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Pre-Service Science Teachers' Perceptual Biases Regarding Sustainable Food Consumption: Negative Footprint Illusion

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Abstract

Global warming presents a threat for human and nature systems. For a few decades, sustainable food consumption behaviors have been considered remarkable to protect environmental sources. Changes in food consumption behaviors can benefit in improving environmental quality. While consumers are trying to reduce their environmental impact, it is needed to study what consumers think about the environmental impact of their consumption preferences. Earlier studies reported that sustainable conditions can bias judgments, since when an unsustainable plus a sustainable condition is thought as less environmentally impactful than the sustainable condition alone called "negative footprint illusion". In line with this, the current study aimed to examine negative footprint perceptual biases regarding sustainable food consumption. A within-subjects design was used with a total of 165 pre-service teachers studying at the department of science education in a mid-sized university in Turkey. Data were collected through a series of scales developed by Gorissen and Weijters (2016). The scales include three-meal menu food types including 'standard menu condition', 'sustainable-addition condition', and 'unsustainable-addition condition'. Participants were asked to evaluate the environmental impact of these menu conditions independently. The results of the study indicated that the participants believed that 'sustainable-addition condition' has a lower environmental impact than 'standard menu condition', even though 'sustainable-addition condition' indicates higher environmental impact—indicating a negative footprint illusion. It can be concluded that pre-service science teachers have perceptual biases related to sustainable food consumption even when they have enough knowledge related to environmental issues.

Introduction

In today's world, since the industrial revolution, human activities have had a considerable impact on the disruption of the environment (Beattie & McGuire, 2016; Boeve-de Pauw, Donche, & Petegem, 2011; Dunlap, Van Liere, Mertig, & Jones, 2000; Oskamp, 2000) and have grown increasingly over the last decades (Karpudewan, Ismail & Roth, 2012). In the light of earlier studies, the acknowledged harmful effects trigger various environmental pollutions, super-exploitation, global warming, acid rain, loss of biodiversity and habitats, the ineffectiveness of waste disposal or recycling, and consumption problems (Boeve-de Pauw et al., 2011; Singh, & Singh, 2017). It is particularly important to change consumption behaviors in order to protect environmental resources and improve environmental quality (Bin & Dowlatabadi, 2005). There are various categories of consumption behaviors that people should pay attention in their daily lives (Bai & Liu, 2013) such as energy conservation (Martinsson, Lundqvist, & Sundström, 2011), travel mode choice (Bamberg, Ajzen, Schmidt, 2003), recycling (Barr, 2007), and food consumption (Ozaki & Sevastyanova, 2011). Sustainable food consumption, among them, has a huge effect on the environment such as greenhouse gas emissions (Scialabba & Müller-Lindenlauf, 2010) and climate change (Dietz et al., 2009; Vandenbergh, Dietz, & Stern, 2011). More recently, the changing preferences of food consumers have attracted researchers working on environmental psychology. (e.g., Aitken, Watkins, Williams & Kean, 2020; Feil, da Silva Cyrne, Sindelar, Barden, & Dalmoro, 2020; Nosi, Zollo, Rialti, & Ciappei, 2020; Ramos & Squeff, 2020) because of its important effect on personal and community health, natural sources, social solidarity and the economic conditions (Reisch, Eberle & Lorek, 2013). Therefore, studies in the field of sustainable food consumption were required in order to better understand the decision-making periods of consumers (Siegrist, Visschers & Hartmann, 2015). Especially, some psychological barriers influencing these periods such as health halo effect (e.g., Sundar & Kardes, 2015), negative spillover (e.g., Thøgersen, 1999), rebound effect (e.g., Chitnis, Sorrell, Druckman, Firth, & Jackson, 2013), negative calorie illusion (e.g., Chernev, 2011) and negative footprint illusion (e.g., Gorissen & Weijters,

2016) lead to make wrong decisions in terms of sustainability. Among them, negative footprint illusion deals with consumers' understandings related to products' impact on the environment (Schnell, 2013). To be more precise, it is related to products' impacts on environmental with regards to its carbon footprint (Weidema et al., 2008). Characteristics of the products such as organically labeled apple or packaged processed foods can be differentiated in terms of environmental impact (Gorissen & Weijters, 2016). However, consumer bias concerns how much sustainable and unsustainable foods have an impact on the environment and climate change. Accordingly, the present research focuses on revealing consumers' perspectives about the environmental effects of foods by drawing attention to potential perceptual biases. Considering previous studies, several studies examined the negative footprint illusion of general products such as buildings (e.g., Holmgren et al., 2018a, 2018b) and mental models (e.g., Kim & Schuldt, 2018; Holmgren, Kabanshi, Langeborg, Barthel, Colding, Eriksson, & Sörqvist, 2019), while only a few studies focused on perceptual biases related to food products' environmental impact (e.g., Gorissen & Weijters, 2016; Kusch, & Fiebelkorn, 2019). Accordingly, due to the insufficient number of studies, the current study was carried out to reveal the importance of fully understanding the negative footprint illusion. This study has some aspects that should be emphasized differently from previous studies. Firstly, in general, previous studies focused on individuals of middle age. However, in the environmental psychology literature, perceptions of young people have been often ignored (Wray-Lake et al., 2010). Turkish population constitutes of 23.24% of young people in the 15-29 age group (Turkish Statistics Institute, 2019). Therefore, this research is of great importance to reveal the level of perceptual biases of young individuals. Further, given the lack of studies in the context of pro-environmental behaviors in developing countries (Ramayah, Lee, & Mohamad, 2010), it is thought that the results obtained from this study are different from those in developed countries. Finally, apart from previous researches, this research focuses on pre-service science teachers who will play a major role in educating future generations. One of the most strengths of this study stems from that environmental education is important in science education (Ateş, 2020a; Littlelyke et al., 2013). For example, environmental education is interested in educating individuals related to human-nature interaction in various areas such as food consumption behavior which presents an important potential to reduce carbon footprint and thus gives support climate change mitigation (Oppenlander, 2013). Environmental education at the level of middle school is taught by science teachers in Turkey (Ateş, 2019a). Accordingly, the study contributes to both environmental psychology and environmental education literature by examining perceptual biases about sustainable food consumption via negative footprint in the Turkish context. The following section includes a comprehensive literature review related to sustainable food consumption, negative footprint illusion, and context of the study.

