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TESTING EFFECTIVE LABELS: A CLIMATE SCALE LABEL HELPS CONSUMERS IDENTIFY GREENER GROCERY ALTERNATIVES – BUT FAILS TO CHANGE AGGREGATE BEHAVIOUR

Food takes up a quarter of Western consumers' climate footprints, which means that changing what we eat is pivotal for the green transition. To guide consumers towards greener groceries the Danish Ministry of Food, Agriculture and Fisheries plans to introduce a national climate label for food products.

The Danish Competition and Consumer Authority has run a series of randomized experiments to test two label options: a best-in-class and a scale.

The results demonstrate that consumers prefer the scale label. This label also significantly improves consumers' ability to identify climate-friendly alternatives.

However, while neither label led to changes in aggregate behavior, the scale label did cause some consumers to change their behaviour. The majority of consumers reacted in the intended way by decreasing their CO2 emissions. However, a minority of consumers, who expressed no interest in a climate label, significantly increased their CO2 emissions, balancing out the effect at the aggregate level.

The two most likely reasons for the lack of aggregate effect are missing information and consumer reactance.

Read the article ↓

Summary
The Danish Competition and Consumer Authority (DCCA) has collaborated with the national working group[1] and the Danish Veterinary and Food Administration to test two different climate labelling schemes for food products in a large online experiment: A best-in-class label (BIC) and a scale label.

Neither of the tested labels significantly reduced the climate impact or composition of consumers' aggregate shopping in a simulated shopping experiment. However, the scale label did help the motivated consumers to reduce their climate impact by 10 pct., but at the same time caused a strong backlash among unmotivated consumers, resulting in an aggregate null effect. The scale label successfully improved consumers' ability to differentiate between more and less emitting products, across all participants.

Although the results of the shopping task are somewhat ambiguous with regards to scale label, survey responses reveal that 69 pct. of consumers support a climate label and nine in ten consumers expect they will make use of it in the future. As such, the lack of effect is not caused by a lack in consumer support. Rather, the lack of effect on consumer choice in the experiment could be explained by a mismatch between the label design and consumers' existing beliefs. Additionally, when results are zoomed in on the group of consumers who expect they would use a label to guide their behaviour, the scale-label caused a 10-pct. reduction of CO_2 in their shopping carts[2].

Consumers know that change is inevitable but need more transparency

Food consumption accounts for a significant share of the global climate footprint, and Danes in particular have one of the largest per person climate footprints from food consumption in the world. An average Dane consumes more than twice as much food of animal origin compared to a world citizen on average and more than the average European consumer as well[3]. If Danes choose to change dietary habits towards a more climate friendly and more plant-base diet then annual emissions from food could be reduced by up to 35 pct. for each consumer, and up to 50 pct. with a vegan diet[4].

One way to reach this goal, without adjusting prices or using monetary incentives, is to make the climate impact of different products more transparent.

In 2022 the Danish Government announced the ambition to introduce a national, state-controlled climate label for food products to guide consumers. A national working group was appointed to give recommendations for such a label by 2023. Denmark is not alone in this ambition. In 2018 Italy introduced the national voluntary label 'Made green in Italy' and France is expected to introduce a national state-controlled climate and environmental label on a voluntary basis in the beginning of 2024, and a potentially mandatory one in 2025. Both the Netherlands and Italy are also looking into introducing national labels[5]. Additionally, the EU Commission is working on a harmonized framework for calculating the environmental footprint of a product's life cycle[6].

A majority of Danish consumers believe that changing dietary habits is an important and necessary step to meet the climate challenge. Six in ten consumers report that they would like to eat a more climate friendly diet[7]. However, recent surveys show that 73 pct. of Danish consumers remains sceptical about reducing their meat consumption[8].

The reluctance to make dietary changes could be explained by the fact that more than one third responded that they simply love meat[9].

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1 To support the development of a state-controlled climate label on food the Danish Government appointed a working group consisting of representatives from the retail industry, the food industry and consumer organizations. A complete list of the group members can be found on page 8 in Udvikling af et klimamærke til fødevarer Anbefalinger fra arbejdsgruppen, the Danish Veterinary and Food Administration (2023).

2 This effect is washed out in the main results because a minor group of respondents in the experiment seemingly select the most CO_2 emitting products when exposed to the label, probably as a reactance to the climate agenda.

3 Klimavenlig mad og forbrugeradfærd, 2023, Klimarådet; IPCC (2022). Climate Change and Land. An IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystem.

4 Lassen, D. A. , Christensen, M. L., Fagt, S. and Trolle, E.Råd om bæredygtig sund kost - faglig grundlag for et supplement til De officielle Kostråd. DTU Fødevareinstituttet (2020) (Rapport-Raad-om-baeredygtig-kost.pdf) Klimamærkningsordninger på fødevarer, 2021, Klimarådet https://klimaraadet.dk/da/virkemiddel/klimamaerkningsordninger-paa-foedevarer.

