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Capturing Young People's Interest in Food Waste Reduction: An Approach Using Qualitative Reasoning

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Abstract. According to the United Nations Food and Agriculture Organization (FAO) more than one third of the food produced globally is lost or wasted. This tremendous amount of food waste highlights the urgent need to investigate this phenomenon promptly with powerful methods in order to reduce it. In the present work, we consider a qualitative reasoning approach in an attempt to understand people's interest in the food waste (FW) problem. To do so, we have run an inperson taste experiment and have acquired data from 188 participants. We apply a measure based on a cosine similarity to capture the degree of interest towards the environment as individuals respond to the New Environmental Paradigm scale (NEP). Previously, they had to decide on whether a piece of fruit allegedly coming from the supermarket is better than another one allegedly coming from an alternative source such as applications designed to reduce food waste. We are using the taste experiment and the questions as a base to gain a more in-depth understanding of the drivers behind FW.

Keywords. Qualitative reasoning, similarity measures, sustainable decision-making, food waste, experimental data.

1. Introduction

Households contribute the most to FW, accounting for 53% of total waste in 2020. Addressing this issue is crucial for a sustainable food supply chain [1]. Numerous research studies are now utilizing artificial intelligence and machine learning to research FW ([2]; [3]; [4]; [5]; [6]; [7]). In this paper we examine if a ranking method that considers a cosine similarity measure is more suitable to capture people's attitudes towards FW than a classic psychometric scale. To do so, we will use a cosine similarity measure to capture individuals' profiles towards FW [8]. Our objective is to understand individuals' behavior when they must make decisions in terms of food purchases or throwing away food. There is a plethora of sources where people can buy products that

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combat FW, selling the surplus of food or products that are suboptimal, such as the 'Too good to go' application. This platform is a network that includes a variety of different establishments like restaurants, supermarkets, and bakeries.

We ran an in-person experiment with 188 participants. Participants were led to believe that they were trying two different kinds of apple, one from the Supermarket and another one from the 'Too good to go' application. After the tasting, they had to answer a series of questions. Our goal in this paper is to investigate whether we can extract people's profiles based on environmental attitudes. We are using a qualitative reasoning approach based on a linguistic computational method to aggregate and compare the qualitative responses from the NEP scale [9]. We consider the cosine similarity to compute the distance between vectors, where each one of the components corresponds to the frequency with which the linguistic terms were used in the NEP scale. Our approach, by applying the cosine similarity measure to participants' qualitative answers to the NEP scale, allows us to differentiate between two different fruit preference groups, where classic statistics fail to do the same.

2. Preliminaries

2.1. New Environmental Paradigm Scale (NEP)

The NEP scale is the most popular unidimensional measure used to quantify environmental concern and pro-environmental tendencies. The NEP scale has been used in many different topics, ages and cultures ([10]; [11]; [12]; for a meta-analysis see [13]). It was originally designed in 1978 by Dunlap and Van Liere based on the premise that within environmentalism, the relationship between humans and nature is implicitly entangled. In the 15-item scale (1=Strongly disagree, 5= Strongly agree), which is the one used in the present manuscript, the eight odd-numbered questions were framed in an ecocentric manner, while the even-numbered questions are framed in an anthropocentric manner. The goal of using the scale is to get a value per participant that will classify them as eco-friendly or not. Two different approaches have already been proposed, in previous studies, when analyzing the responses. The first method (method 1) entails reverse coding the even-numbered questions. As these questions are framed in a human-centric way, responses from the lower part of the scale in these questions indicate proenvironmental ideas. Then the evaluations of each participant are averaged together, therefore the values can range from 0 to 5. This technique was implemented for example in [11] in their application of the NEP scale in a Greek context. The second method (method 2) is described in [12] where the environmental worldview of employees in Kosovo is studied. The authors counted the frequency of the 'Agree' and 'Strongly Agree' items in the odd-numbered questions (ecocentric) and the frequency of 'Disagree' and 'Strongly Disagree' in the even-numbered questions (anthropocentric). They calculated the NEP score by aggregating the frequency of these responses. The values could range from 0 to 15.

