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Abstract

In this paper we try to contribute to the understanding of the persistence and increase of meat eating in the face of mounting evidence on the ills of meat production and consumpion by considering the role of selective attention and learning. We aim to test whether agent type plays a role in this process. If this hypothesis is true, simple informational campaigns about the externalities of meat consumption might be ineffective as the informational content may be lost on precisely the population of interest, omnivores. Policy strategies to reach this goal would then need to be refined. Our conclusions apply more generally to a policy agenda for climate-change curbing action, an area where convergence to nudges or strong incentives is proving very hard for policy makers at all levels, and the potential for information to spark action on its own would be very valuable.

1 Introduction

That people do not always act on information is an established and much studied phenomenon in many areas of economics. The ineffectiveness of policy interventions based on information was behind the Nobel-prize winning approach known as *nudging* (Thaler and Sunstein, 2009), and the more recent focus on *social information*, i.e. information concerning one's peers' decisions, that leverages the importance of social norms (Allcott, 2011; Bhanot, 2017; Bursztyn and Jensen, 2015; Coffman et al., 2017, to give just a few examples).

Failing to observe recognizable impacts of information-based interventions prompts often further investigation into where the chain from information to action gets interrupted. DellaVigna and Gentzkow (2010) summarize the empirical evidence on motivated information starting from the question "To what extent does persuasion affect behavior?". In this context, there is ample evidence that the effectiveness of information depends on recipients' prior beliefs, on sender's credibility, and on the non-informative content of the message, such as the emotional evocativeness of imagery.

However, before a piece of information can affect behavior, it has to at least reach the intended audience. Rather few policy evaluations within economics acknowledge that the failure in the chain information-behavior might happen at the stage before, namely that information might not reach many of the intended beneficiaries at all, or not all in the same way. At least three explanations to this have been investigated: limited attention, active avoidance, and selective retaining of information on the part of the recipients. The importance of limited attention has

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been highlighted in studies of financial investors' response to quarterly earning releases (Hong and Stein, 1999; Hirshleifer et al., 2009), showing that even potentially valuable information, which is publicly accessible, is at times ignored. There is also evidence that agents might take costly action to avoid some type of information (DellaVigna et al., 2012; Freddi, 2017; Andreoni et al., 2017). Lastly, rather than selecting what to avoid, people might be selecting what information to retain, instead. In studies of electoral campaigns and voters' behavior, for example, confirmation bias (Lord et al., 1979) or the attempt to proxy for quality (Gentzkow and Shapiro, 2006) drive a demand for news slanted consistently with the recipient previous opinions.

The link between information and choice does not need to run in only one direction, though. In Becker and Murphy (1993)'s model, information about a product and consumption of the same are complements. By the authors own example, "Someone who owns a Ford truck should be more likely to sit through Ford ads than Toyota ads.". The empirical prediction, that increasing the level of consumption, or more in general the commitment to a choice, increases the marginal utility of information, has been tested in the lab (Ehrlich et al., 1957), but as far as we know not in the field.

Self-selection into or out of the audience of a particular information message might be at least partly related to agent *type*, defined in some relevant dimension. This would be fortunate, because it can potentially be exploited to correct the failure with appropriate targeting. Marketing theories have been centered around this tenet at least since the 1950s' (Smith, 1956). Firms are well aware of the fact that the market is segmented, and normally custom their commercial offer to different types in order to maximize reach. While targeting based on demographics can be seen as a more traditional approach, what is known as *benefit segmentation* (Haley, 1968) is more recent and advanced. Rather than relying on descriptive factors, based on an ex-post market analysis, this theory recommends to look for causal factors of buying behavior, through identifying the benefits which people are seeking when consuming a given product.

