, diets are considered to be sustainable when they consist of fewer animal and more plant-based foods. The purpose of health seems to be essential when it comes to the aims of sustainable diets (Mason and Lang, 2017). Besides reducing diet-related mortality, these diets have benefits in reducing greenhouse gas emissions (Hedenus, Wirsenius and Johansson, 2014; Tilman and Clark, 2014; Springmann et al., 2016).

Focusing on actual practicing sustainable diets in everyday life, several recommendations exist. Friel, Barosh and Lawrence had developed three guiding principles when trying to develop a healthy and sustainable diet, including “[1.] Any food that is consumed above a person’s energy requirement represents an avoidable environmental burden in the form of GHG emissions, use of natural resources and pressure on biodiversity. [2.] Reducing the consumption of discretionary food choices, which are energy-dense and highly processed and packaged, reduces both the risk of dietary imbalances and the use of environmental resources. [3.] A diet comprising less animal- and more plant-derived foods delivers both health and ecological benefits.” (Friel, Barosh and Lawrence, 2014 p. 4).
From this rather abstract principles, other researchers had more detailed recommendations on how to implement a sustainable diet. Garnett published characteristics of healthier and less greenhouse gas and land-intensive eating patterns in 2014, with the suggestion that for more detailed guidelines the cultural and geographical contexts, individual nutritional requirements, and preferences need to be considered (Garnett, 2014a). The general principles include eating a wide variety of food, achieve a balance between energy intake and energy needs, eat minimally processed tubers and whole grains, legumes, fruits, vegetables, unsalted seeds and nuts, eat meat sparingly and dairy products in moderation, eat small quantities of fish and aquatic products sourced from certified fisheries, eat only limited amounts of foods high in fat, sugar or salt and low in micronutrients, eat oils and fats with a beneficial Omega 3:6 ratio such as rapeseed and olive oil and prefer to drink tap water (Garnett, 2014a).


In a more recent publication, the EAT-Lancet Commission addresses the challenge to provide the global population with healthy diets deriving from sustainable food systems within a safe operating space (planetary boundaries). A healthy reference diet is described, that is intended as a universal basis for individual adoption (e.g. due to cultural traditions or dietary preferences within omnivore, vegetarian or vegan diets; Willet et al., 2019). The Commission issued recommendations (with possible ranges) for macronutrient intake and caloric intake of 2500 kcal per day for food groups like whole grains, tubers or starchy vegetables, vegetables (dark green, red and orange and others), fruits, dairy foods (whole milk or derivative equivalents e.g. egg and cheese), protein sources (beef and lamb, pork, chicken and other poultry, eggs, fish, legumes like dry beans, lentils and peas, soy foods, peanuts and tree nuts), added fats (palm oil, unsaturated oils, dairy fats (included in milk), lard or tallow) and added sugars (Willet et al., 2019). It is explicitly stated that the healthy reference diet doesn’t prescribe an exact diet or that everyone on this planet should eat the same food. Quite the contrary, within the mentioned food groups, individual and local adoption is essential for suiting cultural, geographic, and demographic conditions (EAT-Lancet Commission, 2019).

How to practice a sustainable diet becomes even more concrete when we focus on the Mediterranean diet and the New Nordic diet, two well-known examples of sustainable diets. The Mediterranean diet (MD) is diverse and varies from country to country because it considers the different local environments and
economies, as well as social and cultural aspects (Dernini et al., 2013; Dernini and Berry, 2015). Therefore, it can be said that the MD is a complex web of interdependent nutritional, cultural, historical, economic, political, and religious aspects that all somehow interact within Mediterranean food systems when the diet is being practiced (Medina, 2015). These are some of the reasons, why in 2010, the MD was acknowledged as a UNESCO Intangible Cultural Heritage of Humanity (Gamboni, Carimi and Migliorini, 2012).

Also, in 2010 a new MD pyramid (Figure 8), that establishes dietary daily, weekly and occasional guidelines in order to follow for practicing a MD, was developed (Bach-Faig et al., 2011). The pyramid framework gives also recommendations for portion sizes, socialization, cooking, seasonality, biodiversity, eco-friendliness, traditional and local food products, activity, and resting (Bach-Faig et al., 2011). The framework can be adapted to every Mediterranean country and its variations related to the geographical, socio-economic, and cultural contexts of its regions (Bach-Faig et al., 2011).

Common dietary characteristics of MDs are a high amount of olive oil and olives, fruits, vegetables, cereals (mostly unrefined), legumes and nuts, moderate amounts of fish and dairy products, low quantities of meat and meat products and wine in moderation (when consistent with religious and social norms; Dernini and Berry, 2015). More detailed are the 10 basic nutritional principles,
posted by the Fundación Dieta Mediterránea, that should be followed, when practicing a MD: “[1.] Use olive oil as your main source of added fat. [2.] Eat plenty of fruits and vegetables, legumes and nuts. [3.] Bread and other grain products (pasta, rice, and whole grains) should be a part of your everyday diet. [4.] Eat foods that have undergone minimal processing, that are fresh and locally produced are best. [5.] Consume dairy products on a daily basis, mainly yogurt and cheese. [6.] Red meat should be consumed in moderation and if possible as a part of stews and other recipes. [7.] Consume fish abundantly and eggs in moderation. [8.] Fresh fruit should be your everyday dessert and, sweets, cakes and dairy desserts should be consumed only on occasion. [9.] Water is the beverage par excellence in the Mediterranean Diet. Wine should be taken in moderations and with meals. [10.] Be physically active every day, since it is just as important as eating well.” (Fundación Dieta Mediterránea, no date). The Med Diet 4.0 framework was developed between 2014-2015 for revitalizing the MD and to strive against the westernization of the traditional MD. It provides a multidimensional approach for education and communicating the multiple sustainable benefits of the MD (Dernini et al., 2017). The framework provides four sustainable benefits that are strongly interdependent and resulting from the diverse Mediterranean food systems: “(i) well-documented nutrition and health advantages, preventing chronic and degenerative diseases and reducing public health costs; (ii) low environmental impacts and richness in biodiversity, reducing pressure on natural resources and climate change; (iii) positive local economic returns, reducing rural poverty; and (iv) high social and cultural food values, increasing appreciation, mutual respect and social inclusion.” (Dernini et al., 2019, p. 188-189). Today, the MD is an important example for a sustainable diet because of its philosophy of sustainability and contribution to real food security (Gamboni, Carimi and Migliorini, 2012). It understands local food systems and it provides opportunities for conserving diversity in the cultural knowledge of foods and diets (Burlingame and Dernini, 2011). Summarizing, the MD can be considered as a sustainable diet because of “(i) a great diversity that ensures food nutritional quality of diet and biodiversity, (ii) a variety of food practices and food preparation techniques, (iii) main foodstuffs demonstrated as beneficial to health as olive oil, fish, fruits and vegetables, pulses, fermented milk, spices, (iv) a strong commitment to culture and traditions, (v) respect for human nature and seasonality, (vi) a diversity of landscapes that contribute to the wellbeing, (vii) a diet with low environmental impact due to low consumption of animal products.” (Padilla, Capone and Palma, 2012, p. 231).

The second example of a sustainable diet is the New Nordic Diet (NND). The NND is similar to the MD because it shares the thinking and essentials, but utilizes the ingredients and flavors of northern countries. As a regional diet it is taking health, food culture, palatability, and the environment into account (Bügel et al., 2016). In 2003, Nordic chefs formulated the New Nordic Cuisine Manifesto, which was adopted by the Nordic Council of Ministers in 2005, as the ideology of the New Nordic Food program (Bügel et al., 2016). Nordic chefs, scientists,
politicians, and public movements have been successful in defining a NND, by reintroducing and redefining food items already growing or living in Nordic regions (Bügel et al., 2016). The NND builds on the key principles that the food is of Nordic identity, of high gastronomic quality, sustainable, and healthy (Bügel et al., 2016). Similar to the MD, the principles for the NND can be applied in any region within the Nordic countries (Mithril et al., 2012). Today, the Ministry of Food Agriculture and Fisheries of Denmark launched 10 dietary guidelines that follow the key principles for the NND: “[1.] More fruit and vegetables every day [2.] More whole-grain produce [3.] More food from the seas and lakes [4.] Higher-quality meat, and less of it [5.] More food from wild landscapes [6.] Organic produce whenever possible [7.] Avoid food additives [8.] More meals based on seasonal produce [9.] More home-cooked food [10.] Less waste.” (Ministry of Food Agriculture and Fisheries of Denmark, no date, p.2).

Also discussed and examined more and more, are the possible contributions from the organic sector or food systems to practice sustainable diets (Gamboni, 2015; Kahl, 2015; Meier-Ploeger, 2006; Paolletti, 2015; Strassner, 2015; Strassner et al., 2015). What can be said so far is that organic food systems provide essential requirements of a sustainable diet, by producing sustainable and health-promoting food (Strassner et al., 2015). It has been shown that regular consumers of organic products practice overall a more plant-based diet, have in general a healthier lifestyle and thus a better compliance with the concept of sustainable diets (Seconda et al., 2019a; Lairon and Kesse-Guyot, 2015; Strassner et al., 2015). Currently, the need of developing sustainable dietary guidelines seems to be one research priority. Including sustainability issues into dietary guidelines ties in with Gussow’s and Clancy’s call to do so back in 1986. Today we need them more than ever as an essential foundation for developing food and nutrition policy action (Macdiarmid et al., 2012; Fischer and Garnett, 2016; Hyland et al., 2017; Mason and Lang, 2017; Meybeck and Gitz, 2017; Seed and Rocha, 2018), as well as for helping consumers implementing sustainable diets (Lang, 2012; Mason and Lang, 2017; Seed and Rocha, 2018). Therefore, broad guiding principles could be the basis, which can then be differentiated at country and local level and thus adapted to the respective circumstances (Mason and Lang, 2017).

Recently, countries like Sweden, Brazil, and Germany have started to incorporate sustainability considerations into their FBDGs and food policies (FAO, no date; Fischer and Garnett, 2016). Other countries like the Netherlands are currently developing healthy and sustainable FBDGs (Brink et al., 2019). Yet, many countries have no official FBDGs at all (Fischer and Garnett, 2016). The recommendations made (e.g. mainly plant-based diet, seasonal and local foods, reduction of food waste, reduction of highly-processed foods and sugar-sweetened beverages), are mainly focusing on the nutrition and environment dimension of sustainable diets (FAO, no date).

For an overall and far-reaching change towards sustainable diets and food systems, every country needs to establish sustainable dietary guidelines, that follow the same basic principles but are locally and culturally adapted (Mason...
and Lang, 2017). Latest recommendations for the development of sustainable dietary guidelines state that they should be owned by the government and be approved and supported by several government departments, as this is important for further policy development (Fischer and Garnett, 2016; Mason and Lang, 2017). Food policies should then aim industry standards, public sector procurement, school and hospital meals, and advertising regulations (Fischer and Garnett, 2016; Mason and Lang, 2017). Although the guidelines are to be owned by the government, they need to be developed in collaboration with a diverse range of academic expertise (Fischer and Garnett, 2016) and be promoted in a way that as many people as possible know them (Mason and Lang, 2017). Future guidelines should contain realizable recommendations, but still aiming at making a real change towards sustainable dietary patterns. Therefore, guidance on limiting meat consumption, dietary diversity, food waste reduction, safe and energy-efficient food preparation, food planning, food shopping, and the importance of food in our lives and cultures are needed. Overall, it is important to make suggestions on how these changes can be made and implemented in daily nutrition (Fischer and Garnett, 2016; Mason and Lang, 2017).

Despite the documented progress in research on sustainable diets, many questions remain open and research in specific areas is still needed. That is why there are still many gaps in our understanding of what a sustainable diet might comprise today. To connect to previously described, country-specific and local guidelines for sustainable diets must be established that implement the FAO definition (Ridoutt and Huang, 2019). Moreover, it needs to be clarified what constitutes a sustainable diet in terms of quality and quantity (Mason and Lang, 2017). There are already a few approaches to measure or assess the sustainability of diets (Dernini et al., 2013; Lairon and Berry, 2015; Jones et al., 2016; Seconda et al., 2019b; Eme et al., 2019), but we need to be able to identify sustainable food items, which requires a specific evaluation tool, that facilitates data collection on individual food items (Masset et al., 2014). Speaking of individual food items, the need for eating less meat and other animal products requires strategies that address social and cultural values and beliefs to achieve a general transition to sustainable diets. Otherwise, there will remain a long-term resistance to a change in dietary habits (Macdiarmid, Douglas and Campbell, 2016; Mason and Lang, 2017; Kevany, Baur and Wang, 2019). It must also be clearly stated, that each individual has to be open minded and accept dietary changes that are necessary (Masset et al., 2014). Since the concept of sustainable diets consists of complex social, cultural, environmental, and other factors (Mason and Lang, 2017), people need support for practicing these diets (Mason and Lang, 2017). However, consumer, stakeholder, and government interests are currently competing within food systems and are more likely to hinder a development towards sustainable food systems and diets (Johnston, Fanzo and Cogill, 2014). Therefore, the transition to sustainable diet practice is depending on data-driven and evidence-based solutions, that are inspiring and realistic (Kevany, Baur and Wang, 2019), as well as on supportive policies, that address sustainable food
systems and dietary issues (Reisch, Eberle and Lorek, 2013). Studies, examining the sustainability of diets, also need to focus on factors such as land and water use, water quality, biodiversity, economic and social impacts, and not only on health and GHG emissions (Meybeck and Gitz, 2017). Therefore, researchers from different fields like economics, social sciences, nutrition science, agricultural science, environmental science as well as animal science need to be involved, as well as actors from government, food industry, research organizations, United Nations, educators, nutritionists and civil society (Clonan and Holdsworth, 2012; Auestad and Fulgoni, 2015; Alsaffar, 2016; Kevany, Baur and Wang, 2019). The empirical support obtained from such studies is needed for information-based policy action. Policymakers are also playing a key role in promoting strategies for sustainable diets (Johns and Eyzaguirre, 2006; Reisch, Eberle and Lorek, 2013; Johnston, Fanzo and Cogill, 2014; Alsaffar, 2016; Ridoutt and Huang, 2019). But first strategies for implementing programs that promote sustainable diets need to be developed as well as the assignment of coordination and commitment of all involved actors (Johnston, Fanzo and Cogill, 2014). When implementing commitments towards establishing sustainable diets, both, food production and consumption need to be positively influenced or changed. This includes agricultural practices, policies, technology, and innovation; fiscal policies and tools, like taxes and subsidies; public procurement, using the potential for a large-scale impact at individual, community, and national levels; choice architecture and nudging, to alter the choice architecture of our food environment; and education and information to help to make informed choices (Sarlio, 2018). Within the field of education and information, it is important to realize, that nutritionists have to take up a key role in delivering diet-related messages to the civil society (Clonan and Holdsworth, 2012). At the same time, educational programs also need to be supported by other stakeholders, multipliers, and consumers (von Koerber, Bader and Leitzmann, 2017). The European Public Health Association summarized the actions that need to be taken to implement sustainable diets under the four levels of consumers, supply-chain participants, policies, and values (Figure 9). The level of value, including e.g. establishing a culture of healthy living and embrace equitable solutions, adds another important aspect to the call to action (EUPHA, 2017).
1.4 Research gaps

This doctoral research identifies two major research gaps related to the practice of sustainable diets. These concern the barriers causing the intention-behavior gap when trying to practice sustainable diets and especially finding solutions for closing the intention-behavior gap. Within the scientific literature, there is
already a call for more research to identify the dietary changes that are needed to achieve sustainable diets that are at the same time culturally feasible and acceptable. Besides the prior mentioned lack in understanding the composition of sustainable diets, there is a huge gap in understanding barriers, determinants and entry points towards sustainable diets and especially, how sustainable diets can be practiced daily within our food systems (Johnston, Fanzo and Cogill, 2014; Fischer and Garnett, 2016; Leng et al., 2017; Mason and Lang, 2017). In particular, the barriers that prevent the practice of sustainable diets need to be explored more closely, and appropriate solutions must be developed (Grunert, 2011). Because of our literature review, we can tell some reasons why people fail to practice sustainable diets, meaning the identification of certain barriers, and this is partly examined. However, developing tools or other supportive strategies to close the intention-behavior gap, has not been done yet. This requires theoretical and practical innovations, that support people’s behavior change (Rothman, 2004). Thus, this doctoral research is going new paths of research strategies to gain an understanding of how people can overcome the intention-behavior gap when trying to practice sustainable diets. This is particularly important as it raises the question of how to achieve a far-reaching adoption of sustainable diets if even the people who have already developed the intention to practice a sustainable diet are unable to do so. This is why this doctoral research attempts to develop solutions to the dilemma of the intention-behavior gap.

1.5 Objectives and structure of the thesis

The overall objective of this doctoral research is to address the research gap of closing the intention-behavior gap by developing solutions and gain a better understanding of the barriers interfering when people are trying to practice sustainable diets. This doctoral research is composed of three research papers (Chapter 3, 4, and 5). Within the research papers, the following research questions and objectives have been worked on:

1. What can we learn or even adopt from open innovation processes for the purpose of involving stakeholders in the development process of a dietary adoption concept?
   a. To examine academic literature of open innovation to gain information about the methods that enable the performance of open innovation processes.
   b. To examine academic literature of open innovation to gain information about the application of open innovation especially in the food sector.
   c. To analyze the various methods of open innovation based on set criteria related to the dietary adoption concept.
d. To reveal how the methods of open innovation can be usefully applied, to integrate consumers in the development process of ideas/ solutions for closing the intention-behavior gap.

e. To make well-founded recommendations for a feasible research study design.

2. How can we close the intention-behavior gap when it comes to adopting sustainable diets?

a. To develop specific ideas in answer to the research question, more precisely: innovative ideas that help to deal with the barriers creating the intention-behavior gap.

b. To receive ideas in the form of realistic, useful tips that enable people to translate their behavioral intention into actual behavior despite emerging situational barriers.

c. To build the basis for a kind of toolkit that could promote the adoption of sustainable diets and, along with that, the transformation towards sustainable food systems.

3. Exploring external factors affecting the intention-behavior gap when trying to adopt a sustainable diet: a think aloud study

1.1 How do people assess the influence of the factor (availability, education, advertising, price) on the intention-behavior gap regarding the practice of sustainable diets?

1.2 Can people give tips on how to prevent the emergence of an intention-behavior gap caused by the corresponding factor (availability, education, advertising, price), and if yes, how?

1.3 Would it be easier for people to consistently implement a sustainable diet or more likely that the intention-behavior gap doesn’t occur if the external factors (availability, education, advertising, price) wouldn’t create any barriers?

1.4 What other potential external factors are people aware of, that can create an intention-behavior gap regarding the practice of a sustainable diet?

1.5 To what extent do people share the attitude of the following motto: The external factors have to be changed first before I can change something?

1.6 What factors are more decisive in causing the intention-behavior gap, external or internal factors?

   a. To explore the external factors availability, education, advertising, and price that can cause the emergence of an intention-behavior gap while people are trying to nourish themselves sustainably.

   b. To collect tips on how to prevent the emergence of an intention-behavior gap caused by the factors availability, education, advertising, and price.
c. To gain a better understanding of the factors availability, education, advertising, and price in order to be able to make more targeted and valuable recommendations for stakeholder and policy action.
2 Materials and Methods

This research study seeks to reveal ways to support people’s attempt to practice sustainable diets, by closing the gap between intention and behavior that occur when trying to do so. Therefore, this research study was conducted with an interdisciplinary research approach. It consists of applying innovation and social science research methods.

With the outcome of this study, we intend to contribute to the overall goal of sustainable development. Since sustainable development is an extreme challenge for societies (United Nations, 1987), it seems appropriate that society members get involved in such research processes when aiming for a successful process of transformation. For a truly sustainable development that requires a change in the current state, innovative strategies are needed and new paths have to be explored (Lowe, Phillipson and Lee, 2008; Ericksen, Ingram and Liverman, 2009), especially when it comes to dealing with something complex like the intention-behavior gap in nutrition behavior. Besides, consumers play an increasingly significant role in the discussion about sustainable development. That is so because their role as potential influencers of companies and corporate behavior is gaining more and more importance (Schrader, 2007). Within the last years creating new ideas and innovations through collective creativity applied within co-creation processes got a lot of attention from companies and also academia (Antikainen and Niemelä, 2017). To understand people’s needs and what could really support the adoption process of a sustainable diet in their everyday life, we decided that they can be directly involved in the idea generation process. Searching for a suitable approach to create ideas for bridging the intention-behavior gap, we decided to choose the following research strategy:

Starting in 2016, we examined literature on open innovation itself, in both English and German scientific literature. Getting deeper into the subject matter, we focused on how open innovation can be performed and by what methods. Based on the results of the first paper, we decided to conduct participative workshops for idea generation, since to our knowledge, there is no application of this open innovation method regarding our research objective. Our further research included an investigation in creativity methods to build a basis for developing our workshop designs. The first data collection from the workshops took place from September to December 2016.

The gained results were not matching with the research objectives, as they were not providing direct applicable and practical solutions to the addressed problem. Nevertheless, we were able to use the data by coding the results as internal and external factors influencing the behavior. Furthermore, the result of the coding revealed that participants located the responsibility for the intention-behavior gap primarily in the external factors. As a consequence, we decided to adjust our research direction by taking one step back and laying the focus for our third paper on the external factors that cause the intention-behavior gap. Within a
mixed-method approach consisting of a think aloud study including questionnaires and follow-up interviews, we aimed to explore selected external factors and how to overcome them. Therefore, the second data collection took place from January to February 2019.

The following Chapters 3, 4 and 5 each contain sections on materials and methods with a more detailed description.
3 Involving stakeholders in the development of a dietary adoption concept: What can we learn from open innovation?

Journal: World Review of Science, Technology and Sustainable Development
Submitted: 28 May 2018
Published: 24 April 2019 (online)

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3.1 Abstract

Part of the transformation to sustainable food systems is to increase the adoption rate of sustainable diets ideally by choice. At the same time evidence in the field of behavioural science shows that people have trouble translating their intentions into actual behaviour. This phenomenon, known as the intention-behaviour gap, is based on a number of barriers that influence actual behaviour. In search of an appropriate methodology to develop a dietary adoption concept supporting people’s diet adoption processes, we examined the concept and especially the methods of open innovation, commonly applied in modern product and service development. This paper is about what we can learn or even transfer from open innovation to develop a dietary adoption concept. We reveal how the methods of open innovation can be usefully applied, such as integrating lead-users in the development process to let them find solutions to bridge the intention-behaviour gap.
Keywords: consumer involvement; sustainable diets; intention-behaviour gap; open innovation; sustainable development.

3.2 Introduction

Worldwide our industrialised agricultural food production and dietary consumption patterns are causing many problems (HLPE, 2017; FAO, 2017). The way in which people eat has a significant impact on their own health (FAO, 2016; WHO, 2003). Unbalanced diets can be risk factors for cardiovascular diseases, diabetes mellitus type II or cancer (WHO, 2003). In addition to human health, our eating patterns also have impacts on natural resources and biodiversity (Tilman and Clark, 2014). That is because our different diets cause a global demand on food, which partially shapes our food systems and along with that our agricultural practices. Unfortunately, our current food systems do not meet our nutritional recommendations, overall, they are neither health promoting nor sustainable. Besides the environmental impacts of industrial agriculture such as pollution of water and soil (Canter, 2018) we have at the same time malnutrition and overeating worldwide causing different diseases and trouble with food security (Development Initiatives, 2017). A solution to this controversial situation becomes more important with regard to the projected nearly 9.8 billion people expected to live on the planet in 2050 (United Nations, Department of Economic and Social Affairs, Population Division, 2017) and also, if we seriously want to achieve the UN Sustainable Development Goals, such as ending hunger and ensuring sustainable food production systems by 2030 (United Nations, 2015).

What we need for now and future generations are sustainable food systems ‘(...) that ensure[s] food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised’ [HLPE, (2014), p.31]. If the type of farming and its outcomes shape the type of diet and vice versa (Strassner et al., 2015), then it can also be said that besides a more sustainable agriculture we need a higher adoption rate of sustainable diets. Only then will we strengthen the demand on sustainable agricultural production and the expansion and practice of sustainable food systems (Röös et al., 2017; Meybeck and Gitz, 2017).

This is a tremendous challenge. Tackling it starts amongst others with every one of us as individuals who would be amenable to changing our eating patterns and increasing the overall adoption rate of health supporting and sustainable diets (Lang, 2012). Globally, we notice a growing awareness for sustainable consumption and interest in procuring sustainable products in general. However, people do not always translate their good intentions into appropriate behaviour (Loy et al., 2016). There is a variety of reasons, called barriers, implicated (Aschemann-Witzel and Niebuhr Aagaard, 2014; Carrington et al., 2010). These barriers cause the widely occurring phenomenon known as the intention-behaviour gap which needs to be bridged, especially when it comes to
the adoption of health-supporting and sustainable diets. To bridge or even close the gap, people need some kind of support during the process of diet adoption (Sniehotta et al., 2005; Godin et al., 2005). Because there are different kinds of barriers we have to consider a wide range of individual needs during the process of diet adoption. To meet those real needs, it can be supportive to develop a dietary adoption concept that provides us with tools and information as well as training instructions to acquire skills. To develop such a concept an open approach that enables the involvement of people in the development process seems reasonable. It can be argued that people are aware of these needs and that sustainable development in all of its facets is a challenging social process requiring active human agency (United Nations, 1987). We also need real innovation in these processes of change instead of repeating the same research strategies over and over again, thinking that we can successfully initiate a change in the world from the ivory tower of our scientific disciplines (Lowe et al., 2008; Ericksen et al., 2009). One approach that has the reputation of being able to generate real innovations by breaking down field or company boundaries and enabling people to collaborate, is called open innovation (Chesbrough, 2006; Gassmann et al., 2010; Enkel et al., 2009). Open innovation is mainly used to involve stakeholders in product development processes, where its application brings many benefits for the operating company (Chesbrough, 2006). Since, to our knowledge, there is no application of open innovation regarding our research agenda (developing a dietary adoption concept), this paper is intended to serve as a first theoretical investigation. Consequently, the aim of this paper is to explore if there is anything we can learn or even adopt from open innovation processes for the purpose of involving stakeholders in the development process of a dietary adoption concept. Therefore, the objectives are to examine the academic literature of open innovation to gain information about the methods that enable the performance of open innovation processes and about the application of open innovation especially in the food sector. This serves the objective of analysing the various methods on the basis of set criteria related to the dietary adoption concept. Finally, we will be able to make well-founded recommendations for a feasible research study design.

