Nudge Theory, food, and the climate crisis: how behavioral economics can support sustainable choices

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INTRODUCTION

Over the past years, there has been a global imperative to reduce CO_2 emissions due to the increasingly extreme and dangerous consequences of climate change, which pose a threat to human existence itself (IPCC, 2023). One of the major contributors to global CO_2 emissions is food production, particularly the impacts associated with meat production. Estimates suggest that food production is responsible for approximately one-third of global greenhouse gas emissions, with 71% attributed to agriculture and land use choices (Crippa et al., 2021). A comparative study conducted in 2020 examined four diet types: omnivorous, pescetarian, vegetarian, and vegan. The findings highlighted that the omnivorous diet, which includes high consumption of animal products, has the highest environmental impacts in terms of greenhouse gas emissions, energy demand, and land occupation. On the other hand, the vegan diet, which involves higher consumption of organically produced foods using environmentally friendly practices, has the lowest environmental impact (Rabès et al., 2020). Numerous studies, such as Chai et al. (2019) and Rosi et al. (2017), support these findings.

Livestock production is a particularly impactful factor within an omnivorous diet. According to a 2006 report by the Food and Agriculture Organization of the United Nations (FAO), livestock production accounts for 18% of total greenhouse gas emissions (Steinfeld et al., 2006). However, calculations by Goodland & Anhang (2009) estimate that livestock and its associated by-products contribute to at least 51% of global greenhouse gas emissions. Livestock production also significantly contributes to global methane emissions, accounting for approximately 35-40% of them. Methane is a potent greenhouse gas with a warming potential of more than twenty times higher than that of CO_2, posing a serious environmental threat. Additionally, livestock production is responsible for approximately 64% of total ammonia emissions, which contribute to acid rain and water eutrophication processes (Dopelt et al., 2019).

Moreover, meat production has severe impacts on the planet due to factors such as land and water use. Approximately 80% of global agricultural land is dedicated to the livestock industry, which only provides 20% of the world's calorie supply (Ritchie, 2017). This exacerbates issues related to world hunger while also leading to land degradation and loss of biodiversity. The water demand associated with meat production also causes significant environmental stress, with beef production requiring nearly fifty times more water than vegetable production (Mekonnen & Hoekstra, 2010).

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Recently, behavioral economics theories, including the Nudge Theory (Sunstein & Reisch, 2017; Thaler & Sunstein, 2008), have gained prominence as tools to guide consumer choices. Nudges are attempts to influence people's judgment, choices, or behaviors in a predictable way, leveraging individual cognitive biases and the decision-making process within a social context. By utilizing these biases, nudges can redirect consumers toward eco-friendly perspectives (Hansen, 2016). Applying this theory to various domains, including sustainability policies, can be highly effective on a large scale.

Often, individuals make choices unconsciously, relying on habitual behavior without considering the environmental impact of their actions. This is where nudges can play a pivotal role, steering consumers' automatic (fast and unconscious) decisions toward more eco-friendly options. The cumulative effect of these actions, when multiplied by the population of entire nations, is often underestimated. One potential nudge, in this case, is the Carbon Footprint Label, which measures the total emissions of CO_2 and other greenhouse gases associated with the life cycle of a product (Wiedmann & Minx, 2008).

In the context of Italy's food sector, the use of the Nudge Theory to influence citizens' choices toward more sustainable lifestyles seems to be limited. However, it holds tremendous potential for widespread effectiveness.

Therefore, this research aims to investigate whether the use of a nudge can effectively influence people's choices toward products with reduced environmental impact.