Perhaps not surprisingly, because of the lack of private incentives, policy has not been as driven in the effort to reach as many as possible in the most effective way. One area in which the ineffectiveness of information is particularly troubling is environmental and climate policy. A policy agenda that would provide nudges or strong incentives for climate-change curbing action is proving very hard to converge to for policy makers at all levels. Therefore, the potential for information to spark individual action on its own would be very valuable in this context. In this paper we focus on dietary choices, and in particular on meat consumption. The food sector is responsible for a large share of global greenhouse gases (GHG) emissions, and meat production accounts for the largest share therein (Edenhofer, 2015). Moreover, industrial livestock farming (which accounts for 75% of global meat production) results in several other externalities, environmental and otherwise, such as high water usage; distorted land use (Foley et al., 2005), including deforestation; local air and water pollution, including nutrient leakage and eutrophication of water basins (Diaz and Rosenberg, 2008); loss of biodiversity (Newbold et al., 2015) both among farmed animals and other nearby ecosystems; increased antimicrobial resistance due to antibiotics abuse (WHO et al., 2014; Edqvist and Pedersen, 2001). The cheaper meat with lower nutrient and higher fat content produced by this system, leading to overconsumption, is also contributing to the silent epidemics of dietary-related preventable chronic diseases, such as diabetes, cardiovascular and hearth conditions, and some forms of cancer (Mozaffarian, 2016), that are today the first cause of death (WHO et al., 1990) and a significant burden on public finances through health expenditures in developed countries.

Reducing the global production of meat is a fundamental component of any strategy towards diminishing the severity of climate change (Springmann et al., 2018). As a consequence, reducing meat consumption is one of the most effectful actions for an individual to reduce her so called environmental footprint. However, meat consumption is rising globally due to a rising population

and rising levels of wealth (Rojas-Downing et al., 2017).

In this paper we try to contribute to the understanding of the persistence and increase of meat eating in the face of mounting evidence on the ills of meat production and consumption by considering the role of selective attention and learning. We aim to test whether agent type plays a role in this process. In particular, we hypothesize that agents already committed to not eating meat (vegetarians or vegans) are more likely to retain and eventually make use of information about the externalities of the meat industry than omnivores. If this hypothesis is true, simple informational campaigns about the externalities of meat consumption might be ineffective as the informational content may be lost on precisely the population of interest, omnivores. Policy strategies to reach this goal would then need to be refined.

To investigate our question, we use a novel approach, combining a natural experiment with recent techniques of text analysis, which has large potential for replicability. This gives us a measure of incentivized information retention, which does not come from the lab nor is specific to investment decisions, but rather exploits the real-life situation of a graded knowledge test, and as such is a novel contribution to the current literature on this type of behavior. The specific design will be detailed in section 3.

Our results are qualitatively in line with our hypothesis. However the analisys is statistically underpowered, due to a lower than expected prevalence of the type of interest (i.e. there are fewer vegetarians in our sample than in the general population). We think nonetheless that this contribution poses a relevant question and hope it will inspire future research in the same direction.

2 Literature review

The theory of cognitive dissonance predicts that receiving information contrasting personal beliefs causes an uncomfortable tension that needs to be reduced (Festinger, 1962). One way to reduce this tension is to avoid such information. There are multiple ways of avoiding information, for example one could physically avoid it by not looking at it, or one could stop engaging with it by trying to forget the information. Most empirically documented forms of information avoidance in economics have focused on physical avoidance, e.g. Dana et al. (2007) or biased interpretation of information, e.g. Babcock and Loewenstein (1997); Mobius et al. (2011); Eil and Rao (2011).[1]

The role of recall or inattention in information avoidance has been primarily investigated in economic theory, e.g. Akerlof and Dickens (1982); Bénabou and Tirole (2016). In Benabou and Tirole's model, intrapersonal strategic considerations allow for the selective treatment of evidence that threaten personal beliefs (e.g. eating meat harms the environment). In this multiple-self model, agents at time=0 will obfuscate and try to forget information by not transmitting it to their self at time=1 for some parameters, i.e. they will engage in self-deception.

Avoidance by disengaging with available information has received less attention, especially in economic research. Thompson and Loewenstein (1992) show differential recall of facts based on the assigned role in a negotiation game. In a more recent working paper Chew et al. (2018) find that motivated remembering of information is used despite facing an economic cost to do so. In psychology, the literature on memory and learning is vast, yet the connection between dissonant information and memory has been underexplored. In one relatively recent example, Shu and Gino (2012) show that people who cheated on a lab experiment task also remembered fewer items of a moral code they were exposed to before the experiment.

Lastly, the paper is related to the literature on the psychology of meat consumption. If people care for animals or the environment and continue to eat meat, there is an apparent paradox.

[1] See also the summary by Golman et al. (2017).