2.2. Similarity measure based on Linguistic Terms

In this subsection the qualitative reasoning methodology, based in linguistic computation, that is going to be used in the experiment is presented. We introduce the concept of

linguistic terms, as well as some key definitions related to them that will be used to capture similarities in participants' answers.

Let *S* be a totally ordered set of basic linguistic terms (BLTs), $S = \{s_1, ..., s_n\}$, with $s_1 < ... < s_n$, corresponding to the values of a rating scale [14]. In order to determine the strength of people's attitudes towards environmentalism, we introduce a distance measure, between vectors expressed in S terms, based on a weighted cosine similarity. Given the vectors $P_i = (P_{i1}, ..., P_{ik})$ and $P_j = (P_{j1}, ..., P_{jk})$ corresponding to the linguistic responses of a set of *k* items of two different observations, we compute new vectors $(F_{i1}, ..., F_{in})$ and $(F_{j1}, ..., F_{jn})$ with frequencies corresponding to some linguistic terms. Then the similarity index is computed as:

$$Sim(P_{i}, P_{j}) = \frac{\sum_{l=1}^{n} w_{l} \cdot F_{ll}}{\sqrt{\sum_{l=1}^{n} w_{l} \cdot F_{ll}^{2}} \cdot \sqrt{\sum_{l=1}^{n} w_{l} \cdot F_{jl}^{2}}}$$

where F_{il} and F_{jl} are the absolute frequencies respectively and w_l is the normalized weight for each one of the linguistic terms. Note that the greater the similarity between two vectors, the value of the similarity measure is closer to one.

In the proposed method (method 3), similarly to method 1, we reversed coded the odd numbered questions. Then, in a similar way as in method 2, we computed F_1 and F_2 as the cumulative frequencies of $\{s_1, s_2, s_3\}$ and the cumulative frequencies of $\{s_4, s_5\}$, respectively. The rationale is to use the frequencies approach, as in method 2, but taking into account the cosine similarity to the optimal ecocentric vector (pure environmentalist).

3. Experiment

3.1. Participants

One hundred-eighty-one participants were tested ($Mean_{age} = 19$, $SD_{age} = 1$, female =97). An additional 7 participants were tested but eliminated from the final sample due to the following reasons: technical error (n=5), not enough data (n=2). Participants were undergraduate students from the ESADE Business School and were given extra-credit scores in exchange. The current experiment was approved by the local ethical committee of ESADE (009/2023), and all data were treated confidentially. Participants signed a written consent form before the experiment began. Data collection is still ongoing.

3.2. Materials

A local Catalan variety of apples (Golden Empordà) was chosen for the experiment. The fruit was always fresh and was cut no more than 10 minutes before testing. To ensure symmetrical pieces, we used an apple cutter after peeling. The exact same apple was served in two transparent separate bowls that were later identified as coming from the supermarket or the 'Too good to go' application. This type of procedure is used widely in marketing, cognitive science, and other disciplines when the research question

revolves around the external factors that can influence taste. For instance, participants were offered the exact same chocolate but critically it was shaped differently using a 3-D printer. Participants' taste differed depending on the shape (circular or angular), this is due to a mental association between shapes and other features like taste or sounds [15]. This type of experimental settings is well accepted and typically include deception as the same product is used but labelled differently to investigate whether labelling the product can change the perception of the consumers.