MATERIAL AND METHODS

To assess the effectiveness of the Nudge Theory, a within-subjects experiment was designed, comparing a beef hamburger, known for its high environmental impact, with a plant-based alternative with significantly lower environmental consequences. An online questionnaire was administered to a sample of individuals in Italy, asking them to choose between the beef burger and the plant-based substitute in two scenarios. The first scenario (Figure 1) involved no nudge, allowing participants to make choices based on their daily habits without any information about the products' CO_2 emissions. After the first scenario respondents were presented a brief explanation of the carbon footprint label with the relative logos (Figure 2). In the second scenario (Figure 3), the Carbon Footprint Label was introduced accompanying the plant-based substitute as a nudge. The price of both foods was assumed to be the same (€ 3.99) to avoid influencing the choice. The choice of the price for the proposed products was made observing current prices at supermarkets in northern Italy for 300gr of beef burger and the equivalent portion of a plant-based burger.

Google Forms was utilized as the data collection tool to administer the online questionnaire during a two-week period from May 16th to May 27th, 2022, resulting in 254 responses.

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Figure 1 – The first-choice scenario presented to respondents without nudge.

Immagini di essere al supermercato e di dover acquistare uno dei seguenti prodotti di origine   *
italiana. A parità di prezzo (€3,99) quale acquisterebbe?
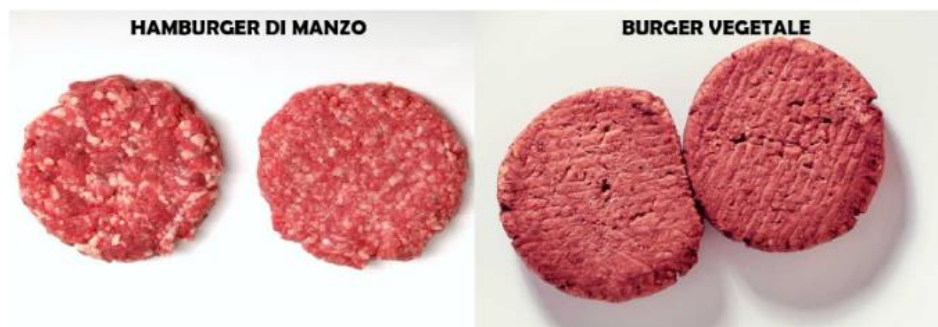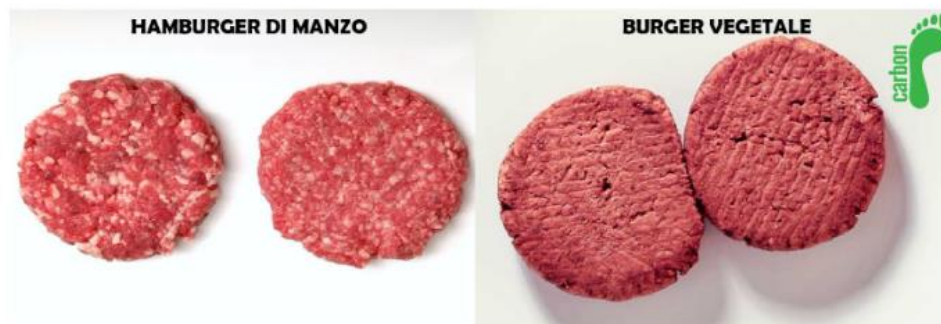
○ Hamburger di manzo

○ Burger vegetale

Figure 2 – The information provided to respondents between the first-choice scenario without nudge and the second-choice scenario when the nudge was introduced.

L'etichetta "Carbon Footprint" indica quanto la produzione di un determinato cibo contribuisce in termini di emissioni di CO_2 (anidride carbonica) al riscaldamento climatico. Tale etichettatura viene effettuata usando i seguenti loghi:

RIDOTTO CONTRIBUTO AL CAMBIAMENTO CLIMATICO

MEDIO CONTRIBUTO AL CAMBIAMENTO CLIMATICO

ELEVATO CONTRIBUTO AL CAMBIAMENTO CLIMATICO

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Figure 3 – The second-choice scenario presented to respondents with the nudge.

Immagini di ripetere la scelta appena effettuata, a parità di prezzo (€3,99), se sulla confezione venisse introdotta l'etichetta "Carbon Footprint", quale prodotto acquisterebbe?