This "meat paradox" (e.g. Loughnan et al., 2010) is the subject of a recent working paper by Hestermann et al. (2017), in which they survey a representative part of the french population to find that there is an inverse relationship between how much meat someone eats and the imagined severity of animal suffering in the industrial production of meat. This correlation is then investigated by adapting the model by Bénabou and Tirole (2016) to show that underestimating farm animals' suffering is one way to alleviate guilt caused by the meat paradox. Clearly, the paradox can easily be extended to encompass the environmental domain: if someone cares about the environment, eating meat stands in gross contrast with that belief.

To investigate whether prior beliefs affect the attention to and use of information, we ran a randomized experiment in a classroom. In the experiment, students wrote essays on their plan for a Christmas dinner menu after being exposed to a lecture and reading materials on the externalities of meat production, and could decide to make use of this information. We posited that groups that included at least one vegetarian or vegan person have a higher likelihood of using that information in their essays.

We measure the usage of information by comparing the words in the text of the essay with a preregistered word list designed to capture the information conveyed in the lectures and readings. Thus, our method is related to the Linguistic Inquiry and Word Count (LIWC) measure, a common and valuated tool in linguistic analysis of texts (Tausczik and Pennebaker, 2010).

A deeper understanding of the effects of prior held beliefs (or individual types) on information avoidance is important for multiple reasons. Providing evidence that people have a differential propensity to make use of or recall threatening information might increase our understanding of how people manage and form their beliefs. In addition, the question is policy relevant. Identifying who would benefit from informational campaigns may help raising the efficiency and effectiveness of policies, in a similar way that marketing enhances sales.

3 Experimental Design

In order to investigate the effect of individual type on information retention, we performed an incentivized experiment in the classroom. At the beginning of the experiment, the subjects filled in a short survey in which they reported the quantity of meat they had consumed during the previous week, and could identify themselves as vegan or vegetarian if the definition applied. All subjects received information on the externalities caused by the food industry, in the form of a classroom lecture and a set of mandatory reading material. The information that was provided portrayed, among others, the problems stemming from the meat industry and personal meat consumption.

Given the self-reported types, we randomized all 282 students into 92 groups. 11 of these groups contained a vegetarian or vegan student. The students then received the task to write a mandatory essay, together with the other members of the group, describing and motivating their choice of menu for a hypothetical Christmas dinner.[2] We hypothesize that there is a difference in how carnivores and vegetarians[3] deal with the provided information about the food industry. We assume that the information stands in opposition to a high consumption of meat. In particular, we want to test whether groups that include a vegetarian student recall a larger share of the information than groups made up only of carnivores. To incentivize the students, the mandatory essay gives study credits toward the final grade of the course (10/100 points).[4]

[2]The essay question is reported in the Appendix.

[3]For readability purposes, we will use the term *vegetarian* to indicate both vegetarians and vegans.

[4]This is to our knowledge the first experiment to use course credits as reward to incentivize effort. Waldum and Sahakyan (2012) reward *participation* with course credits, not *performance*. This is a cheap and reliable strategy that suits perfectly in particular the study of attention and learning, and should be exploited more in

To measure the share of information retained we counted how many words related to the information on the food industry externalities are mentioned in the essay. To this end, we preregistered a list of 30 words in both English and Swedish[5] related to the learning outcomes. We then used a script to measure how many of the 30 words appear in the essay (when a word was used multiple times it was only counted once). We call this number the essay's *score*. The essays were also read and graded by the teacher, and the grade, reflecting general comprehension of the topic rather than just the presence of keywords, is what counts for the students. We expect score and grade to be correlated, however not perfectly. We also expect the grade to capture the ability of the students to a higher degree compared to the score, as the automatized word count fails to consider the context in which the words are mentioned.

4 Analysis

4.1 Summary statistics

Table 1: Summary statistics of group-level variables

	mean	(s.d.)
Vegetarian	0.12	(0.33)
Score	4.43	(2.91)
Grade	4.88	(1.82)
Previous grades' median	8.51	(0.62)
Previous grades' spread	1.40	(0.87)
Big group	0.09	(0.28)
Small group	0.01	(0.10)
Whole sample (N = 91)		

Notes: This table reports the summary statistics of group-level variables. *Vegetarian* is an indicator variable for whether the group has one vegetarian or vegan member. *Score* is the main dependent variable, representing the number of hits from a preregistered list of keywords that were found in the group's essay. *Grade* is the grade (0-10) that the essay was awarded towards the final exam. *Previous grades' median* and *Previous grades' spread* are the median and the spread of grades achieved by the group on other essays (0-10). *Big group* and *Small group* are indicator variables for whether the group has more or fewer members than 3.