3.3. Paradigm

We adapted the paradigm used in [16] to our research question. Participants were tested in a sound attenuated room in the Decision Lab located at the ESADE Sant Cugat Campus. They were seated in a chair opposite to a table where two transparent bowls were placed with the slices of apple. In the middle a recyclable, cardboard paper cup was placed with water. Participants were first asked to sign the consent form and whether they had any food allergies. The experimenter asked if they had heard of the 'Too good to go app' before. Regardless of their response, the experimenter gave the same brief description to all participants to ensure that they all have the same understanding of the alleged origin of the fruit. Then they were asked to try one kind of apple. The experimenter informed them where the apple came from (Supermarket or 'Too good to go') and that they can have as many slices as they like to make sure they have an idea about the taste of the fruit. Once they were done with the first apple, they were instructed to have some water and then to try the other apple. The order and side of presentation of the two kinds of apple was counterbalanced across participants. After the tasting they were guided to an adjoining room, where a Microsoft Surface Tablet with a physical keyboard was placed. They were asked to answer a series of questions privately. Among them, they had to answer a closed-ended question on which apple they preferred (Supermarket, 'Too good to go', or Both). They were also asked to share their opinion on the taste and the quality of the fruit, and to fill in the New Environmental Paradigm scale [9].

3.4. Data analysis

The data presented in this manuscript belongs to a bigger project on FW. We computed the NEP scores (method 1, method 2) and the cosine similarity distance (method 3). Out of the 181 participants, 48 preferred the fruit coming from the supermarket (26%), 70 had no preference (39%) and 63 preferred the fruit coming from the application (35%). We calculated the proportion of participants that were above the mean, i.e., environmentalist in each method. The thresholds considered to classify participants in two groups according to the answers they gave on the NEP scale for the two psychometric methods are 3 for method 1 and 7 for method 2.

We ran three two-proportions z-test comparing the two groups separately for the two methods (Supermarket vs. 'Too good to go', 'Too good to go' vs. Both, Supermarket vs. Both). Our preliminary results show that method 1 and method 2 were unable to capture any statistical differences between the three profiles of the people showing different preferences (see table for values).

In method 3, the threshold selected was 0.707 which is the similarity of an indecisive person (the one that answers 7 times 1, 2 or 3 and 7 times 4 or 5) to a pure environmentalist. Where the similarity was greater than this opinion, a person was considered to have an environmentalist attitude. In this case, the proposed method was able to detect a significant difference between the 'Too good to go group' and the Supermarket group (Z= -1.71, p= 0.04). However, it found no differences between either group or Both.

Method 1	Above Threshold	Below Threshold	Sum
Supermarket	45 (0.94)	3 (0.06)	48 (1)
Both	63 (0.90)	7 (0.10)	70(1)
Too good to go	57 (0.91)	6 (0.09)	63 (1)
Method 2	Above Threshold	Below Threshold	Sum
Supermarket	36 (0.75)	12 (0.25)	48 (1)
Both	57 (0.81)	13 (0.18)	70(1)
Too good to go	56 (0.88)	7 (0.12)	63 (1)
Method 3	Above Threshold	Below Threshold	Sum
Supermarket	32 (0.67)	16 (0.33)	48 (1)
Both	51 (0.73)	19 (0.27)	70(1)

51 (0.81)

Table 1: Comparison of the results obtained using the three methods.

4. Conclusions

Too good to go

In this paper we contribute a new real-life application to capture differences across profiles towards FW by means of a similarity measure. Traditional measures based on psychometric scales are used in most cases to analyze scale data. Our study based on the results from the NEP scale show that the majority of participants were more environmentalists. In addition, our results suggest that considering the NEP scale as a qualitative scale and using a similarity measure based on linguistic computation, we can distinguish the different profiles while the classic psychometric tools are unable to do so.

12 (0.19)

63(1)

A limitation of the present experimental work is that our sample is comprised of only young adults. This is due to two reasons. Firstly, we know that younger people waste more food therefore it is worthwhile to study this particular population in an attempt to try to fight this issue to its root. Secondly, our recruitment is mainly done at the University's premises which makes it challenging to test various age groups in person so that they can try the fruit themselves.

In this paper we have combined experimental work with a qualitative reasoning approach, considering linguistic computation in the context of FW. Our findings hold the potential for replication in the future and we are optimistic that our work will inspire others to study this pressing phenomenon using innovative techniques.

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