Theoretical Framework and Literature Review

Sustainable Food Consumption

Sustainable food can be defined as food “*with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations*” (Food and Agricultural Organization, 2010; p. 7) or “*level of consumption which causes a level of environmental impact over time that does not degrade basic ecosystem services, such as the provision of fresh water, fertile soil and a protective ozone layer*” (Salzman, 1997, p.1246) and involves purchasing fresh, seasonal, regional, organic, or unprocessed foods, consuming less animal based products or not eating animal products and opposing packaged products (Brons & Oosterveer, 2017). However, because of careless use of resources, it was revealed that people's consumption has exceeded nature's capacity to produce by 30% and food consumption demand has trebled in the past 50 years (Staniškis, 2012). In addition to the process of food consumption, food waste is regarded as an important issue with regards to environmental, health and economic (WRAP, 2015) and related to the disappearance of natural resources used for its production and distribution and costs concerning waste management (Morone, Falcone, Imbert, & Morone, 2018). Waste reduction has great importance for medium and high-income countries because last studies revealed that the main reason for the problem with sustainability stems from behaviors at home (e.g., Braun, 2012). Approximately, it is estimated that one-third of the total environmental influence of household is related to food consumption (Danish Environmental Protection Agency, 2002) which has approximately 20% and 30% of environmental influence (Tukker & Jansen, 2006) and cause generation of almost 20% of greenhouse gas emissions (Reisch et al., 2013). Furthermore, food consumption is important in many aspects such as human health and rights, animal welfare, water and land use and biodiversity (Aiking, 2011; Govindan, 2018; Herrero et al., 2015; Leip et al., 2015; Premalatha, Abbasi, Abbasi, & Abbasi, 2011; Rana & Paul, 2017). More precisely, if people don't pay attention to their food consumption, human beings face important environmental deterioration including deprivation of habitats and biological diversity, eutrophication problems, decline in the soil condition, lack of water, water contamination, increasing air temperature and climate change (Bazilian et. al., 2011; Hedenus, Wirsenius, & Johansson, 2014; Intergovernmental Panel on Climate Change,

2014, Reisch et al., 2013). Similarly, international organizations including British Cabinet Office (2007), Commission of the European Communities (2007), Food and Agricultural Organization, (2015), High Level Task Force (2015), United Nations Sustainable Development Goals (UNSDG; 2015), EAT Initiative and Sustainable Development Solutions Network (2020) attached great importance to sustainable food consumption. Among them, in UN Summit hold in 2015, 17 Sustainable Development Goals were determined and some facts were revealed (UNSDG; 2015, p.1,6):

- “More than 1 billion people still do not have access to freshwater.
- One in nine people in the world today (795 million) are still undernourished.
- The vast majority of the world’s hungry people live in developing countries, where 12.9% of the population is undernourished.
- Poor nutrition causes nearly half (45%) of deaths in children under five – 3.1 million children each year.
- 66 million primary school-age children in developing countries attend classes hungry
- 149 million children under 5 years of age—22 percent of the global under-5 population—were still chronically undernourished in 2018.”

Negative Footprint Illusion

Besides the motivation to accept the importance of sustainable consumption (Nash, 2009) and its positive effect on reducing environmental effects (Bin & Dowlatabadi, 2005; Dietz et al., 2009; Panzone et al., 2016), the importance of how well people process and comprehend information about the environmental impact of foods was also acknowledged (Schnell, 2013). However, some of earlier studies showed that consumers have difficulty predicting the environmental effects of food consumption (Lea & Worsley, 2008; Tobler, Visschers, & Siegrist, 2011) and don’t exercise due care to sustainable consumption behavior (Bleda & Valente, 2009; Gleim, Smith, Andrews, & Cronin, 2013; Upham, Dendler, & Bleda, 2011). In order to increase social awareness, researchers, policymakers, institutions, and educators make some efforts such as presenting green labels like domestic production, GMO-free, eco or organic label (e.g., Republic of Turkey Ministry of Agriculture and Forestry, 2013) which are expected to encourage consumers to consume more sustainably (de Pelsmacker, Driesen, & Rayp, 2005; Napolitano, Pacelli, Girolami, Braghieri, 2008). However, consumers are still not convinced of the importance of the results of their food selection behavior (Macdiarmid, Douglas & Campbell, 2016) and have misunderstandings or lack of information related to food consumption behavior (Gorissen & Weijters, 2016) and the relationship between sustainable impact and food choices (Chen, 2020). In line with these findings, earlier studies focused on erroneous ways of reasoning which are biases influencing evaluations regarding the understanding of the environmental impact of food behaviors (Holmgren, Kabanshi, Marsh, & Sörqvist, 2018a). In the past studies, it was revealed that people's assessment of the impact of a food product on the environment depends on external factors such as symbolically meaningful information (Sütterlin & Siegrist, 2014), size (Cowen & Gatersleben, 2017) and eco-labels (Sörqvist et al., 2015). Therefore, consumers supposed that their choices toward pro-environmentally behaviors make compensations for less pro-environmentally behaviors (Kaklamanou, Jones, Webb, & Walker 2015).