This paper is structured as follows. First we provide the theoretical background on what we understand as a dietary adoption concept, the theories of human behaviour and behavioural change, the intention-behaviour gap and open innovation and its methods. Next we present our results from the review of extant literature on open innovation with a special focus on linking open innovation to the development process of a dietary adoption concept. Then, we analyse our findings in terms of relevant studies and discuss a possible research study design for implementing open innovation methods for our research purpose. Finally, we draw conclusions and give research recommendations.
3.3 Theoretical background

3.3.1 Dietary adoption concept for sustainable diets

Sustainable diets are defined as “(…) those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimising natural and human resources” [FAO, (2012), p.7]. This international definition is far from being practicable for people to use on an individual level. That is why researchers are striving to integrate sustainability principles within existing national dietary guidelines as well as non-official guidelines like Barilla’s Double Pyramid Recommendations for a Sustainable Diet and WWF’s LiveWell for LIFE (Seed and Rocha, 2018; Fischer and Garnett, 2016). Food-based dietary guidelines, dietary recommendations and visual food guides like pyramids or plates are the current basis for guiding people’s behaviour and also policy activities (Seed and Rocha, 2018). Therefore, it is important that they are tailored to local conditions (national, regional and local level) and target groups (children, adults, elderly, pregnant women, etc.) (Meybeck and Gitz, 2017; Seed and Rocha, 2018; Fischer and Garnett, 2016; Mason and Lang, 2017). Obviously, there cannot be just one sustainable diet, as existing examples like the traditional Mediterranean and the New Nordic Diet show (WHO, 2018; Garnett, 2014). Guidelines for diets need to be practical and flexible to be viable for people (WHO, 1998). Having this in mind and seeing people struggling with the intention-behaviour gap, we see a need for dietary adoption concepts. To our understanding a dietary adoption concept can be seen as a guide supporting individual behavioural change. It serves the continuous long-term adoption of a sustainable diet by extending the already existing information to tools, helping people to bridge the intention-behaviour gap. These tools can be ready-to-use tips in the form of helpful hints coming from practical experience as well as training instructions to gain skills for a better understanding of how to implement a sustainable diet.

3.3.2 Theories of behaviour and behaviour change

In the last decades, theories have been developed to understand human behaviour (Kollmuss and Agyeman, 2002). According to most of them, people’s behaviour relates strongly to their intentions (Sheeran, 2002). When we discuss or address the intention-behaviour gap, we need these theories to understand why and how behaviours can change or differ from the intentions. The most widely cited and applied theories are the Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975; Ajzen and Fishbein, 1980) and the Theory of Planned Behaviour (TPB) (Ajzen, 1985), whereby TPB is a form of the TRA that
has been developed further. Both theories are applied in health-related research (Godin and Kok, 1996; Conner and Sparks, 1996), nutrition intervention (McConnon et al., 2012; Conner et al., 2002), pro-environmental behaviour (Oreg and Katz-Gerro, 2006; de Leeuw et al., 2015; Harland et al., 2006) and sustainability behaviour (Rex et al., 2015). Since these fields of application fit with our research agenda of supporting the adoption of sustainable diets they are further elaborated on.

The TRA assumes that behavioural intentions lead to behaviour. Thereby behavioural intentions base on two antecedents, namely attitude and subjective norms. Both have an indirect influence on the behaviour because of their impact on the intention. The TRA further assumes that people have volitional control over the desired behaviour, so that they can easily perform the preferred behaviour if they so desire (Fishbein and Ajzen, 1975; Ajzen and Fishbein, 1980). Ajzen (1985) further developed the TRA to the TPB. He added perceived behavioural control as the third antecedent besides attitudes and subjective norms (Madden et al., 1992). Similarly to the TRA the TPB also assumes that behavioural intentions are the most important preliminary stage for leading to the desired behaviour. Nevertheless, it differs in that TPB includes the possibility that people may not always have full control over performing the desired behaviour that meets their intentions (Sheeran, 2002). This is because of the direct link between the perceived behavioural control and the behaviour (Ajzen, 1985).

Both theories propose that the most important aspect of performing the desired behaviour is the behavioural intentions. According to Madden et al. (1992), the TPB is superior to the TRA when it comes to explaining the expression of the targeted behaviour or to identify strategies for changing the behaviour.

3.3.3 The intention-behaviour gap

The terminology of the intention-behaviour gap describes the phenomenon that people’s behavioural intentions and their actual behaviour do not match. Behavioural intentions describe people's decisions on specific action and can be labelled as the motivation to behaviour performance. Therefore, behavioural intentions encompass the direction and the intensity of a behavioural decision (Sheeran, 2002). Generally, people build intentions to perform a specific behaviour. However, often people fail to translate their intentions into corresponding behaviour and thus there is a discrepancy between the intention and the behaviour (Sheeran and Webb, 2016).

3.3.3.1 Barriers creating the intention-behaviour gap and approaches to bridging it

According to Sheeran and Webb (2016), the intention-behaviour gap is so large that just half of the time intentions are translated into the desired behavioural action. Thus, barriers must be strong enough to cut the relation between
intentions and behaviour. Many barriers can create the gap between the intention and the behaviour. Generally spoken, barriers can be habits or something that makes people forget their intentions or miss their chance for action (Loy et al., 2016). Barriers can be external or personal reasons and differ amongst individuals. More specifically, barriers can differ along the same behavioural intention. For example, if one has the intention to buy organic food, barriers for not buying can be the price, a lack of information, poor presentation or low availability (Padel and Foster, 2005).

Since intentions have been identified as the most important predictor of behaviour, the question arises what kind of interventions could support people to overcome the gap between intention and behaviour and strengthen the intentions influence on the behaviour. What strategies for behavioural change can be used to overcome the obstacles and bridge the intention-behaviour gap? Researchers have developed approaches, based on three different identified key aspects that can be used to bridge the gap between intention and behaviour. These are detailed action planning, perceived self-efficacy and action control (Sniehotta et al., 2005).

Detailed action planning bases on the observation that behavioural intentions are more likely translated into action when people develop action plans before the situation for acting arises (Zhou et al., 2015; Sniehotta et al., 2006). It is also common practice that the action plans follow the SMART principles known from project management (Zhou et al., 2015).

Perceived self-efficacy concerns peoples’ beliefs or confidence in their own skills to perform specific behaviour. Like detailed action planning it is a prospective process (Bandura, 1997). It is also considered a motivational variable (Reyes Fernández et al., 2014). According to Bandura (1997), persons with a strong self-efficacy set clear goals, monitor themselves with optimism and spend much effort in goal achievement.

Action control is a concept that bases on self-regulatory strategies containing three facets: awareness of standards (goals), self-monitoring of progress and self-regulatory effort (Sniehotta et al., 2005). That means that the ongoing behaviour is constantly evaluated by self-monitoring (Sheeran and Webb, 2016). Action control can mediate the influence of intentions, planning, and self-efficacy (Sniehotta et al., 2005). That is why action control can be seen as the most proximal volitional predictor of behaviour (Bandura, 1997).

3.3.4 Open innovation

“Open innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology” [Chesbrough, (2003), p.xxiv]. Chesbrough (2003) and Hilgers and Piller (2009) describe open innovation to mean that valuable ideas for product or process innovation can come from inside and outside a company. That means that external ideas are as important as
internal ideas for the innovating firm. He also developed the open innovation paradigm based on the opposite, the closed innovation paradigm (Figure 1). The illustration of the open innovation paradigm shows that sources of knowledge outside the firm’s boundaries are involved in the research and development during an innovation process.

Figure 1 The closed and open innovation paradigm

![The Closed Paradigm for Managing Industrial R&D](image1) ![The Open Innovation Paradigm for Managing Industrial R&D](image2)

Source: Chesbrough (2003)

Open innovation is also the use of purposive inflows and outflows of knowledge to accelerate internal innovation (Chesbrough, 2006). This additional description arises from the facts that have been learnt from the practice of open innovation and underline the flow of knowledge within the open innovation process (West et al., 2014). Recently the open innovation process was redefined as a distributed innovation process that bases on purposively managed knowledge flows across organisational boundaries, by using pecuniary and non-pecuniary mechanisms in line with the organisation’s business model (Chesbrough and Bogers, 2014). There is a lot of research about open innovation (Tidd and Bessant, 2014) and different open innovation approaches have been published since Chesbrough first coined the term in 2003. It was followed by a more detailed classification of open innovation. Based on empirical research three core processes for open innovation have been identified (Gassmann and Enkel, 2004; Faber, 2008). These are the outside-in process, inside-out process and the coupled process. The outside-in process describes the utilisation of external knowledge by involving customers, suppliers and other sources of external knowledge to increase the innovativeness of a firm. The inside-out process stands for externalising the firm’s knowledge by taking out ideas or selling innovative products to other firms. The coupled process stands for a combination of both processes (Gassmann and Enkel, 2004). When it comes to practice, it is important for a firm to know what kind of process is more suitable and what capabilities are needed for a successful application. Each of the core processes needs a different
capability of the firm’s management: absorptive capability (outside-in process), multiplicative capability (inside-out process) and relational capacity (coupled process) (Gassmann and Enkel, 2004).

Considering firms, the sectors of open innovation application are typically pioneering industries for software, electronics, telecommunications, pharmaceuticals and biotechnology (Chesbrough, 2003; Huizingh, 2011). Meanwhile other sectors have followed, such as machinery, turbines, medical tools, fast moving consumer goods, food, architecture and logistics (Gassmann et al., 2010). Early adopters of open innovation concepts were also identified in the sectors of aerospace, diversified chemicals, medical devices, bioscience tools and services, inks and coatings, thermoplastics, lubricants, assembly technology and fasteners as well as consumer packaged goods (Chesbrough and Crowther, 2006). In the early years of research in the field of open innovation, mostly large, high-technology multinational enterprises were investigated. However, in recent years small and medium sized enterprises were also analysed (Lichtenthaler, 2008; van de Vrande et al., 2009).

Over the last decade there was and still is a trend towards increased open innovation application in firms. At the same time, it is not an imperative for every firm and R&D department (Gassmann, 2006). Applying open innovation seems appropriate to a firm that includes the following issues of development amongst their own business alignment: globalisation, technology intensity, technology fusion, new business models and knowledge leveraging (Gassmann, 2006). Gassmann et al. (2010) add that open innovation is mainly applied in product and process innovation processes, but not very utilised in the service sector yet. Still, these findings show the variety of different products and manufacturing industries which are applying open innovation in their practice.

Furthermore, research has been focusing on the probably most important external sources of knowledge for an open innovation process: the users (von Hippel, 1988; Reichwald and Piller, 2005). Von Hippel (1988) identified that most of the innovators are users. Users are firms (who buy products from other firms) and individual consumers (von Hippel, 2005; Reichwald and Piller, 2009). The major advantage in involving users as innovators is that user innovations can improve the firm’s knowledge about the user’s needs (von Hippel, 2005). The heterogeneity of user’s needs in our times is very high. That is because many users want different features on the same product. In such cases, mass-customised products will not meet the user’s needs and support the firm’s success (von Hippel, 2005), whereas user involvement will certainly improve the success of the innovation. Early research (von Hippel, 1988) and recent developments (Enkel et al., 2009) have shown that users will be more and more involved in all kinds of industry sectors to develop and create goods that meet their needs. That is because users are able to develop innovative products on their own (Enkel et al., 2009). There are a number of studies and examples where users made essential contributions to the innovation of new products or services. For instance, sport equipment for mountain biking or canyoning, medical equipment
for surgeons, outdoor equipment, libraries and software products. Only the users know their real needs and can provide the lacking knowledge to the innovating firms, making user involvement crucial for a successful innovation (von Hippel, 2005).

There are other approaches to user involvement that are linked to open innovation. However, it is not always clear if the approaches are a form of open innovation or other innovation approaches (West et al., 2014). These include crowdsourcing, co-creation or living labs (Busse and Siebert, 2017; Hossain, 2013). For many people open innovation is an umbrella term for all (new) kinds of innovation and there seem to be no sharp boundaries between these.

### 3.3.4.1 Possible benefits as motives for implementing open innovation

Motives for a firm’s application of open innovation are primarily to maintain growth, reduce time-to-market, utilise internal creativity, acquire missing knowledge, spread risks, enlarge social networks and reduce costs (van de Vrande et al., 2009). Huizingh (2011) shows in a number of case studies that open innovation can be a successful concept for creating value for firm’s R&D departments. The main motive for firms intending to apply open innovation is gaining benefits. Various research has identified the following possible benefits: a shorter time-to-market; less costs and risky, monetized spill overs; improved absorptive capacity; more flexibility for changing markets; exploitation of new market opportunities; more innovations in general; and an increased quality of products and services (Chesbrough, 2003; Chesbrough et al., 2006; Tidd and Bessant, 2014; International Chamber of Commerce, 2014). The increased quality of the new product or service in all probability meets the user’s requirement and that can be key to customer satisfaction and connectivity (Chesbrough, 2003). Although we know the benefits in general, better approaches for measuring the benefits or success of open innovation are needed (West et al., 2014).

However, the emergence of possible benefits depends strongly on various factors such as the openness of open innovation processes (Dahlander and Gann, 2010). Success depends e.g. on when it is reasonable to implement open innovation and when not (Gassmann and Enkel, 2004). Each possible benefit has a corresponding challenge to overcome (Table 1; Tidd and Bessant, 2014).

### Table 1 Open innovation – potential benefits and challenges to apply

<table>
<thead>
<tr>
<th>Six principles of open innovation</th>
<th>Potential benefits</th>
<th>Challenges to apply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tap into external knowledge</td>
<td>Increase the pool of knowledge</td>
<td>How to search for and identify relevant knowledge sources</td>
</tr>
<tr>
<td></td>
<td>Reduce reliance on limited internal knowledge</td>
<td>How to share or transfer such knowledge, especially tacit and systemic</td>
</tr>
<tr>
<td>External R&amp;D has significant value</td>
<td>Can reduce the cost and uncertainty associated with internal R&amp;D, and increase depth and breadth of R&amp;D</td>
<td>Less likely to lead to distinctive capabilities and more difficult to differentiate</td>
</tr>
<tr>
<td>Do not have to originate research in order to profit from it</td>
<td>Reduce costs of internal R&amp;D, more resources on external search strategies and relationships</td>
<td>Need sufficient R&amp;D capability in order to identify, evaluate and adapt external R&amp;D</td>
</tr>
<tr>
<td>Building a better business model is superior to being first to market</td>
<td>Greater emphasis on capturing rather than creating value</td>
<td>First-mover advantages depend on technology and market context</td>
</tr>
<tr>
<td>Best use of internal and external ideas, not generation of ideas</td>
<td>Better balance of resources to search and identify ideas, rather than generate</td>
<td>Developing a business model demands time-consuming negotiation with other actors</td>
</tr>
<tr>
<td>Profit from others’ intellectual property (inbound open innovation), and others’ use of our intellectual property (outbound open innovation)</td>
<td>Value of IP very sensitive to complementary capabilities such as brand, sales network, production, logistics, and complementary products and services</td>
<td>Conflicts of commercial interest or strategic direction</td>
</tr>
<tr>
<td></td>
<td>Negotiation of acceptable forms and terms of IP licenses</td>
<td></td>
</tr>
</tbody>
</table>

Source: Tidd and Bessant (2014)

Indeed, researchers mention two major challenges which firms have to overcome: the so-called not-invented-here-syndrome and the internal commitment of the firm (Katz and Allen, 1985; Chesbrough and Crowther, 2006). The not-invented-here-syndrome is defined as “the tendency of a project group of stable composition to believe it possesses a monopoly of knowledge of its field, which leads it to reject new ideas from outsiders to the likely detriment of its performance” [Katz and Allen, (1982), p.7]. For a successful application of open innovation, the internal commitment of the firm’s leadership has to be sustained over a sufficient period of time (Chesbrough and Crowther, 2006). For a successful application of open innovation factors like the organizational structure, the firm’s culture and the human issues are crucial (van de Vrande et al., 2009). Although we know much about benefits and challenges, we do not know much about disadvantages or failures. Hossain (2013) pointed out that there is limited research on failed open innovation applications in firms and that we need to know them. Otherwise, the leading opinion that open innovation per se is a guarantee for success cannot be sufficiently corroborated.
3.4 Methodology

For this paper we examined literature on open innovation in both English and German scientific literature. Our qualitative literature research was conducted between June 2016 and February 2018. We mainly searched publications in online databases and scientific libraries starting with the keyword open innovation. Considering the amount of existing literature, our selection of relevant publications for our paper was based on screening the titles and abstracts of our findings. First, we were looking for publications on open innovation itself, to gain basic knowledge about it. Getting deeper into the subject matter, we focused on the how of open innovation: how can open innovation be performed, by what methods. This further research included the keywords open innovation methods, open innovation tools and open innovation application. In order to build a good foundation for the purpose of the paper, we then searched intensively for open innovation applications in the food sector and also regarding the topic of diets. For this we used the keyword open innovation in combination with food sector, food, nutrition, diet and agriculture; the latter to see if there were links within the publications to food or diet. We mainly used published peer-reviewed articles from scientific journals and scholarly book chapters. Fundamental research and recent published work have been taken into account to track the development in this field.

Based on the diverse findings we analysed a possible connection between the open innovation approach and its methods and the process of developing a dietary adoption concept. Our main focus was on the possible application of the methods in our planned developing process.

3.5 Results of literature research

3.5.1 Methods of open innovation

To perform open innovation in a firm and turn it to advantage, certain methods are needed to enable the customers or other external partners to contribute their ideas or take part in the innovation process (Gassmann et al., 2010).

Huizingh (2011) points out that it is important for managers to clarify the question when (in what stage of the innovation process), how, with whom, what purpose and in what way firms should cooperate with partners outside the firm’s boundaries.

Reichwald and Piller (2009) and also Busse and Siebert (2017) describe four methods through which open innovation can be performed in practice. These are the lead-user method, innovation contests, toolkits for open innovation, and open innovation communities. These methods are described briefly in the following section before analysing them in terms of their possible use for our research purpose.
3.5.1.1 Lead-user method

Von Hippel (1988) identified that most of the innovators are users, specifically, his research shows that a particular kind of user emerges to be especially valuable for the firm’s innovation process. He called them lead-users. One characteristic of lead-users is that their existing strong needs will become general needs in the marketplace some months or years in the future. In addition, lead-users can serve as a need-forecasting laboratory for marketing research and can provide new product concept and design data (von Hippel, 1986). Lead-users will anticipate personal benefits through satisfying their needs. On account of this, lead-users have developed the most commercially attractive products and product modifications. This is linked to von Hippel’s (2005) findings that the lower the intensity of interest, the lower the rate of user innovations.

Briefly speaking the so-called lead-user method contains the involvement of lead-users in the innovation process. This involvement can be conducted through innovation workshops. For such a workshop, it is necessary to invite identified lead users (approximately 10–15) and to arrange a defined schedule for leading the development of ideas for innovations (Reichwald and Piller, 2009). Within such a setting, lead-users act as equal partners along with the manufacturer (Busse and Siebert, 2017). Besides the participants, an experienced host is needed. The host leads and guides the participants through the workshop, mediates and organises the idea contributions, and captures results during the workshop. Furthermore, a specific application of creativity techniques whereby the participants are able to create solutions to the problem is recommended. Such a workshop starts with a briefing of all participants through the host. Therefore, it is important to point out the problem and requirements of the firm’s desired innovation. The workshop can end with a presentation of the results. The duration of the workshop depends strongly on the kind of problem. Thus, it can last for a half day or up to a number of days (Reichwald and Piller, 2009). Busse and Siebert (2017) add that such a workshop is typically a single event, but that it shows a high level of interaction between the participants. Beyond these findings, there isn’t yet a specific guide or concept for a successful workshop (Reichwald and Piller, 2009). As an example, for the application of this method, we found Pobisch et al. (2007) who ran a project in cooperation with a bakery to examine within a single case study the method of an innovation workshop from a business perspective. The workshop was conducted to develop ideas and concepts for a more successful communication concept of the firm’s organic bread. Another example is a series of user innovation workshops for developing a new product and service regarding smart grids within a scientific research project (Mohaupt et al., 2017).
3.5.1.2 Innovation contests

Innovation contests are also known as idea competitions or design competitions. The contest is mostly a web-based competition where participants (innovators) can use their skills, experience and creativity to provide a solution for a particular contest challenge defined by the organiser (Haller, 2013). Essentially, firms can cover the whole innovation process through an innovation contest. In general, the contest is run by the firm that publicly advertises the problem or challenge they are facing. The contest takes place mainly on internet-based platforms. The target group is more or less specified, depending on the problem (Haller, 2013). Busse and Siebert (2017) state that within an innovation contest the participants are autonomous dialogue partners. After the kick-off, participants can contribute their submissions until a set closing date. An expert jury or the firm’s leadership then evaluate the submissions. The best contributions receive a reward in the form of a material prize or money. The principle behind the innovation contest is that the factor of competition (and the incentive of a reward) may enhance the quantity and quality of the participant’s submissions (Haller, 2013).

3.5.1.3 Toolkits for user innovation

Toolkits for user innovation are a (web-based) platform that enables users to develop products or services via provided specialised toolkits. Toolkits could also be for user co-design or for transferring ideas (Reichwald and Piller, 2009). Users are more and more interested in designing products efficiently on their own. Manufacturing firms who can provide users with such a toolkit platform can make use of this. Toolkits for user innovation can be design tools and can also provide the opportunity for prototyping and design testing. They can enable users to design their own custom-made products. Besides, toolkits have the potential to be applicable to all kinds of products and services where the users show heterogeneous needs (von Hippel, 2001). However, research has shown that a wide application is not yet the case because of the limited possibilities within the toolkits design (von Hippel, 2005). A successful toolkit should therefore contain attributes like being user-friendly, offering a solution space encompassing desired and producible designs (von Hippel, 2005).

3.5.1.4 Innovation communities

Innovation communities are groups of individuals or firms often thematically specialised. They are interconnected and offer additional important functions to participants like information transfer. It is also common to provide innovation communities with useful tools for developing, evaluating and integrating their innovations – the members of the community themselves can also provide this (von Hippel, 2005). Besides, the infrastructure for communication is very important to reduce the time that it takes to innovate and increase the quality of
the innovations. Therefore, chat rooms or e-mail lists can be useful (von Hippel, 2005). Active participants in innovation communities are in general very open and willing to spread their ideas for the common good. Yet a mediator is needed who constantly checks on the development of the contributions and ideas. Mostly the user initiates the innovation process. The manufacturer or crowdsourcer (in the case of virtual innovation communities) provides the platform with relevant information and screens the ideas in certain cases (Busse and Siebert, 2017). Innovation communities are for instance common in open source software development (von Hippel, 2005).

3.5.2 Open Innovation in the food sector

The food sector is one of the most interconnected sectors in our economy. From the agricultural production to the consumed foodstuff, along the value-chain many other sectors play a part in the network of the food sector, such as logistics, trade, retail and consumers (Samadi, 2014; Fortuin and Omta, 2009). Especially user-oriented innovation is not new to the food sector and the fork-to-farm approach to food chains has been promoted in various guises (Grunert et al., 2008). One of the reasons that make this kind of innovation within the food sector important is the demand for individualised food products. Moreover, there are public demands with respect to sustainable resource utilisation, considerations concerning ethics and the environment and improvement of the work environment that will not merely challenge the organisation of production, but also affect innovation of products, services, and distribution forms (Grunert et al., 2008). This is a critical issue because it addresses the whole food sector and especially future food systems. Costa and Jongen (2006) analysed that the behaviour of today’s consumers is changing faster than ever. Moreover, the needs and preferences of consumers are diverse. Important aspects of (western) consumer’s food choices are for instance the quality of life, well-being, protection of the planet’s environment and transparency concerning the means of food production. For firms in this sector it is crucial to gain a more detailed knowledge of consumers’ needs and wishes. That means that innovation in general is increasingly more important for food product development (Costa and Jongen, 2006). Sarkar and Costa (2008) describe that the food industry has a large number of actors within the value and supply chain and that it is therefore important to establish interorganizational relationships with customers, suppliers, research institutions and others. Therefore, it is important to acquire knowledge and skills for innovation processes. Fortuin and Omta (2009) state that although open innovation is probably a powerful tool for the food sector with its many chain and network ties, there is hardly any evidence of its use in this sector. They add that users – or in this case consumers – are highly underutilised in the innovation processes within the food sector. Omta et al. (2014) discovered that there was no empirical evidence for a relevant role of open innovation in the food sector. Others say that open
innovation processes in the food sector mainly take part in the field of food engineering (Saguy, 2015; Samadi, 2014). Some papers about open innovation in the food sector mention that investigations into open innovation in the food sector are, despite the actual application, still scarce (Sarkar and Costa, 2008; Enzig et al., 2011).

Recently, more researchers are examining the food sector for applied open innovation (Galati et al., 2015; Sarkar and Costa, 2008). Medeiros et al. (2016) listed 37 open innovation related studies in the agrifood chain (from 2006 to 2015), containing 23 articles, one book, four book chapters, four conference papers, four reviews and one conference review. We also found that this research takes part in the food sector of different countries worldwide including Italy (Galati et al., 2015), Hungary (Fertő et al., 2016), Turkey (Seyfettinoğlu, 2016) and Trinidad and Tobago (Motilal et al., 2014). These findings suggest a fast growth of open innovation process application in the food sector.

Successful outcomes for applying open innovation are, for example, Procter and Gamble's printed Pringles' potato chips (Huston and Sakkab, 2006), a genetically modified tomato for the fresh market from the biotechnology firm Calgene (Vanhaverbeke and Cloodt, 2006), a toolkit for customised food flavours from the company International Flavors and Fragrances (Thomke and von Hippel, 2002), Biovalencene, a natural aroma launched by Isobionics (Usman and Vanhaverbeke, 2016), Cargill’s web-based application to manage consumers’ ideas (Awazu et al., 2009), Lay’s new chip flavours and Coca Cola’s crowdsourcing platform called ‘a drink with every order’ (Soon and Saguy, 2017). Additionally, we found global companies who have applied the approach of open innovation, including, Mars Inc. (Bilgiardi and Galati, 2013), Nestlè S.A. (Traitler et al., 2011), Kellogg’s Co, Mondelez International Inc., PepsiCo Inc. and Unilever Group (Ramirez-Portilla et al., 2015).

But not only large companies apply open innovation in the food sector (Ramirez-Portilla et al., 2015). We also found that in September 2015 the German Federal Ministry of Education and Research organised an idea competition and a workshop on ‘agricultural systems of the future’. The aim of this open model of idea sourcing was, according to the authorities, to develop a common vision and recommendations for research policy on future agricultural systems (BMBF, 2015). This process performance can be considered as a kind of innovation contest with a subsequent innovation workshop. Detailed information or reports were not made available.

The examples described show that the innovation addresses either the product itself or the technology of the manufacturing process (Ramirez-Portilla et al., 2015). If we take the example of the German Federal Ministry of Education and Research, we can say that the innovation process also addresses a whole system. The innovation is mostly focused on firm and industry level within the food sector. Actors within the innovation process are mainly members of the industry, government or academia (Ramirez-Portilla et al., 2015).
When it comes to examining scientific literature concerning open innovation in the food sector, we found two divergent opinions. On the one hand, researchers state in their papers that there is a lack of applied open innovation (Fortuin and Omta, 2009; Omta et al., 2014), but on the other hand we found many sources indicating that there is already a wide range of application of open innovation in the food sector and that open innovation is considered as an appropriate paradigm for addressing new challenges of the food industry (Bigliardi and Galati, 2013). One explanation for these divergent statements can be the chronological development. Based on the sources data we can mostly exclude this. Another explanation may be the fact that knowledge, experience and innovation seem to underlie strong property rights in the food sector. It follows that there is little to find in scientific literature.