As Table 1 shows, 12% of groups include a vegetarian student; 9% have 4 or 5 members rather than 3 (*Big group* indicator); and 2% of groups only have 2 members (*Small group* indicator). The average score is very low: the average group only mentioned 4.5 out of 30 registered words. The grade for this assignment is also substantially lower than for previous assignments. Possible explanations are that either the essay question was particularly difficult, or that the topic did not engage the students enough to motivate learning or effort in completing the assignment. The correlation between grades and score is shown in Table 2, where *grade4* is the grade on the same

similar settings.

[5]Only two out of 91 essays are written in English. The complete lists are reported in the Appendix.

essay for which the score was computed. As expected, the correlation is positive but not perfect with any of the grades, therefore the score is not simply capturing ability or effort.

Table 3 reports other statistics from the baseline survey which are not included in our pre-analysis plan. As well as estimating their own meat consumption during the previous week[6], the students were asked to guess the average meat consumption of their classmates, and the average weekly meat consumption *of the previous generation* (the question was prompting them to think about their parents at their own age).

Unfortunately, far from all students replied to the survey, and not all of those who did filled in the questions on meat consumption. We can anyway use these measures to validate the *Vegetarian* dummy:average meat consumption for groups including one vegetarian member is about 40% lower. They are also more optimistic about their classmates, but more pessimistic about their parents. None of the differences are however significant.

	score	grade1	grade2	grade3	grade4
score	1				
grade1	0.13	1			
grade2	0.09	0.28	1		
grade3	0.3	0.1	0.1	1	
grade4	0.43	0.02	0.18	0.21	1

Table 2: Correlation matrix of score and grades

Table 3: Summary statistics by treatment group

	Meat-eaters (N=58)		Vegetarians (N=10)		t-test
	mean	(s.d.)	mean	(s.d.)	p-value
Own meat consumption	1,073.45	(753.01)	681.45	(610.75)	$P = 0.1238$
Class meat consumption	1,347.55	(691.97)	1,288.83	(585.21)	$P = 0.8010$
Parents' meat consumption	1,229.36	(584.97)	1,313.82	(724.28)	$P = 0.6847$

Notes: This table reports the summary statistics of individual-level variables collected in the baseline survey. *Own meat consumption* is the estimated quantity of meat consumed by the student during the previous week. *Class meat consumption* and *Parents' meat consumption are the corresponding quantities estimated for the average of their classmates, and their parents at their age, respectively. All variables are expressed in grams and estimated with the help of a meat content table provided to the students (available in the online Appendix).*

4.2 T-test

Following our pre-analysis plan, we start by comparing the mean score for the groups including a vegetarian to the mean score of the all-meat-eater groups. On average, groups including a vegetarian student (m = 4.818) scored higher than groups with all meat-eaters (m = 4.375), but insignificantly so [$t(13.15) = -0.486$, $p = 0.635$, 95% C.I. = (-2.411, 1.524)].

The estimated Cohen's d (0.347) is much smaller than the minimum detectable effect in our sample.[7] In other words, our analysis is underpowered in this sample. Post-hoc power analysis

[6]This was based on recall of meals day by day, and helped by a table exemplifying the weight in grams of various common meat dishes, such as hamburger, meatballs and so on. The table is reported in the online Appendix.

[7]The minimum detectable effect in this sample is 0.8, see Berlin and Mandl (2018) for the details of the power analysis.