On the basis of the previous study results, the negative footprint illusion, seen as a new concept of perception, has been included in the sustainable food consumption literature (e.g., Gorissen & Weijters, 2016; Holmgren et al., 2018a; Holmgren, Andersson, & Sörqvist, 2018b). The new concept explains the change in total environmental impact by adding green products to non-green products regarding carbon footprint (Hillier, Hawes, Squire, Hilton, Wale, & Smith, 2009). Even if the combination of these two types of food increases total environmental impact, consumers perceive the total as opposite. In line with these views, Gorissen and Weijters (2016) prepared a study design that targets consumers' perceptual understanding in three ways. Firstly, Belgian consumers were asked the impact of a main-meal only (potatoes, steak, and mushrooms), a main-meal plus organic side (organically labeled salad), or a main-meal plus nonorganic side (packaged sauce) on environmental impact with regard to greenhouse gas emissions. Secondly, the impact of ‘a burger’, ‘a burger + an eco-labeled apple’ and ‘a burger + a cheeseburger’ on the environment was asked concerning greenhouse gas emissions. Thirdly, the impact of a main-meal only, a main-meal plus organic-labeled dessert, or a main-meal plus non-labeled dessert were asked to evaluate in terms of greenhouse gas emissions. The results indicated that Belgian consumers estimated lower environmental effect for a simple meal added with an organic or sustainable option than for same meal alone even though the combined version increases the total environmental effect. In the second part of evaluations, consumers made the right predictions, as they reported that a simple meal combined with unsustainable or nonorganic foods had a greater environmental impact than just one meal. These experiments revealed negative footprint illusion since it was perceived that involving an organic or sustainable food option to meal menu reduces, rather than enhances the total effect on greenhouse-gas emissions. Similarly, Holmgren et al. (2018b) investigated 90 Swedish participants’ averaging biases related to

environmental impact predictions in a between-participants design via using negative footprint illusion paradigm with two experiments. In the first experiment, participants were asked to evaluate three house conditions types as carbon footprint in terms of environmental impact. The first one includes '15 control condition', the second includes '15 condition plus 5 conventional houses' and the third option includes '15 control condition and 5 green houses'. People made their predictions from very low environmental impact to very high environmental impact. The results of the study demonstrated that participants believe that the lowest environmental impact belongs to the green-addition condition (third option). In the second experiment, researchers changed the situation and number of houses. Participants were asked to evaluate the environmental influence of '15 conventional buildings', '15 green buildings' and '15 conventional buildings plus 15 green buildings' in terms of their carbon footprints. According to the participants' predictions, the carbon footprint of 'conventional plus green buildings' is lower than 'conventional only option' while it is higher than the 'green only option'. The results of both experiments indicated that Swedish participants have negative footprint perceptual biases since they perceive that the total carbon footprint of buildings reduces when 'green buildings' are added. Holmgren et al. (2018a) conducted to determine participants' perceptions related to the number of trees needed to compensate for the environmental burden of two sets of buildings: one set of 150 buildings with conventional energy ratings and one set including the same 150 buildings but also 50 'green' (energy-efficient) buildings. A total of 33 undergraduate students and 22 energy system graduates in Sweden were involved in the study and a within-between mixed participants design was used. The results of the study indicated that both the undergraduate students and the energy system experts stated that the number of trees needed should be less for 'conventional' and 'green' buildings than 'conventional' buildings. These results imply that similar to past studies, both undergraduate students and energy system experts have perceptual biases related to total environmental impacts called negative footprint illusion. Holmgren et al. (2019) presented two scenarios in which the total atmospheric concentration of CO₂ was asked to evaluate. In the first scenario, Swedish university students were informed that during 5 years atmospheric carbon dioxide concentrations (CO₂) in parts per million (PPM) is 2 PPM CO₂/year and asked to estimate the total atmospheric concentration of CO₂ within the given 5 year period. In the second scenario, it was stated that during 5 years, carbon dioxide concentrations (CO₂) in parts per million is 2 PPM CO₂/year and after some environmental regulations the contribution of carbon emissions to the atmospheric concentration was become 1.4 PPM CO₂/year followed a 5 year period and finally, total atmospheric concentration of carbon dioxide within the given 10 year period was asked to evaluate. The findings revealed that the participants believed a lower contribution to the atmospheric CO₂ concentration for the high + low scenario (i.e., 2 PPM/year for 5 years +1.4 PPM/year for another 5 years) compared to the high scenario (i.e., 2 PPM/year for 5 years) implying that Swedish university students have negative footprint perceptual biases. Kusch and Fiebelkorn (2019) tested negative footprint illusion with the environmental impact of "basic condition (fries and a plastic bottle containing water)", "basic condition plus a burger (meat condition)", "basic condition plus a solely vegetarian ingredient (vegetarian condition)" and "basic condition plus mix of ground insects and vegetarian ingredients (insect condition)". According to participants' estimations, carbon gas emissions in the 'meat condition' and 'vegetarian condition' are higher than the 'basic condition'. These findings imply that participants had a negative footprint illusion since 'insect condition' was perceived as less environmentally impactful than 'basic condition' despite the fact that the actual footprint of the condition increases with each added ground insects and vegetarian ingredients. Similar negative footprint illusion was found the study of Kim and Schuldt (2018) who investigated environmental impact judgments about the car type (hybrid or conventional) and the number of the car (one or two automobiles). The findings showed that participants believed that while having two conventional cars increase the total environmental impact as compared to one conventional car, two-hybrid cars have less environmentally impactful than one hybrid car.