○ Hamburger di manzo

○ Burger vegetale

RESULTS

Based on the sociodemographic information collected in the questionnaire (Table 1), the sample exhibited near-even gender distribution, with 47.6% men, and 50.8% women and 1.6% not specified. The most represented age category was individuals between 18 and 25 years old (46.1%), followed by age groups between 46 and 55 years (15.7%), 26 and 35 years (13.8%), and 56 and 65 years (12.2%). Individuals over 65 years old and those between 36 and 45 years old constituted smaller proportions of the sample. More than half of the respondents had obtained a high school diploma, with a significant number holding a university degree. The sample included a smaller portion of individuals who completed only middle school or possessed a master's or doctoral degree.

Regarding dietary habits, 90.6% (N = 230) of the respondents reported consuming meat. Among them, almost half consumed red meat at least once a week, a significant fraction consumed it more than twice a week, while less than 10% consumed it less than once a month. However, over 50% of meat consumers indicated a reduction in meat consumption over the past five years. Additionally, most respondents in this category had tried plant-based burgers and 65% expressed willingness to purchase them again. Both vegetarians and omnivores cited ethical and environmental reasons as primary motivations for consuming plant-based products, while only a small percentage favored the taste over meat. The main reason inhibiting plant-based products consumption was the perceived lack of similarity in sensory characteristics compared to meat. Nonetheless, even among non-consumers, there was a tendency to recognize the lower environmental impact of plant-based alternatives.

Considering the full sample (vegetarians and omnivores, N = 254), the results of the first experimental phase indicated a clear preference for the beef hamburger, chosen by 68.1% of the sample. However, in the second phase, when the necessary information regarding the Carbon Footprint Label was provided, and the plant-based substitute was presented with this label as a nudge, the preferences were almost reversed, with a significant majority favoring the plant-based (vegan) option (57.1%) (Figure 4).

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Table 1 – Sample socio-demographic characteristics

Variable	Levels	n	%	$\sum$ %
Gender	Other	4	1.6	1.6
	Woman	129	50.8	52.4
	Man	121	47.6	100.0
	all	254	100.0	
Age	<18	4	1.6	1.6
	18-25	117	46.1	47.7
	26-35	35	13.8	61.5
	36-45	18	7.1	68.6
	46-55	40	15.8	84.4
	56-65	31	12.2	96.6
	>65	9	3.5	100.0
	all	254	100.0	
Education	Elementary or lower secondary school diploma	13	5.1	5.1
	High school diploma	156	61.4	66.5
	Bachelor's degree	81	31.9	98.4
	Master/PhD	4	1.6	100.0
	all	254	100.0	
Employment status	Housewife	4	1.6	1.6
	Executive	5	2.0	3.5
	Unemployed	6	2.4	5.9
	Employee	98	38.6	44.5
	Freelance	15	5.9	50.4
	Worker	14	5.5	55.9
	Retired	11	4.3	60.2
	Student	101	39.8	100.0
	all	254	100.0	
Living status	On the average	217	85.4	85.4
	Over the average	31	12.2	97.6
	Under the average	6	2.4	100.0
	all	254	100.0	
Environmental Assoc. Membership	No	226	89.0	89.0
	Yes	28	11.0	100.0
	all	254	100.0	
Region	Campania	1	0.4	0.4
	Friuli Venezia Giulia	6	2.4	2.8
	Lombardia	5	2.0	4.7
	Marche	19	7.5	12.2
	Piemonte	1	0.4	12.6
	Other (Spain)	1	0.4	13.0
	Trentino - Alto Adige	5	2.0	15.0
	Veneto	216	85.0	100.0
	all	254	100.0	
Meat consumer	No	24	9.4	9.4
	Yes	230	90.5	100.0
	all	254	100.0	

Notably, 37.6% of initial beef hamburger choosers subsequently opted for the plant-based burger after the introduction of the label highlighting its reduced CO_2 impact (Figure 5). This group accounted for

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25.6% of the sample. The full sample results therefore highlight that the introduction of the nudge would reduce the amount of people buying meat by around 25% in the sample considered in our experiment.