3.5.3 Linking open innovation to the development process of a dietary adoption concept

Although open innovation is studied in research disciplines like sociology, anthropology and psychology (von Krogh and Spaeth, 2007) as well as in the food sector, we could not find any research about open innovation that concerns human nutrition or diets per se. However, the broad range of highly varied sectors where open innovation has been applied shows us that there is a clear potential for transferring the open innovation process and its methods to our intention to develop a dietary adoption concept. Also, open innovation could support firms and governments’ contributions to a global sustainable development by developing sustainable products and services (Hossain, 2013). Open innovation has the potential to contribute to sustainability-oriented innovations. The key lies in the serious involvement of the stakeholder groups to gain their satisfaction and connectivity (Hansen and Große-Dunker, 2013; Chesbrough, 2003; Chesbrough et al., 2006; Tidd and Bessant, 2014; International Chamber of Commerce, 2014). Additionally, user involvement promises a variety of possible innovations because different users will tend to develop different innovations (von Hippel, 2005). For such an individual matter as diet adoption, various impulses are needed to meet the heterogeneous needs of all people. With users in our case we mean in general all people, because everybody has to eat and consequently has a diet (an eating regime).
If we can relate new (innovative) products and services with dietary adoption concepts, and product development with concept development, then it is also possible that the gained customer connectivity can be related to a long term adoption of a diet concept (Figure 2), both based on consumer satisfaction. Furthermore, one possible benefit we could gain may be an increased adoption rate of health supporting and sustainable diets overall. This is reasonable because the customer’s or in this case the diet adopter’s heterogeneous needs are considered during the development process. In order to proceed, it seems justified to include similar methods of stakeholder involvement in the development process for dietary adoption concepts.

3.6 Discussion

Developing a dietary adoption concept for health supporting and sustainable diets to bridge the common phenomenon of the intention-behaviour gap is the goal of our research. To this end we pursue the question: what exactly can we learn or transfer from open innovation? Within the following in-depth discussion, we answer this question by examining the four open innovation methods by a set of self-established criteria (Table 2). These criteria are based on our idea of a dietary adoption concept and the development process. Therefore we think that with the suitable method it should be possible to facilitate a communicative exchange at the beginning and during the process (that everyone has a common understanding of what is being worked on), to create as many ideas and innovation contributions as possible (because of heterogeneous needs), promote collaboration among the participants (to use synergies), integrate creativity techniques (to support the idea generation) and deliver results in a set
time frame (through strong commitment of participants). The criteria were assessed as appropriate (+) or not (–) for the respective methods. The evaluation was based on the afore-going research into the methods.

**Table 2 Matrix of open innovation methods compared to set criteria**

<table>
<thead>
<tr>
<th></th>
<th>Communicative exchange among all involved</th>
<th>Generates many ideas and innovation contributions</th>
<th>Encourages collaboration among the participants</th>
<th>Integrates creativity techniques</th>
<th>Delivers results in a set time frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead-user method</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Innovation contests</td>
<td>–</td>
<td>+</td>
<td>–</td>
<td>+/-</td>
<td>+</td>
</tr>
<tr>
<td>Toolkits for user innovation</td>
<td>+/-</td>
<td>+</td>
<td>–</td>
<td>+/-</td>
<td>+/-</td>
</tr>
<tr>
<td>Innovation communities</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+/-</td>
<td>+/-</td>
</tr>
</tbody>
</table>

*Source: Authors’ compilation*

The lead-user method scores positively in all categories. We think that a lead-user workshop provides a good working environment to support exchange of information. It seems that this method, especially applied within a workshop, offers a scope for individual design and, depending on the workshop design, many contributions (ideas). Based on this we could arrange collaboration among participants through application of (creativity) techniques to a certain extent and of course set a well-planned timeframe. Another advantage of lead-users can be that their needs will become general needs in future and that they are interested in actively finding solutions. What could be difficult is finding and identifying lead-users for bridging the intention-behaviour gap.

The principle behind an innovation contest is the competition and a reward. These two things are the main motivation for people to participate. This is mainly why we don’t see a good opportunity for an exchange among the involved people, unless it is between those responsible and the individual participants. A positive aspect is that there is a source of motivation for people to participate (receiving many ideas) and that a contest sets a timeframe. Nevertheless, we do not see a competition-based method as suitable to develop something that should help to support as many (different) people as possible, but rather see a need of building synergies to overcome the problems described. Participants usually develop one idea and then all submissions are screened by others to identify the best idea that wins. This seems inapplicable because we do not see a possibility
for capturing all heterogeneous needs in just one contribution. Besides innovation contests are mostly web-based. We are not sure if this anonymity (more or less specified participants) could, on the one hand, produce liberated good ideas or, on the other hand, inappropriate contributions.

We understand toolkits for user innovation as predefined possibilities that can be assembled differently according to the users’ needs. This cannot (yet) serve the sense and purpose of our research purpose, because we first need to know what people actually need for adopting health promoting and sustainable diets and how this can be realized or implemented. Examining this method according to our criteria, the evaluation is similar to the innovation contest but without a reward as a motivator. Maybe such kind of a toolkit can serve in future to assemble a personal dietary adoption concept based on the prior developed options (solutions). Toolkits for user innovation are mostly web-based too. Besides, it is more suitable for user co-design – meaning actual design of a product or service. But it needs a prior development of the items for the toolkit. Then we have the innovation communities who are also mainly web-based. Moreover, an innovation community seems for us (at this stage of our research agenda) a kind of laissez faire because the consumer initiates the innovation process. We need results for our research in a set time frame and the establishment of such communities per se could take a lot of time. What can be positive is that contributed ideas from the community can be screened during the time process. That means we (as a kind of client) could provide the community with direct feedback and indications of a possible shift in focus regarding the results. Therefore, a communicative exchange seems to be possible. Once established, many ideas could be contributed and the possibility for a collaboration among the participants seems to be given. At this point of our research, we do not see the certainty that this method suits our research purpose because of the stage of commitment of anonymous possible participants and the time they need to actually develop ideas or other forms of contributions. It seems like an experiment where we are not really in charge of the process design and outcome. Another challenge would be finding a specialised group of people who are willing to participate, because usually consumers initiate this process.

Summarising the points we can say that innovation contests, innovation toolkits and innovation communities seem at this stage less suitable to us for the frame of our research purpose, mainly also because for these three methods we cannot estimate the quality of the posts due to the web-based anonymity. It may furthermore be that they tend to remain in the form of ideas and not get tested or at least discussed during the development process. An innovation only occurs when an idea is successfully implemented – one further reason against using these methods. But we see a potential to use these methods at a later point of our research project. For example, creating the diet adoption concept as a kind of toolkit, where everyone can pick the ‘items’ that best suits their lifestyles. The method that we see as a promising approach to solve our problem is the lead-user method-based innovation workshop. Lead-users can be valuable because
we are facing global heterogeneous needs regarding the diet adoption process and along with it for an overall different food system in our future (sustainable food system or even organic food system) (de Schutter, 2014, 2017; World Bank Group, 2016). Our research shows that the involvement of lead-users can be the key to meeting those needs. More importantly, we now know that the needs of lead-users will become general needs of people sometime in the future. So that the idea behind this can be that we let the lead-users find solutions for their own needs, because their needs will become future need of the masses. If that works, it can be a valuable contribution to current research on consumer behaviour. Research is being carried out on the barriers that emerge when people try to implement their positive intention towards sustainable behaviour and how they can overcome these barriers. Especially in the food sector various stakeholders (politicians, manufacturers, retailers) play a role in helping to overcome barriers (Grunert, 2011). In addition to the individual barriers that cause the intention-behaviour gap, some gaps are well known to enable a sustainable diet at all. Those are food determinants like food prices, affordability, availability, consumer information and the socio-economic status (Meybeck and Gitz, 2017; Brug, 2008; Leng et al., 2016). We need to understand the determinants of food choice to understand why barriers can emerge and create the intention behaviour gap.

The methodological approach of developing something innovative together within a workshop appears to be suitable for our problem because of the high interaction level between the participants that can lead to possible synergies based on different points of view. It may be that the application of different creativity techniques can enable the participants to develop ideas together that they have not thought of before individually (possible generation of synergies). The framework of a workshop offers a defined schedule for leading the developmental process of idea generation, which goes along with our research purpose. In addition, a communicative exchange can take place at the beginning of the workshop. This way we could provide participants with information, so that everyone has the same understanding of what we work on. This can be a big advantage, especially for complex topics like sustainable diet adoption. The application of such a workshop gives lead-users the opportunity to develop different ideas and supporting concepts that may help to bridge the gap between intention and behaviour when it comes to adopting health supporting and sustainable diets. For a solid sample of participants gaining as many ideas as possible, it seems to be appropriate and doable within performing a corresponding number of this kind of workshops. The actual design of the workshop detail needs to be considered further. We also need to identify lead users for our subject area who can and will participate in the workshops. Possibly lead-users are those who are interested in the topic and will respond to a workshop call. We think so because of the effort (for example time, arrival and departure) that comes along with workshop participation. However, to set these details requires further investigation.
3.7 Conclusions

To our knowledge, this paper is the first that takes the methods of open innovation and explores theoretically if and how they can be transferred and utilised for the development of a diet adoption concept for sustainable diets.

Our main findings are that we can compare the possible benefits of applying open innovation processes to our research agenda (Figure 2). Besides we could gain some insights in the application of open innovation in the food sector. This offers us direct links to which we can refer and learn from, especially when it comes to the methods used. Our most important finding is the potential that comes with involving lead-users in open innovation processes. The possibilities that this approach includes can be key to many problem-solving processes.

To tackle the challenge that we are facing it seems consistent to explore uncommon approaches to those we usually apply in our research field. We can observe this in the food sector in general. Innovation and sustainability are keys for companies’ future success and existence. That is why we see a broad application of open innovation methods when it comes to sustainability issues in the food sector (Arcese et al., 2015). It seems like sustainable development acts as a magnet for open innovation processes. In recent years we have a growing discussion on connecting open innovation to sustainability-related innovations, not only in the food sector (Rauter et al., 2017). A review from 2017 on this topic concluded that we need further investigation on how the open innovation methods can contribute to the needed innovations, as well on the difficulties associated with their application. It was also noted that a great potential is seen in lead-users and their contribution to proper innovations (Rauter et al., 2017). In addition to lead-users, NGOs can also play an important role as partners in sustainable innovation development processes. Brunner and Marxt (2013) have used the example of three successful innovations (so-called green products) to examine the potential of a joint venture between NGOs and companies. It concerns the lack of knowledge of the companies, which can be filled in by the NGOs as a partner during the development process of an innovation. This adds another interesting perspective to our research agenda, since there is a lot of valuable NGO work on sustainable diets (Garnett, 2014; WWF, 2013).

Of course, this is only the beginning of a subsequent investigation and our results therefore have limitations. One constraint is that our literature research is very broad. As a result, it may not be deep enough in some cases like a review. This puts us at risk of missing out on important research results. In addition, we can only make our assumptions on what we have read. Of course, these are mainly results from practical examinations, but we ourselves have no practical experience with applied open innovation methods. These experiences seem to be necessary in order to be able to make clear statements as to whether or not the methods can be suitable for our further research agenda.

Nevertheless, our paper contributes to a current discourse of innovation and sustainable development. Within our approach, we clearly state that we want to
seek collaboration and break new ground to support a shift towards more sustainable action. We think that exploring these new avenues in the field of human nutrition can contribute to bridge the outlined intention-behaviour gap. Our future research will focus on developing an appropriate workshop design and testing it as a form of the mentioned lead-user method with consumers and other stakeholder groups, to involve them as innovators. We encourage other researchers to consider applying innovation approaches and involve stakeholder groups by tackling sustainability issues within our food systems. It is precisely because food systems are so complex that research is needed in many cases. The exchange of collected experience and other data can exploit synergies that promote sustainable development in a new dimension.

3.8 Acknowledgements

We gratefully acknowledge the support and generosity of the Software AG Foundation for the work of the lead author.

3.9 References


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4 Participative processes as a chance for developing ideas to bridge the intention-behavior gap concerning sustainable diets

Journal: Sustainability  
Submitted: 30 September 2018  
Published: 27 November 2018

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4.1 Abstract

Sustainable diets are drivers and results of sustainable food systems. Therefore, they are crucial for improving our global diet-related problems. When trying to adopt sustainable diets, people often struggle with the gap between their good intentions and their actual behavior. Here we see a need for support. To understand people’s needs and what could help them, it stands to reason that they can be directly involved in the development processes for appropriate ideas. On that account, we conducted six workshops in different German cities from September to December 2016 with 82 participants in total. We collected data by letting participants generate ideas to bridge the intention-behavior gap. The qualitative data was then coded in internal (168) and external factors (989). Analyzing data shows that the higher numbers of external factors offer a wider range of aspects that contribute to closing the intention-behavior gap from the participant’s point of view. We discuss whether the external factors such as availability, advertising, pricing, and education about food and nutrition may be a prerequisite for a broad mass of people to practice a more sustainable diet.

Keywords: sustainable diets; diet adoption; sustainable food system; intention-behavior gap; citizen participation; innovation workshop

4.2 Introduction

Recently the consumption of sustainably produced food, e.g., organic food is increasing [1]. Practicing sustainable diets can promote diet quality and, thus, human health and has—generally speaking—a positive impact on the environment [2]. In order to be clear on the term “sustainable diets” we use the
FAO definition, in which “Sustainable Diets are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources.” [3]. Numerous reports on food system related issues, movements towards sustainable lifestyles and, for example, the launch of the United Nations’ Sustainable Development Goals are raising public awareness for the importance of sustainable consumption and nutrition [4–9]. These cognitive contact points give people an impulse for their own behavioral improvement [10]. However, a consistent adoption of a sustainable diet seems difficult. To change one’s own behavior is no piece of cake. That is why people often struggle with the implementation of their behavioral intentions [11]. This circumstance describes the so-called intention-behavior gap, based on the inconsistency between the behavioral intention and the actual behavior [12]. This gap is a critical aspect of behavior changes, especially when only half of the possible intentions are translated into desired actions [11]. The Theory of Planned Behavior (TPB) describes that human behavior is strongly based on the formed intention (Figure 1). In addition, the model reveals that there are determining factors influencing the formation of an intention. Behavioral beliefs, meaning possible positive or negative consequences of performing the behavior, lead to a specific attitude towards the behavior in question. Normative beliefs represent beliefs about a possible judgment of relevant persons and social pressure. This kind of social influence leads to a specific subjective norm. Control beliefs consider possible internal or external factors that may positively or negatively influence a person’s behavior. Furthermore, beliefs on how easy or difficult the performance of the behavior can be, leads to a certain degree of perceived behavioral control [13,14]. The TPB also considers other possible variables called background factors that can influence behavioral, normative and control beliefs. Another variable is feedback loops arising through information from previous behavior. It is assumed that the more the belief that the behavior is under control and the more favorable the attitude and subjective norms are, the more likely it is to form a positive intention towards a particular behavior. Formed intentions don’t always lead to the corresponding behavior. This depends on whether a person has actual control over the behavior or whether there are internal (information, skills, abilities, emotions, compulsions) or external factors (opportunity, dependence on others) that are interfering. This actual behavioral control is strongly related to the determinant of perceived behavioral control [14,15].
The TPB is one of the most widely used social-psychological models for researching human behavior, especially when it comes to examining health behavior or the relation between intentions and behavior [14,17,18]. It offers clearly defined constructs and considers internal and external control factors that can influence the intention-behavior relation [14,18,19]; this is important to our research context.

The imminent need for changing our dietary behavior is argued by many and sustainable dietary consumption is one key driver for the existence of sustainable food systems [20]. At the same time, sustainable diets are also results of sustainable food systems [21]. The question here is how to deal with the difficulties and obstacles associated with the adoption of a sustainable diet.

Recommendations for nutritional changes coming from the scientific domain are usually perceived as weak in terms of usability in everyday life. That is why we decided to leave the traditional research paths of nutrition science and go towards innovation to seek solutions for overcoming the intention-behavior gap. With solutions, we mean theoretical and practical innovations that will help us to improve and sustain targeted nutrition behavior [22]. Research, in which responsibilities are shared and collaboration between science and society is promoted, is urgently needed [23].

Therefore, it is clear that we need sustainable development in this area towards a higher adoption rate of sustainable diets. Since sustainable development is an extreme challenge for society [24], it is important that society gets involved in this process of transformation. For a truly sustainable development that requires a change in the current state, innovative strategies are needed and new paths have to be explored [25,26], especially when it comes to dealing with something complex like the intention-behavior gap. In searching for a suitable approach to creating ideas for bridging the intention-behavior gap, we decided to choose the
following strategy. To understand people’s needs and what could really support the adoption process, it stands to reason that they can be directly involved in the idea generation process.

This paper focuses on the participative idea workshop approach for generating ideas that go along with our research question: How can we close the intention-behavior gap when it comes to adopting sustainable diets? Therefore, the aim is primarily to deliver results in answer to the research question, more precisely: innovative ideas that help deal with the barriers creating the intention-behavior gap. Since the process is open to a certain extent, we cannot commit ourselves in advance to any one type of expected results. In our anticipated range, everything from the necessary framework conditions to practicable approaches and behavioral strategies for everyday nutrition can be contained. Since this research approach in context with our research question is new, it will also be examined for suitability in the context of this research.

This paper is structured as follows. It opens with a methodological view on the development of the research approach and workshop design. Next, we present the data gained from the workshop series. Then we analyze the data within the discussion and finally draw conclusions.

4.3 Materials and Methods

To develop a suitable workshop design, a comprehensive literature research on participative innovation processes was carried out in advance. Our findings led us to the open innovation process, an approach commonly used in modern product development [27]. Our hypothetical conclusion was that we can derive similar benefits [28] from applying open innovation methods as product developers do. More specifically, we aimed for suitable ideas for bridging the intention-behavior gap, which then led to an increased adoption rate of sustainable diets. Based on our comprehensive research in the field of open innovation we decided that our envisaged involvement of citizens can take place in specially arranged workshops for idea generation, based on the lead-user workshop concept [29–31], which is part of open innovation practices. This concept inspired our research to develop and apply a similar approach. However, we do not claim to call our approach a lead-user workshop, because the recruitment of our participants does not fit with von Hippel’s methodology to identify lead-users [32,33].

The aim of conducting the workshops was to develop specific ideas in answer to our research question. We expected to receive ideas in the form of realistic, useful tips that enable people to translate their behavioral intention into actual behavior despite emerging situational barriers. These ideas would then serve as the basis for a kind of toolkit that could promote the adoption of sustainable diets and, along with that, the transformation towards sustainable food systems.

To develop our workshop design, we defined the following criteria: a one-day workshop, allow all interested citizens to participate without special
requirements, a fixed participant number between 10 minimum and 20 maximum, an attractive setting as an incentive for participants, a structured workshop led by two moderators and support of the idea generation process by using creativity techniques. In order to gather as many ideas as possible and to achieve a small comparability of the applied methodology, we decided to carry out a series of workshops. To capture different and regional influences regarding existing food systems and communities we decided to choose a major city in the west, north, east, and south of Germany. In particular, these were Dortmund, Hamburg, Berlin, and Freiburg. These workshops were open for every interested citizen. Two additional workshops with students from the University of Kassel with an agricultural background and students from Münster University of Applied Sciences with a nutrition background completed the workshop series. For the workshops, a time frame of eight hours including lunch and coffee breaks was set. All workshops were scheduled for a Saturday from 9 am to 5 pm. We chose Saturdays because of the higher likelihood of people having more available leisure time. According to our reasoning, we wanted to give ideally everyone, who was interested in participating, the opportunity to do so without checking a particular suitability in advance. We assumed that anyone who signs up for the workshop is interested in the topic and can develop ideas suitable for dealing with the intention-behavior gap in everyday life—at least for themselves. Because nearly everyone deals with this gap in some way, we assumed that no specialized prior knowledge or abilities were necessary. We wanted to attract motivated citizens to participate and not researchers or field experts with alleged solutions. One main challenge was recruiting participants for the workshop. The basic idea was to invite as many people as possible to the workshops in order to enable interested citizens to participate in the workshops. The participants were recruited via general mailing lists, flyers, online event calendars, and writing to companies, associations, and organizations with the request to forward the invitation to all possible contacts (creating a snowball effect). Participation was voluntary and non-remunerated, so the only direct incentive was the workshop topic and format itself. This may have led to selection bias, which we will discuss more detailed in the limitations listed in the discussion. In addition, we had paid extra attention to a pleasant setting and full day catering, where possible, in organic quality. The chosen locations offered a comfortable atmosphere, enough space, modern facilities, and adequate equipment. We decided on a structured workshop led by two facilitators. The role of the facilitators was to introduce new work stages and lead the participants through the workshop, but not interfere with their idea generation processes and be as neutral as possible. The basic conceptual idea for the whole workshop was to generate as many ideas as possible by first stimulating divergent thinking and then enabling thought condensation by convergent thinking. The workshop procedure provided a combination of different work tasks with different creativity techniques (Table 1). Integrating work tasks offered the possibility to bring a certain structure into the process and to give a certain
thematic input of different topic areas. Applying creativity techniques can support the generation of innovative ideas [34,35]. We applied different creativity techniques combined to address the research question from multiple perspectives and to maximize the potential for creative ideas. Since there is no single working formula, we sought to address the different participants by applying various techniques [36].

Depending on the work task, participants worked alone, together with a partner, or in groups of three to five people (Table 2). At the end of the workshop, the idea generation processes led to action-planning in form of developing a concept for implementing the chosen idea.
Table 1. The applied methods; Description and Purpose.

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
<th>Purpose</th>
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<tbody>
<tr>
<td>Open space [37-40]</td>
<td>For the open space method, we combined two techniques: stimulus picture technique and sentence additions. A total of 8 pairs of pictures and 4 sentence beginnings were hung on brown paper. In this kind of gallery walk, the participants could write down everything they could think of when looking at the pictures and how the picture pairs could relate to each other. The sentences should be supplemented according to spontaneous ideas. Pictures and sentences are closely linked to the topic of sustainable food systems. After the Q&amp;A session participants are supposed to generate ideas in answer to the research question, using the notes from the open space activity.</td>
<td>This methodology allows us to capture impressions before coming up with a thematic input. Based on this, ideas will be generated later in the process. Here, the participants are addressed on a visual and linguistic level.</td>
</tr>
<tr>
<td>Idea storage</td>
<td>Classic brainstorming, here, called idea storage. After the Q&amp;A session about the workshop’s research question, participants are asked to generate ideas they come up with spontaneously in order to answer the question.</td>
<td>Generate intuitive first ideas without using in-depth methods.</td>
</tr>
<tr>
<td>(brainstorming) [37,39-41]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Info poster [38-40]</td>
<td>In group work, participants create info posters (illustrations) on a given topic. In the first step, participants depict the topic and all associative aspects. In the next step, the groups walk to a poster from another group and write down everything they can see on the info poster, what they associate with it and what they believe it is supposed to represent. In the final step, the poster illustrations are removed first and only the transcriptions remain available. On this basis, after re-routing the groups, ideas in answer to the research question are generated.</td>
<td>The given topics reflect different eating settings: Nutrition during lunch break Nutrition and rural life Nutrition and out-of-home catering Nutrition and city life Nutrition on the go and during journeys Nutrition and invitations to family or friends The ideas to be generated can address the challenges of implementing a sustainable diet in various settings.</td>
</tr>
<tr>
<td>Progressive abstraction [40,41]</td>
<td>The progressive abstraction can be used to generate thematic connections and corresponding measures. Our modified version starts with a given term. In relation to this, question X is answered. Referring to this result, question Y is then answered. Then, in turn, question X related to answer Y is answered. In this system, both questions X and Y will be addressed three times. All three answers to question Y will be used in the next step. Further ideas will be derived from the research question. X: What’s good about it? Y: How can this be achieved?</td>
<td>The given terms were economy, ecology, society, culture, and accountability. These are the five dimensions of the Best Practice Guidelines for Agriculture and Value Chains (IFOAM Organics International). Due to this thematic background, common sustainability dimensions (supplemented by culture and accountability) should have a certain impact on the idea generation. Progressive abstraction serves to question how something positive about an aspect can be achieved in other ways.</td>
</tr>
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</table>
### Topic tables [37-39, 41]

In group work, the participants discuss a given topic and create a mind map. All aspects mentioned in the discussion are included in the Mind Map. This type of network can later be used as an input for the further development of ideas.

The topics for this methodology represent societal challenges that may also be related to the topic of nutritional behavior:
- Nutrition and religion
- Nutrition and developing countries
- Nutrition and industrialized countries
- Nutrition and age (from young to old)

The results should serve as general input for the subsequent concept development.

### Opposites method (negative brainstorming) [37-41]

The opposites method is a kind of negative brainstorming. This means that the participants are asked questions that are formulated contrary to the actual research question. The next step is to generate ideas in answer to the research question by transferring the previous answers to positive solutions.

The questions bring the participants out of their previous thinking processes by considering the complete opposite of what they did before, e.g., how positive contributions to the implementation of sustainable diets can be prevented:
- How can we get people not to be interested in their nutrition?
- How can a worldwide unfair distribution of food be organized?
- How can we prevent a connection between regional, sustainable agricultural production and human nutrition?
- How can we discourage people from a healthy diet?
- How can we reduce the consumption of sustainably produced food?
- How can we complicate the implementation of sustainable diets?
- How can people having no access to (healthy and sustainable) food be achieved?
- How can we prevent a connection between organic farming and consumers of the produced food?
- How can we convince people not to act according to their knowledge and values regarding their diet?

Through the provocative formulation of the questions, a certain kind of creativity should be encouraged that is refreshing and brings variety, in the same way as trying to be negative to get a positive outcome. Based on the results, participants could then generate ideas for answering the research question.

### Concept development [38, 40]

Based on the selected favorites of the previously generated ideas, a further development of these should be done in group work. Each group received two selected favorite ideas of each idea generation step. Based thereon, concepts for idea implementation should be developed.

In this way, favored ideas should be further developed towards an implementation concept. This also served to give the participants something tangible at the end of the workshop.
Table 2. The workshop design and procedure.