Food Consumption in Science Education

Given the importance of food consumption in the world, the educational aspect of it has also great importance for sustainable development which "*meets the needs of the present without compromising the ability of future generations to meet their own needs*" (World Commission on Environment and Development, 1987, p. 41). In addition, education for sustainable development (ESD) "*enables people to develop the knowledge, values, and skills to participate in decisions about the way we do things individually and collectively, both globally and locally, that will improve the quality of life now and without damaging the planet for the future*" (Council for Environmental Education, 1998, p.3). With scope of ESD, universities have great importance in the advancement of sustainability and lead the whole movement of sustainability by giving students relevant values and beliefs and improving knowledge (Tang, 2018). Great importance should be attached to pre-service teachers who should have enough knowledge and pedagogy to provide that students will have skills, values, and knowledge at a good level while they improve their quality of lifestyles without harming the environment

(Dawe, Jucker, & Martin, 2005) in order for universities to undertake these important tasks. For the interrelationships between environment and human beings and commitment to take responsible actions, the process of training science teacher includes the learning and teaching of pedagogical approaches for ethical awareness and sensitivity, scientific literacy, creative problem-solving and critical thinking skills for the interrelation between human and nature (Winter & Firth, 2007). However, according to researchers, there are still shortcomings in training programs of science teacher and in classes on how to understand and teach sustainability (Frisk & Larson, 2011). In addition, past studies have revealed that pre-service teachers have low self-confidence that they will develop sufficient knowledge and skills to teach the nature of global sustainability (Summers, Corney, & Childs, 2004).

In higher education level in Turkey, science education places great importance to sustainable development. For example, in science teacher education program, there are many topics related to sustainability: The concept of sustainability and its uses; sustainability in science education; sustainability in the context of social change; education and sustainability; the future of humanity and sustainability; migration, poverty and inequality; sustainable environment; ecology, global environmental issues, and sustainability; sustainable society in harmony with nature; population, economic system and natural environment; technological developments, consumption habits and environment; social responsibility activities, sustainability in terms of tangible and intangible cultural heritage; rethinking of human-nature relations in terms of sustainability (Turkish Council of Higher Education, 2018). Issues related to sustainable food consumption were also included in science teacher education programs. In some courses, there are some topics related to sustainable food consumption such as natural and healthy nutrition, fight against obesity, food additives, healthy living and exercise, and fight against addiction (tobacco, alcohol, substance abuse, etc.). In addition, in science curricula published by the Turkish Ministry of National Education (2018) at the level of elementary school (4th, 5th, 6th, 7th, and 8th grade level), the concepts about sustainable food consumption are involved in different grade levels. The aim of the science course is to create awareness about the nutritional varieties, healthy and balanced nutrition, harms of smoking and alcohol use and benefits of healthy nutrition to students. In this course, concepts such as frozen foods, packaged foods, expiration date and the relationship between obesity and eating habits are emphasized. In addition, there are some objectives expected from students to obtain. With this course, based on research data, students discuss the importance of fresh and natural food consumption to live a healthy life and take over the responsibility to cut down on cigarettes in their social lives (Ateş, 2019b).

The Purpose and Research Questions

This study aims to reveal Turkish pre-service science teachers' negative footprint perceptual biases regarding sustainable food consumption. Following research questions are tested.

1. How do pre-service science teachers evaluate the food menus in terms of environmental impact? (Standard menu, standard menu+sustainable option and standard menu+unsustainable option)
2. How do pre-service science teachers evaluate the food menus on an evaluative scale in terms of ecological footprints? (Standard menu, standard menu+sustainable option and standard menu+unsustainable option)
3. How do pre-service science teachers evaluate the food menus on a quantitative scale in terms of ecological footprints? (Standard menu, standard menu+sustainable option and standard menu+unsustainable option)

Method

Research Design

A within-subjects design was used with show of 'three meal menus' as the independent variable and environmental impact as dependent variable. Each menu was tested within participants includes three conditions: standard menu (1), standard menu + sustainable food (2) and standard menu + unsustainable food (3) and finally, participants were asked the environmental impact of all meal menu conditions.