5 Udvikling af et klimamærke til fødevarer Anbefalinger fra arbejdsgruppen, the Danish Veterinary and Food Administration (2023); Regulation for "Made Green in Italy" implementation scheme and adhesion | Ministero dell'Ambiente e della Sicurezza Energetica (mase.gov.it) (2018); EMPOWERING CONSUMER CHOICE AND ECODESIGN BEST PRACTICES FOR FMCG WITH ENVIRONMENTAL LABELLING OF FOOD – FAQ on the French Case.(2022). Institut du Commerce; J.A. Boone, R. Broekema, M.A. van Haaster-de Winter, I. Verweij-Novikova, H. Adema. LCA-based labelling systems: Game changer towards more sustainable food production and consumption across Europe. Wageningen Economic Research (2023) (587264 (wur.nl)).

6 Product Environmental Footprint Methods, 2021, The European Commission: https://green-business.ec.europa.eu/environmental-footprint-methods_en

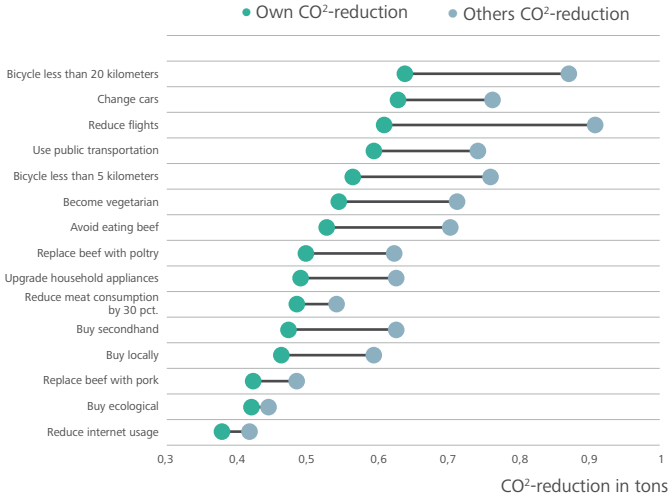
7 Madkulturen (2022a). Danskernes holdning til klimavenlige madvaner.

8 Grønt survey (2020); Grønt survey (2022). DCCA. *Question: "To what extent would you be willing to replace all meat consumption with vegetarian alternatives by next month?" Response: 19 pct. replied "To a lesser degree" and 54 pct. replied "to a very small extent". To the question. "To what extent would you be willing to replace 30 pct. of your meat consumption with vegetarian alternatives", 45 pct. replied "to a very small degree"*.

9 Grønt survey (2020); Grønt survey (2022). DCCA

Furthermore, a forthcoming analysis by the DCCA[10] demonstrates that consumers consistently underestimate how much the climate will benefit from reducing meat consumption. Another study reveals that three out of four consumers find it difficult to evaluate the climate footprint of different foods, and in a food sorting task (of eight products) only two out of 1.100 consumers got the order correct[11]. Finally, the forthcoming DCCA analysis also shows that consumers consistently underestimate the potential climate impact from changes to their personal behaviour relative to that of their peers (cf. figure 1). This result is in line with previous research that demonstrates a noticeable "better-than-average" effect when it comes to consumers' perceptions about their own vs. others pro-environmental behaviour[12].

Figure 1: **Danish consumers' perception of their own vs. others' CO_2-reduction potential (2022)**

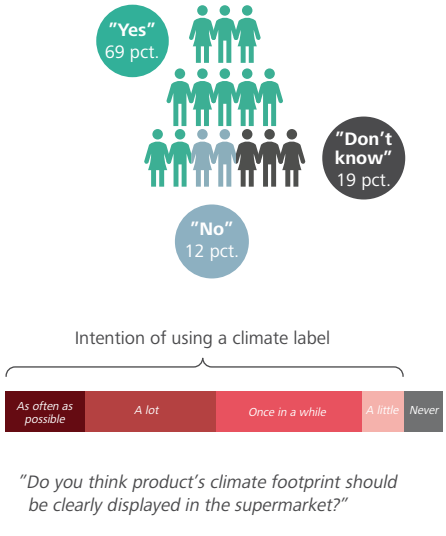


Source: Grønnere forbrugeradfærd: Forbrugernes syn på potentialer og barrierer. The Danish Consumer and Competition Authority. Forthcoming.

More transparency could be an important step towards correcting consumer misperceptions about their climate impact and product labels is one potential way to achieve this. There are several examples of previously successful environmental label schemes, such as the Danish Eco Label (the Ø-label) for food products and the EU Energy Label for electronic devices[13].

The current study demonstrates that 69 pct. of Danish consumers support the introduction of information on products' climate impact at the point of purchase, cf. figure 2. Additionally, a majority of consumers (91 pct.) say that they intend to use this information actively when shopping for groceries.

Figure 2: **Consumer motivation**



Note: Intent to use the climate label is measured with the question: "If food is labelled with a climate label in the future, how often do you think you will be guided by it when shopping?" (Data collected in 2023 on an approximately nationally representative sample of adult Danish consumers. N= 1357)
Source: The behavioural study of climate labels by the Danish Competition and Consumer of Authority.