<table>
<thead>
<tr>
<th>Time</th>
<th>Duration (minutes)</th>
<th>Method</th>
<th>Constellation</th>
<th>Work/Ideas Are Captured on</th>
</tr>
</thead>
<tbody>
<tr>
<td>09:00–09:10</td>
<td>10</td>
<td>Welcome</td>
<td>All together</td>
<td></td>
</tr>
<tr>
<td>09:10–09:30</td>
<td>20</td>
<td>Introduction of participants</td>
<td>All together</td>
<td></td>
</tr>
<tr>
<td>09:30–09:50</td>
<td>20</td>
<td>Open Space method</td>
<td>Individual work</td>
<td>Brown paper</td>
</tr>
<tr>
<td>09:50–10:20</td>
<td>30</td>
<td>Input and Q&amp;A session on intention-behavior gap</td>
<td>All together</td>
<td></td>
</tr>
<tr>
<td>10:20–10:30</td>
<td>10</td>
<td>Idea storage (brainstorming) in answer to the research question</td>
<td>Individual work</td>
<td>Yellow cards (1)</td>
</tr>
<tr>
<td>10:30–10:40</td>
<td>10</td>
<td>Derive Ideas in answer to the research question (from the Open Space posters)</td>
<td>Individual work</td>
<td>Orange cards (2)</td>
</tr>
<tr>
<td>10:40–11:00</td>
<td>20</td>
<td>Info posters, part 1</td>
<td>Group work, 3 participants</td>
<td>Flip chart paper</td>
</tr>
<tr>
<td>11:00–11:10</td>
<td>10</td>
<td>Info posters, part 2</td>
<td>Group work, 3 participants</td>
<td>Flip chart paper</td>
</tr>
<tr>
<td>11:10–11:25</td>
<td>15</td>
<td>Derive Ideas in answer to the research question (from the info posters)</td>
<td>Group work, 3 participants</td>
<td>Blue cards (3)</td>
</tr>
<tr>
<td>11:25–11:40</td>
<td>15</td>
<td>Coffee break</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11:40–11:55</td>
<td>15</td>
<td>Progressive abstraction</td>
<td>Partner work</td>
<td>DIN A3 templates</td>
</tr>
<tr>
<td>11:55–12:05</td>
<td>10</td>
<td>Collect and exchange results</td>
<td>Partner work</td>
<td></td>
</tr>
<tr>
<td>12:05–12:20</td>
<td>15</td>
<td>Derive Ideas in answer to the research question (from the progressive abstraction)</td>
<td>Partner work</td>
<td>Green cards (4)</td>
</tr>
<tr>
<td>12:20–12:35</td>
<td>15</td>
<td>Selection (1, 2, 3) of favorite ideas</td>
<td>Individual work</td>
<td>Sticky dots</td>
</tr>
<tr>
<td>12:35–13:35</td>
<td>60</td>
<td>Lunch break</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13:35–14:20</td>
<td>45</td>
<td>Topic tables</td>
<td>Group work, 3–5 participants</td>
<td>Brown paper</td>
</tr>
<tr>
<td>14:20–14:35</td>
<td>15</td>
<td>Opposites method (negative brainstorming)</td>
<td>Partner work</td>
<td>DIN A3 templates</td>
</tr>
<tr>
<td>14:35–14:50</td>
<td>15</td>
<td>Rotation &amp; Derive Ideas in answer to the research question (from opposites method)</td>
<td>Partner work</td>
<td>Red cards (5)</td>
</tr>
<tr>
<td>14:50–15:05</td>
<td>15</td>
<td>Selection (4, 5) of favorite ideas</td>
<td>Individual work</td>
<td>Sticky dots</td>
</tr>
<tr>
<td>15:05–15:20</td>
<td>15</td>
<td>Coffee break</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15:20–16:20</td>
<td>60</td>
<td>Concept development</td>
<td>Group work, 3–5 participants</td>
<td>Brown paper</td>
</tr>
<tr>
<td>16:20–16:50</td>
<td>30</td>
<td>Presentation, discussion round</td>
<td>All together</td>
<td></td>
</tr>
<tr>
<td>16:50–17:00</td>
<td>10</td>
<td>Feedback, close the workshop</td>
<td>All together</td>
<td>Feedback questionnaires</td>
</tr>
</tbody>
</table>

The workshops took place from September to December 2016. For the six workshops, we had 82 participants in total, of these 67 were female (81.7%) and 15 male (18.3%; Table 3). People registered themselves by mail. In no case were more than 20 registrations reached for any workshop. Additionally, some registered people did not attend the workshop.
Table 3. The demographic information for the workshop participants.

<table>
<thead>
<tr>
<th>City</th>
<th>Date</th>
<th>Number of Participants</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>( n = 82 )</td>
<td>( n = 67 ) (81.7%)</td>
<td>( n = 15 ) (18.3%)</td>
</tr>
<tr>
<td>Dortmund</td>
<td>24.09.2016</td>
<td>18</td>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td>Kassel</td>
<td>22.10.2016</td>
<td>13</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Hamburg</td>
<td>12.11.2016</td>
<td>11</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Berlin</td>
<td>26.11.2016</td>
<td>10</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Münster</td>
<td>03.12.2016</td>
<td>18</td>
<td>18</td>
<td>0</td>
</tr>
<tr>
<td>Freiburg</td>
<td>10.12.2016</td>
<td>12</td>
<td>9</td>
<td>3</td>
</tr>
</tbody>
</table>

4.4 Results

Before we present the data, we would like to mention that we have tried to avoid the loss of words and meanings by translating the ideas generated from German into English for this article.

For each idea generation step, we had different colored cards, on which participants wrote down their ideas. In this way, we collected the qualitative data during the workshop (these were always ideas in the form of first solutions and not elaborated contributions in the form of directly implementable solutions). Since we collected a large amount of qualitative data, we needed to organize them. For data analysis and coding, all ideas were transferred to a simple spreadsheet software. Analyzing the data, we decided on internal (code 1) and external (code 3) as code-categories for factors influencing the intention-behavior relation as described in the TPB. As we screened data, we expanded these categories by one each (internal+ (code 2) and external+ (code 4)). This additional coding was necessary because of the vague wording of the ideas. From a factual perspective, the coder often had to think one step further or interpret the data in order to assign it to the thematic context of the research question rather than eliminate it.

In total, 1223 ideas were generated during the six workshops that we allocated to five codes (see Supplementary Materials, Table S1). Overall, we can see from Table 4 that we have coded 168 internal (including 142 internal+) and 989 external (including 811 external+) factors. A total of 66 (5.4%) items of the screened data were excluded (code 0). Excluding criteria were (i) pure questions from which no indirect idea can be read and (ii) ideas irrelevant or with no direct link to our research question or (iii) to the subject area of sustainable diets and (iv) sustainable food systems. To illustrate examples of data entries, we listed five ideas for each code (Table 4). It turns out that the external factors outweigh the internal factors, which we will discuss later.
Table 4. The results of data coding, $n = 1223$.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Factors</th>
<th>Examples of Participants’ Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Internal</strong> $n = 168$, 13.7%</td>
<td>Taking time for grocery shopping, eating, and cooking&lt;br&gt;Pack food (organic etc.) to go&lt;br&gt;Eating as a conscious time-out&lt;br&gt;Do not buy abundantly, then you can buy healthy things&lt;br&gt;Highlight the individual benefits of sustainable nutrition</td>
<td><strong>Internal+</strong> $n = 142$, 11.6%&lt;br&gt;Gardening yourself (for a little self-supply and a lot of insight)&lt;br&gt;Create Consciousness: What impact has my behavior on other people in the world and in view of that we all share the world?&lt;br&gt;Question trends, do not chase after them&lt;br&gt;Accept more personal responsibility&lt;br&gt;Development of implementation strategies</td>
</tr>
<tr>
<td><strong>External</strong> $n = 989$, 80.9%</td>
<td>Enable a need-based purchase through unpacked goods (packaging-free shops), and in that way stem food waste (special value packs for fresh products tempt us to by abundantly)&lt;br&gt;Celebrities as an advertising medium for sustainable nutrition (role models)&lt;br&gt;The higher tax rate for animal-based and unhealthy foods, lower for plant-based and healthy foods&lt;br&gt;Apps for information on sustainability when purchasing&lt;br&gt;Explain sustainable diet starting in schools, through courses (cooking class etc.)</td>
<td><strong>External+</strong> $n = 811$, 66.3%&lt;br&gt;Community gardens (as a getting started guide)&lt;br&gt;Increase public advertising&lt;br&gt;Price tag with “real” price $\rightarrow$ conscience appeal&lt;br&gt;Organic products at every turn&lt;br&gt;More support from the government</td>
</tr>
<tr>
<td>Neither internal nor external (not used) $n = 66$, 5.4%</td>
<td>Individual traffic (cars) $\rightarrow$ reduce emissions in the cities&lt;br&gt;Stupid people run, smart people wait, wise people go into the garden&lt;br&gt;Repair cafes&lt;br&gt;Start with simple things: “Who likes to shower with dead animals?”&lt;br&gt;Where is the problem in general, when people do not act despite consciousness?</td>
<td></td>
</tr>
</tbody>
</table>

After generating the ideas, we gathered them on a pinboard, where every participant could select two favorites for each color card set. This allowed us to identify the participant’s favorite ideas during the workshop and the data analysis. Out of this selection, we generated a top 25 list of favorite ideas (Table 5). Here we point out that not all ideas were available for selection in all workshops.
### Table 5. The top 25 favorite ideas, rated by participants during the workshops.

<table>
<thead>
<tr>
<th>Points</th>
<th>Idea</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Consume/live consciously and in a resource-saving way</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>Direct farm sales, without many processing steps</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>More packaging-free grocery stores</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>Clarification and education</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>Value and advertising-free food (valuation only on content, for example “with x% fruit content” instead of “high content of x”)</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>Consumers visit farms and discuss animal husbandry, fertilization, etc.</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>Nutrition as a subject (cooking, gardening...)</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>100% utilization (of things)</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>More education in schools</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>A product database including true costs (resource consumption etc.) (for example sausages Aldi €0.69 → Earth costs €2.69)</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Food prices must represent the total cost</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Ban factory farming (plus new stricter regulation of fertilizer)</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Create more time resources for people</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Food prices must reflect the full cost</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Higher (value-added?) tax rate for animal-based and unhealthy foods, lower for plant-based and healthy foods</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Create reward systems for sustainable nutrition</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Create infrastructure for sustainable strategies (e.g., for neighborhood cooperation)</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Legal simplifications, e.g., for (food) sharing points, shopping communities; establish jobs that maintain the infrastructure, carry out work</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Sustainability parties in the same way as “Tupperware parties”</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Show an ecological footprint on the product</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Responsible school catering-learning effect for children</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Prohibit or strictly regulate lobbying in agriculture and the food industry</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Make sustainability “noticeable”-price?</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Governmental support</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Organic farming as the only solution for feeding the world</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Integrated production/processing in the city, e.g., urban gardening, rent a field</td>
<td>4</td>
</tr>
</tbody>
</table>

Looking at the results we notice that they are more factors that influence behavior than precise and practicable ideas or useful suggestions to bridge the intention-behavior gap in everyday life.

During the evaluation, it became apparent that a range of topics came up repeatedly. This has led us to an additional inductive data coding, in order to allow a more in-depth discussion of the data. We would like to point out that some data can be assigned to several categories and some data did not fit into the main categories at all. We prefer to use the terminology thematic cluster instead of code categories because we have collected several similar thematic aspects under a generic term (Figure 2).
Availability (also meaning the supply, access, and distribution channels) of sustainably produced food with 175 mentions is one large category within the data (example: easier availability \(\rightarrow\) as easy as buying conventional food). Others are nutrition education and education about the food industry including sub-topics like exchange of information, provision of information, and learning (289 mentions; example: creating general knowledge and experiences about food in schools, kitchens, health centers, rural and urban, e.g., nutrition education as a “must”), transparency related to the production and methods as well as to the information on the packed foods by labeling (80 mentions; example: more transparency about the ingredients of food products and understandable declaration) and advertising including all actions that raise public awareness for sustainable nutrition, food, and production. This includes campaigns, positive image building, role model staging and marketing activities (113 mentions; example: promote advertising in favor of organic food and sustainability). It continues with the category community meaning collective action within families and societies (111 mentions; example: introduce collective rituals for the

**Figure 2.** The thematic cluster of factors influencing the intention-behavior relation.
appreciation of food by cooking together, harvest festivals), policies such as promotion, subsidization, prohibition, sanctioning and legislation (178 mentions; example: politically regulate lobbyism in the food industry) and agriculture meaning aspects like food production and the role of farmers (141 mentions; example: promotion of small-scale agriculture with greater consumer involvement). Regarding food products the following aspects were clustered: food pricing (59 mentions; example: offer healthy food more cheaply), organic (113 mentions; example: introduce more organic products into everyday life), local (61 mentions: example: linking regional products and suppliers with the urban world (internet, delivery, “country” shops)) and seasonal (21 mentions; example: supermarkets with seasonal products and a stronger signage). Other clusters concern purchasing (22 mentions; example: avoid emotionally influenced grocery shopping: do I really need it?), cooking (59 mentions; example: cooking, baking, canning, preserving, stockpiling—making it more attractive and imparting craftsmanship), eating (32 mentions; example: develop new eating habits), building awareness including consciousness, mindfulness, and appreciation (79 mentions; example: creating awareness: what effects does my behavior have on other people in the world? Especially considering that we all share the world), food culture (20 mentions; example: (re)establish food culture) and time (33 mentions; example: problem: time pressure → no sustainable nutrition possible; solution: find time and take time to eat). In addition, urban life was often mentioned, especially urban gardening (32 mentions; example: rent a field: urban gardening in open spaces, unused urban areas, parks, green areas) as well as the thematic aspect of food packaging (25 mentions; example: using sleeves instead of plastic packaging for the differentiation of food) concerning the amount and type of packaging material.

4.5 Discussion

As part of our research, workshops were conducted to collect ideas in answer to the research question. To the best of the authors’ knowledge, this was the first attempt of such a method being applied to develop ideas for bridging the intention-behavior gap for adopting sustainable diets.

As described in the introduction, we expected to receive qualitative data in the form of useful ideas that will help people to overcome emerging barriers when dealing with the gap. However, we could not anticipate in advance what kind of ideas we will receive. Looking at the results, they do not seem to provide direct practical or applicable solutions to the addressed problem (no ready-to-use ideas). Within the ideas we coded as internal factors, we have a few that correspond to direct situational solutions.

Most of the data offer important information that we discuss in more detail below, starting with the five most occurring thematic clusters: education, politics, availability, agricultural production, and advertising.
Education is the most mentioned aspect amongst the ideas. Missing knowledge about something can influence the actual behavioral control as an external factor. We can form an intention without having all (necessary) knowledge about aspects concerning our target behavior, which can turn out to be a barrier in the course of the action. This is why lifelong education about nutrition and our food industry is still important. Education may be the one aspect where most research has been done and the most intervention programs have been conducted so far. Many nutrition education approaches are health-related and especially obesity-related [42–46]. Nevertheless, the efficacy of intervention programs for nutrition is still debated [47]. As far as we know, there are no generally applicable guidelines focusing on how to implement an effective intervention program and measures when an intervention is really effective (for example when children help their parents to make more sustainability-led choices). Clearly, educational institutions like schools can directly promote sustainable development by improving the type and quality of the provided food [48,49]. However, it should be noted that social stratification also plays a role in whether children attend school meals or not. Therefore, there is a high probability that those who may need this education cannot be reached [50,51]. In addition, there is some knowledge about different types of emerging resistance when healthy food proposals are implemented in schools [52].

In order to gain knowledge and education, transparency is an important factor and also often mentioned in the data.

The data show that regulatory intervention at the political level is intentional and necessary to have a positive impact on the development of the sustainable food system to enable sustainable nutrition, according to the participants. This mainly concerns subsidies, controls and the labeling of sustainable foods, as well as sanctions for unsustainable economies. This also goes along with the other frequently mentioned aspects such as agriculture, food pricing, organic, local, and seasonal foods and food packaging.

One further observation that seems very important is the frequently emerging aspect of food availability (in grocery stores, restaurants, canteens, catering). Consumption behavior, including that of sustainable nutrition, is based on a decision-making process. Here, the everyday behavior is mainly determined by factors such as habits and convenience that are persistent in terms of possible changes [53,54]. That is why intentions alone can be poor predictors of behavior. In order to change everyday nutritional behavior, external factors play a more important role, especially the availability of what is called sustainable food [53,55]. Without offering such food, people cannot opt for or against food items at the point-of-sale. Moreover, no corresponding consumption patterns can be formed [56]. Food availability can create a direct link to people’s behavioral control because everyone can have the intention and behavioral persuasion to practice a sustainable diet but it can be impossible to do so because of a lack of (appropriate) food availability [53]. If availability and accessibility are drivers of food consumption and consumers are drivers of food production [56] then we
have a mutually reinforcing, but also interdependent cycle of necessary factors where one cannot exist without the other. Considering that one factor must exist first for this cycle to get going, it is the availability without which there cannot be a corresponding consumption. However, there can be a pure availability of food by agricultural production and corresponding distribution without a demand through consumption (leaving aside economic aspects).

Agricultural food production is, of course, a hot topic considering that the availability of the desired food quality cannot exist without prior sustainable production. The basic premise is that there must be more sustainable agriculture and funding to produce food in the desired quality. In addition, the (sustainable) agricultural production of food is the basis of a (sustainable) food system and human nutrition.

Advertising seems to be a little-used aspect to promote sustainable dietary behavior. The data contain many ideas about marketing strategies, advertising campaigns, and corresponding media communication. The assumption is that a greater media presence of sustainable products is considered necessary to influence the purchasing decisions positively. There are studies about buying behavior successfully influenced by advertising—but mostly for foods that do not promote a healthy and sustainable diet and often targeting children and adolescents [57–60].

The collective action appears to be the way to a new kind of lifestyle, where not everyone undertakes life only individually, but many actions take place at a community level. The mentioned actions are producing, purchasing, cooking and eating food together. Added to this is the demand that people learn to cook and practice this frequently, whether alone or in the community. Another aspect that seems to play a decisive role in here is “time”: to spend more time on nutrition decisions, have more time for cooking and eating. Eating also goes hand in hand with the development of awareness of nutrition and consciously deciding for or against food items or behavioral action. This is where the aspect of a food culture also comes in, which should be lived out more distinctively, according to the workshop participants. One of the biggest barriers to sustainable food consumption is the price [61–63]. Within our data, participants suggest that prices for sustainably produced food should be lower than those for conventional products. Another observation we make is, that the workshop contributions also aim at a change in urban space and use. For example, establish a nutrition parliamentary committee in the municipality; edible City: free fruit, nuts, vegetables for everyone (allowed by the municipality); Integrated production/processing in the city, e.g., urban gardening. One reason for the number of urban targeting ideas can be that the workshops took place in bigger cities. Another reason for the focus may be the global challenge of urbanization in particular with food [64–66].

The above discussion shows that all these aspects are highly connected to each other. Altogether, aspects like education, politics, availability, and advertising serve the purpose of bringing sustainable food into the public focus and forming
a certain image. Ideally, these transformations would trigger a real trend towards sustainable diets. Previous isolated efforts through nutrition interventions for dietary change and public health could not bring any significant reversal from unhealthy diets [55]. It can, therefore, be assumed that real changes in the sense of improving diets require a large-scale movement of change involving multiple sectors and actors that affect everyday life.

The data indicate what kind of external framework conditions need to be created according to the workshop participants so that there is no gap between intention and behavior regarding the implementation of sustainable diets. Conversely, the data can be used to read perceived aspects that influence dietary behavior (missing availability of health-supporting and sustainably produced food, nutrition education throughout life) or what the potential barriers are (allegedly higher prices of health-supporting and sustainably produced food, lack of time for nutrition and related processes). Individual aspects overlap and can also be found in the literature [53,55,56]. Consequently, we have factors that could be key or at least suitable tools for bridging the intention-behavior gap in decision-making situations.

According to the TPB, intentions are formed and therefore can be influenced by our attitude towards the behavior, our subjective norms, and our perceived behavioral control. In addition, individual, social and informational background factors can have an impact on these variables. Once an intention is formed, the decision-making process to translate the intention into actual behavior can be affected by the person’s actual behavioral control consisting of internal and external factors. As we were able to code our results by internal and external factors influencing the behavior, we see how numerous and varied these can be—especially with a complex behavior such as nutrition. Some of the results, e.g., aspects of education, culture, and media also fit the background factors (Figure 1). First, we may need a clearer understanding of or separation between factors influencing the actual behavioral control and background factors. Second, using the TPB, we could also examine within a study which background factor affects which beliefs of attitudes, subjective norms and perceived behavioral control and thereby indirectly influence the intention and behavior [14,16]. This is a very important aspect to consider since the TPB also includes feedback loops coming from behavior to beliefs. Meaning, a performed behavior provides information about consequences, reactions and about how easy or difficult it was to perform the behavior. This information can change people’s behavioral, normative, and control beliefs, thereby influencing future intentions and behavior [14].

Combining our results with a suitable follow-up research design may shed light on how our findings may affect the intention-behavior relation. This, in turn, could be used to develop targeted solutions to bridge the intention-behavior gap. One further interesting aspect we can observe within the results is a kind of rejection of the intention-behavior gap by the participants themselves. The results are, with a few exceptions, never worded as self-referential. Instead, they aim for changes that others have to make, both internal and external. There is mention of
individuals who are often called consumers, farmers, politicians, and society, also named community. When screening the data, it seems that the solutions are mainly intended for others and for future generations, rather than for direct optimization for the participants themselves here and now. This is why a large part of the data can be interpreted as targeting a long-term system change that must come from the top down, which is a very interesting aspect to come from applying a bottom-up approach. One indication of this is the high number of external factors (80.9%). In addition, we are able to show a ranking within our dataset. It is also noticeable that among the top 25 selected favorites (Table 5), almost all are external factors (96%). One prominent example of a top-down action that has resulted in a broad change in behavior applies to tobacco. A large-scale strategy that included anti-smoking campaigns, stringent product labeling and offensive media communication of scientific evidence has led to a lifestyle change for many people [55]. If such a multiple offensive can alter a manifested behavior (with an addictive character) such as smoking, this example offers the potential for a similar strategy targeting nutritional behavior.

There are a number of limitations of our study which we want to list here. The first limitation concerns the participants. The absence of a monetary incentive might have selected only people who are very committed to sustainable nutrition and related issues. Their assumed high educational status could be one reason why there are so many external factors compared to internal factors within the results. Since we have collected almost no additional data from the participants, we cannot say much about the socioeconomic composition of the sample. However, as stated above we can say that most of our participants are highly educated which may affect the representation of the intention-behavior gap. We raise this in relation to research about the relationship between intentions and behavior affected by the socioeconomic status [67,68]. Social stratification in general also plays an important role, e.g., food consumption is strongly affected by people’s economic and cultural resources. Due to the lack of data, we cannot make any statements regarding our results in this respect. In addition, our sample consists of 81.7% women (Table 3). The gender aspect can also have an impact on health-related behavior. For example, women tend to eat more healthily than men do [69], which in turn could imply that men and women’s intention-behavior gaps differ to a great extent. If the proportion of men in our sample were higher, it could have an impact on the results. Another limitation concerns the definition and interpretation of a sustainable diet. Such a complex construct leaves room for individual interpretations. People’s ideas might differ from the scientific definition and its intended meaning. Although we introduced the concept of a sustainable diet at the beginning of each workshop, individual interpretations may have influenced the nature of the results. A further limitation may be the methodology itself. Because we applied a new approach, we see a need for a subsequent discussion on it, to possibly find out to what extent the type of results was influenced by the applied methods and other
parameters. For many people, working with creativity techniques is a new experience and the way of their application can be perceived as abstract and not effective. When using creativity techniques, there are four complex parameters that can be decisive to the success or failure of the creative process. These parameters are processed (problem perception, problem-wording, idea generation, idea evaluation, idea realization), product (what is being worked on), environment (physical and social), and person (attitude, motivation, abilities, personality traits) [70]. Going into detail about these parameters and their individual aspects would go beyond the scope of this discussion. However, we can see here that many factors, some of them uncontrollable, interact, which should be considered when planning to apply such methods. For our research, this means that within this discussion we can take a close look at our workshop design, the research question, and ideas to be generated, possible environmental factors and the participants. The workshop design includes the choice of methods and their combination. Among many methods, we chose those that we considered suitable individually and in combination. The combination of the individual work steps could have been arranged differently. However, there is no standard procedure for a successful workshop of this kind and for this research question. Another aspect is the lack of discussion rounds, which could have also acted as a control for the results. In addition, the interaction between the facilitators or organizer and the participants could have helped to correct or steer the direction in which ideas have been developed. Another consideration is the number of group work tasks. Here the group work and the desired creativity may be contrary. In order to achieve an optimal participation, group dynamic abilities like autonomy, spontaneity, and communication skills have to be learned [70]. Possibly mainly individual work in combination with subsequent discussions could have been more conducive to expose the own ideas of all participants [38,71]. From workshop design to the desired product, the formulation of the research question needs to be discussed. The research question is rather generally worded. One option would be to phrase the question more specifically to situational aspects (e.g., out-of-home catering, grocery shopping) to gain more precise direct situational solutions. However, at the beginning of the workshop, the research question, aim, and expectations were discussed. What remains to be mentioned is that the term ‘sustainable food systems’, was used in the invitation and the initial explanation. This may have led the participants to generate the ideas in their present form (targeting the whole food system). Further, the participants might not have been able to generate self-related ideas of the kind targeted. They may possibly have a lack of appropriate skills and experience in dealing with creativity techniques or the research question, but this is only an assumption. The structure of the workshop was designed in such a way as to be possible for all people to successfully participate without special prior knowledge; this worked well. First of all, we assumed that every interested participant has experience with the intention-behavior gap and the associated situational barriers. Thinking that anyone could contribute some
ideas on how to act in specific situations to bridge the gap was possibly a fallacy. However, we need experts in the continuous practice of sustainable diets. These experts must be found and recruited or at least selected more specifically. Our participants had a variety of backgrounds and we had no further information about their skills and abilities for dealing with the methods and the research question. If we return to the lead-user approach, it is about people who already have solutions. Therefore, it should be considered that a more specific selection of participants and training could be a possible success factor. Within our research, we dealt with a lack of capacities to implement this approach. In addition to the participants, of course, the facilitators also play a major role in a workshop. The facilitators were neutral during the creative process and did not judge the ideas. It seems important to reconsider if a stronger steering would be more effective to release more potential innovative ideas. In a similar way, a lead-user workshop has stakeholders join the workshop and always give clear instructions about what they have in mind. In such cases, the success of the company may very well depend on the developed product. In order to make our applied method more resilient and to find out exactly which aspects have significantly influenced the processes of idea generation, a follow-up study with all participants would be necessary. Though we have not carried this out at this time, what we already have is an evaluated feedback questionnaire distributed to all participants at the end of each workshop. In order to ask for the participant’s personal attitude towards the workshop design and other specific aspects, we used a 5-point Likert scale (Table 6).