Participants and Data Collection

The study was carried out with a total of 165 pre-service science teachers studying at a mid-sized university in Turkey. The participants were determined with convenience sampling because of expense, time, and

accessibility advantages (Cohen, Manion & Morrison, 2007). Even though the convenience sampling method has the potential to limit the generalizability of the research, it was stated that young people are reliable in environmental psychology based studies (Cheah & Phau, 2011; DelVecchio, 2000). The sample consists of 92 third grade students and 73 fourth grade students (65% of them were female and 35% were male) who achieved all of the courses related to the environment. The majority of participants' income is between 2501-4000 Turkish Liras. Approximately 7% of them stated that they do not consume meat. Table 1 shows the socio-demographics characteristics of the participants.

Table 1. Sociodemographics Characteristics of Participants

Demographics	Item	N	%
Gender	Female	107	64.85
	Male	58	35.15
Grade Level	3	92	55.76
	4	73	44.24
Income	Less than 2500 TL	39	23.64
	2501-4000 TL	58	35.15
	4001-5500 TL	35	21.21
	5501-7000 TL	21	12.73
	More than 7000 TL	12	7.27
Meat Consumption	Yes	153	92.73
	No	12	7.27

Note. TL: Turkish Liras

Before data collection process, the necessary permissions and consent forms were obtained from participants and university. The study, conducted from September 2018 to January 2019, was carried out on the participants determined on a volunteer basis in a classroom environment. The scale was applied by the researcher to ensure the consistency of the data collection procedure and took about 20 minutes to complete. All the stages were implemented in compliance with the ethical principles of American Psychological Association (2017) and declaration of Helsinki (The World Medical Association, 2018).

Materials

A series of scales developed by Gorissen and Weijters (2016) was used to collect data. At first, pre-service science teachers were presented the aim of the study and information related to Salzman' (1997) definition of sustainable consumption at the top of the page, in Turkish language, as "*level of consumption which causes a level of environmental impact over time that does not degrade basic ecosystem services, such as the provision of fresh water, fertile soil and a protective ozone layer.*" After this short information, the participants were informed that they were about to carry out the evaluation related to environmental impact of various meal menus. The main scale section consists of various meal menus and the evaluations of the participants about the extent to which these menus have an impact on the environment in terms of carbon footprint. In the process of determining meals, in addition to Gorissen and Weijters (2016)' strategy, criteria that determine the difference between environmental impact of foods was evaluated in accordance with previous studies' (e.g., Siegrist et al., 2015) and web pages (e.g., www.voetprintcooking.nl; <http://shrinkthatfootprint.com>). In the first part, a standard menu (Potato + Steak + Mushroom) was given and then an eco-labeled food (Salad) was added to this menu and finally an unsustainable food (Packaged Sauce) was added to first menu. This scale consists of 7-point Likert type ranging from 'very low environmental impact' to 'very high environmental impact'. The alpha reliability (α) of the scale was found as .74. In the second part, firstly, a hamburger was involved and then a fruit with an eco-label (Organic Labeled Apple) was added to the hamburger and finally an unsustainable food (French Fries) was added to hamburger. However, in this part, the environmental impact was determined with a color coded point rating evaluative scale ($\alpha=.72$) from 'green' to 'red' and a quantitative scale ($\alpha=.73$) ranging from 0.1 kg to 0.9 kg of CO₂ gas emission (see Figure 1). According to Gorissen and Weijters (2016), using various kind of scales provide that the dimensions of interest (such as the environmental effect) could be explained in different ways that are not completely equal and therefore elicit different ratings of the same structure. In the third part, a standard menu (Chicken + Potato + Broccoli) was given and then eco-labeled dessert (yogurt) was added to this menu and finally a normal dessert (yogurt) was added to first menu (difference between second and third condition is the presence of an eco-label). This scale consists of 7-point Likert type ranging from 'very low environmental impact' to 'very high environmental impact' ($\alpha=.76$).

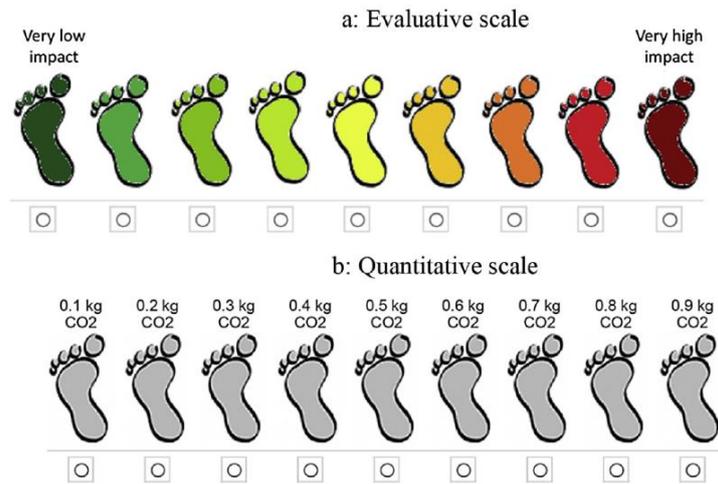


Figure 1. Display of Environmental Impact of Meal Menus with regard to Color and CO₂ gas Emission (Gorissen & Weijters, 2016)

Data Analysis

In this section, two kinds of statistical analysis were used: Descriptive statistics and inferential statistics. Descriptive statistics were performed to reveal participants' evaluations about environmental impact of different meal menu types, while inferential statistics were carried out to reveal significant difference between meal menu types with the help of analysis of variance (ANOVA) after several assumptions including "level of measurement, random sampling, independence of observations, normal distribution and homogeneity of variance" were tested (Pallant, 2007, p. 197,198).