In line with the recommendation from the Danish Climate Council, the Danish ministry of Food, Agriculture and Fisheries plans to introduce a national climate label for food products. In 2023, a national working group gave its recommendations for a future climate labelling scheme in Denmark to support the further work in the realm of Danish Veterinary and Food Administration[14]. The DCCA assisted this process with the current study.

What makes labels effective?

Labels help consumers navigate markets by giving them relevant information on key product attributes at the point of purchase. The information provided by labels typically reduces information asymmetry between consumers and suppliers/producers, e.g. on a product's CO_2-emissions, on product attributes that are difficult or impossible to test and compare directly.

10 Grønforbrugeradfærd: Forbrugernes syn på potentialer og barrierer. The Danish Consumer and Competition Authority. Forthcoming.

11 Fødevarers Klimabelastning er vanskelig at gennemskue for forbrugerne, 2021, Forbrugerrådet TÆNK. Fødevarers klimabelastning er vanskelig at gennemskue (taenk.dk)

12 Bergquist, Magnus. "Most people think they are more pro-environmental than others: A demonstration of the better-than-average effect in perceived pro-environmental behavioral engagement." Basic and Applied Social Psychology 42.1 (2020): 50-61.

13 Klimavenlig mad og forbrugeradfærd. Klimarådet (2023)

14 Udvikling af et klimamærke til fødevarer Anbefalinger fra arbejdsgruppen, the Danish Veterinary and Food Administration (2023).

The DCCA has previously outlined criteria for effective labels[15]. Three of these are particularly important for a food product climate label:

I. **The label should be easy for the consumers to understand**
Labels are simplified representations of more complex information. If a label is hard to understand it will need support from extensive (and expensive) communication campaigns to have an effect.

II. **The label should be prominent and suggestive**
Labels should make it easy for consumers to identify relevant alternatives. This means that labels must be prominent and accessible at the point of purchase. It also means that they should provide clear, suggestive information. A label could be easy to understand but hard to notice (e.g. if its small, done in obscure colours or hidden at the back of a product). It might also be easy to notice and understand but hard to act on, e.g. when there are no clear alternatives to the labelled product.

III. **The label should present relevant information**
Finally, labels should supply information that consumers demand. This means that labels must build on public perceptions of the thing the label is trying to inform about.

The online experiment
The DCCA tested two different labelling schemes using an online experiment (cf. box 1) – a best-in-class scheme and a cross-category scale.

Box 1: **Online experiment**

Online experiments are conducted over the internet, often through websites, survey-tools or apps. Participants engage with the experiment remotely, and data is collected electronically.

Methodological strengths
Accessibility: reach a more diverse, national representative participant pool.
Cost-Efficiency: lower expenses without physical facilities.
Convenience: participants can join at their own convenience.

Methodological weaknesses
Limited Control: less control over participant environment.
Selection Bias: participants may not represent the entire population.
Limited experimental set-up: complex experimental manipulations may be challenging to implement online.

The best-in-class scheme includes one best-in-class label (BIC) represented by a blue cloud, cf. figure 3A. The BIC label was attached to products with CO2e emissions per kilo below a certain threshold within a given product category[16].

The cross-category scale scheme uses a scale with several levels to inform about a product's CO2 emission relative to all other types of food and drink products. In this scheme all products can be labelled and their climate impact compared across categories. The scale label was designed as a colour scale with five categories, ranging from green to red and supplemented with letters from A to E, cf. figure 3B.

Figure 3: **the tested labels**

A: the best-in-class label

B: The scale label

Source: Udvikling af et klimamærke til fødevarer Anbefalinger fra arbejdsgruppen, the Danish Veterinary and Food Administration (2023)

The experiment had four parts:
1) a shopping task
2) a product-impact perception task
3) a CO2 estimation task
4) label evaluation and attitudes

In **the shopping task** consumers were asked to imagine that they had to shop for breakfast, lunch and dinner in an online supermarket, which the DCCA constructed for the purpose of the experiment. The online supermarket offered more than 500 products and resembled a small grocery-store or convenience kiosk[17]. It had a landing page with a random selection of products from the entire webshop and ten product-categories (cf. figure 4). Finally, there was a cart page with a check-out option that took participants to the second part of the experiment.

15 Konkurrence- og Forbrugerstyrelsen (2021), *Adfærdspsykologisk litteraturstudie: Fem gode råd om effektive mærkningsordninger til forbrugerne*, Velfungerende Markeder (52)

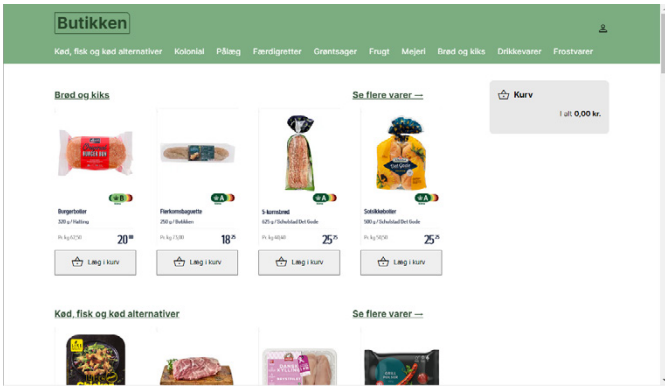
16 For technical details about the categories and the thresholds see the official report by the Danish Veterinary and Food Administration: Udviling af et klimamærke til fødevarer Anbefalinger fra arbejdsgruppen, the Danish Veterinary and Food Administration (2023)

17 The categorization of products as well as product details such as price, images and weight details were based on details from the webshop https://hjem.føtex.dk and collected using a scraper.