**Table 6.** The results of the feedback questionnaire, n = 63.

<table>
<thead>
<tr>
<th>Selected Questions</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
<th>Neither agree nor disagree</th>
<th>No information</th>
</tr>
</thead>
<tbody>
<tr>
<td>The methods used were suitable and appropriate for the workshop.</td>
<td>50</td>
<td>12</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>The methods used were suitable to support creativity.</td>
<td>45</td>
<td>15</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>The research question is suitable for processing within an idea workshop.</td>
<td>47</td>
<td>14</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>The aim of the workshop was clear after the presentation of the question.</td>
<td>27</td>
<td>33</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>The implementation of several regional workshops makes sense for the research question.</td>
<td>45</td>
<td>15</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>The work materials provided (pens, paper, etc.) were sufficient.</td>
<td>61</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>The amount of time was appropriate for the workshop.</td>
<td>45</td>
<td>14</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>The venue was appropriate for the workshop.</td>
<td>58</td>
<td>4</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>The atmosphere during the workshop was pleasant.</td>
<td>58</td>
<td>5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Any interested citizen can participate in this workshop without special prior knowledge.</td>
<td>31</td>
<td>24</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Including citizens in such scientific research makes sense.</td>
<td>50</td>
<td>13</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
By involving citizens in the development of ideas to bridge the intention-behavior gap, ideas can be successful later.

| Overall, the facilitators were competent. | 56 | 6 | - | - | 1 |
| The facilitators were clear in the speeches and work tasks. | 42 | 20 | - | - | 1 |
| The facilitators reacted sufficiently to questions. | 57 | 5 | - | - | 1 |
| The facilitators remained neutral within the facilitation. | 54 | 8 | 1 | - | - |
| The facilitators guided the participants well through the workshop. | 59 | 3 | - | - | 1 |

In total, 63 (76.8%) participants of a total of 82 completed the questionnaire. Since the workshops’ procedure was identical, we decided on an overall evaluation without distinguishing between the individual workshops. The discussion of the results below only refers to the participants who completed the questionnaire. It is not possible to make informed statements about the attitudes of the other participants. That is why, despite the generally positive feedback results, we cannot assume that all participants share these opinions. We can see that in total, 62 participants agreed that the applied methods were suitable for the workshop and 60 participants think that the methods were suitable for supporting creativity. In general, we can say that for 61 participants the research question was perceived as suitable for processing within an idea workshop. Additionally, the workshop’s aim was clear for the participants (60 participants agreed).

Addressing environmental parameters, we can see that in general participants agreed on appropriate time management (59 participants), appropriate venue (62 participants), and pleasant atmosphere (63 participants).

Regarding the question, whether it makes sense to involve citizens in such research, all 63 agreed. However, 6 participants disagreed on the statement that any interested citizen can participate in this workshop without special prior knowledge (whereas 55 agreed on that). Another important point is that 58 participants thought that involving citizens in the development of ideas to bridge the intention-behavior gap can be successful for their later application.

Finally, we cannot say exactly why the results are influencing factors rather than situational solutions and if a different methodological approach would have generated other results that more innovatively address situational barriers, or whether the external factors such as availability, advertising, pricing, and education about food and nutrition are simply a prerequisite for a broad mass of people to practice a sustainable diet. While not a new point, this does seem to reinforce its importance.

4.6 Conclusions

Sustainable diets cannot exist without sustainable food systems and vice versa. Sustainable food systems wherein environments provide only sustainable food choices evolve slowly, if at all. That is why it is important to support society by researching the adoption and practice of sustainable diets.

The diversity of the gained data and their possible interpretations alone show that our research is part of a highly charged discussion where we are easily
crossing set research boundaries. Since the results in themselves are not entirely new ideas, research into innovations that make a decisive contribution needs to continue. All the listed limitations within the discussion could lead us to say that our gained results are rather a list of desiderata of a selected group of people who would like to be able to practice a more sustainable dietary behavior. We have to accept this on the basis of the mentioned limitations, and also because of the sample size and geographical limitation (Germany). However, the interesting aspect of the results is that those participants themselves reject the intention-behavior gap (as we discussed earlier). We see this as an important research topic that deserves further investigation.

Our research did not solve the problem at its first attempt and it seems that we are just at the beginning of the problem-solving process. To achieve our planned goal to research solutions to overcome barriers and bridge the intention-behavior gap we are planning to adjust our methodological approach and our sample, as discussed. It is necessary to collect more socioeconomic data about the participants so that we can later analyze and interpret results in differentiated ways. Ideally, studies will be conducted with particular selected groups of people such as men, woman, mothers, the privileged, the deprived, and experts. It is conceivable to carry out a study that examines the intention-behavior gap of the participants (researching their behavior in vivo). The design should strongly be based on Ajzen’s TPB, his published research, and supporting guides on TPB-based questionnaires and interventions [72]. On the other hand, the study design should involve the participants in the solution process. Therefore, we need to develop a methodological approach that leads people to work on ready-to-use ideas for bridging the intention-behavior gap.

We encourage other scientists to apply further methodological approaches that promote participative processes and collaborate with society because studies are required to deliver applicable solutions to people’s everyday life. On the basis of our work, we further suggest that future research can use a mixed methodology approach. This allows researchers to collect and distinguish quantitative and qualitative data from participants with different intention-behavior gaps. Consequently, the factors that cause these differences could be more closely analyzed and understood, which in turn could lead to applicable solutions. It remains to be said that, as with many other studies there is no innovation without a risk [73].

4.7 Supplementary Materials

The following are available online at http://www.mdpi.com/2071-1050/10/12/4434/s1, Table S1: Complete dataset (Excel chart).
4.8 Funding

The workshops were funded by the Department of Organic Food Quality and Food Culture at the University of Kassel, Germany. The costs of this open access publication were covered by the Open Access Publications fund from the University of Kassel which is financed by the German Research Foundation (DFG) and the Library of University of Kassel.

4.9 Acknowledgement

We express our thanks to all participants who dedicated their time.

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5 Exploring external factors affecting the intention-behavior gap when trying to adopt a sustainable diet: a think aloud study

Journal: Frontiers in Nutrition
Submitted: 11 November 2019

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5.1 Abstract

Not least from an ecological and health perspective, it can be posited that a broader part of consumers should practice sustainable diets. People who are already willing to do so are often confronted with the intention-behavior gap, caused by a range of internal and external factors. To eliminate these barriers requires a deeper and more comprehensive understanding of these factors and their interplay. Therefore, a think aloud study with 20 adult German participants was conducted to explore the four chosen external factors of availability, education, advertising and price. Furthermore, questionnaires for all four factors were handed out and a follow-up interview was conducted to gain additional qualitative data. Results show that these four external factors seem to have a major impact on the intention-behavior relation. According to the participants all factors interact in some way with other internal and external factors, making practicing sustainable diets a complex activity.

In conclusion, the four external factors availability, education, advertising and price need to be addressed by various stakeholders within our food systems in order to move forward in the process of making sustainable diets practicable and sustainable food systems firmly established.

Keywords: intention-behavior gap, sustainable diet, think aloud, nutrition behavior, behavioral factors, sustainable food systems

5.2 Introduction

The understanding that our daily practiced diets have an impact on our environment and influence the world’s climate, water quality, soil conditions and
biodiversity is not new (1–6), similarly the fact that our diets can take a dual role as cause and prevention of human and environmental health (7). The compilation and composition of a diet is related to what a food system offers. In turn the demand on food, created by diets, has a direct impact on what the food system delivers (8). Therefore, diets can play an important, if not a key role when it comes to eliminating the threats to the environment and achieving the UN’s Sustainable Development Goals. Along with our diets, our food systems need to become more sustainable in the face of current and future challenges such as health and environmental issues (9,10). The close link between a food system and a diet in terms of sustainability becomes also evident by having a look at their definitions:

“A sustainable food system (SFS) is a food system that ensures food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition of future generations are not compromised.” (11)

“Sustainable Diets are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources.” (12)

We can see that both definitions address, amongst others, the dimensions health, environment, economy and society and that they are interdependent (13). Especially their extent of sustainability depends on each other (14). This interdependence can be illustrated by the current state of research on the Mediterranean diet as one example of a sustainable diet (15). The framework for revitalizing the Mediterranean diet provides four sustainable benefits that are strongly interdependent and resulting from the diverse Mediterranean food systems: [1] well-documented nutrition and health advantages, preventing chronic and degenerative diseases and reducing public health costs; [2] low environmental impacts and richness in biodiversity, reducing pressure on natural resources and climate change; [3] positive local economic returns, reducing rural poverty and [4] high social and cultural food values, increasing appreciation, mutual respect and social inclusion (16,17). Of course there is not one Mediterranean diet, because it varies from country to country while considering different local environments and economies, as well as social and cultural features (18,19). Therefore, it can be said that the Mediterranean diet is a complex web of nutritional, cultural, historical, economic, political and religious aspects that all somehow interact within Mediterranean food systems when the diet is being practiced (20). Despite the overall complexity that comes with today’s understanding of sustainable diets we need to make dietary decisions that preferably don’t jeopardize our health, environment, economy and society (21). In order to proceed a corresponding sustainable development, behavior changes will be needed (22), as well as strategies that promote sustainable diets
in different contexts worldwide (23). A starting point for awareness raising is to include sustainability in food based dietary guidelines (21,24) as well as to promote that diets with a higher amount of plant-based food and a lower intake of meat and dairy food products produce less greenhouse gas emissions (25,26) and bring a range of other health, environmental, economic and social benefits (1,27). The importance of practicing sustainable diets is now increasingly widely acknowledged (28,29) and partly consumer behavior is already changing towards purchase of sustainable food products because of raised awareness (30). However, most of the time we are struggling with nourishing ourselves sustainably, even if we consciously formed the intention to do so. In general, the phenomenon of not acting as we intended is called the intention-behavior gap. In Figure 1 we can see that according to Ajzen’s Theory of Planned Behavior (TPB) our formed behavioral intention is based on the attitude towards the behavior, subjective norms and perceived behavioral control. The formed intention is then not always directly translated into behavior (31,32). Ajzen states that “People can be expected to act on their intentions only to the extent that they have sufficient control over the behavior in question.” (33). Whether people’s intention for a specific behavior will successfully be performed is therefore dependent on confidence and commitment towards the intention and the perceived and actual behavioral control. There are internal and external factors which act as barriers by interfering with our behavioral control. Internal factors such as the general ability to exercise behavioral control, information, skills, abilities, will power, emotions, stress and compulsions can influence our behavioral control as well as external factors such as time, opportunity and dependence on others (31). People with a higher perceived control of influencing factors are likely to translate their intention into the foreseen behavior (34). Barriers to or influencing factors on practicing a sustainable diet can be for example availability of food, lack of information, poor presentation or food prices (35).
Figure 1: Theory of Planned Behavior (TPB)

If it is already difficult for people who have formed a positive intention to act decisively, what about those who still need to be convinced? To tackle unsustainable food consumption, we need to promote sustainable diet practices on an individual level. On the one hand this includes increasing the awareness of sustainable diets and on the other hand exploring determining factors for practicing sustainable diets (36). Food system improvements and innovations are necessary to promote and enable people’s behavior change (37). People need support to close the intention-behavior gap and to be able to continuously practice sustainable diets. To get to this point we need a better understanding of the factors influencing our nutrition behavior. Therefore, this paper seeks to explore external factors that are involved in causing the intention-behavior gap when it comes to practicing sustainable diets, and to get a broader understanding of their interrelationships. Then we can better make valuable recommendations for policy, stakeholder and consumer action within food systems, for closing the intention-behavior gap. We focus on the external factors because addressing them within our food systems can be a good starting point to create the best conditions enabling people to nourish themselves sustainably. On this account a mixed method approach is conducted to gather qualitative and quantitative data. The analysis allows us deeper insights which in turn enable us to better understand these particular factors and the resulting problem of the intention-behavior gap and how to handle it in future.

5.3 The think aloud approach

To learn more about the external influencing factors and their effects, it can be helpful to know what people are thinking. One method that helps researchers to do so is the think aloud approach which can offer us insights into people’s thoughts, feelings and intentions (38). According to scholarly literature the think aloud method offers the opportunity to gain data that cannot be gained in any
other way by any other method. Moreover, qualitative researchers assume that based on think aloud data, models of cognitive processes can be developed (38). In its original form, the method provides that humans are asked to verbalize their thoughts coming during an activity (task) which is being studied. These verbal utterances then represent the gained qualitative data. However, feelings and daydreams are, according to Ericsson and Simon (39), not considered as hard verbal data, because their clear interpretation and analysis is difficult. The only data that should be evaluated are those about what the subject is doing during solving the task and in what order (40). However, researchers are not always in agreement with that and collect the data that is valuable for their studies (41).

There are four core principles that should be pursued when applying the think aloud approach according to Ericsson and Simon: give subjects detailed instructions for thinking aloud, remind subjects to think aloud and do not intervene otherwise collect and analyze only hard verbal data (40). However, not all research applications of the method follow these core principles (41). It is important for the think aloud process that each subject has an own session in a comfortable and quiet setting and should constantly talk (42,43). After collecting data through audio or video recording, these verbal protocols need to be transcribed, analyzed and evaluated (42). Ericsson and Simon (39) differentiate between concurrent verbalization during performing a task and retrospective verbalization after performing a task. Retrospective verbalization is further differentiated between immediate retrospection and delayed retrospection (38). In addition, think aloud examinations can be supplemented by triangulation to ensure as complete information gathering as possible (44). Therefore, researchers need a follow-up strategy. This can be, for example, a follow-up interview or a questionnaire (45). As there are different variants of the method and researchers are collecting different kinds of data, the validity of the method stands for question. Although there is little research on the validity of the methodology (46), knowledge about potential threats to validity for concurrent and retrospective verbalizations exists (47). To ensure the validity researchers can remind participants to constantly think aloud and use a control group (47) as well as avoid collecting data via retrospective protocols (48). Aiming for completeness of the verbal protocols, think aloud studies should include other methods (49), as mentioned before.

For a majority of people thinking aloud is new and requires practice, which should be considered when planning an investigation (40,43). The think aloud approach finds current application in the fields of problem-solving, language acquisition and reading research, teaching research, decision research, media research and usability tests (38). In addition the method is widely used in marketing and consumer research, advertising effectiveness and purchase decision-making (50). In the food and nutrition sector the method is used to examine behavior at the point of sale (51–53), to explore or identify factors that influence purchasing behavior or food choices (54–59), to improve a questionnaire design (60–62) or to examine nutrition education and interventions
Researchers are also using the think aloud data to develop or explore hypotheses (49).

5.4 Materials and Methods

This research study was publicized via e-mail distribution lists of students from the Department of Food - Nutrition - Facilities at Münster University of Applied Sciences and oral dissemination in the professional environment of the lead author. Participants were recruited in January 2019. We selected our participants primarily based on their interest to participate. In accordance with method practice we rather aimed for a medium sample size and proceeded with 20 participants. As with many other research method applications, there is also a heated debate on how many subjects are needed for a think aloud study. Despite that there are studies including about 20 participants or even up to 70 participants and more (42,45,54,55,57,64,66–72), think aloud studies are known for actual not requiring a large sample (70,73) and may have designs with under 10 participants. This is especially applicable when qualitative topics are explored and no statistical generalizations are made (74). As an incentive we offered each participant five Euros and a sustainable food item (seasonal vegetable from a local organic farm). A written informed consent was received from all participants. In addition, the participants have received a data privacy policy which gives them the opportunity to ask for their data to be deleted at any time. All interested potential participants were informed by e-mail about what to expect when participating in the study. The think aloud method was already explained in advance, so that people who felt very uncomfortable with the idea had the opportunity to opt out of participation. Along with this information participants received a handout on sustainable diets, which essentially contained the FAO definition (12) and the dimensions and principles of a sustainable diet according to von Koerber (75). By reading the handout, we wanted to ensure that all participants have the same basic understanding of a sustainable diet, even if they may not practice a sustainable diet.

The study took place from January 21 to February 1, 2019. All individual sessions took place in a specially prepared meeting room at Münster University of Applied Sciences. The room offered a pleasant atmosphere (windows, centered work desk) to let the participants feel as comfortable as possible within this setting. Other than Ericsson and Simon (31) we also wanted to collect data that is not considered as hard data. This is mainly because we don't attempt to build cognitive models, but rather seek to gain insights and also capture feelings and preferences towards the issue under study.

In developing our research design, we decided to proceed with a simplified think aloud approach. Since our research focus lies on the behavioral control influencing external factors and not on the pure action process itself, it was considered suitable for us to use video simulations of typical daily situations.
This approach is often used in client simulation think aloud studies (42). We produced four videos in each of which one external factor is responsible for creating the intention-behavior gap. Based on previous research (76,77) we decided to choose the external factors availability, education, advertising and price. The videos were produced in the style of cut-out animation. This is a film technique in which cardboard cut-outs (figures and other items) are moved by hand on a surface and put into relation to each other. This procedure is filmed in live-action, cut, set to music and a narrator's voice is added to tell a story, or explain something. The task of the participants was therefore to watch the videos one after another and simultaneously verbalize all their thoughts. Our think aloud guideline for the participants included the following procedure:

- Welcome participant and offer a glass of water
- Express thanks for willingness to participate
- Hand out a questionnaire to collect demographic data
- Give a brief instruction to the procedure and explain each step
- Provide time for any queries
- Start warm-up practice
- Provide time for any queries
- Start the think aloud session (including supplementary questionnaires for each external factor/ video). This includes the following text: “Please remember to constantly verbalize all thoughts that come to your mind.”
- Follow-up interview; including four questions
- Reflect the study procedure with the participant
- Hand out a feedback questionnaire concerning the method application
- Express thanks for participation and present the incentive
- Say goodbye to the participant

We stayed absent from the room during the actual think aloud procedures and did not intervene at any time. We also supplemented our think aloud data with a questionnaire and a follow-up interview. Mainly, we did so to ensure that we get data if the participants wouldn’t think aloud sufficiently for analysis purposes (back-up plan) as well as getting specific information on subtopics. The full sessions were audiotaped and transcribed fully verbatim with the support of the software MAXQDA 2018. With this software we also evaluated the data of the think aloud protocols, the qualitative part of the questionnaires and the follow-up interviews. We decided to first proceed with an inductive coding of the material to structure the material and then we conducted a qualitative content analysis.
5.5 Results

5.5.1 Study Sample

The final study sample included a total of 20 participants comprising thirteen women (65%) and seven men (35%). Additional study sample characteristics are shown in Table 1. In response to the question of whether the participants try to practice a sustainable diet, 17 responded with yes and 3 with no.

<table>
<thead>
<tr>
<th>Socio-demographic characteristics</th>
<th>Total number (n=20)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>13</td>
<td>65</td>
</tr>
<tr>
<td>Male</td>
<td>7</td>
<td>35</td>
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<td><strong>Age</strong></td>
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<tr>
<td>18-19</td>
<td>1</td>
<td>5</td>
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<td>20-29</td>
<td>10</td>
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<td>40-49</td>
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<td>5</td>
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<td><strong>Marital Status</strong></td>
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<tr>
<td>Single</td>
<td>18</td>
<td>90</td>
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<tr>
<td>Married</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Separated/ Divorced</td>
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<td>0</td>
</tr>
<tr>
<td>Widowed</td>
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<td>0</td>
</tr>
<tr>
<td><strong>Household composition</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 person</td>
<td>7</td>
<td>35</td>
</tr>
<tr>
<td>2 people</td>
<td>8</td>
<td>40</td>
</tr>
<tr>
<td>3 people</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>4 people</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>8 people</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abitur (high school diploma)</td>
<td>9</td>
<td>45</td>
</tr>
<tr>
<td>Bachelor degree</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>Master degree</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>Diploma degree</td>
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<td>5</td>
</tr>
<tr>
<td><strong>Monthly income (net)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 500 €</td>
<td>3</td>
<td>15</td>
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<td>501-1000 €</td>
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<td>25</td>
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<td>1001-2000 €</td>
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<td>30</td>
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<tr>
<td>2001-3000 €</td>
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<td>10</td>
</tr>
<tr>
<td>3001-4000 €</td>
<td>2</td>
<td>10</td>
</tr>
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</table>
5.5.2 Results from the think aloud method application

Each participant provided a think aloud protocol for every chosen external factor (availability, education, advertising and price). Some are longer or more detailed than others. Overall, however, it can be said that almost no participant had difficulty expressing their thoughts aloud. Three participants were conspicuous in that they verbalized only a few words or short sentences. The authors have translated the quotes from German into English, keeping to the original even where sentences are incomplete or the quotes are grammatically incorrect.

Having a look at the inductive coding of the think aloud protocols brings us insights to each of the external factors. In Table 2 we can see that within the protocols for availability there are factors that come up very often like availability (50 codings), planning (22 codings), hunger (21 codings), information (14 codings), personal norms and values (14 codings) and time (13 codings).

<table>
<thead>
<tr>
<th>Main code</th>
<th>Sub code</th>
<th>Availability Coding</th>
<th>Education Coding</th>
<th>Advertising Coding</th>
<th>Price Coding</th>
</tr>
</thead>
<tbody>
<tr>
<td>External</td>
<td>Advertising</td>
<td>0</td>
<td>0</td>
<td>38</td>
<td>2</td>
</tr>
<tr>
<td>External</td>
<td>Availability</td>
<td>50</td>
<td>8</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td>External</td>
<td>Education</td>
<td>0</td>
<td>9</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>External</td>
<td>Information</td>
<td>14</td>
<td>16</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>External</td>
<td>Labeling</td>
<td>0</td>
<td>13</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>External</td>
<td>Packaging</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>External</td>
<td>Politics</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>External</td>
<td>Price</td>
<td>4</td>
<td>13</td>
<td>1</td>
<td>37</td>
</tr>
<tr>
<td>External</td>
<td>Social</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>External</td>
<td>environment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External</td>
<td>Time</td>
<td>13</td>
<td>1</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>External</td>
<td>Transparency</td>
<td>2</td>
<td>9</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Internal</td>
<td>Consciousness</td>
<td>5</td>
<td>13</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td>Internal</td>
<td>Finance</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td>Internal</td>
<td>Health</td>
<td>5</td>
<td>2</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Internal</td>
<td>Hunger</td>
<td>21</td>
<td>1</td>
<td>18</td>
<td>0</td>
</tr>
<tr>
<td>Internal</td>
<td>Knowledge</td>
<td>7</td>
<td>28</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Internal</td>
<td>Personal norms and values</td>
<td>14</td>
<td>20</td>
<td>8</td>
<td>18</td>
</tr>
<tr>
<td>Internal</td>
<td>Planning</td>
<td>22</td>
<td>0</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Internal</td>
<td>Taste</td>
<td>3</td>
<td>0</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Internal</td>
<td>Willpower</td>
<td>7</td>
<td>1</td>
<td>15</td>
<td>7</td>
</tr>
</tbody>
</table>
Based on the codings and content analysis we can state that a higher availability of sustainable food is needed, so that people have access to buy it. Especially when people are hungry and on the go, and are short of time, it would be helpful, if there is a high and fast availability, otherwise other offers such as widespread fast food chains will (or must) be used instead.

P4: “(...) And then you feel bad, but there is just no other way and yes, because nothing is available. If there is nothing offered, then I cannot buy something. And if I haven’t planned that, then that is very unfavorable and then sometimes there is no other way and yes, then you have to face the intention-behavior gap. You have to eat something anyway, because you’re hungry.”

One important factor seems to be the planning of the daily diet and to gather information in advance where to find something suitable to eat when one is out of home.

P13: “(...) And you should at least take care of your food-supply half or three-quarters of a day. Then look, um, where you can dine. In addition, she [character in video] could have informed herself in advance. Or just ask a stranger/ local person.”

As already mentioned in the above quotes, the provision of information is also of decisive importance. Respondents indicated that people need access to information about where to find sustainable food offers in a supermarket or restaurant.

P19: “(...) What is difficult is that many facilities such as supermarkets and restaurants have a rather conventional offering and not focus on organic and sustainability. Information from locations may also be poor, poorly given. Maybe it would be helpful if you would somehow use apps or something similar. Available are conventional foods. That, um, what has a lot of money and is directly available and is on your way. And that is the economic system which is just established, it’s not yet operating that the focus is on organic or local. And in the meantime, the pressure of time that arises in our society [meaning having lack of time], doesn’t contribute to facilitate that one could somehow inform himself or herself in detail where to go [to buy sustainable food]. (…)

For education there are coded factors like education (9 codings), knowledge (28 codings), personal norms and values (20 codings), information (16 codings), labeling (13 codings), price (13 codings) and consciousness (13 codings) that come up quite often within the protocols. It is striking here that education itself doesn’t have the highest number of the codings, as it is the case with the other three external factors. Knowledge, information, labeling, personal norms and values and consciousness have more codings, as they may be included in the understanding of education from the participants’ point of view. At best,
education leads to knowledge. This is what a number of quotes indicate, and, furthermore, that people need to deal with education offers themselves to gain knowledge.

P3: “(...) Of course you have to know that, or make the transfer that it [vegetables] usually only grows in the summer. Exactly, and not in the greenhouse. That this is, of course, not good for the life cycle assessment, you have to know that too. That means you have to deal with it. (...)”

According to the participants, knowledge can then also be key to buy the “right” food items and know how to prepare them.

P10: “(...) So, education is very important. I notice that with my roommates. They have no idea and buy, um, tomatoes from Spain in winter. And, um, yes/ I wouldn’t do that, or I fundamentally changed my behavior and only buy local food. (...) I buy in season, but also because I simply have the knowledge of what vegetables grow when and which fruits can be eaten in the winter, um, anyway, because they can be stored, as for example apples. Many students don’t even know how to prepare seasonal or local vegetables. They don’t know that at all. For example, they don’t know what to do with a rutabaga, or they don’t know how to prepare fennel and therefore they don’t buy it.”

Within educational work, information about food labeling needs to be incorporated according to the participants, and in general comprehensive food labeling needs to be established. Moreover, there must be more education about nutrition and food systems in schools, so that people are already trained and know how to act when they are adults, as exemplified by the following response.

P11: “(...) So that’s a classic example for the need for comprehensive labeling and, um, appropriate labeling. And that must be much more taught, um, also in schools and also on the, yes, also on the learning path. Especially in all schools. Um, that should be part of the basic education besides math, German, et cetera. Um, that you know how you can find your way around in the supermarket. I think these two ways should merge. And, um, on the one hand people should be enlightened about such things already in school. And, um, on the other hand, that this label jungle is also somehow reduced, but with good standards.”

Furthermore, participants suggest that even supermarkets can support education by providing their customers with information about food labeling and the product itself. In this way there is a direct confrontation with the product’s background at the point of sale.

P19: “(...) The economic system states that cheap food is better, because it doesn’t cost that much. It would be good, if there would also be information about the product itself and what the labeling means. An alternative would be maybe that supermarkets would
provide information by somehow putting up posters or stand up displays, where
information is generated. Then people can have access during shopping. (...) And I
think that somehow you have to confront people directly and that they cannot generate
information by themselves. (...)

The most common codings within the think aloud protocols for the factor advertising show the following distribution: advertising (38 codings), hunger (18
codings), willpower (15 codings), availability (14 codings), consciousness (14
codings), planning (9 codings) and personal norms and values (8 codings).
Participants said that advertising is subconsciously influencing people’s
behavior and it evokes needs that are otherwise not present or relevant.