Findings

One-way analysis of variance (ANOVA) was performed for all conditions to demonstrate to what extent the negative footprint illusion was included. Three menu types were involved in the experiment [A Standard Menu (Potato + Steak + Mushroom), Menu + Eco-Labeled Salad and Menu + Packaged Sauce]. For the first condition, there was a statistically significant difference in mean scores of menu types on perceived environmental impact [$F(2, 163)=8.9, p=.037$]. In spite of obtaining statistical significance, the real difference in means within the groups of meal menu type was rather small. The effect size, analyzed calculating eta squared (η^2), was .018. Post-hoc comparisons performing the Scheffe test indicated that as can be seen in Figure 2, the mean of 'Menu + Eco-Labeled Salad' ($M=3.45, SD=1.16$) was significantly lower than standard menu (Potato + Steak + Mushroom)' ($M=3.96, SD=1.21$). In addition, the mean of 'Menu + Packaged Sauce' ($M=4.76, SD=1.22$) was significantly higher than both of them.

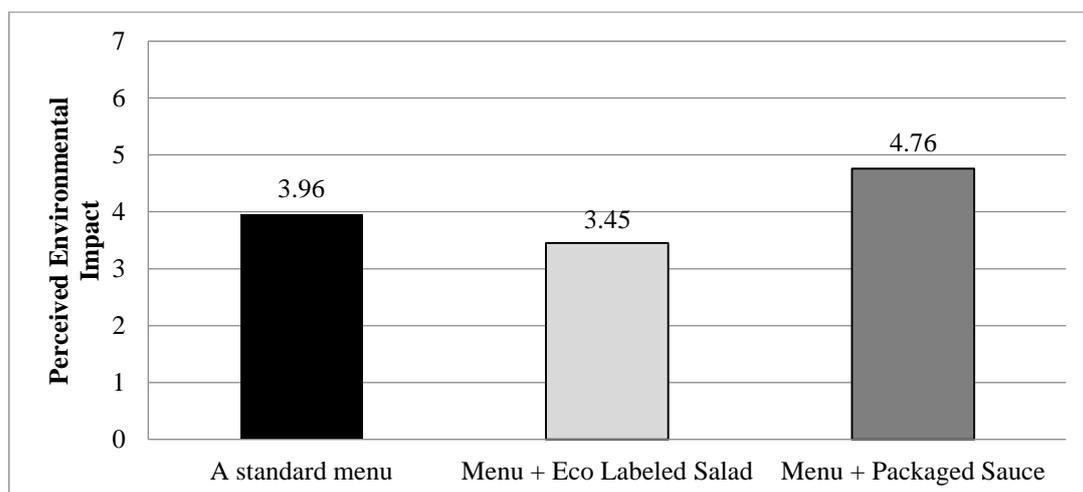


Figure 2. Display of Negative Footprint Illusion of First Study

In the second study, the ANOVA results indicated significant difference between environmental impact of hamburger menu types in both evaluative [$F(2, 163)=7.6, p=.022, \eta^2=.019$] and quantitative scales [$F(2, 163)=6.8, p=.018, \eta^2=.023$]. Lower impact perception included in Figure 3 was observed in menu of 'Hamburger + Eco-Labeled Apple' ($M_{ev}=5.40, SD_{ev}=2.00; M_{qu}=4.94, SD_{qu}=2.01$) than in 'a Standard Hamburger Menu' ($M_{ev}=6.89, SD_{ev}=1.75; M_{qu}=6.35, SD_{qu}=2.12$) and menu of 'Hamburger + French Fries' ($M_{ev}=7.68, SD_{ev}=1.73; M_{qu}=7.44, SD_{qu}=1.99$) for both evaluative and quantitative scales.