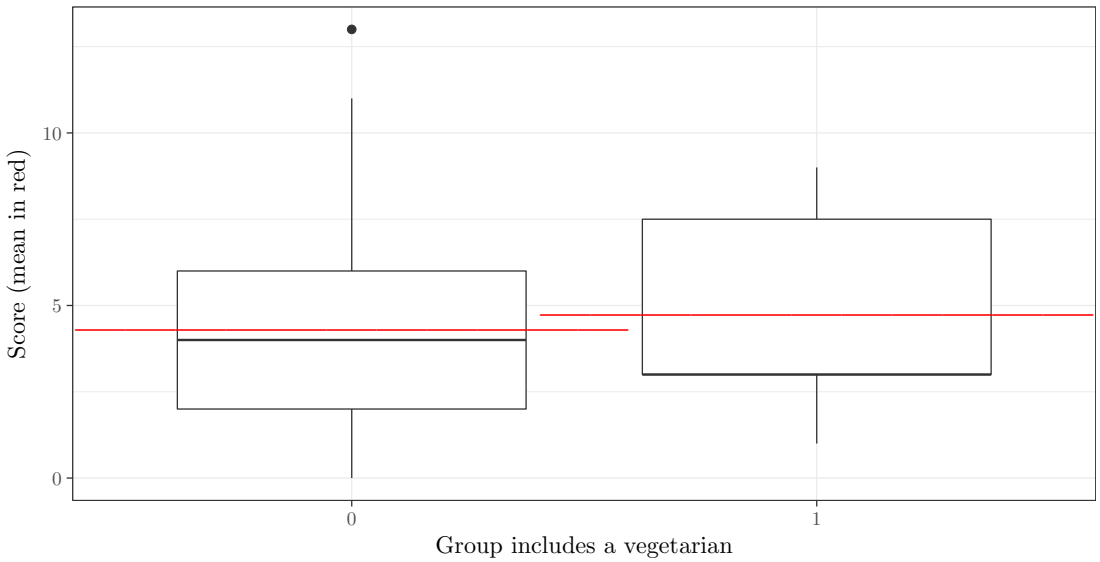

Figure 1: Box plot of group score by treatment status

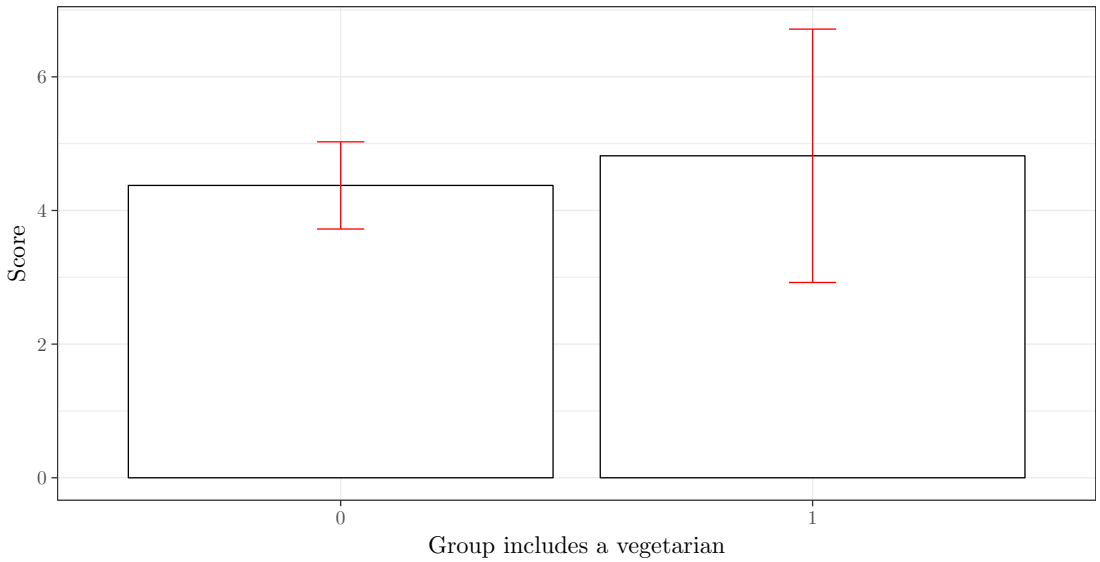

Figure 2: Bar plot of group score by treatment status

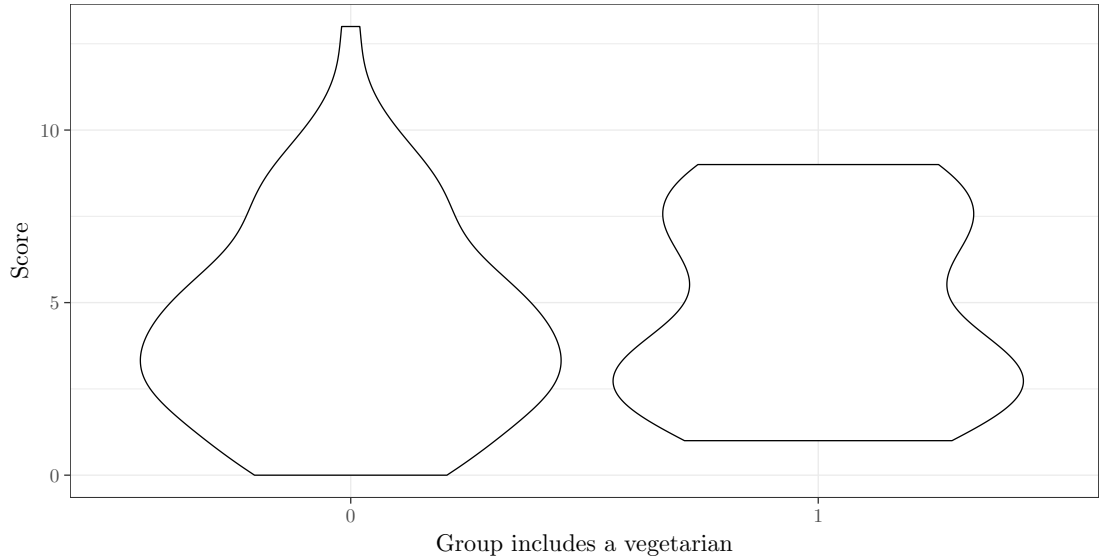

Figure 3: Violin plot of group score by treatment status

(with type S and type M error, following Gelman and Carlin, 2014) that we proposed to perform in the pre-analysis plan do not make sense given that we do not find a coefficient significantly different from zero.

Figures 1 to 3 lend us some more insights into the variation in the sample. From the graphical analysis it is clear that the *treated* group displays larger variation in score outcomes, possibly due to the smaller than anticipated sample size. The distribution of achieved scores among the vegetarian groups is bimodal, with a lower mode close to the mode of the *control* distribution, and an additional mode corresponding to higher scores. This might suggest that the *type* is not the only factor affecting (attention and) performance. In other words, not all of the individuals with the relevant type display increased retention of information, and a substantial fraction remains closer to the norm for the other type.

4.3 Regression with controls

In line with our pre-analysis plan, we run a regression in order to control for potential omitted variables, and net out some of the variation in the score data that is not related to our variable of interest. The essay is produced by a group and hence it reflects potentially the output of mediation between different individuals' understanding of the question and knowledge of the topic, and also the result of some sort of negotiation about the content. To the extent that the keywords on the registered list accurately reflect the content of the lectures and reading material, we therefore expect that higher ability students should influence the group process