The shopping task was hypothetical, which means that participants did not pay for or receive the products. A number of steps were taken to ensure a high degree of external validity (which is how well results from the experiment can be expected to extrapolate to real purchasing behaviour).

1) Participants were not informed about the purpose of the experiment prior to the shopping task. This reduces the risk that participants respond artificially to conform to the researcher's hypothesis.
2) The shopping task was designed to closely mimic a real online supermarket and both product images and prices corresponded to real products.
3) Participants were asked to shop for three meals as they often would.
4) Participants were initially given a list of all available labels with short explanations, which contained six common retail labels. Climate labels were included in the list for the intervention groups.

Figure 4: **Example of the landing page of the online super-market with the scale applied**



Source: The behavioural study of climate labels by the Danish Competition and Consumer of Authority.

In **the product-impact perception task** participants were asked to indicate which of five random products had the smallest climate impact pr. kilo. Participants saw both within category choice-sets, where all products belonged to the same category, e.g. meat and meat alternatives, dairy products or lunch toppings, as well as between category choice-sets with a mix of products from the different categories (cf. figure 5A and 5B).

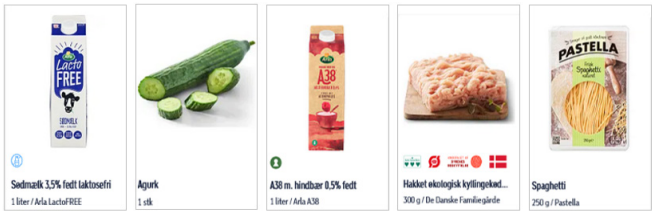
Figure 5: **example of choice-sets in the product-impact perception task**

A. Choice-set with within category products

Which product do you think is the least harmful in terms of **climate impact per kilo**

B. Choice-set with between category products

Which product do you think is the least harmful in terms of **climate impact per kilo**



Source: The behavioural study of climate labels by the Danish Competition and Consumer of Authority.

The estimation task measured consumers' beliefs about the CO_2 emission of 15 different products. Participants were given the CO_2e level of a litre of milk as a reference.

Lastly in **the label evaluation and attitudes task** participants evaluated the labels and expressed their attitudes towards labelling schemes more generally.

1,357 consumers, recruited through the Norstat panel in Denmark, participated in the experiment. Consumers in charge of grocery shopping were prioritized, and the sample approximated a national representative sample, with slightly lower participation from elderly consumers. Descriptive statistics for the full sample can be found in the appendix.

Participants were randomly divided into four groups who saw different versions in the shopping and product impact perception tasks:

1. **A scale group**, who saw the scale label applied to all products (n=371)
2. **A best in class group**, who saw the best-in-class label applied to all products (n=340)
3. **A control group**, who saw no labels on any products (n=284)
4. **A biased-label group**, who saw the scale label applied to half the products in the assortment with varying bias of products represented on the scale. (n=362)

Once assigned to a group, participants stayed there throughout the first and second tasks. The third and fourth task were identical for all groups.

The biased label group was designed to examine how the label is affected by producers of more CO2 intensive products opting out of the scheme. In the group, participants were randomly allocated to four scenarios where the ratio of green to red products was increasingly biased towards the low end of the scale, cf. table 1.

Table 1: **the percentage of labelled products in the four versions of the voluntary-scale group**

	No bias	Slight bias	Medium bias	Strong bias
A	50	67	83	100
B	50	58	67	75
C	50	50	50	50
D	50	42	33	25
E	50	33	17	0

Results

Results I: Consumers are able to decode the two tested labels, but struggle to understand reference classes

More than 93 pct. of the participants understood the labels' main message. They reported that the climate cloud (best-in-class) referred to products with the lowest climate impact, and that an A label on the scale referred to products with low impact and an E label to products with a high impact. However, participants struggled to understand the labels' reference class, and specifically whether comparisons referred to certain categories or all products.

40 pct. of the participants interpreted the best-in-class label correctly as referring to better climate options among certain product categories, but 30 pct. wrongly interpreted it as referring to better climate options among all products. 30 pct. did not know.

46 pct. correctly interpreted the scale as a cross-category label. 34 pct. wrongly interpreted it as a label only comparing the impact of products within specific product categories. 20 pct. did not know. Participants, who have been exposed to either label in the shopping task performed slightly better on this task. This could indicate that reference classes issues would resolve as consumers gain more practical experience with the labels.