Figure 4 – Choice frequencies between the first-choice round without nudge (No_Nudge) and the second round when the nudge was introduced (Nudge), considering the full sample (N = 254).
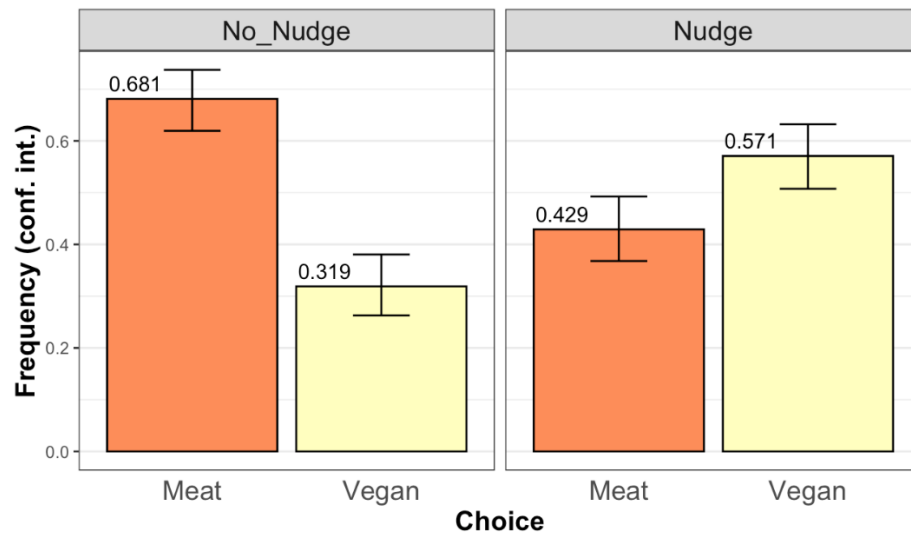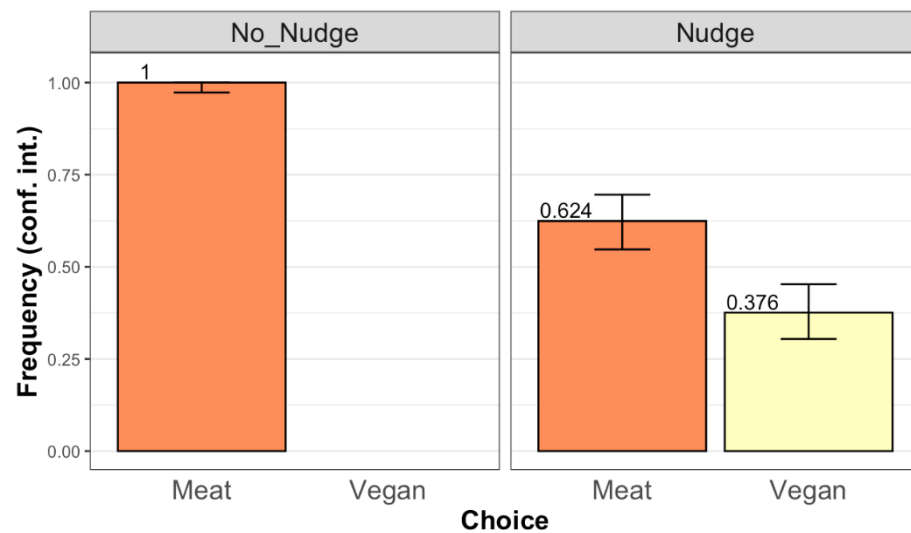

Figure 5 - Comparison between the results of the first and second phase of the experiment regarding those who had chosen meat as first choice (N = 173).