towards the inclusion of more such words in the essay. However, if the relevance of the words is contentious, we might expect a higher disagreement in larger groups and a higher degree of consensus in smaller groups. By the same logic, the impact of having a vegetarian in the groups can be expected to be bigger if the words are not "obvious".

The only significant factor affecting scores in Table 4 is the distribution of grades. Higher

	(1)	(2)
Intercept	4.38 (0.33)***	−0.84 (1.34)
Vegetarian	0.44 (0.94)	0.34 (0.87)
Grade median		0.94 (0.21)***
Grade spread		−0.00 (0.00)**
Big		−1.13 (1.02)
Small		1.21 (2.74)
R^2	0.00	0.19
Adj. R^2	−0.01	0.14
Num. obs.	91	91
RMSE	2.92	2.69

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Table 4: Regression analysis

median and lower spread are expected to capture students' ability. Better students, or rather better groups since all the assignments are a group-level exercise, consistently produce essays with a higher score, in other words remember more of the lectures and readings content.

	Exam q	Exam grade
Intercept	0.63 (0.04)***	38.39 (0.84)***
Vegetarian	0.00 (0.11)	2.06 (2.45)
R^2	0.00	0.01
Adj. R^2	−0.01	−0.00
Num. obs.	76	76
RMSE	0.31	6.90

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Table 5: Regression analysis - additional outcomes

Robustness checks were performed with different specification, using the share rather than number of keywords present in the essay, the LIWC, and also an expanded keyword list including the more common words associated with the keywords in the essays. Finally, the performance of the students on three exam questions that also elated to the same topics was used as an alternative dependent variable. Nt surprisingly, since the underlying issue is related to sample size and variation, the conclusion remains the same in all of these cases: mean performance is higher for the vegetarian "type" but not singificantly so.