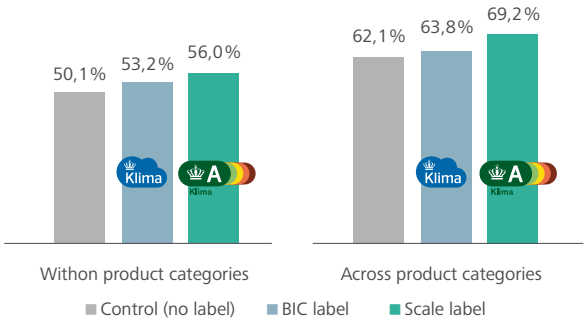
Additionally, 83 pct. of all consumers in the experiment prefer the scale label scheme to the best-in-class scheme.

Result II: The scale label makes it easier for consumers to identify climate-friendly options

Overall, consumers who saw products labelled with the scale were significantly better at identifying the more climate-friendly alternative relative to both the control and the best-in-class group.

For within category choice-sets[18] the scale increased correct answers by 12 pct.[19] and 11 pct. when choice-sets contained a mix of products from different categories,[20] cf. figure 6. There was no statistical difference between the best-in-class and the control group,[21] cf. figure 6.

Figure 6: **share of consumers, who correctly identify the product with the least harmful climate impact**



Note: Choice-sets with products from typical supermarket categories and products from a mix of categories (control: n= 284, BIC: n= 340, Scale: n=371).

These average effects are primarily found when the scale is applied to lunch toppings, where 62 pct. correctly identified the most climate-friendly alternative compared to 50 pct. in the control group.[22] The scale label also marginally improved the rate of correct answers in the dairy category, cf. figure 7.[23] There was no statistical difference between the control and the best-in-class groups[24] within any of the product categories, and no significant differences for the categories 'fruit and vegetables', 'meat' or 'ready meals' between any of the label-groups and the control.

18 Five categories were included in the test. Fruit and vegetables, lunch toppings, ready meals, meat and meat alternatives, and dairy products.

19 A statistically significant increase from 50 pct. to 56 pct. (Chi2= 10.9, df = 1, p-value < 0.001).

20 A statistically significant increase from 62 pct. to 69 pct. (Chi2= 10.52, df = 1, p-value < 0.001).

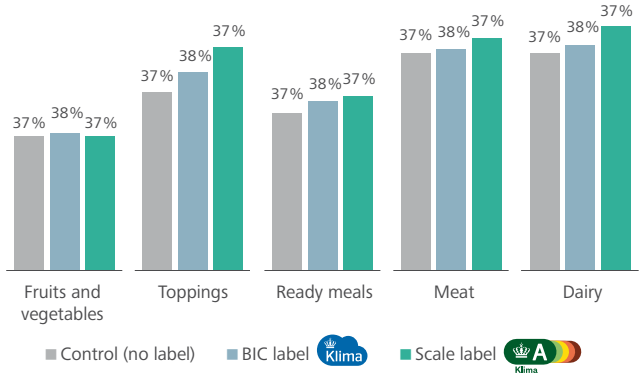
21 For choice sets within categories: Chi2= 2.84, df = 1, p-value < 0.092. Choice sets across categories_ Chi2= 0.53, df = 1, p-value = 0.468.

22 Chi2= 9.48, df= 1, p-value = 0.002.

23 Dairy products: Chi2= 2.85, df= 1, p-value = 0.09.

24 Toppings: Chi2= 2.17, df= 1, p-value = 0.14. Dairy: Chi2= 0.07, df= 1, p-value = 0.787.

Figure 7: **Category specific correctness among the test groups**



Note: Choice-sets containing random products from the tested product categories. The graph shows the share of correct choices made in the three groups. (Control: n= 284, BIC: n= 340, Scale: n=371).

The lack of significant results from the best-in-class label could be due to the definition of the underlying categories. A typical supermarket category (e.g. the dairy section) features both plant- and animal-based products. However, the best-in-class label treats plant-based and animal-based products as different categories or "classes". In practice, this means that both plant-based and animal-based alternatives in the choice-set could have best-in-class labels, since all categories in the choice-sets could contain vegetarian or plant-based alternatives. This makes it harder for consumers to use the label as a guide to the most climate-friendly choice.

When products are labelled on a global scale the reference class problem is strongly reduced, since the A-threshold on the scale is the same for all products,[25] cf. figure 3 for a specification of the thresholds. The scale is thus more suggestive by design, at least when it comes to identifying the lowest emitting product in a set.