P11: “So, advertising should be significantly more regulated. So that unhealthy foods
should not be promoted that way, because kids can see it [advertisement] too. There is
also a significant imbalance between food products that are promoted by advertising,
between fresh and healthy foods and, um, yes, snack food. Through this imbalance also
needs are arising that otherwise wouldn’t exist. Yes. Yes, that’s definitely a big
influence, if not a very big one [influence]. Um, I think in many ways also
underestimated [advertising]. Because that subconsciously just triggers so much over
the years. You grow up with it. And I think you would have completely different eating
habits, if you were not confronted with so much advertising from your childhood
onwards. (...)”

Also, participants indicate that it seems to be very difficult to resist advertising
because it has such a strong power and influence on people, especially when
advertised foods are available everywhere.

P14: “(...) Um yes, but it is already proven that, um, no matter how much we are
aware of what advertising triggers in us, it still has an effect because it affects a lot our
subconscious, exactly, it effects a lot in the subconscious. (...) So, as I said, it still has
an impact on us when we, um, when we are confronted with advertising and then, in
that moment we think, wow I’m hungry, there is such an awesome chocolate bar, I take
it. And to control oneself in that situation needs a lot of strength. That’s difficult, I
think. Yes, well, there are certainly more assertive people than me, but, um, so the
majority of society is probably pretty weak in that case. Especially because we are
constantly confronted with advertising. Yes. (...)”

Another insight from the data is that according to the participants advertising
should be used to promote sustainable diets or sustainable food. This goes
together with education or providing people with information; also, that people
are able to assess advertising and don’t let it have a negative influence on their
behavior, as exemplified by the following excerpt.
P19: “Of course, you could also use repeating advertisements in a positive way, to promote sustainable diets. But I believe that the one, who has the most money, is the one who advertises. And these are not really the ones who act ecologically sustainable, um. (...) I think this also interacts with education, um, if you fall for these advertising strategies or not. Or, if you can better assess them or estimate their credibility. Because without this basic knowledge, I think that it will not work.”

Price was the fourth external factor for exploration in our study. The most frequent codings within the protocols are price (37 codings), finance (32 codings), personal norms and values (18 codings), social environment (15 codings), availability (12 codings) and consciousness (12 codings). Participants stated that if people don’t have any money, they cannot spend it on a sustainable diet, because it is just not available.

P4: “(...) That situation, if you want to do it, but you haven’t enough money for it and then despite that just try to, what is personally important to you! For example, animal based products, that’s always very important to me, that I buy at least these in organic quality. Yes, but if you just don’t have any money, then it’s just not possible. That’s just how it works here in Germany and in other countries I think even more. That’s just one big issue, so money, so finances are! This is really one of the biggest barriers. Because it’s [the money] just not there then. You just don’t have it then. And then you can turn yourself upside down, but then you just don’t have it. So, if, maybe then you have to plan your budget in advance and look how you can divide it. But in that moment, you don’t have it, you don’t have it and then it is, yes a dealbreaker.”

Participants highlighted that the availability of money also depends on the social environment in which one lives. For example, if people need to provide a family with food.

P11: “Yes, with children, of course, you always have a budget, a certain budget available, just like every household. Exactly. Especially towards the end of the month. That means that the price, of course, plays a role. And if I think of our society, there exists also a great inequality and unfortunately people from lower social strata cannot afford it [to buy higher priced sustainable food]. (...) I believe, as I said, that this is a real problem for families and people from, um, socially difficult strata and from, um, with little income, really little income. (...) So, it depends on the population group. I would say that there is a big difference. For some people it has a very large impact, and for others a very small influence, I would say.”

In the context of food prices, it also seems important to plan in advance and whether a person should reconsider their diet. Then there may be potential savings at some points. For example, if people would rethink their buying behavior and their diet, then their budget can be spent on other food items with a better quality.
P6: “(...) But you can also manage, for example, that you just then don’t buy meat and then for this money what you would have paid for the meat you can then just, um, buy other food [sustainable food]. Theoretically you could do it this way. Yes, the price has a very big influence, especially for us Germans. Very, very, I think that the price is the biggest influence on our behavior.”

What is interesting is that people seem to want to save money as a general orientation and that the thought of saving money may be internalized.

P10: “(...) Yes, sometimes I am also happy when I see cheap things and then I always must remind myself to, um, not to see that as a priority, but to buy the food with a higher quality. But sometimes the cheaper products are also finding their way into my shopping cart. Especially if I’m shopping for a group, so if, for example, I have friends come over and I have to cook large quantities, then, um, I often buy cheaper food and no-name products and if I only buy for myself, then the amount is less and then I can also often afford sustainable products. But actually, it’s not about if I can afford something, it’s more a mental thing. You always want to save money and that’s always a bit inside of me. So always this thought of saving money. Um, I think, if I really wanted it, I could afford to buy it. Of course, it would be more expensive and then I would have to lower my sights at other matters of expense. (...)

One participant stated that for him quality has always the highest priority. When people have this personal norm that the food quality comes first, then the factor of a higher price can be beaten. One further interesting point of view regarding the allegedly higher food prices is that less food waste can be produced in the household due to the lower quantity contents of packaged food.

P20: “(...) Um, so there, um, so in terms of price, for me I always find that it is very difficult. Well, personally, I don’t mind that [higher food prices], I always think the quality has to be right and, um, I think Germany is one of the countries, especially compared to other European countries, where the food is really cheap. And even organic food is very cheap in discount supermarkets. Um, for me, as always, the quality must always fit. And that’s why the price is not decisive for me. (...) And if I buy organic products, they usually have the same price as conventional products, but there is less in it. Which of course is first not so good, but I think, um, currently, I prefer that because then I throw nothing away. And, um, yes, that is why I often choose the organic product anyway. (....)

Visualizing the results of the think aloud protocols shows, that the four external factors availability, education, advertising and price interact with other external and internal factors (Figure 2).
5.5.3 Results from the supplementary questionnaire

The supplementary questionnaire was filled out for each external factor. It included three questions, two closed questions with multiple choice answers and one open question. With this questionnaire we wanted to gain information about the strength of the influence of each factor on the intention-behavior gap, if the factors are actual barriers for the participants personally and in general and with the last question we wanted to gain ideas how to tackle these external factors, so that they cannot interfere with an intention to follow sustainable diets.

Table 3 provides an overview of the results from the first question. We can see that all four factors were attributed a rather strong influence on the intention-behavior gap. Especially the factors price and education have a strong influence according to the participants’ assessment. From all factors considered, advertising seems to be the one that does not have the same strong influence as the other external factors.
TABLE 3 | Influence of external factors on causing the intention-behavior gap (n=20)

Q1: In the video the external factor availability/ education/ advertising/ price was displayed. How do you assess the influence of this factor on the intention-behavior gap regarding the practice of sustainable diet?

<table>
<thead>
<tr>
<th>Influence</th>
<th>Availability n (%)</th>
<th>Education n (%)</th>
<th>Advertising n (%)</th>
<th>Price n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong influence</td>
<td>7 (35)</td>
<td>9 (45)</td>
<td>2 (10)</td>
<td>10 (50)</td>
</tr>
<tr>
<td>Moderately strong influence</td>
<td>9 (45)</td>
<td>6 (30)</td>
<td>7 (35)</td>
<td>5 (25)</td>
</tr>
<tr>
<td>Fairly strong influence</td>
<td>2 (10)</td>
<td>5 (25)</td>
<td>9 (45)</td>
<td>5 (25)</td>
</tr>
<tr>
<td>Undecided</td>
<td>1 (5)</td>
<td>0 (0)</td>
<td>1 (5)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Rather minor influence</td>
<td>1 (5)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Moderately minor influence</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>1 (5)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Minor influence</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>No influence</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

For the second question we can see in Table 4 that there is a big difference between the assessment for the participants personally and in general except for the factor availability. Here we can see that it applies as a causing factor in almost all cases personally (95%) and in general (100%). The factors education (100%), advertising (95%) and price (100%) apply almost always in general. Education (45%) and advertising (40%) apply to less than half of the participants personally. The factor price (60%) applies to more than half of the participants personally.

TABLE 4 | External factors’ contribution in causing the intention-behavior gap (n=20)

Q2: Please indicate below whether this external factor may be the reason for the emergence of a intention-behavior gap for you, personal and, according to your opinion, for the general public.

<table>
<thead>
<tr>
<th>Influence</th>
<th>Availability n (%)</th>
<th>Education n (%)</th>
<th>Advertising n (%)</th>
<th>Price n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>For you personally</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Applies</td>
<td>19 (95)</td>
<td>9 (45)</td>
<td>8 (40)</td>
<td>12 (60)</td>
</tr>
<tr>
<td>Doesn’t apply</td>
<td>1 (5)</td>
<td>11 (55)</td>
<td>12 (60)</td>
<td>8 (40)</td>
</tr>
<tr>
<td>In general</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Applies</td>
<td>20 (100)</td>
<td>20 (100)</td>
<td>19 (95)</td>
<td>20 (100)</td>
</tr>
<tr>
<td>Doesn’t apply</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>1 (5)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

Quotes for the third question can be found in Table 5. Ideas for the factor availability target a higher availability of sustainable food and a better individual
planning of the daily diet to avoid a lack of availability. For example, precooking and taking food from home with. Along with planning goes information gathering via tools such as mobile applications that can show persons where to find sustainable food offers.

<table>
<thead>
<tr>
<th>Idea quotes (translation provided by authors)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Availability</strong></td>
</tr>
<tr>
<td>Offer more &quot;healthy fast food&quot; in cities, train stations, highways</td>
</tr>
<tr>
<td>City apps offer targeted information for sustainable, healthy and readily available nutrition options</td>
</tr>
<tr>
<td>Better planning of everyday nutrition - do not leave it to chance</td>
</tr>
<tr>
<td>Meal prepping and trying to have sustainable snacks always with you, especially if you know that you are out of home</td>
</tr>
<tr>
<td><strong>Education</strong></td>
</tr>
<tr>
<td>The aspects of nutrition, health and sustainability should already be treated in elementary schools regularly</td>
</tr>
<tr>
<td>Educational work in the media</td>
</tr>
<tr>
<td>Political local implementation strategies that directly affect the population</td>
</tr>
<tr>
<td>Public information, e.g. on the products or on stand-up displays in supermarkets</td>
</tr>
<tr>
<td><strong>Advertising</strong></td>
</tr>
<tr>
<td>Be aware of the impact advertising can have. Counter it.</td>
</tr>
<tr>
<td>Promote healthy and sustainable products more strongly; So that people are not only bombarded with advertising for unhealthy food products but also with desirable products</td>
</tr>
<tr>
<td>Consumers can use tricks to protect themselves from advertising, such as not shopping hungry and carrying a grocery list</td>
</tr>
<tr>
<td>One can also use this positively and advertise sustainable products and place them cleverly for shopping</td>
</tr>
<tr>
<td><strong>Price</strong></td>
</tr>
<tr>
<td>Plan and manage your monthly budget at the beginning of the month</td>
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<tr>
<td>Sustainability communication: why are the products more expensive and what</td>
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<tr>
<td>Internalization of costs of conventional foods; This makes them more expensive and organic food able to compete</td>
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<tr>
<td>Educational work on consuming in general. People consume so many unnecessary things that it follows that the money cannot be spent on</td>
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To prevent the intention-behavior gap caused by the factor education, participants see more educational work especially in schools and through media as promising, as well as political support for implementing this, but also providing information about the food products directly at the point of sale. Looking at ideas for tackling advertising as an influential factor, participants stated that people must be aware of advertising and the effects that come along with it and try to avoid getting confronted with food advertisement. Ideas were also raised to use advertising for sustainable food items and to promote them in the same way as is done currently with sweets and other food items. Regarding the price, participants voiced ideas to strictly plan the monthly budget for food if it is rather tight and to use educational work so that people know and are aware of why sustainably produced food is more expensive (and are then willing to pay the higher prices). Additionally, they suggested regulating food prices by political action, so that they are reflecting the real price. Especially when applied to non-organic products.

5.5.4 Results from the follow-up interview

The follow-up interview directly after the think aloud session included four questions to gain more information about external factors and their influence on practicing a sustainable diet and comparing their influence on the intention-behavior gap to the influence of internal factors.

The first question (Q1: Would it be easier to consistently implement a sustainable diet or more likely that the intention-behavior gap doesn’t occur, if the external factors presented (availability, education, advertising, price) wouldn’t create any barriers?) was answered by all participants in the affirmative. Most of them said that these external factors are the most decisive ones because they dictate the framework conditions.

P5: “Well, yes that would be easier. I think these are the basic reasons why it does not work. For now, I cannot think of other reasons why it does not work. (…)”

One participant added that probably nobody intentionally doesn’t behave sustainably.

P7: “Yes, in my opinion it would be easier, yes definitely. So, especially if people were educated and the price is just right. I think everybody wants to do something good or wants to act sustainably and if this problem is not so big, depending on the persons how big the problem is/ But, um, I think everyone wants to try to live as sustainably as possible, so I think no one wants to buy no organic food on purpose.”

Other participants focused on factors such as the price and availability of food.
P8: “Yes, absolutely. So, for me personally in any case, because for example, I currently earn no money and then it is partly really difficult due to the price, if you don’t have so much money available and organic is sometimes much more expensive. (…)

With the second question (Q2: What other potential external factors are you spontaneously aware of, that can create an intention-behavior gap regarding the practice of a sustainable diet?) we asked for possible other external factors that can have an influence on our behavioral control and thereby contribute to the intention-behavior gap. Twelve people mentioned the social environment.

P18: “So externally means, so for example, if I have friends or acquaintances in the clique, who are also totally in to it and say, uh no way, you have to buy the fair trade bananas and not the super cheap ones. That is clearly an important external factor for me. Such examples, or if there are role models, like for example parents for their children. (…)

Three people stated that the food packaging can also have an influence. It depends mainly on whether the packaging is useful and necessary, especially for vegetables and fruit.

P8: “(…) Above all, um, what I find difficult is to say yes, organic is great, but for example, organic is partially wrapped in plastic and the other stuff that isn’t organic isn’t [wrapped in plastic], and then you get in to a conflict. Yes, you actually want to buy it, but at the same time it’s packed in plastic, which makes no sense at all, yes.”

Two people have come to think that the factor time can also have an impact on our intention-behavior relation.

P9: “(…) So that and the factor time, of course. If you are in a hurry. So you don’t want to prepare anything or you are just about to leave, uh, then you sometimes take pre-packaged and convenience food. (…)

For one participant the attractivity, here meaning the appearance of the food itself, the shopping atmosphere and the product presentation can have an influence on buying behavior.

P2: “Um, the appearance of the food. That’s silly, but in most organic markets, everything is so beautifully presented and, um, polished to a high gloss. And if you sometimes see such a crooked organic carrot, you might think ”Huh?”. Um, the ambience (…) creates a feel-good shopping atmosphere. (…) It’s just a presentation of the products that you are willing to pay the higher price because you think it’s worth it. Yes, product presentation. (…)”
The external factors mentioned might be supplemented with the factor labeling (named by one participant), in which transparency plays a role, according to the following statement.

P8: “(…) But that one cannot tell from the product’s appearance, um, whether it is sustainable or not. Although there are labels, but there are many (…) and sometimes very misleading [talking about the food labels]. And um, that’s why it’s sometimes difficult. (…)”

The third interview question (Q3: From previous research we have gained the impression that external factors are often made responsible for failure to implement sustainable diets. To what extent do you share the attitude of the following the motto: The others have to change something first before I can change something?) wasn’t answered clearly all the time. Seventeen times participants said that they don’t agree with that statement.

P17: “I do not share this, because I want to change that [talking about diet] for myself and maybe for my children and grandchildren. A grandchildren-suitable world and so on. (…)”

At the same time we have also five participants that agree with the statement, that other things have to change first before they can change something.

P12: “Um, actually I share that, because I personally think that, um, the consumer is imposed too much responsibility. (…) The individual is the architect of their own fortune. And then the individual is also the architect of their own fortune in relation to the food system in which they live and, um/ (…) because, um, I really see the politics as the primary responsibility. (…)”

In addition, two participants have said that in order to answer this question you have to look at it on an individual level.

P1: “(…) Yes, that can be seen individually, I think. I mean it depends/ You cannot generalize that [talking about whether agreeing to the statement or not]. (…) Yes, I would say it is customizable and/ Yes.”

The answers for the last question (Q4: In your opinion, what factors are decisive in causing the intention-behavior gap, external or internal factors (such as willpower and skills)?) show that the opinions about what factors are more decisive, internal or external, are divided. Six participants said that the internal factors are more decisive.
P18: “So, I think the internals [talking about internal factors] are mainly important, because I have to want it first. And if I want it, then I can manage the rest somehow. I would say. That’s how I see it. Yes.”

Whereas four participants said that external factors are more crucial than internal ones.

P11: “(...). Well, I generally believe the external factors actually. Because, um, I believe that if you would ask every human being the question if they want to nourish themselves sustainably, everybody would say yes. (...)

It is also interesting that half of the participants (10) said that both internal and external factors are equally crucial when it comes to influencing our behavioral control.

P16: “I think both are important. Probably the one then also plays into the other. Because, yes, if everything is expensive or everything is somewhere in another corner of the city, then I also lack the motivation to change something. Well, I do not think you can say that one thing is more important than the other. Both are very important.”

5.6 Discussion

With this investigation we wanted to explore external factors that have influence on people’s behavioral control when it comes to practicing sustainable diets. These factors are known to possibly act as barriers and create the so-called intention-behavior gap. Our applied research design offered us valuable data which enabled us to explore each of the factors and gain further understanding of possible interactions and connections as well as how they can possibly be tackled to overcome the emerging barriers.

First, we discuss our data for the factor availability. From the think aloud protocols it becomes clear that according to the participants it is very difficult to perform a sustainable diet when there is a low availability of sustainable food or no availability at all. This result can be confirmed by the results from the supplementary questionnaire. Participants assessed that availability has a strong influence on causing the intention-behavior gap. Besides, participants (except one) indicated that availability applies to them personally and in general. When people eat out of home, a lack of availability becomes a problem, too, especially when other factors such as strong hunger and lack of time are implicated. At such occasions people usually act fast and not rationally and they are rather buying food that is available fast – even if it’s not suitable for a sustainable diet. By analyzing the content of the protocols, it can be said that a possible key to oppose the emergence of the intention-behavior gap based on lack of availability is a better planning of the daily nutritional routine. The high number of codings also reflects the importance of this factor. It suggests that people should not rely on
ready-to-eat offers when traveling, but rather prepare food at home and take it with them. Planning should also involve obtaining information about where to find sustainable food offers, whether in the supermarket or in restaurants. Therefore, information needs to be available as well. This becomes especially important when people are travelling to foreign cities. According to these results, both external and internal factors play a role in order to tackle the influencing factor availability. Availability is a strong factor overall that affects our food choices, because it is not possible to consume particular products that aren’t offered (78–84). This supports the recommendations made elsewhere (12,85–87) that we generally need to create a higher availability of sustainable food offerings. As a successful example we mention organic food purchasing in Denmark, where the availability as well as the assortments of organic food in typical supermarkets and discounters has been increased and where the promotion efforts of organic food products has been intensified (88,89). Improving the availability of sustainable and health promoting food can have a positive influence on people’s intention-behavior relation and support the practice of a sustainable diet (90).

Data for the second external factor education showed us that the most important thing about education seems to be gaining knowledge, as maintained by the participants. Thereby this external factor has a direct link to the internal factor knowledge. Personal knowledge is also the basis to develop skills for purchasing, cooking and preparing food. Participants stated that education about food system related topics should be implemented in school lessons, so that children can get in contact with the topics from an early stage. People also need to be proactive and engage with education offers. Awareness plays an important role here, as well as personal norms and values. Gaining knowledge can build personal norms and values that are important for one and build a reliability during purchase action. What we can read from the protocol data is also that education needs to involve providing information about food labeling, so that people are aware of the meaning of food labels. Food labeling should offer information about the product’s background, such as production, origin, etc. and be a reliable indication. People must be able to notice, read and understand the labeling. Furthermore, labels need to be credible and thus reliable for people. To achieve this, the engagement of various actors including manufactures, retailers and public bodies is needed (91). Participants said that even supermarkets themselves can become part of the education system as providers of information by posting information about the products at the point of sale. Education or lack of it was assessed to have a strong influence on causing the intention-behavior gap. What is interesting is that over half of the participants say that education is not responsible for causing their personal intention-behavior gap, however, that is the case for just under half of the participants. The question therefore arises whether education is also equated with lack of information and transparency, such as having exact information about the individual products in the supermarket. According to the results from the questionnaire participants see the
need for more educational work in schools, as well as through media and information distribution at the point of sale. Because people cannot make informed choices when they have insufficient knowledge (78), education can have a significant influence on our consumption behavior (81). Therefore, it is necessary to implement further educational work on sustainable diets and food systems. Information need to be provided also by media, food stores or restaurants, private organizations and governments for instance through awareness raising campaigns (92). Since previous educational work hasn’t always been successful, a rethinking of new paths must also be made here (93). It seems promising when people act as multipliers. Influencers can also play an important role in digital times, especially with regard to the young population (94).

The third external factor was advertising. During the think aloud sessions participants often said that advertising influences our subconscious and that is has a strong power over our behavioral control. Also, because people are confronted with it via multiple channels and there is a corresponding availability of the advertised products, it makes it very hard to resist. People who are hungry while they are out shopping for groceries are especially easy to influence. Participants said that in general it is very difficult to resist advertising strategies from companies. These statements are interesting in juxtaposition with the results of the supplementary questionnaires. Participants assessed advertising influence as rather moderate to fairly strong in causing the intention-behavior gap. This result stands out against the other three factors. Again, this is the only factor where not all participants attribute the responsibility for causing the intention-behavior gap in general, even if this is only a small difference made by one participant. In addition, here we have the highest number of participants who say that the factor is not responsible for the emergence of their personal intention-behavior gap. The results of the supplementary questionnaire suggest that, according to participants, the influence of advertising on behavioral control is strong, but not as strong as the other factors. Resisting the influence caused by advertising demands distinct consciousness and strong willpower to be able to do so. Another strategy to tackle the intention-behavior gap caused by advertising can be to use advertising strategy to promote sustainable food and sustainable diets. This approach could translate the "unwanted and negative" consequences of advertising into positive ones and strengthen the intention-behavior relation. Since people are usually exposed to a wide range of advertisements in magazines, on radio, TV and billboards, food that is not promoted that intensively, like fresh unpacked vegetables and fruits, possibly don’t appear to be that attractive to buy. The strong influence of advertised fatty, salty, sugary snacks and drinks (95) is quite omnipresent and therefore it may be interesting to use similar advertising techniques for sustainable food products. Pollard et al. state that maybe more innovative advertising strategies are needed to promote health promoting and sustainable food (80).
The price of food was the fourth external factor that was investigated. From the protocol data it becomes very clear that the price has a direct link to the individual financial situation of people. By that we mean, the lower the own budget, the higher the influence of the price on the behavioral control. The influence of the factor price depends also on the income of the people and hence differs amongst people (80). For people who just don’t have enough money at hand, this can be a limiting factor. Of course, this can be for different reasons, but the social environment can also play a role here. For example, if a person has to provide for a whole family, the budget has to be shared among several people. What also plays an important role when dealing with higher food prices seems to be personal norms and values, as maintained by the participants. People need an understanding of values i.e. that food is worth spending money on. This understanding goes hand in hand with consciousness, which can also be seen by reference to the codings. Consciousness is needed, because participants also said that the thought of saving money is in some way part of people and to get rid of it seems to be very difficult. The supplementary questionnaire results for price show the highest assessment of participants that the price has a strong influence in causing the intention-behavior gap. Moreover, the results show the second highest number for a factor as responsible for causing the intention-behavior gap for over half of the participants personally. In order to eliminate price as an influencing factor, it seems helpful for individuals to manage the monthly budget that can be spent on food and for this reason also to rethink the diet composition. In this way people may save money that they can spend on higher quality food. It is also necessary to offer educational work that informs people why the price of, for instance, organic food is higher than for non-organic. Through this educational work, knowledge and thus consciousness can be built up and strengthen the intention-behavior relation by having control over the behavior. With the price factor, we also see that external and internal factors interact with each other. Higher prices for sustainable food like organic are still a main barrier (96,97) and crucial for people’s daily food choices (79,98). Therefore, it seems to be important in order to support the practice of sustainable diets, that people don’t have to struggle with higher food prices (98). It follows that one part of the solution here can be a realistic pricing of food forced by policies. The concept of internalizing external costs into food prices is not new and would indicate what food is produced in a more sustainable way and what food in a less sustainable way. Today a higher price is an indicator of a higher quality (99). This would then be the other way around.

Internal factors play an important role within every examined external factor. The factor personal norms and values was present with a relatively high coding within all four factors’ protocol data. This can indicate that people need to live up to their personal norms and values so that external factors cannot evolve such a strong influence on their behavior control. Looking at Ajzen’s model of the TPB (Figure 1) we find values within the background factors. Moral and personal norms have a proven impact on people, so that they are acting according their
intentions (100,101). This can be illustrated by one participant’s quote in this study. The participant said that quality always comes first for him. By forming this strong personal norm or value he can eliminate the higher food price as a possible barrier. Therefore, it can be key in suppressing the emergence of the intention-behavior gap to establish personal norms and values that are in line with what sustainable food systems stand for.

Planning as an internal factor shows the highest number of codings within the protocol data on availability. According to literature the intention-behavior gap can in many cases be bridged through planning (102). The intention-behavior relation can be generally strengthen by planning and implementation intentions (103) which are, essentially, verbalized if-then plans that are formed to enhance the translation of intentions into behavioral action (104).

What is also striking is that knowledge is the most frequent coding within the education protocol data. Gaining knowledge seems to be considered essential to making informed decisions, but people don’t always apply their knowledge when acting (90). It may become clearer that one factor alone cannot have such a strong positive influence, but always in interaction with others. This still stands to debate. Knowledge can also be found as a background factor within the model of the TPB.

Willpower is, besides hunger, the most frequently coded factor within the protocol data about advertising. People’s lack of willpower is often mentioned when try to stay on a diet or withstand external influences (105). To be able to resist external influences, for instance unhealthy food offerings or the social environment, requires willpower and also strong conviction of the planned behavior.

Within the price protocol data finances are the most frequent coding. In society the personal finance situation can limit access to many things in life, especially food. For most people, the financial situation mainly depends on the income, which is also listed as a background factor within the TPB model.