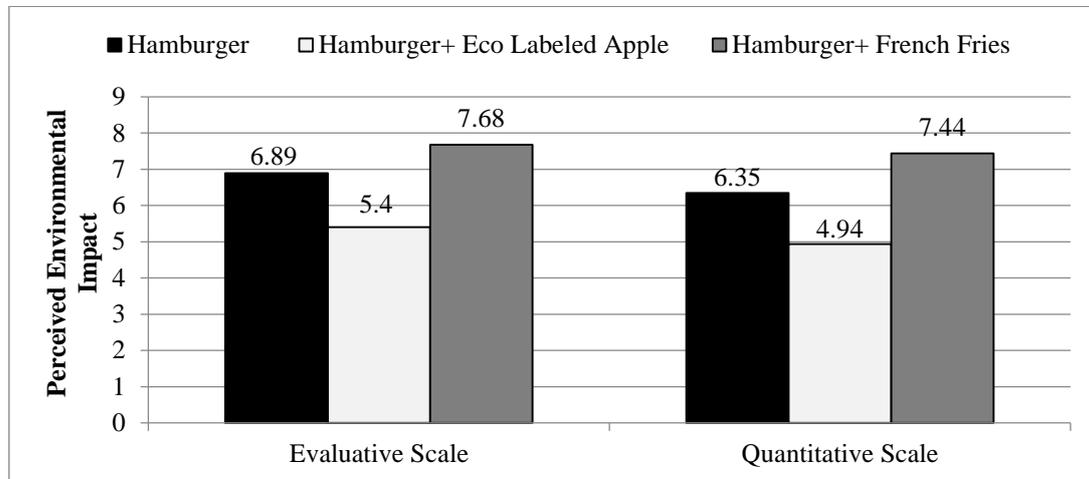


Figure 3. Display of Negative Footprint Illusion of Second Study by Type of Scale

For the third study, participants evaluated the environmental impact of 'Menu + Eco-Labeled Dessert (Yogurt)' ($M=3.12, SD=1.30$) has significantly lower than 'A Standard Menu (Chicken + Potato + Broccoli)' ($M=3.29, SD=1.28$) and 'Menu + Dessert (Yogurt)' ($M=3.35, SD=1.53$), when eco-labeled dessert (yogurt) is offered as a sustainable option [$F(2, 163)=11.68, p=.038, \eta^2=.010$] (See Figure 4).

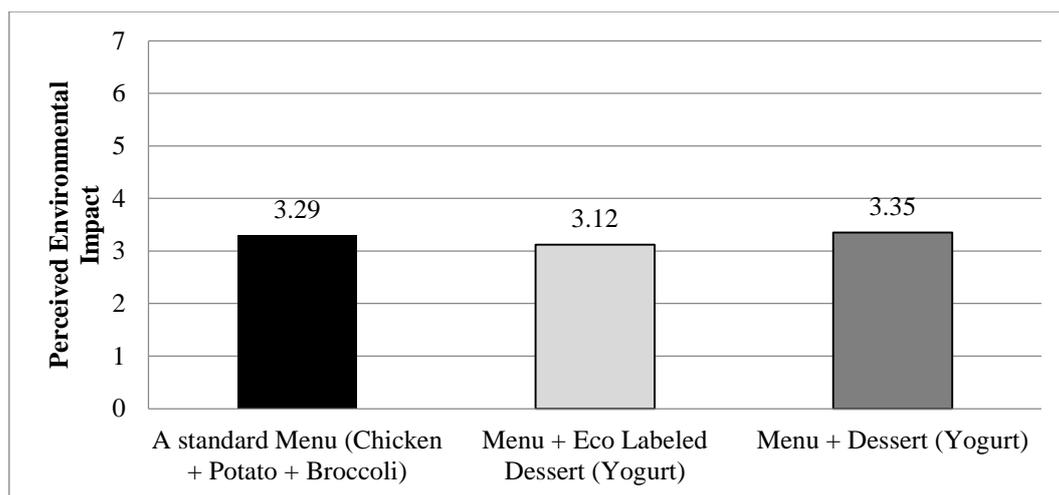


Figure 4. Display of Negative Footprint Illusion of Third Study

Discussion and Conclusion

The purpose of this study was to examine pre-service science teachers' negative footprint perceptual biases regarding food consumption. The implications revealed two important results. Firstly, for three experiments, pre-service science teachers were biased to think that an addition of sustainable option to meal menu can decrease the total environmental impact and CO₂ gas emission for both evaluative and quantitative scales—indicating a negative footprint illusion. This consideration is in contrast with the total environmental impact and carbon emission which increases when sustainable or organic food types are added. However, secondly, participants made the correct judgments since they stated that adding 'unsustainable options' to the 'standard meal menu' would increase the overall environmental impact. Similarly, past studies were in line with findings

of this study (e.g., Gorissen & Weijters 2016; Holmgren et al. 2018a, 2018b, 2019; Kim & Schuldt, 2018; Kusch, & Fiebelkorn, 2019).

A potential reason for the negative footprint illusion based on earlier studies (Holmgren et al., 2018b) is that the impact is supported by an averaging process. In the study, pre-service teachers seem to be basing their predictions on average of A and B rather than basing their predictions about the environmental impact of a category of items on the sum of A and B. The environmental impact evaluation obtained from this experiment focuses on a logic that can be expressed as $A + B < A$; so A refer to unsustainable food options and B are sustainable food options (e.g., Holmgren et al., 2018a). This erroneous reasoning method was called the averaging bias and may be responsible for consumers' false beliefs that green items avail the environment when they are simply 'less bad' than their traditional ones (Holmgren et al., 2018b). According to this view, one of the other explanations of the negative illusion of illusions is that people more simply evaluate the sum of unsustainable foods and sustainable foods as $A - B$, where unsustainable foods are seen as bad for the environment and sustainable foods as useful.