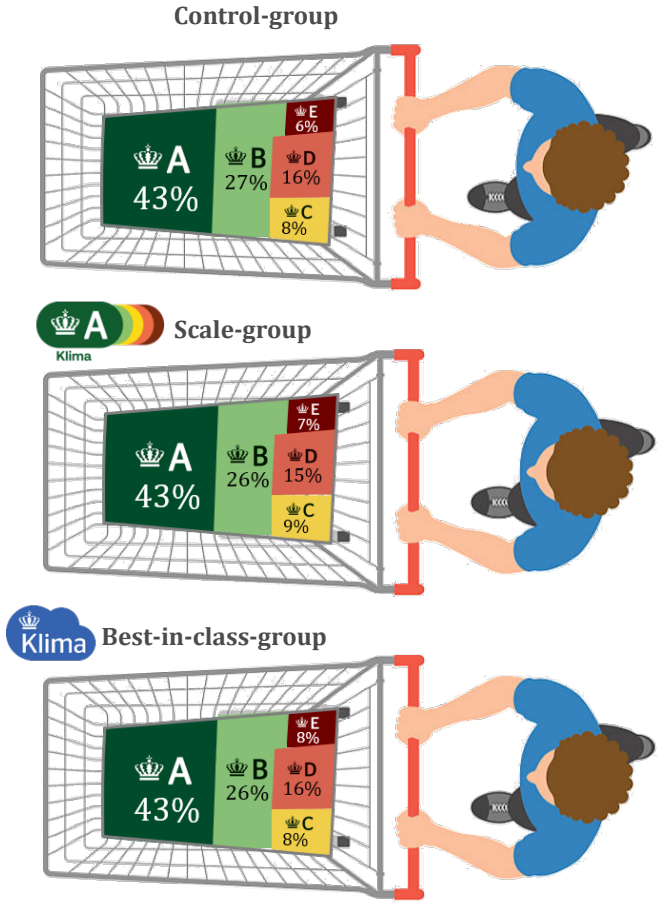
Result III: On aggregate, neither of the two labels led to more climate-friendly selections overall in the shopping task

There was no overall effect on the amount of CO_2e for either label in the simulated shopping task or the composition of high and low emission products purchased.

Participants in the control group picked groceries totalling 17.9 kilo CO_2e on average, whereas those in the scale group purchased 17.3 kilo CO_2e and the best-in-class group purchased 18.0 kilo CO_2e.[26] Both label groups had a slightly higher CO_2e level per product relative to the control group since participants in these groups purchased one less product on average.[27]

Furthermore, the composition of products in the different levels of the scale (A-E as well as the share of best-in-class products) did not differ between the groups (c.f. figure 8). There were also no more BIC labelled products in the carts of the best-in-class group (65 pct.) compared to the control group (66 pct.).

Figure 8: **The composition of products in the scale categories**



Source: The behavioural study of climate labels by the Danish Competition and Consumer of Authority.

Result IV: Consumers, who expect to actively use the label have less CO_2 in their shopping carts when the scale is used

While neither label led to greener purchases on average, the scale-label did have an effect on the 91 pct. of the participants who expressed an intent to use the label, cf. figure 2.

25 Choice-sets where two products had an A-label the effect of the label disappeared, and participants were no better than the control group.

26 10 pct. trimmed mean off the top and bottom of the group.

27 The control group had 14 products on average in their carts with an average of 1.19 CO_2e level per product. The best-in-class group and the scale group both had 13 products on average in their carts with an average CO_2e level of 1.31 and 1.22 CO_2e per product respectively.

If participants with no intent of using the label are excluded from all three groups, the scale label significantly reduced the average CO2 purchased by 10.9 pct. from 18.3 kilo in the control group to 16.3 kilo in the scale group. The best-in-class group purchased 17.9 kilo CO2 on average, which is not statistically lower than that of the control group.[28]

These results emerge because the presence of the label had a strong (negative) effect on the fraction of participant with no intent of using the label (9.pct.).

In the shopping task this group purchased far more CO2 intensive products on average when exposed to either label compared to the control (control group: 12 kilo, best-in-class group: 20.9 kilo, scale group: 26.5 kilo).

Although this may seem counterintuitive at first glance it is likely caused by a form of reactance[29], where participants who expressed no intent of using the label strategically expressed an underlying aversion to the climate agenda through their choices in the shopping task.

Note, however, that the participants' reactance also dramatically increased the total price this group paid for their groceries (total costs for the group with no intent to use the climate label was 216 DKK for the control group; 313 DKK for the best-in-class group; and 325 DKK for the scale group). There were no similar differences in price paid among the 91 pct. of participants who indicated that they intended to use the label.

The result might suggest, that label-positive participants actively used the label to guide their purchases in accordance with their preferences. However, as the questions about participants intent to use a label took place at the end of the experiment, the exposure to the labels in the shopping and comparison tasks could have influenced participants' answer this question. Therefore, and because it is not possible to assess to what degree consumer reactance would influence real purchases, these results should be interpreted with caution.