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If we take into consideration only meat eaters (N = 230), in the first scenario the beef hamburger was chosen by 75.2% of respondents (N = 173), while the plant-based alternative by 24.8% (N = 57) people (Figure 6). After the introduction of the nudge, 37.6% (N = 65) of those who had chosen the beef hamburger in the first scenario opted for the plant-based hamburger in the second scenario. This represents 28.3% of meat eaters: it is therefore possible to affirm that the nudge changed the purchase intention of 28.3% of meat eaters.

Figure 6 – Choice frequencies between the first-choice round without nudge (No_Nudge) and the second round when the nudge was introduced (Nudge), considering only meat eaters (N = 230).
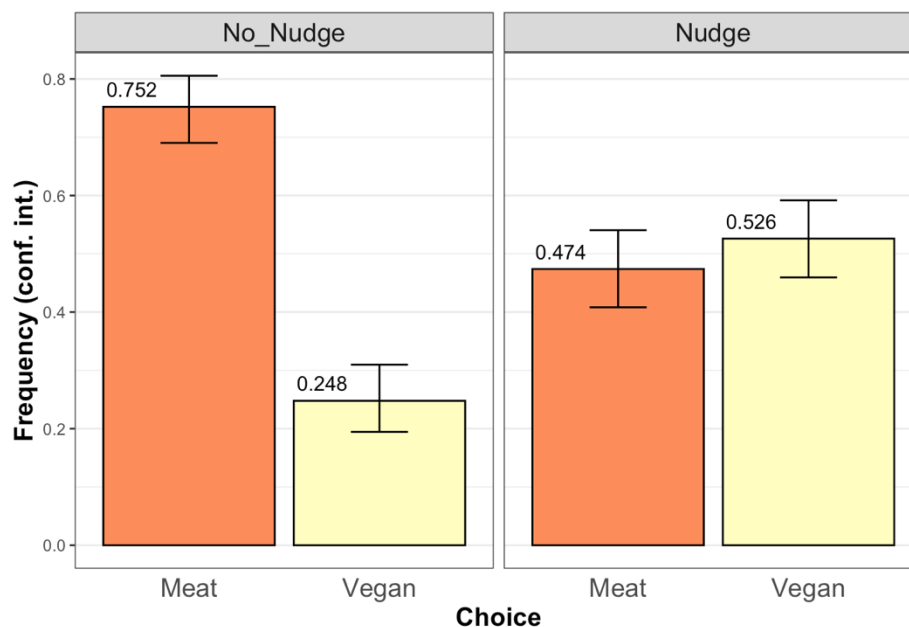
Subsequently, in order to verify the effectiveness of the treatment, a non-parametric test (the McNemar test) was carried out given the experimental setting within-subjects. Such a test can determine whether there are variations in a dichotomous dependent variable between two distinct groups. A decidedly significant p-value was obtained (p-value < 0.001), once again highlighting a significant shift in consumer choices due to the introduction of the nudge. The same results were obtained considering the full sample (N = 254) and only meat eaters (N = 230).

Among the respondents who changed their initial choice, certain factors can be considered. A logistic regression (Table 2) was applied to check on which groups of respondents, based on their socio-economic and attitudinal characteristics, the nudge had a greater effect. The logistic regression considered the respondents (N=172[1]) that on the first scenario (without nudge) opted for the meat burger choice. The dependent variable in the logistic regression was a dummy assuming value 1 if the respondent changed his/her choice from meat burger to vegan burger.

As can be inferred from the results reported in Table 2, the effect of the nudge depends on the respondent's gender, specifically having a greater effect on women compared to men. However, no

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[1] From the 173 subjects, 1 observation was dropped by the Stata software (Gender = Other) given that it did not result statistically significant.

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significant differences in the effect are observed regarding age groups, as indicated by the model (p > 0.05). Therefore, it can be concluded that the effect of the nudge does not depend on the age of the individual subjected to the stimulus.