5 Conclusions

In this paper we try to contribute to the understanding of the persistence and increase of meat eating in the face of mounting evidence on the ills of meat production and consumption by considering the role of selective attention and learning. We aim to test whether agent type plays a role in this process. If this hypothesis is true, simple information campaigns about the externalities of meat consumption might be ineffective as the information content may be lost on precisely the population of interest, omnivores. Policy strategies to reach this goal would then need to be refined. To investigate our question we use a novel approach, combining a natural experiment with recent techniques of text analysis, which has large potential for replicability. Our results are qualitatively in line with our hypothesis. However, the analysis is statistically underpowered. We explore nonetheless interesting patterns in the data, that can lead the way to future research in the same direction. Due to the unfortunate inconclusiveness of the experimental results, we see our contribution as mainly raising an important question, and at the same time proposing an useful methodology to address it.

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Appendices

A Essay question

Swedish original

Föreställ er att ni ska planera en julmiddag. Ni i gruppen kommer att bjuda en annan slumpmässigt vald grupp, ni vet inte vilka de är. Prata ihop er och bestäm en meny. Ni som har gjort övningen i fredags, individuellt eller i en annan grupp, kan självklart bygga på det ni gjorde då eller ändra hur ni vill. Ta hänsyn till allt ni anser är relevant: tradition, nya trender, smak, era olika preferenser, möjliga preferenser/känslighet bland era gäster, kulturella aspekter, nyttighet, hållbarhet, budget, mer? Skriv ner era huvudargument, avvägningar som dra åt olika håll, samt eventuellt (om utrymmet räcker) det ni kommer ihåg av diskussionen som ledde till den första meny ni skapade i fredags med motiverade eventuella förändringar. Dra explicita kopplingar till relevanta föreläsningar och läsmaterial. 1000 ord + meny. Tänk på att det är diskussionen som blir betygsatt, inte själva menyn.

English translation

Imagine you are planning a Christmast dinner. Your group is inviting another randomly chsen group in the class, you don't know whom. Discuss among you and decide a menu. If you have done the exercise last Friday you can continue based on that or modify it if you want. Consider all the aspect you think are relevant: traditions, new trends, taste, your preferences, possible preferences or restrictions for your guests, cultural aspects, wholesomeness, sustainability, budget, others? Write down your main arguments, trade-offs you face, and (if you have space) the orgiignal motivation you had when you did the exercise on Friday, motivating eventual changes. Make explicit links to the lectures and reading material. 1000 words plus the menu. The discussion will be evaluated, not the food you choose to have on the menu!

B Conversion table

Figure 4 was shown in class while the students were asked to fill a survey estimating their meat consumption during the past week. Based on a description of the meals they consumed at different times during each day of the week, and with the help of the information contained in the table, they were asked to compute the approximate amount of meat in grams they had consumed. The items in the table are, in order of appearence: one McDonald's hamburger, one slice of cold cuts, one meatball, one hot dog, one slice of meatloaf/entrecote/beef/pork loin around 1,5 cm thick, one chicken breast or leg.

HUR MYCKET KÖTT ÄTER VI?

Exempel	Vikt
Hamburgare (McDonald's)	110
Påläggskiva	10-15
Köttbullar (st)	10-15
Varmkorv	50-60
1,5 cm skiva biff/entrecote/oxfile/fläskkotlett	125
Kycklingfilé eller klubba	150-180

Figure 4: Approximate meat content in common meat-based dishes (gr)

C Word lists

Table 6 reports the lists of keywords, in Swedish and English, that were registered in the pre-analisys plan (Berlin and Mandl, 2018), and used for the text analisys. The number of keywords from the relevant list found in each essay is the basis for the variable *score*.

Table 6: Lists of pre-registered words

Swedish	English
klimatpåverkan	climate change
växthusgasutsläpp	GHG emissions
metangas	methane
övergödning	euthrophication
näringsämne	nitrogen and phosphorus
markanvändning	land use
avskogning	deforestation
vattenanvändning	water use
koldioxidintensiv	carbon-intensive
industriell djurhållning	factory farm
monokultur	monoculture
trålning	trawling
palmolja	palm oil
torsk	cod
strömming	sprat
laxodling	salmon farming
antimikrobiell resistens	AMR
zoonoser	zoonosis
speciesism	speciesism
domesticering	domestication
hjärt- och kärlsjukdomar	circulatory diseases
diabetes	diabetes
cancer	cancer
biologisk mångfald	biodiversity
ekosystemtjänster	ecosystem services
pollinering	pollination