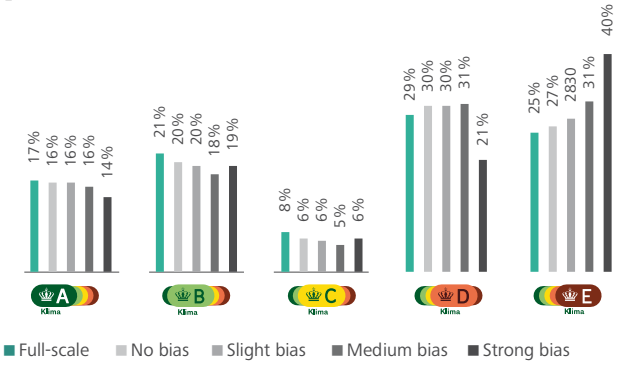
Result V: A biased labelling scheme leads to higher CO2 purchases

When half of the products in the shopping task were labelled consumers bought slightly more CO2 (18.5 kilo CO2e on average across the biased-label group)[30]. When the label is biased towards more low emission products and fewer high emission products consumers shopped for more CO2e per product (1.33 kilo CO2e per product for both medium and strong bias and 1.28 kilo CO2e for both the no bias and slight bias group. The average CO2e per product in the full-scale group was 1.22 kilo).

When fewer products in the E-category were labelled (i.e. a more biased scale) the products chosen from this category had a higher CO2e and thus a larger share of the cart's CO2 came from products in this category, cf. figure 9. However, the composition of products in the cart was the same regardless of bias and similar to the control group. Although the share of products from this category was similar across groups, the group who saw the biased label scheme chose E products with a significantly higher CO2e impact.[31]

This suggests that consumers might be less attentive to the relative impact of the products in the highest category, such as beef and butter, resulting in more people choosing heavier products.

Figure 9: **The share of CO2e from chosen products across the scale as the bias of less high emission products increase**



Note: (Full-scale: n=371, No bias: n=88, Slight bias: n=110, Medium bias: n=88, Strong bias: n=76).

28 A marginally statistical decrease in the amount of CO2e in the carts relative to the control group, when controlling for the number of products purchased (General Linear Model, intercept=4.096, SE =1,53, t-value= 2.67, p-value=0.007; BIC = -0.970, SE= 2.12, t-value= -0.46, p-value=0.65; Scale = -4,24, SE=2.19, t-value = -1,93, p-value= 0.053)

29 In the psychology literature 'reactance' refers to the unintended consequence of an attempt to persuade or encourage a specific behavior with information or rules resulting in the adoption of an opposing position or deliberate non-compliance. (Brehm, J. W. (1966). *A Theory of Freedom and Control*. Academic Press) It is sometimes also referred to as the "boomerang-effect".

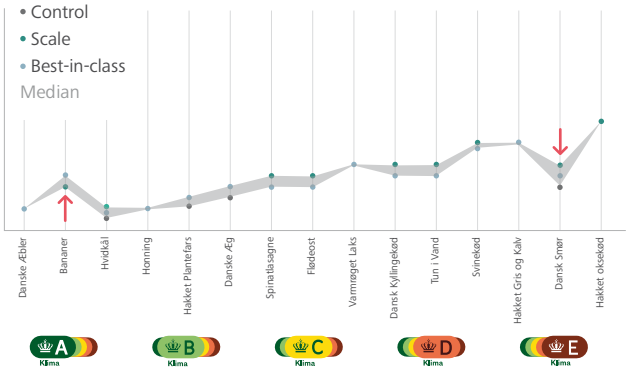
30 A marginally statistical increase relative to the full scale-group, when controlling for the number of products purchased (General Linear Model, estimate= 4,24, t-value = 1,78, p-value= 0.075). Note that the group sizes of the different biased-label groups are smaller than the control group and Scale group, since the biased-scale group contained four sub-groups with different bias-levels (No bias: n=88, Slight bias: n=110, Medium bias: n=88, Strong bias: n=76).

31 The Co2 emission from E products are significantly higher for the strong bias group compared to the other bias groups (Mann Whit-ney z = -2.53, p-value = 0.01) and CO2 from the D category is marginally significantly lower (Mann Whitney z = 1.83, p-value = 0.067).

Result VI: Consumers underestimate the climate impact of CO2-heavy products

The CO2-estimation task of the experiment investigated whether the labels improve consumers overall evaluation of CO2 emissions from common food options. Results show, that participants estimated equivalent CO2 levels across the control group and the two label-groups (cf. figure 10). As such, the perception of products' CO2 emissions does not change after being exposed to the labels. Moreover, the median CO2 estimates neatly follow the actual order of the 15 products' emissions, except bananas and butter, with bananas being overestimated and butter underestimated by all three groups. This suggests that participants in the experiment had a sufficiently precise preconception of high and low emitting products, so that neither of the labels improved this.

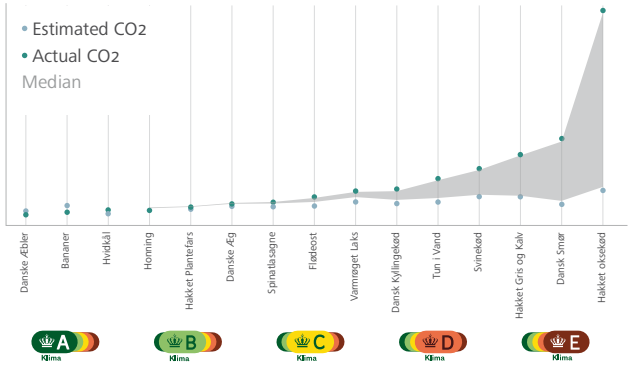
Figure 10: **Consumers perception of product-emission**



Note: CO2 estimates for 15 products asked in a random order by treatment group. The shading illustrates the distance between the groups' estimates.