Moreover, the study revealed that the negative footprint illusion is resistant to some levels of expertise, studying in the department of science education and at least a basic understanding of the true environmental impact of the objects to be predicted. In fact, it is not possible to draw conclusions about expertise with this finding, since the expertise difference was not compared in the study. As a matter of fact, it should be noted that there are study areas in which experts perform better than novices to make truly correct decisions (Spence & Brucks, 1997; Kuusela Spence & Kanto, 1998). Considering the findings, it was revealed that pre-service science teachers assume that adding an organic garnish reduces the effect of the whole dish (although it rationally increases the effect). This suggests that consumers do not measure the effect of the items and combine them, but quantitative footprint estimates are based on the heuristic impressions of the overall dish. The heuristic impression is heavily impacted by the green virtue component (Gorissen & Weijters 2016). However, studying with teachers rather than pre-service teachers may reveal a different perspective. First of all, teachers spend time with students for a long time and they have a higher opportunity to improve themselves for the scope of environmental lessons. Having experience requires a longer focus on environmental issues such as sustainable consumption. Moreover, they do more research and participate in scientific activities such as in-service training to ensure their professional development.

In the light of the above findings, it could be predicted that the averaging bias can be involved in many contexts and behavior settings in which people consider a mix of objects and behaviors such as consumer goods (Chernev & Gal, 2010). The averaging bias can also support the belief that engaging in pro-environmental behaviors can make compensations for less pro-environmental behaviors (Kaklamanou et al., 2015). In addition to negative footprint illusion, similar cognitive biases such as negative calorie illusion and eco-label were also found in sustainable food consumption literature. In negative calorie illusion, consumers believe, for example, burger and a salad can be perceived as healthier and include fewer calories than burger only (Chandon & Wansink, 2007; Raghunathan et al., 2006). However, total calorie amount increase with combination of burger and healthy option and unhealthy one (Chernev & Gal, 2010). A different type of work is about eco-label on products which have importance in science education literature (Ateş, inpress). Among two foods, if one provide eco-label and another one doesn't provide any label, people believe their tastes are different (Lee, et al., 2013; Sörqvist & Langeborg, 2015), they contain different amounts of calories and buy eco-friendly option by paying more money (Lee et al., 2013; Wiedmann et al., 2014).

Implications, Limitations, and Suggestions for Future Studies

The current study has some theoretical and practical implications. First of all, the present study is first attempt to examine pre-service science teachers' perceptual biases related to negative footprint illusion in Turkish context- a developing country, even though a few of earlier studies were conducted in developed countries (e.g., Gorissen & Weijters, 2016; Kusch, & Fiebelkorn, 2019). Pre-service science teachers had some biases while discriminating foods in terms of their environmental impact. The results cause some harmful effects in the classroom setting. Especially students in middle school start to get environmental education and may think that all information they learn is correct and may not question what you learned. Accordingly, in case science teachers teach wrong, it can cause misconception that may affect the lifelong effect of the student. Moreover, within the scope of Sustainable Development Goals suggested by UNSDG (2015), the topic of "biases in food choice and consumption" can be consummately involved in science lessons so as to accomplish the goal of "Responsible consumption and production" (Goal 12). Science teachers can benefit from the experimental design in the current study in classroom and then put forward ideas how these biases are emerged and how to

prevent them (Kusch, & Fiebelkorn, 2019). For example, argumentation seen as a leading teaching approach and educational target for science education (Osborne, Erduran, & Simon, 2004) can be helpful in discussing this issue. One way to engage younger students with the work of the scientific initiative and ensure that they have access to it is argumentation since argumentation is a basic epistemic practice in science (Duschl & Grandy, 2008).

Although the present study has contributed to the literature, there are some limitations. In the scope of this study, all the process was completed with self-report evaluations which may include excessive or inconsistent ideas due to inaccurate memory or social willingness. Future studies can be extended with qualitative research methods to obtain more detailed information about negative footprint illusion. The study was limited to pre-service science teachers. In this case, external validity of the study can reduce since generalization is not possible beyond the sample. Furthermore, any of characteristics of the sample was not statistically controlled. For example, some participants might be vegetarian whose beliefs related to the impact of meat consumption on environmental effect may differ from others. Accordingly, the situation can change result of the study because a change in meat consumption by following a vegetarian or pescatarian diet can reduce greenhouse gas emissions by more than 20% (Aleksandrowicz, Green, Joy, Smith, & Haines, 2016). Thus, researchers should be careful when determining the characteristics of the sample to be controlled. Similarly, sociodemographic variables were not controlled in the study. The effect of demographic characteristics including gender, age, income, education level and life style in urban versus suburban on environmental impact may provide different results to reveal factors affecting negative footprint illusion. Earlier studies revealed that gender plays a major role on environment since female have more pro-environmental sensitivity than male (Pienaar, Lew, & Wallmo, 2013, 2015). In this context, in the current study, the number of female is almost twice the number of male which can affect the result of the study. Further studies should take into consideration the distribution of demographic variables. Finally, to provide clearer answers, the number of negative footprint illusion studies previously conducted by different researchers in different context and behavioral settings such as value judgments of averaging bias related to the health of food product, compensatory green beliefs related to making up for flying abroad on holiday using public transport, sustainable food options, comparing green and conventional building and hybrid and conventional car (Chernev & Gal, 2010; Gorissen & Weijters 2016; Holmgren et al. 2018a, 2018b, 2019; Kaklamanou et al., 2015; Kim & Schuldt, 2018; Kusch, & Fiebelkorn, 2019) can be increased.

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