If we instead examine the effect of the nudge considering the respondents' opinions, it is possible to observe that those who do not consider meat production a significant contributor to climate change (Meat_Climate variable in Table 2) are less likely to change their choice compared to those who hold an opposite opinion. Therefore, the nudge has a lesser effect on these individuals.

The importance attributed by respondents to the environment on a scale from 1 to 5 (1 = not important at all; 5 = very important) is also statistically significant. As the importance attributed to the environment by respondents increases, the effectiveness of the nudge also increases.

Considering the odds ratios reported in Table 2, the odds ratio for the female population to change their choice following the introduction of the nudge are greater by a factor of 2.6 (160% more) compared to those of men. For each additional point attributed to the importance of the environment, the odds ratios are greater by a factor of 2.18 (118% more). However, for those who do not consider meat production as a cause of climate change, the odds ratios are lower by a factor of 0.086 (91.4% less) compared to those who are convinced of this aspect.

In summary, therefore, the studied nudge appears to be more effective on female subjects who attribute significance to meat production in terms of its contribution to climate change and consider the environment to be important.

Table 2 - Logistic regression to characterize the respondents who changed their choice (N = 172) following the introduction of the "nudge".

	Odds Ratio	Std. Err.	z	p-value	[95% Conf. Interval]	
Gender (reference: Man)						
Other[§]	-	-	-	-	-	-
Woman	2.595	0.944	2.62	0.009	1.272	5.292
Age (reference: < 18)						
18-25	1.103	1.573	0.07	0.945	0.067	18.067
26-35	0.992	1.476	-0.01	0.996	0.054	18.328
36-45	0.741	1.177	-0.19	0.85	0.033	16.662
46-55	0.981	1.440	-0.01	0.989	0.055	17.426
56-65	0.553	0.838	-0.39	0.696	0.028	10.769
>65	0.723	1.344	-0.17	0.862	0.019	27.631
Meat_Climate[§§] (reference: Totally agree)						
I don't know	0.378	0.228	-1.62	0.106	0.116	1.230
Partially agree	0.500	0.221	-1.57	0.117	0.210	1.189
Partially disagree	0.115	0.085	-2.94	0.003	0.027	0.486
Totally disagree	0.086	0.101	-2.09	0.037	0.008	0.863
Importance_environment[§§§]	2.181	0.647	2.63	0.009	1.220	3.900
constant	0.030	0.056	-1.9	0.057	0.001	1.107
N = 172; LL = -96.12566; McFadden Pseudo R^2 = 0.153						

[§] omitted, 1 observation
[§§] "Meat_Climate" refers to the following question: "La produzione di carne rappresenta uno dei contributi più significativi al cambiamento climatico. Cosa pensa riguardo a questa affermazione?".
[§§§] "Importance_environment" refers to the importance attributed by respondents to the environment on a scale from 1 to 5 (1 = not important at all; 5 = very important).

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CONCLUSIONS

The results indicate that the use of a nudge, specifically the introduction of the Carbon Footprint Label on the packaging of the plant-based burger, significantly influenced respondents' choices. The percentage of individuals selecting the plant-based option increased by approximately 79% compared to the previous scenario where the label was not present. This suggests that providing information about the reduced environmental impact of the plant-based option successfully influenced consumer behavior, leading to a substantial shift in preference.

It is worth noting that the sample size of 254 respondents is relatively small and cannot be considered representative of the entire Italian population. Additionally, the concentration of respondents in the Veneto region makes it challenging to generalize their perceptions to residents of other regions in Italy. To obtain more reliable and representative results, the questionnaire should be re-administered to a larger and more diverse sample that reflects the age distribution in Italy.

Nonetheless, the findings indicate that the respondents exhibited particular attention to nature and a heightened awareness and concern for the environment. This suggests a positive inclination toward sustainability and a willingness to make choices aligned with ecological values. The study highlights the potential role of promoting environmental awareness and education in fostering environmentally conscious behaviors and encouraging individuals to make more sustainable choices in their daily lives.

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