However, while the participants did estimate the correct ordinal ranking of products in terms of their emissions, they significantly underestimated the actual emission levels, particularly for high emission products (cf. figure 11). Participant estimates are thus more or less linearly distributed, whereas the actual distribution of products' CO2e levels have a much steeper increase.

Figure 11: **CO2 estimates in the experiment compared to actual product emission**



Note: The median estimation relative to the actual CO2e levels of 15 products in the experiment. The shading illustrates the distance between the estimated emission level and the actual.

Discussion

The scale label succeeded on two of the three criteria for effective label schemes by being easy to understand and prominent as well as suggestive. The intention behind the scale label was easy for consumers to understand and decode and it also made it easier for them to identify the more climate-friendly alternative.

However, as demonstrated by the hypothetical shopping task, the scale did not influence consumers to choose more climate-friendly products overall. Keeping in mind that the experiment did not involve changes to prices, there are (at least) three potential explanations for the absence of an effect.

1) Consumers already purchase according to their climate preferences and have all the information necessary for selecting their preferred products.

2) Or, the scale label fails in communicating the necessary, complex information about climate impact from different products. Results from the CO2-estimation task reveal that the scale label quite possibly communicates information that consumers already have, namely, the rank of products in categorical terms. Consumers already seem to have a decent understanding of which products emit more than others, but a very poor understanding of just how much more. The failure of the label to influence behaviour could be due to the fact that neither of the tested labels provide consumers with information about emission differences in magnitude.

3) Finally, this study only builds on behaviour from a single shopping experience. As such, it cannot capture how consumers might change consumption patterns when

exposed to the label repeatedly, or when exposed to it in a physical store rather than in an online supermarket. Furthermore, the current study reveals the effect of the labels on shopping behaviour without any prior introduction or supporting communication. It is possible that the scale, over time and with more supportive communication, could have a larger impact.

When the results from the shopping task are isolated to the group of consumers, who at the end of the experiment express that they would actively use a climate label, the average amount of CO2e in the carts is significantly reduced for the scale group. The scale label thus seems to enable this particular group of consumers to adjust their behaviour according to their preferences. Efforts to encourage the use of the label when shopping could mean that it had a larger effect. In the experiment around 9 pct. indicated unwillingness to follow the guidance from a label and behaviour from this group eliminated the positive effect of the scale label, resulting in an aggregate null effect across all participants. In the experiment this reactance led to a 50-pct. increase in the meal expenditures. A behaviour which is difficult to transfer to real purchases. However, in reality it is unknown how large this group of climate sceptics is and what their reaction to a label might result in. This result should thus be treated with caution.

Finally, the experiments demonstrate that voluntary label schemes come with some risks. If producers of CO2-intensive products refrain from labelling their products it will bias the scheme, which in turn will reduce the label's effect.

Conclusion

Denmark is looking to introduce a national, voluntary climate label on food products to help guide consumers towards more climate friendly food choices. Consumers also seem to welcome the idea of a climate label. As such 91 pct. state that they expect to use a climate label to guide their future food choices (cf. figure 2) when such a label is introduced.

The current study tested two potential labels based on different labelling schemes. A best-in-class label applied to products with CO2e emissions below a certain threshold. And a scale label with five levels ranging all products from least emitting to most emitting.

Of the two labels tested the scale was both easy to understand and enabled consumers to identify the greener alternative across different choice sets, whereas the best-in-class label did not. However, neither of the labels induced more climate friendly shopping behaviour in a simulated shopping exercise. Overall, consumers, who saw either of the two tested climate labels shopped for the same amount of CO2 as the control group. They also had the same share of 'green' and 'non-green' products in their carts.

This outcome is possibly due to a failure of the tested labels to accurately represent magnitudes. The level of CO2 in food production differs massively and the production of e.g. beef emits up to 50 times more than that of vegetables. The labels' failure to capture and communicate the very large differences between the levels on the scale may be the primary reason for the lack of effect on purchases. Consumers might, over time and with supporting communication efforts, learn about the CO2 magnitudes between the levels on the scale and as such how to interpret the labels correctly.

For consumers who intend to make use of the label, the scale label led to a statistically significant reduction of 10 pct. in CO2e in the shopping task. Efforts to encourage the use the label could possibly increase its effect.

Appendix

descriptive statistics

1.357 (57 pct. female and 43 pct. male) consumers took part in the entire experiment and were included in the final analysis.

The following quality criterion was applied to increase internal validity of the shopping task (task one):

- Participants must have chosen at least six products upon check-out to successfully simulate shopping for three meals.

Participants were not informed of this criterion and as such it has not influenced the choices made in the shopping task.

902 participants were screen-out based on the abovementioned quality criteria.

1.194 (88 pct.) of participants indicated that they were the primary responsible for grocery-shopping in their households.

Below are the distribution by income, region, age and employment status in percentage.