In addition we gained further general insights into the impact of external and internal factors influencing behavioral control. Results from the follow-up interview show that the four external factors availability, education, advertising and price can have a big influence on behavior, at least according to the participants, because all twenty said that it would definitely be easier to consequently practice a sustainable diet, if the four factors weren’t interfering as barriers. Some of the participants have thereby focused on individual factors and allocated them a particularly strong influence. When we asked participants for other external factors, not all were able to mention one or more. It is noticeable that twelve participants identified the social environment as a further external factor. This factor seems to be relatively influential, according to the participants. Other answers for external factors were food packaging (three mentions), time (two mentions), attractivity (one mention) and labeling (one mention). It remains unclear if the participants spontaneously had no idea, whether they were simply unaware of other external factors, or if other external factors don’t exert the
similar strong influence on behavioral control, such as the four chosen factors that were explored. To find out more about the importance of external factors as influences on behavioral control we then asked participants if they agreed with the saying that others have to change something first before they can change something, which alludes to external factors as a key condition. What is interesting is that answering this question didn’t seem to be easy, because some participants didn’t give a clear answer and could not decide definitively on one answer, but rather saw it on the one hand and on the other. From the answers to the first question we get the impression that external factors have a strong influence on people’s behavioral control and thereby create the intention-behavior gap. Relating this impression to the answers of the third question, then the answers of the participants would be in some way contradictory, because here the participants still see the responsibility with them. On the other hand, it could be said that the participants see the responsibility as their own, but the control of their own behavior cannot withstand the strong influence of external factors. Therefore, the results of the last interview question may help this debate further. While ten participants stated that both external and internal factors are decisive in causing the intention-behavior gap, four said definitely that external factors are more decisive and six participants are convinced that internal factors are more decisive. This shows a small majority attributing the greater influence to the internal factors. Nevertheless, the external factors are also said to have a significant influence on the behavior and therewith on the intention-behavior gap, if they are, for example, a limiting necessity, like in terms of availability.

What the results and this discussion show is that all four external factors interact in some way with one another and also with other external and internal factors (Figure 2). This in turn opens up different approaches to dealing with the influencing factors. Therefore, approaches to solutions cannot always be one-dimensional, as would be, for example, the approaches there must be a higher availability of sustainable food products, there must be more education for sustainable diets and food systems, there must be less advertising for unsustainable food products, and there must be lower prices for sustainable food products. The factors can be tackled with different interacting strategies from different actors. Policy, stakeholder and consumers themselves can shape external as well as internal factors (which form the nutrition environment) that positively influence people’s behavioral intention and behavioral control and thereby support the practice of sustainable diets (Figure 3).
Finally, we can say that by applying a mixed methods approach we were able to gain valuable data on our four chosen external factors. Nonetheless, a few limitations have to be listed for this study. First, selecting our participant sample was only based on their willingness to participate. When asking if participants are trying to practice a sustainable diet, three participants negated it. It may be questioned whether people who are not trying to practice a sustainable diet are able to make more valuable contributions about factors that can interfere with the intention to do so. Furthermore, we used video-simulations that participants watched during the think aloud sessions. The fictional stories used to represent the external factors in the videos may have had too much impact on the participants’ verbalized thoughts, as we don’t know whether they have the same experiences as shown in the videos. Therefore, it may have been better to accompany the participants in their daily life (e.g., during groceries shopping, travelling or family dinners). However, this turns out to be rather difficult in the execution. In addition, we refrained from sitting in on the sessions and constant reminding of the participants to think aloud. Upon request, the participants

Figure 3: Actors supporting people practicing sustainable diets
preferred to be alone in the room because they felt more comfortable this way. We also haven’t used a control group, because we didn’t aim for a comparison. Nevertheless, it should be noted that the recruitment of participants from the nutritional section at the University of Applied Sciences could have an impact on the results.

5.7 Conclusion

In order to establish sustainable food systems and especially eliminate ongoing environmental threats, we need a higher adoption rate of sustainable diets. Because in our existing food systems we are surrounded by factors that influence our behavioral control it is important to offer people support for enhancing the practice of sustainable diets. Therefore, the aim of this study was to explore the external factors availability, education, advertising and price that can cause the emergence of an intention-behavior gap while people are trying to nourish themselves sustainably. The objective was to gain a better understanding of the factors in order to be able to make more targeted and valuable recommendations for policy, stakeholder and consumer action. Within this research we were able to analyze and understand the factors availability, education, advertising and price more closely. The findings of our study show that depending on the shape of the factors, they can cause the intention-behavior gap and lead people to not practicing sustainable diets or they can support peoples’ practice of sustainable diets (Figure 4).
Hence, external factors can have a decisive influence on our behavioral control and also represent limiting factors that stand in the way of performing a sustainable diet. That is the case for the external factor availability. If sustainable food isn’t available to people, they cannot buy and eat it. Therefore, a corresponding availability should be given in order to meet the possible and future demand. Policy action should on the one hand target subsidies for sustainable food production and establish sustainability standards to build a basis for a higher availability of sustainable food products (106). On the other hand, governmental action should address public food procurement. Hence, this call for more availability is also aimed at all producers, distributors, persons in charge in the food retailing industry and in out-of-home foodservice such as restaurant chefs or catering directors to produce and offer more sustainable food products. Since restricting peoples’ choices is not always a welcomed way to go, nudges can be implemented – especially for reducing meat consumption in

**Figure 4:** Practice of sustainable diets influenced by the shape of the factors availability, education, advertising and price
public procurement (107,108). Nudges are known for their potential of promoting healthy and sustainable diets within public procurement. They can be implemented for example in the form of acoustics, lighting, reward, commitment, role models, or dishes, food presentation or trigger food (109). For targeting time pressure of people as a barrier for practicing sustainable diets, special services can come with sustainable food offers, like express service during lunch breaks (110). Nudges for supermarkets can target visual cues like the size of a display area and the amount of sustainable food products displayed. This can lead to a higher purchase of sustainable food through more visibility (111). Providing retailers, supermarkets, food stores etc. with financial incentives that come with offering sustainable food products can be attractive to increase the availability, as people will come and buy (106). Here, communication and information distribution become important. People need to know where to find sustainable food products. Therefore, providing them with information in the form of a list or a mobile app of sustainable food offers and where to find them, can be helpful. The resulting geographic overview of supermarkets, stores, farmers markets, etc. also makes it clear that there must be a good distribution of shopping facilities to improve access to sustainable food for all people (112). What is also worth mentioning is that not only the amount of sustainable food products should be increased but also the variety in terms of biodiversity (112). As long as there is no ubiquitous availability of sustainable food products, people have to plan their daily nutrition and inform themselves about possible sources of purchase (whether in the supermarket or in out-of-home foodservice) in advance or do meal prepping at home for lunch breaks, travels etc. Depending on the possibilities, a garden for vegetables, fruits or herbs can be laid out. Therefore, gaining knowledge through education seems essential. But also support by the media is needed, especially for informing about food offers via advertising or mobile apps.

The results further suggest that we need more educational work in general, that focus on food system education in schools but also on appropriate offers for adults. Without knowledge, it is difficult to make better buying decisions for sustainable food products in our current existing food systems. Politicians, especially in education ministries, and official educational institutions are as much implicated in addressing this as are all employees and volunteers in educational settings and private individuals in their social environments. Education is essential for promoting awareness. Therefore, starting education in kindergarten and schools with topics like nutrition, cooking, gardening or school meals preparation can support awareness building (113). Education also includes providing information about food products and their backgrounds. Here, also retailers and supermarkets can support this by providing people with information at the point of sale to enable reasoned buying decisions. Restaurants and other out-of-home foodservices can inform their customers about the offered food and meals to make a contributing to people’s education and consciousness development. Media play, as mentioned before, an
important role to inform people where to find sustainable food products, inform about food labelling or strategies for practicing sustainable diets in everyday life. Here, influencers can play a key role – especially for younger generations – by talking and posting about sustainable lifestyles and practicing sustainable diets. At the same time, people need to actively seek out and take advantage of existing educational opportunities. Otherwise, practicing sustainable diets without needed skills for shopping and cooking, knowledge or consciousness will become difficult.

Food advertising is mainly used for fatty, salty, sugary snacks and drinks (114–116). Different advertising strategies successfully influence people’s nutrition behavior. It could be promising to use these for sustainable food to influence people like it is already done for other public interests like stop smoking, use condoms or NGO work related ads like from Greenpeace. In order to initiate a corresponding change, political action is needed, especially with regard to advertising for children’s food (117–120). Only restrictions or bans can reduce people’s (and especially children’s) exposure to the advertising of unhealthy and unsustainable food products (121,122). Advertised food products are mainly brand-name products that have a high availability in almost every store. Therefore, stakeholders like NGO’s, producers (using farmer-to-consumer direct marketing) and companies from the sustainable food industry have to think about showing initiative and consider to use similar offensive advertising strategies and at the same time offering a higher availability of sustainable food products. Above all, strategies have to be developed for fresh foods, such as fruits and vegetables, which usually do not belong to a well-known brand or are advertised at all, so that these foods do not remain anonymous, but instead become more attractive to buy. By promoting these foods and sustainable food products in general, advertising and communication strategies should target values, so that people can relate to the products (112). Media as well as influencers and celebrities can be used to promote sustainable food products and make a positive contribution to enhance the practice of sustainable diets. Especially to reach today’s youth who live in a media-saturated environment, multiple channels and techniques need to be used as marketing efforts that serve their health (123). Meanwhile consumers need education to be able to identify advertising for unsustainable food products and not to be negatively influenced by strong advertising efforts. Therefore, a strong willpower is needed that can be supported by the social environment of friends and family. The extension of the social environment to the overall nutrition and food environment paints the picture of the structures in which we live and where it can be difficult to practice a sustainable diet. Individual practice of sustainable diets can only occur in a supportive environment, where sustainable food products are accessible and affordable (123). Therefore, the settings like school, home, work sites, retail food stores, convenience and corner stores, supermarkets, fast food outlets, restaurants, neighborhoods and communities are as important as are family, friends and peers, that build our nutrition environment (123,124). What is
striking is that these influential factors, especially food prices, availability and offers in our neighborhoods can have a direct link to the health status of people living in it (123).

The higher prices of sustainable food are a long-burning issue. It may seem that some people cannot overcome the price barrier or in other cases they simply cannot afford to spend more money on sustainable foods. But buying cheap food and practicing poor diets comes with higher follow-up cost for healthcare and repairing environmental damage (if at all possible) (125). According to research UK consumers have actually to pay twice as much for their food when considering the true costs for diet-related diseases and natural capital (125). A true cost accounting for food can transform food systems when food products reflect their true costs (126). This policy action would solve the awareness deficiencies of people and would probably immediately increase the willingness to buy sustainable food products. Just reducing food prices for sustainable products without using policy subsidies would be disastrous for producers. Another approach is to tax unhealthy and unsustainable food products and subsidize healthy and sustainable food products (127–132). What can be said is that sustainable food should be affordable for all people. Otherwise, a large part of society cannot be expected to buy them. Among others, maybe politicians, producers, traders and economic experts can manage to agree on price models for food (e.g. cost sharing arrangement based on income) that can be implemented in the future. Meanwhile, people, within their financial resources, can try to show willingness to pay the supposedly higher prices for sustainable food products. Here again the link to education and resulting knowledge about food and their costs can build consciousness which leads to the willingness to pay. Also targeted advertising strategies can have a positive impact on the willingness of people to pay more for sustainable food products (133).

What arises from our findings is that we need innovations for system improvements and different interacting strategies to promote a behavior change towards health promoting and sustainable diets (37). Therefore, every stakeholder (farmers, industry, caterer, media, NGO’s etc.) acting within food systems has a part to play and can think about making an effort and contribute to an improvement of our current food systems (36,91). Therefore, we definitely need appropriate and supportive policy action in some cases that enable changes in the current system and structures (21) but also individual consumer efforts. We strongly encourage scientists to further investigate other external and internal factors that influence people’s behavioral control to deliver applicable supportive strategies that bring about the necessary changes. It still is a major challenge to support people’s behavior towards sustainable diets and establish sustainable food systems.
5.8 **Conflict of Interest**

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

5.9 **Author Contributions**

AP had the idea for this study. LF and AP developed the idea further. LF, CS and AP designed the study. LF created the videos, conducted the study, transcribed the think aloud protocols and follow-up interviews. LF, CS and AP analyzed the data and wrote the manuscript. CS did the final language editing. All authors read and approved the final manuscript.

5.10 **Acknowledgments**

We would like to thank all participants for taking part in this study and dedicating their time and thoughts. We also thank the Central Equal Opportunities Officer from Münster University of Applied Sciences for a PhD scholarship for LF. Furthermore, we express our thanks to the open access publications fund from the University of Kassel which is financed by the German Research Foundation (DFG) and the Library of University of Kassel for covering the costs of this open access publication.

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5.12 Supplementary Material

Video Clip 1-4

5.13 Data Availability Statement

The raw data supporting the conclusions of this manuscript will be made available by the authors, without undue reservation, to any qualified researcher.
6 General Discussion

6.1 Overall discussion of the research studies

The overall objective of this doctoral research was to find solutions for closing the intention-behavior gap when it comes to practicing sustainable diets. Furthermore, we wanted to gain a better understanding especially of the external factors that are interfering, to be able to make more targeted and valuable recommendations for policy, stakeholder, and consumer action. To achieve this, we wanted to break new ground within our research strategy and applied methods. We sensed that it is the time, where innovative contributions are needed to further a change towards more sustainable diet implementations. Our approach foresees the involvement of consumers in the development process of solutions, that are necessary for closing the intention-behavior gap because only then we would be able to consider different needs in different nutrition situations. Besides, for an overall sustainable development, it is important to acknowledge that consumers can act as co-drivers of the needed change by using their power of influencing civil society, markets, and policies through diverse networks (Oosterveer and Sonnenfeld, 2012). Moreover, the food choices made by consumers create a demand on which foods are produced (Johnston, Fanzo and Cogill, 2014).

Based on a literature search, we decided to examine open innovation as a suitable way to go, because it is an approach that has the reputation of being able to generate real innovations by breaking down field or company boundaries and enabling people to collaborate (Chesbrough, 2006; Enkel, Gassmann and Chesbrough, 2009; Gassmann, Enkel and Chesbrough, 2010). Within the first paper, the four methods of open innovation were examined (based on a set of self-established criteria) regarding their suitability for our foreseen research strategy. The method that we saw as a promising approach to develop solutions was a lead-user method-based innovation workshop. This constitutes on the possibilities to facilitate a communicative exchange at the beginning and during the process (that everyone has a common understanding of what is being worked on), to create as many ideas and innovation contributions as possible (because of heterogeneous needs), to promote collaboration among the participants (to use synergies), to integrate creativity techniques (to support the idea generation) and to deliver results in a set time frame (through a strong commitment of participants). As we have drawn from literature and the discussion within the first paper (Chapter 3.6), we considered involving lead-users in the process of finding solutions to close the intention-behavior gap, to be valuable because we are facing global heterogeneous needs regarding the adoption process of sustainable diets (De Schutter, 2014, 2017; Townsend et al., 2016). The fact that the needs of lead-users will become general needs of people in the future (von Hippel, 1986), can be the key to meeting people’s needs that have to be addressed for closing the intention-behavior gap.
One main objective of this doctoral research was to develop solutions to facilitate the practice of sustainable diets by closing the intention-behavior gap. Therefore, we conducted six participative workshops for idea generation. Since, to our knowledge, this was the first attempt of applying this method in the specified context, we were not aware of the expected results. However, the results have not shown to provide direct practical or applicable ideas that will help people to overcome emerging internal or external barriers (no ready-to-use ideas). As discussed within the second paper (Chapter 4.6) the ideas refer rather to external factors than to internal ones. They generally aim for changes that others (not the participants for themselves) have to make. Overall the data can be interpreted as targeting a long-term system change and indicating what kind of external framework conditions need to be created (according to the workshop participants) so that there exists no gap between intention and behavior regarding the implementation of sustainable diets. These concerns, for example, the availability of health-supporting and sustainably produced food, nutrition education throughout life, allegedly higher prices of sustainably produced food, lack of time for nutrition, and related processes. According to the TPB, the decision-making process to translate a formed intention into actual behavior can be affected by a person’s actual behavioral control consisting of internal and external factors. As we were able to code the gained data by internal and external factors influencing the behavior, we got a picture of how numerous and varied these can be for sustainable diets. Nevertheless, our first research study did not bring the desired solutions at its first attempt and it seems that we were just at the beginning of the problem-solving process, which needs further continuation. The average German consumer is mostly influenced by the price when it comes to food purchases (PricewaterhouseCoopers, 2017). This is why, compared to other Europeans, German consumers spend relatively little money on food and prefer to shop in discount supermarkets. If money would not matter, German consumers state that they would prefer to buy locally produced and high-quality food. In addition, German consumers have and take less and less time for nutrition in general (Ritterwerk, 2019). It seems like external factors play a major role in influencing our daily nutrition. This is why we as consumers tend to fail to practice sustainable diets in everyday life. Everyday nutrition depends on general conditions, for example on food availability, prices, accessibility, labeling, origin, specific values, and tastes, as well as on the individual situation of consumers, shaped by income, education, gender, age, household form and housing situation (Brand, 2006; Spitzmiller, Pflug-Schönfelder and Leitzmann, 1993). Of course, we also have to consider cultural differences among consumers that influence their consumption behavior. While external factors seem to be an important driver of food choices for German consumers, Chinese consumers, for example, are more likely to be influenced by internal factors such as referring to past experiences or considering their own benefits (Qi and Ploeger, 2019). By developing strategies to support the practice of sustainable diets, we must focus on this issue of nutrition in everyday life and take it into account (Eberle et al.,
These strategies concern the management of the household budget and the assessment of food quality as well as the question of how a sustainable diet can be integrated into everyday routines. Thus, nutrition must be reconciled with work and leisure, within the given time and financial frame, or with the preferences and wishes of other household members (Eberle and Hayn, 2007). In Germany, the responsibility for nutrition is increasingly shifting from privacy to public space, where responsibility for meeting current nutrition needs has not yet been adequately taken (Eberle et al., 2005).

This is why we used the results for the subsequent study and selected four major external factors that we wanted to explore more closely to be able to make constructive suggestions and recommendations for further policy, stakeholder and consumer action. Availability, education, advertising, and the price of food are four main barriers causing the intention-behavior gap, when people try to practice a sustainable diet. We examined these factors within a think aloud study, including questionnaires and follow-up interviews as further methods to gain additional data. The findings of our second study show that external factors can have a decisive influence on our behavioral control and also represent limiting factors that stand in the way of performing a sustainable diet at all. For example, the availability of sustainable food products can be crucial by offering or denying an offer of sustainable food. Although the motivation of people to consume sustainable products can be high, it may be impossible to do so because of a low availability (Vermeir and Verbeke, 2006). Availability also includes the enormous potential of public procurement for sustainable diets (Strassner et al., 2015; Sonnino, 2019). Proper education is also highly important when practicing sustainable diets. People need to consider various sustainability dimensions which makes the consumer choices at some points more complicated (Brunori et al., 2016). In addition, practiced diets can always be affected by provided information (or advertising) and the food stores themselves (Benedetti, Laureti and Secondi, 2018). Without nutrition or food system education, people cannot make informed food choices that contribute to sustainable diets or the protection of natural resources (Gussow and Clancy, 1986). Many consumers are lacking in problem awareness, problem-solving skills, and motivation to practice a health-promoting and sustainable diet (Meier-Ploeger, 2005). This is why we have argued that as long as there are no sustainable food systems that almost automatically require sustainable diets, there must be more educational programs that provide people with knowledge (Grunert, 2018). Innovative and cooperative strategies have to be developed and established that have a far-reaching and real impact on people (Duchin, 2005). Therefore, the federal government needs to provide consumers with information through a coordinated education program that is adjusted to age and target groups. It is important to strengthen the nutritional and health expertise of the citizen through coordinated education. Particular attention should be given to the field of media and advertising in the food sector (Meier-Ploeger, 2005). This is because
advertising strategies and other forms of communication in print, on radio, on
TV, and the internet can have a crucial impact on people’s food choices (Mason
and Lang, 2017). Sustainable produced food needs to be promoted like, for
example, highly processed foods (Alsaffar, 2016). They have a strong advertising
and marketing strategy and high availability, which contributes to their
overconsumption by people (Monteiro, 2009). Marketing departments from
sustainable food companies need to acknowledge and can learn from this. What
is almost always crucial for the food choice is the price and affordability (Lee et
al., 2013; Leng et al., 2017). Higher food prices e.g. for organic food products act
often as a barrier for purchase. It is been discussed for a while, that prices of
unsustainable food products need to be increased by the regulation of policies
(Oosterveer and Sonnenfeld, 2012).

Overall, the research studies have shown that external factors are highly
connected to each other and to internal factors as well. People, acting as
consumers, need to change their behavior when we will progress the
implementation of sustainable diets and establish sustainable food systems. But
dealing with such interconnected factors, that influence their everyday nutrition,
without support from a system seems unrealistic (Mason and Lang, 2017). This
is why it is important to develop a conglomerate of interacting strategies for
policy, stakeholders, and consumers that are not isolated from each other. A
transformation of the global food system to a sustainable one that promotes
sustainable diets is a social challenge and therefore it can be seen as a community
project (Hayn 2007; Eberle et al., 2006; Willet et al., 2019). Research and action on
sustainable diets require interdisciplinary approaches and also, especially with
regard to sustainable development, common efforts and a shared responsibility
of political decision makers, economic sectors, consumers, researchers, and mass
media in order to cooperate, use synergies and build networks to be able to
develop problem-appropriate, everyday adequate transformation strategies
(Nguyen, Morrison and Neven, 2019; Hayn and Schultz, 2004; Terlau and Hirsch,
2015; Rücker-John, 2015; Brand, 2006; Willet et al., 2019; Garnett et al., 2015). To
underline this call of assuming general responsibility, we would like to point out
that even in the 17th SDG it is written that “A successful sustainable development
agenda requires partnerships between governments, the private sector and civil
society. These inclusive partnerships built upon principles and values, a shared
vision, and shared goals that place people and the planet at the centre, are needed
at the global, regional, national and local level.” (United Nations, no date). In
addition, the participation of all actors is important in order to translate different
cultures and practices into proper policies (Öko-Institut, 1999). Then it is
important again, that the corresponding political measures are supported by the
society (Schack, 2004).

A recently published article by the EAT-Lancet Commission on Food, Planet,
Health says very well that the strategies that will be necessary to transform the
global food system and to be able to feed a world population of nearly 10 billion
people in 2050 health-promoting and sustainable diets are: (1) Seek international
and national commitment to shift towards healthy diets. (2) Re-orient agricultural priorities from producing high quantities of food to producing healthy food. (3) Sustainably intensify food production to increase high-quality output. (4) Strong and coordinated governance of land and oceans. (5) At least halve food losses and waste, in line with global sustainable development goals (Willet et al., 2019).

Since isolated efforts have shown to be unsuccessful in the past (Duchin, 2005) and no single actor or breakthrough can bring a whole system change (Willet et al., 2019), we have compiled from the findings what policymakers, stakeholders, and consumers can do to help improve the current situation, close the intention-behavior gap for practicing sustainable diets.

There is a need for integrated policy approaches that address the discussed challenges by making clear decisions for promoting sustainable development (Morley, McEntee and Marsden, 2014). The basis for such a policy for sustainable nutrition should be a socially supported vision that specifies how we want to shape our diets to sustainable ones. Accomplishing this task requires cross-political and cross-sectoral cooperation (Eberle et al., 2006). Nutrition policy is a complex and interconnected policy area (Straka, 2007). The related policy areas are, for example, agriculture, food, economic, research, development, technology, transport, urban, land, labor market, environmental, health, consumer, social, family, gender and education policy (Straka, 2007; Waskow and Rehaag, 2004; Spitzmüller, Pflug-Schönfelder and Leitzmann, 1993; Eberle et al., 2006; Reisch and Bietz, 2014). Because several policy areas are affected by food and nutrition, it is a specific challenge for a change towards sustainable nutrition policy (Biermann, 2007). In addition, a policy approach to more sustainable nutrition requires an integrative concept, which includes action on international, European, national, federal, state, municipality policy levels (Waskow and Rehaag, 2004).

Although it is seen more critical when politics dictate to people what they should and should not eat, prohibition may be needed in some cases (e.g. reduction of meat) to establish an environment for practicing sustainable diets. Nonetheless, this is politically delicate (Mason and Lang, 2017) and not always necessary when policies increasingly promote sustainability issues within our food systems. This applies especially to the availability of sustainable food products. Policy action is needed to support environmentally sound production methods in the industry in general, target subsidies for sustainable food production, supporting biodiversity, varieties and species diversity in crops and animals and establish sustainability standards to build a basis for higher availability of sustainable food products (Chkanikova and Mont, 2015; Meier-Ploeger, 2006; Zöller and Stroth, 1999). Moreover, public food procurement and providing higher availability of sustainable food offers within the numerous snacks, breakfast, lunch, and dinner options, needs governmental action addressing it. Politicians have to pay attention to the demand of consumers to improve healthier food consumption patterns (Kearney, 2010). Political measures are missing that support the
integration of sustainable food products and services into everyday life. At the product level, for example, this could be the supply of healthy, sustainable fast food or convenience products and, in general, a high-quality mainstream offer in public procurement and other out-of-home food services (Eberle et al., 2005). Nutrition policy and related policy areas determine what foods will be available to consumers who’s total diets also depend on what foods are made available (Garnett et al., 2015; Helsing, 1991). Policy also determines what food is affordable, accessible, and normal in a given society (Garnett et al., 2015). The fact that a radical change in politics is possible can be illustrated by the example of Denmark. Organic farming became a political agenda for Danish politics. In 1987, the Danish government adopted a law on a governmental certification scheme for organic farms, producers, and retailers and at the same time ensured subsidies for farmers who would change their practices to organic farming. Furthermore, funds for research, product development, awareness campaigns, and consulting activities for organic food and agriculture were established (Terlau and Hirsch, 2015). In 2012 the Danish Ministry of Food, Agriculture and Fisheries launched a Danish Organic Action Plan 2020 (revised in 2015), that strives for more sustainability by stimulating the demand for Danish organic agriculture through a primary focus on increased public procurement of organic foods (Sørensen et al., 2016). The Danish government wants the public sector to lead the way by supporting public kitchens to go organic and serve organic meals every day in, for example, canteens, hospitals, and nurseries (Sørensen et al., 2015; The Ministry of Food, Agriculture and Fisheries of Denmark, 2015). The Danish market for organic products also works well because organic foods are sold through conventional supermarkets where they are well promoted and where food like dairy products, rye bread, and eggs have relatively low prices due to farmers’ subsidies (Terlau and Hirsch, 2015). The example of Denmark shows that with a corresponding policy, barriers such as low availability and high prices of sustainable food products can be eliminated.

Besides increasing the availability of sustainable food products, politicians, especially in education ministries need to focus on establishing more educational work in general, that focus on food system education in kindergarten and schools but also on appropriate offers for adults. Without knowledge, it is difficult to make informed buying decisions for sustainable food products in our current existing food systems. Education is also essential for promoting people’s awareness. Therefore, starting education in kindergarten and schools with topics like nutrition, cooking, gardening, or school meal preparation can support awareness building (Jones et al., 2012). Schools are a promising context for educational interventions (and also for sustainable procurement), contributing to the development of nutrition and health literacy (Garnett et al., 2015). Therefore, the content of curricula and textbooks needs to be changed through a reform of the educational organization (Meier-Ploeger, 2005). Teachers can teach the relevance of topics like sustainable nutrition and food culture in a subject-related and interdisciplinary way. This also includes how sustainable nutritional
behavior can be implemented in everyday life (Methfessel, 2005). Education, as well as campaigns, marketing, and promotion activities, can raise awareness of the consumers for sustainable nutrition and related issues (Terlau and Hirsch, 2015).

Awareness is an important factor when it comes to advertising. Food advertising is mainly used for fatty, salty, sugary snacks and drinks (Lewis and Hill, 1998; Lobstein and Dibb, 2005; Powell et al., 2007) and successfully influence people’s nutrition behavior. To initiate a corresponding change, political action is needed, especially concerning advertising for children’s food (Livingstone, 2005; Caraher, Landon and Dalmeny, 2006; Garde, 2008; Galbraith-Emami and Lobstein, 2013). Only political restrictions or bans can reduce people’s (and especially children’s) exposure to the advertising of unhealthy and unsustainable food products (Boyland et al., 2016; Cawley and Wen, 2018).

What keeps people from buying sustainable food products is often the price, because they cannot overcome the price barrier or in other cases, consumers with a small budget due to low income or providing for a family simply cannot afford to spend more money on sustainable foods. In addition to corresponding changes in social and labor pay laws, access to sustainable food for citizens can also be made possible by establishing sustainable public procurement in, for example, schools and cafeterias (Aschemann-Witzel and Zielke, 2017; Zöller and Stroth, 1999). Especially the average German consumer seems to need a relief in the financial expenditure for food to practice sustainable diets. This could be supported by offering more and more sustainable food products in other sales channels like discount supermarkets (Eberle and Hayn, 2007). In Germany, many people shop their food in discount supermarkets, which offers an opportunity for selling more and more sustainable food items like organic products (Ritterwerk, 2019). Even committed buyers of organic food may welcome new sales channels that open the market for price-sensitive buyers (Gottschalk and Leistner, 2013). In Germany, there has been a rising trend towards this in recent years. Another strategy is a true cost accounting for food as a policy action that can solve the awareness deficiencies of people and would probably immediately increase the willingness to buy sustainable food products. Just reducing food prices for sustainable products without using policy subsidies would be disastrous for producers. Another approach is taxing unhealthy and unsustainable food products and subsidize healthy and sustainable food products (Mytton, Clarke and Rayner, 2012; Gustavsen and Rickertsen, 2013; Jensen and Smed, 2013; Niebysliski et al., 2015; Abadie et al., 2016; Harding and Lovenheim, 2017; Dyhr Edjabou and Smed, 2013; Bailey and Harper, 2015). What can be said is that sustainable food should be affordable for all people. Otherwise, a large part of society cannot be expected to buy them. Among others, maybe politicians, producers, traders, and economic experts can manage to agree on price models for food (e.g. cost sharing arrangement based on income) that can be implemented in the future. In the long term, the consumption of sustainable and organic food products will only be possible for a broad mass of consumers.
when the starting conditions for pricing are equitable. Prices for conventional products need to contain social and ecological follow-up costs. To change the basic conditions is clearly a task of the practiced policy (Brunner and Schönberger, 2005).

Overall, governments play a strong role in shaping the consumers’ environment and the socioeconomic determinants (Garnett et al., 2015). Policies for availability, education, advertising, and price need to be tailored to specific population characteristics (Leng et al., 2017). To relate to German nutrition politics, it is therefore important to establish an independent nutrition policy that covers, amongst others, institutional conditions of nutrition and agricultural policy, food safety, and global markets (Meier-Ploeger, 2005). Cooperation needs to be established at a European and international level, as well as between the federal and municipality governments. Further, it is important that there are clear and consistent responsibilities for state, federal, and municipal governments. Responsibilities could be allocated by appointing a Sustainable Nutrition Minister or by establishing a coordinating body (Eberle and Hayn, 2007; Eberle et al., 2006). This includes an intersectoral alignment of different policy areas such as environment, family, social, and health policy (Eberle et al., 2005). The further aim should be to develop a concrete nutritional action plan that involves actors like policymakers, food industry, consumers, educational institutions, and the health care system (Meier-Ploeger, 2005). Such an action plan needs to create suitable framework conditions that facilitate and promote action on sustainable food systems, food products, and nutrition among professional practitioners as well as consumers (Eberle and Hayn, 2007; Eberle et al., 2006). This includes the production of safe and high-quality food, promotion and monitoring of food supply, nutritional emergency preparedness, upholding the human right to food, considering consumer interests across departments, including support for consumer organizations and consumer participation, consumer education and information, as well as nutrition research (Meier-Ploeger, 2005). Nutrition research should focus on the development of an overall concept for sustainable diets with coordinated measures and the development of corresponding concepts for everyday adequate and target group-, gender- and lifestyle-specific differentiation of nutritional goals (Eberle et al., 2005). Focusing on everyday compatibility of diet concepts and recommendations is especially important since this is a shortcoming of policy-making in general. Sustainable development understood as a process of social transformation requires the identification of shared meanings and needs of all societal groups and actors and therefore a better understanding of the differences between everyday life and political practices (John, Jaeger-Erben and Rückert-John, 2016). In addition to nutrition research important changes in agricultural policy, active consumer policy, and especially active and independent nutritional communication are required (Brand, 2006). Nutritional communication and information is one of the most important instruments of consumer-oriented nutrition policy and can be used to inform about food products, markets, and prices, as well as to promote proper
nutritional behavior (Barlösius, 1999). For the latter, it is important to consider individualized information transfer and differentiated target group orientation when developing communication strategies (Brand, 2006) including diverse forms of knowledge and perspectives like everyday relevance, morality, and ethics, as well as the participation of social actors (ambassadors) in public nutrition communication (Eberle et al., 2005).

Fundamentally, political and other involved actors need to develop appropriate sectoral policies and tools to translate sustainable nutrition policy into social practices such as sustainable diets (Reisch and Bietz, 2014). Policy tools can affect the existing system in different ways and can be classified as strategic tools (establishing overarching principles, objectives and identify policy instruments to be mobilized in the pursuit of the objectives), governance tools (shaping the distribution of roles and responsibilities among actors), market-based tools (incentives, subsidies, loans, guarantees, insurance schemes, trade agreements and barriers, taxes, fees, fines, penalties, liability and compensation schemes, food assistance for most deprived people and public procurement), direct activity regulation tools (authorizations, prohibitions, limitations, quotas) and knowledge-related tools (research and innovation policy, education, information, communication, advertisement, nudging tools and food labeling) (Galli et al., 2018). The development of policy tools can also be guided by environmental policy instruments, which are differentiated into cognitive-related instruments (including tools aimed at processes of perception, information acquisition, and processing, as well as cognitive motivation), interaction-related instruments (including tools that are aimed at the interactions and cooperatives between actors), incentive-related instruments (including tools which are intended to motivate to act in an environmentally friendly manner by means of positive or negative incentives) and preliminary instruments (including instruments that limit the freedom to make decisions by prescribing, excluding or reducing options for action; Daskalakis and Beckenbach, 2017).

Within a food system, besides politicians, several stakeholders (e.g. seed industry, farmers, food industry, processors, suppliers, distributors, persons in charge in the food retailing industry and out-of-home food services such as restaurant chefs or catering directors) hold important positions when it comes to shaping the food system and nutritional environments for consumers (Öko-Institut, 1999).

There seems to be great potential for increasing availability by producing and offering more sustainable food products via different operative strategies. The basic task for agriculture in this context is to provide sustainably produced products in sufficient quantities (Eberle and Hayn, 2007). However, environmentally sound production methods like organic farming need, as mentioned before, more political support (Meier-Ploeger, 2006).

The task for food processing companies is to work towards ensuring that their products are produced in line with sustainability criteria. This includes selecting the raw materials and preprocessed products, improving working conditions in
national and global supply chains through appropriate conditions and fair trade partnerships, and reducing the environmental impact of food production by continuously optimizing manufacturing processes (Eberle and Hayn, 2007). Public food procurement (e.g. in canteens, hospitals, schools, universities) and other out-of-home food services (e.g. restaurants, snack bars, fast food outlets) need to increase sustainable food offers to support making sustainable food choices into everyday food choices (Brand, 2006). Especially establishing widespread sustainable lunch offers, an important contribution could be made to help to make it easier for consumers to practice a sustainable diet (Häußler, 2007; Eberle et al., 2006). In addition, the supply structures (e.g. in schools) can be changed by banning food and beverages that are unsustainable or unhealthy (e.g. high in sugar) from vending machines (Rückert-John, 2015). The increased use of out-of-home food offers in recent decades has made food privacy issues a matter of public concern. Governmental responsibilities, to change food offers into sustainable food offers, has not been addressed sufficiently by food policy. A takeover of the responsibility by actors from the out-of-home foodservice market has also not yet taken place sufficiently (Waskow and Rehaag, 2004), although in Germany a tendency to a change is recognizable. In this case, the state governments can and should serve as a role model for state canteens and cafeterias by providing sustainable food service (Zöller and Stroth, 1999). Moreover, public food procurement and other out-of-home food services can make use of nudges, who are known for their potential of promoting healthy and sustainable diets. They can be implemented for example in the form of acoustics, lighting, reward, commitment, role models, or dishes, food presentation, or trigger food (Langen et al., 2017). For targeting the time pressure of people as a barrier for practicing sustainable diets, special services can come with sustainable food offers, like express service during lunch breaks (Campbell-Arvai, Arvai and Kalof, 2014). A more concrete approach is using so-called defaults, which are a kind of a pre-selection of foods. Actors in charge like catering directors or head chefs can contribute to sustainable nutrition by developing and offering daily menus, which already include sustainable food products, like organic, local, or seasonal ones (Kamm et al., 2015). This pre-selection makes it easier for consumers, especially in the lunch break, to opt for a sustainable dish. Sticking to nudging, supermarkets can target visual cues like the size of a display area and the number of sustainable food products displayed. This can lead to higher purchase of sustainable food through more visibility (Coucke et al., 2019). Incentives to implement sustainable food shopping can be improved by installing a bonus program for sustainable food products, that foresees that customers can use, for example, points or vouchers to lower food prices to be rewarded for purchasing sustainable food (Kamm et al., 2015). More importantly is that supermarkets consistently equip their assortment of goods according to sustainability criteria (Eberle and Hayn, 2007). Sustainable food retailing considers a wide range of organically, locally, and in the season produced food, offers fair trade products, does not list genetically modified
foods, and creates transparency for consumers (Öko-Institut, 1999). Large sales chains with high market power and small players can contribute to sustainable food trade (Öko-Institut, 1999). Providing retailers, supermarkets, food stores with financial incentives (from a political level) that come with offering sustainable food products can be attractive to increase availability in all kinds of retail markets, as people will come and buy (Chkanikova and Mont, 2015). What is also worth mentioning is that not only the number of sustainable food products should be increased but also the variety in terms of biodiversity (Vermeir and Verbeke, 2008).

In addition, it is important to strengthen the consumers’ purchase competences with regard to sustainable and high-quality products, for example via target group-specific and everyday life relevant information and advice offers, or through special promotions with sales, show cooking, or tastings (Eberle and Hayn, 2007). It is obvious that communication and information distribution become important here. People need to know where to find sustainable food products. Therefore, providing them with information in the form of a list or a mobile app of sustainable food offers and where to find them, can be helpful. The resulting geographic overview of supermarkets, stores, farmers’ markets, etc. also makes it clear that there must be a good distribution of shopping facilities to improve access to sustainable food for all people (Vermeir and Verbeke, 2008). Stakeholders like restaurants and other out-of-home food services who are selling sustainable food products can inform their customers about the offered food and meals to contribute to people’s education and consciousness development. Nutrition communication at the point of sale can create a local connection between the produced food and the consumer. This can be done by moderated live cooking events in supermarkets or restaurants, interesting stories about regional farms and food told at the point of sale, information on the tradition of products, their production, and recipes, or using new communication tools like blogs, podcasts, and social media. It can be noted that credible mediators or ambassadors are needed for a successful communication and knowledge transfer about food production, nutrition, culture, cuisine, and cooking (Schreiner-Koscielny, 2010). Another important information tool is food labeling. Important food characteristics must be made more noticeable to consumers to make buying decisions in line with sustainability criteria. Since there are already many (in some countries too many and rather confusing or misleading) food labels, it is important to bring order here. It should also be borne in mind that characteristics that are not recognizable to the product, like air transport or greenhouse production, should be declared as a new label or added to existing labeling (Jungbluth, Tietje and Scholz, 2000).

In addition to the educational efforts of actors from the out-of-home food market and food retail market, there should be, as mentioned before, school and extracurricular education as well as education programs for adults. For nutrition communication, for example, exhibitions, consultations, individual tastings, excursions, informational events, campaigns, courses or seminars, projects,
publications (e.g. in books or magazines), conventions, congresses or mass media (e.g. social media like Twitter, Instagram or Facebook, websites, newspapers, television, radio) can be used (Brand, 2006). Educational concepts are needed that enable especially children to make their own experiences and that bring together lifestyles, nutrition, understanding of nature, and all related processes to food production (Ploeger, 2003).

Sustainable food consumption can, in addition to education, be promoted by raising involvement and awareness of people. This effort needs to be taken up by any stakeholder involved in sustainable food systems (Vermeir and Verbeke, 2006). To practice sustainable diets, consumers must be convinced that their dietary behavior has an impact on sustainability issues (Vermeir and Verbeke, 2006). Otherwise, they are unlikely to perform (Roberts, 1996). Media and today especially influencers play also an important role to inform people about sustainable lifestyles and strategies for practicing sustainable diets, as well as where to find sustainable food products and inform about food labeling. New media have brought new ways of looking at things in recent years and have changed the way food and nutrition are handled. Social media channels are extremely used and lifestyle bloggers, influencers, and hashtags like #foodporn became from a trend to an economic branch (Ritterwerk, 2019). To be able to benefit from this success and the potential influence, we need a media agenda and a public social media debate on sustainable nutrition in everyday life (Büning-Fesel, 2007). Therefore, using nutrition models for promoting sustainable diets can be one way to go. However, it must first be clarified how these can look like (Meier-Ploeger, 2004). Models should provide orientation and illustrate how sustainable diets can be implemented in everyday life nutrition through easy-to-understand information and everyday nutritional guiding concepts (Eberle et al., 2006; Eberle and Hayn, 2007). Moreover, they should be desirable for consumers to emulate (Straka, 2007). Examining nutritional models for different styles of nutrition can help to understand daily nutrition, motives of nutrition behavior, needs, and everyday arrangements. In turn, these insights can be translated into strategies for practicing sustainable diets in different everyday situations and contexts (Rückert-John, 2011).

Nutritional models, media, and influencers also come into play, when thinking about advertising strategies for promoting sustainable diets. Advertising is an important, immediate, and compelling influence on consumption behavior (Garnett et al., 2015). Advertised food products are mainly brand-name products that have successful advertising strategies and high availability in almost every store. Therefore, stakeholders like NGOs, producers (using farmer-to-consumer direct marketing), and companies from the sustainable food industry have to think about showing initiative and consider using similar offensive advertising strategies and at the same time offering a higher availability of sustainable food products. Above all, strategies have to be developed for fresh foods, such as fruits and vegetables, which usually do not belong to a well-known brand or are advertised at all, so that these foods do not remain anonymous, but instead
become more attractive to buyers. By promoting these foods and sustainable food products in general, advertising and communication strategies should target values, so that people can relate to the products (Vermeir and Verbeke, 2008). Media as well as influencers and celebrities can be used to promote sustainable food products and make a positive contribution to enhance the practice of sustainable diets for example by building awareness (Johnstone and Lindh, 2018). Especially to reach today’s youth who live in a media-saturated environment, multiple channels and techniques need to be used as marketing efforts that serve their health (Story et al., 2008). As mentioned within the policy recommendations, stakeholders (e.g. producers, traders, and economic experts) can manage to agree on specific price models for sustainable food that provide affordability for the (hopefully then successful advertised) sustainable food products for all people.

Other relevant stakeholders in the food system are, in addition to the ones mentioned in this previous discussion, consumer initiatives or communities like urban gardening projects, food-sharing or container initiatives, rentable vegetable garden plots, land sharing, producer-consumer communities like Community Supported Agriculture, intercultural gardens or Guerrilla Gardening. These social innovations have evolved from everyday life. The search for opportunities for a healthy and sustainable diet takes place along the potential in everyday life (Rückert-John, 2015). However, all kinds of solution approaches for promoting sustainable diets can be implemented on a political, economic, institutional, cultural, individual level as well as on an international, national, regional, and local level, but they should be visible at all levels (Hofer, 1999).

One promising approach, especially for the retail and food service sectors, to support a change towards sustainable diets, is the Shift Wheel (Figure 1) developed by the World Resources Institute (Ranganathan et al., 2016).
Figure 1. The Shift Wheel (Ranganathan et al., 2016).

It comprises four complementary strategies to bring about change in people’s consumption behavior: minimize disruption, sell a compelling benefit, maximize awareness, and evolve social norms. Minimizing disruption concerns consumer’s habits. Changes that come along with offering more sustainable food products (e.g. taste, look, texture, smell, packaging, or the product’s location within a store) should be kept to a minimum in order to not interfere with manifested habits. Selling a compelling benefit includes identifying motivating product attributes (e.g. health or affordability) to stimulate consumers’ behavior change towards sustainable food consumption. Maximizing the consumers awareness can boost consumption because, for example, the desire for it is always present. This plays into the recommended enhancement of the availability and advertisement for sustainable food products. Evolving social norms is important because people’s dietary behavior is always influenced by their nutritional environment including culture and social norms. Therefore, it is important to inform and educate consumers, as well as making sustainable food products
more socially (Ranganathan et al., 2016). To implement the approach of the Shift Wheel promising intervention points, like a demographic group (e.g. millennials), occasions (e.g. family evening meals), or specific settings (e.g. school or workplace cafeterias), need to be identified. Then approaches to achieve the chosen shift need to be designed individually and tested in practice (Ranganathan et al., 2016).

Additionally, it can be helpful here to consider a distinction of consumers in terms of their nutritional styles or models. The typology of nutritional styles provides concrete indications of potential but also of obstacles to a more sustainable and healthier diet. This approach was also used in the mentioned research project Ernährungswende as an essential starting point for the development of target group-related communication and counseling services as well as everyday appropriate products and services (Hayn, 2005).

All people, including politicians and all different stakeholders, are considered consumers. Consumers are at the center of this research, as one objective was to develop solutions to close the gap between intention and behavior in order to practice sustainable diets. Even if we couldn’t gain ready-to-use ideas that enable all people to unimpededly practice sustainable diets, we can make valuable recommendations on how to deal with some of the obstacles that cause the intention-behavior gap. As long as there is no ubiquitous availability of sustainable food products, people have to plan their daily nutrition better. This includes informing themselves about possible sources of sustainable food purchase (whether in the supermarket or out-of-home food service) in advance or doing meal prepping at home for lunch breaks, travels, etc. Depending on the possibilities, a garden for vegetables, fruits or herbs can be laid out to make a small contribution to the own food supply. Therefore, consumers have to be aware of environmental and social problems that are linked to the global food system (Meier-Ploeger, 2006).

Consumers need to gain knowledge through education and support by the media seems essential, especially for informing about food offers via advertising or mobile apps. What is worth mention here is that people have to actively seek out and take advantage of existing educational opportunities. Otherwise, consumers may not be able to practice sustainable diets, despite having a high level of willingness and awareness, if they have no knowledge about the implementation (Kamm et al., 2015). This includes nutrition competence including food purchase, cooking, finance and budget, health, media, and decision-making competencies, as well as the ability to adequately assess the production, processing, quality, storage and preparation of food (Eberle et al., 2005; Eberle et al., 2006; Innemann, 2013). Making an optimal sustainable food choice in everyday grocery shopping requires a comprehensive background knowledge (Hayn, 2008). It is not always enough to just differentiate between factors like packaged versus unpackaged, organic versus non-organic, low versus highly processed, or local versus nationwide (Hayn, 2008).
It will also remain difficult to identify advertising for unsustainable food products and not to be adversely affected by strong advertising efforts, without appropriate education. A Swiss study points out that especially in stress-related situations consumers tend to be less aware of environmental sustainability. In such situations, decisions on buying sustainable food must be supported in a targeted manner. Therefore, simple decision heuristics are a central element that can be implemented to enable even consumers without detailed knowledge can pay attention to the sustainability aspects of products (Kamm et al., 2015).

Counteracting advertising requires in addition to knowledge strong willpower, that can be supported by the social environment of friends and family. The link to education and resulting knowledge especially about food and their costs can also help to build consciousness which leads to the willingness to pay the higher prices for sustainable food products. People must try to show a willingness to pay the supposedly higher prices, of course within their financial resources. Furthermore, consumers can reduce the total costs of consumed goods by reducing meat, sweets, and alcoholic beverages when buying organic food. Savings potential for supposedly higher-priced sustainable food products can thus be realized through a changed food selection in general (von Koerber and Kretschmer, 2001). In addition, the earlier mentioned nutritional styles and models have a budget specific character. Its development is based on the context of biographical experiences, personality, life attitudes, and value orientations (Häußler, 2007). The attitude towards food prices is therefore dependent on many factors that can be identified and made available for interventions by exploring the different nutritional styles. Consumers’ eating and drinking behavior is, for example, related to emotional, religious, and cultural aspects.

Nutrition culture is characterized by norms, values, mentalities, and nutritional knowledge (Hoffmann, Schneider and Leitzmann, 2011) and represents a societal value system. Sustainable nutrition culture exists when people are aware of their ecological and social responsibility related to their diet (Meier-Ploeger, 2001). Educational activities and awareness-raising play an important role in creating a more intense consumer engagement in sustainability issues and promote and empower consumers to practice sustainable diets (Garnett et al., 2015).

Overall, we need innovations for system improvements and different interacting strategies to promote a behavior change towards health-promoting and sustainable diets (Rothman, 2004). This includes first and foremost strong nutrition and consumer policy that focus on sustainability aspects and offers guidance that supports people practicing sustainable diets in their everyday life (Ploeger, Hirschfelder and Schönberger, 2011). Dietary behavior is complex (Hartmann and Siegrist, 2017) and people rather tend to not be willing to make additional efforts or comprise on factors like food availability and prices (Hoek et al., 2017). This is why a supportive food system that meets individual needs is essential (Reynolds et al., 2019). We need profound changes in our food systems, which require responsible and effective policies (FAO, 2014). Enabling people to practice sustainable diets should therefore be a priority for policymakers (Garnett...
et al., 2015). But not only every politician but also stakeholders (farmer, food industry, caterer, media, NGO, etc.) and consumers need to question their own practice concerning sustainability (Eberle et al., 2006), make an effort, and contribute to an improvement of our current food systems (Grunert, 2011; EUPHA, 2017). Also meaning shaping external and internal factors (that are affecting our dietary behavior by influencing the intention-behavior relation) in a way that they support the practice of sustainable diets and not causing an intention-behavior gap. Responsibilities need to be shared by all, since a change in our food systems and practiced diets cannot be realized by politics, companies nor consumers alone (Eberle and Hayn, 2007).

6.2 Prospects

6.2.1 Scientific contribution

This doctoral research contributes to the scientific discussion on sustainable diets in a way, that has not been addressed yet. We considered the intention-behavior gap and the factors causing it to be a major burden of progressing the implementation of sustainable diets from a consumer perspective. We have made it our research aim to search and develop ideas for closing the intention-behavior gap in order to pass solutions on to people as a supportive tool. Moreover, the aim includes exploring especially the external factors that are causing the gap more closely to gain further insights. We believe that this approach is of great importance when we consider the concern about how to achieve a far-reaching adoption of sustainable diets if even the people who have already developed the intention to practice a sustainable diet are unable to do so.

Based on this, we have set out to involve consumers in the process of developing ideas to close the intention-behavior gap and exploring the causing factors more closely. To our knowledge, this doctoral research is the first that takes a method of the open innovation approach and utilized it for the development of ideas for bridging the intention-behavior gap of sustainable diets. Also applying the think aloud approach including questionnaires and follow-up interviews for gaining further insights has not been done yet. At least not to our knowledge.

Within this research, we were able to analyze and understand the external factors (especially availability, education, advertising, and price) more closely. External factors can have a decisive influence on our behavioral control and also represent limiting factors that stand in the way of performing a sustainable diet in general. Another scientific contribution of this research is that the results show, that there are already solutions at hand. These must finally be recognized by all actors in our food system environment and then implemented in order to progress. The diversity of issues within our gained data show that our research is part of a highly charged discussion where we are easily crossing set research boundaries.

6.2.2 Insights for future research
Through our studies, several insights have been gained that open up potential future research possibilities.

On the one hand, future research could focus on applying different methodological approaches, to develop solutions in the form of ready-to-use ideas for closing the intention-behavior gap. It is recommendable to apply methods with particular selected groups of people such as men, women, mothers, adolescents, elderly people, the privileged, the deprived, and experts. In this way, more different needs can be involved in the development of solutions. One thing that would be conceivable is, to develop other workshop designs. Along with this, it could be valuable to identify real lead-users of sustainable diets and involve them in the development process of solutions.

On the other hand, it is conceivable to carry out a study that further explores the intention-behavior gap of people by examining their behavior in vivo. This would allow us to gain more insights into external and internal factors that influence people’s behavioral control. Based on that applicable supportive solutions could be developed.

Another possible starting point for future research is the involvement of other stakeholders (e.g. farmers, industry, supplier, retailer, caterer, media, NGO’s and politicians), acting within food systems, in the development of appropriate and supportive policy strategies towards sustainable diets and food systems. We need innovations for food system improvements and different interacting strategies to promote a behavior change towards health-promoting and sustainable diets. Every stakeholder plays a part within our food systems and should therefore, think about how to make an effort and contribute to an improvement of the current status quo.

6.3 Limitations

Within this research study, there are limitations for each research contribution listed in Chapters 3, 4, and 5.

Generally speaking, one of the biggest limitations concerns the choice and number of participants in both studies, as well as the geographical limitation that only considered parts of Germany. Within the first study (Chapter 4) we might have selected only people who are very committed to sustainable nutrition and related issues (due to lack of incentives). Selecting our participants for the second study (Chapter 5) was only based on their willingness to participate. In addition, most of the participants came from the nutritional section at the University of Applied Sciences, which could have an impact on the results. When asking if participants are trying to practice a sustainable diet, three participants negated it. It may be questioned whether people who are not trying to practice a sustainable diet are able to make valuable contributions to factors that can interfere with the intention to do so. Regarding the gender distribution of the samples, it can be seen that there was a majority of female participants: the first study sample consists of 81.7 % women and the sample from the second study
consists of 65% women. The gender aspect can also have an impact on health-related behavior. For example, women tend to eat more healthy than men do, which in turn could imply that men and women’s intention-behavior gaps differ to a great extent.

Another limitation that might be crucial concerns the definition and interpretation of a sustainable diet. The complex construct of sustainable diets leaves room for individual interpretations. People’s ideas that fit into their everyday life might differ from the scientific definition and its intended meaning. Although we introduced the concept of a sustainable diet at the beginning of each workshop and in advance of the think aloud sessions, individual interpretations may have influenced the nature of the results.
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