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ARTICLE

Carbon calculators as a tool for a low-carbon everyday life?

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The number of Internet-based carbon calculators that estimate personal carbon footprints has been growing in recent years. This article discusses the roles that these calculators can play in changing everyday practices and how users evaluate them. The study builds on results from a questionnaire survey and focus groups with users of a Danish Internet-based carbon calculator developed in 2009, the year of the Climate Summit in Copenhagen, when climate change was prominent on the political agenda. The article concludes that the subject website primarily attracts people already interested in the issue, and that its main contribution is to confirm their engagement. Furthermore, we show, on one hand, that users seem to accept the individualized approach of the carbon calculator while, on the other hand, they question the allocation of responsibility for mitigating climate change. The article suggests designing Internet-based carbon calculators that actively engage users in collective actions instead of primarily presenting individualistic interventions. Finally, we show that users are different with respect to which of their everyday practices they feel able or inclined to change, with air travel being the practice that, by far, they are least willing to alter.

KEYWORDS: emission reduction, social behavior, social responsibility, Internet, computer applications, communication

Introduction

At least since the Brundtland Commission released its report on sustainable development in 1987, numerous public efforts have been directed toward educating and persuading people to change their everyday-life habits to make them more sustainable. These campaigns have typically been based on an assumption of causal relationships among beliefs, attitudes, and behavior and have employed what Hargreaves et al. (2008) have termed the "A-Bc model" (Attitude-Behavior connection) or Shove (2010) has called the "ABC paradigm" (Attitude, Behavior, and Choice). Adopting a rather individualistic approach, these campaigns typically focus on providing information through mass media and leaflets to inform people about the environmental consequences of their behaviors—for example in relation to transportation, housing, and food—and to encourage them to change behavior by informing them about more ecofriendly alternatives.

Following this line of thinking, many researchers have come to understand the absence of sustainable behavior as resulting from a value-action or attitude-behavior gap (e.g., Blake, 1999; Young et al. 2010) primarily caused by a knowledge deficit, which can be bridged by creating appropriate information campaigns. Policy makers widely believe that providing consumers with feedback about their energy consumption will induce energy reduction; however, research shows that this is only the case to a quite limited extent (Fischer, 2008; Darby, 2010).

During the last decade, numerous websites have been developed that include calculators to estimate personal ecological footprints or carbon use. Evaluations of these tools carried out to date have primarily focused on their accuracy, and several studies have shown large variations in the results generated by different calculators (Padget et al. 2008; Kenny & Gray, 2009; Kim & Neff, 2009). Evaluations of other communication initiatives also suggest that disseminating new knowledge does not necessarily lead to changes. People question the knowledge and compare it with their own experience, and new practices also need to fit in with established practices in everyday life (Hobson, 2001; Gram-Hanssen et al. 2007). Research also shows that direct communication, for instance with an energy professional, is much more effective than public campaigns in inducing actual changes in people's practices and thus reductions in their carbon-dioxide (CO_2) emissions (Hargreaves et al. 2008). Further, new behaviors are often more likely to transpire if they are introduced in social networks, for example within the context of low-carbon communities, that can serve as a context for individual behavioral change (Heiskanen et al. 2010).

In summary, studies indicate that simple one-way dissemination of information has a limited effect because changes in practices happen through an interaction with adjustments in collective structures rather than through individuals' isolated actions and because information in itself does not automatically lead to changed everyday practices. The problem is, however, that initiatives, including direct contact and

joint intervention in collective processes, are expensive and complex, which might explain the preference for mass communication.

In this article, we evaluate a Danish mass communication initiative (an Internet-based carbon calculator) intended to support sustainable behavior. The analysis is inspired by the practice-theoretical approach developed by Schatzki (1996). Practice theory is further developed in the next section; here we describe how this conceptual approach seeks to overcome the structure-actor dualism regarding whether human behavior is primarily determined by social structures or individual agency. Based on this approach, we do not expect any simple relationship between disseminating new knowledge and the change of individuals' daily habits. However, as developed in the following discussion, the practice-theoretical approach does acknowledge that information and new knowledge can play a role in constituting everyday-life practices. Thus, our main interest is not to document a simple relationship between using the carbon calculator and changes in practices. Rather, the purpose is to understand to what degree and how websites, such as the one evaluated here, might contribute to structuring the knowledge and meanings that govern the different habits that give rise to CO_2 emissions. On the basis of users' experience, we also suggest how this type of website could be improved to better facilitate changes to a low-carbon everyday life by viewing ordinary practices as collective rather than individual activities.

Understanding Change and Continuity in CO_2-Related Everyday Practices

Recent years have seen several efforts to use a practice-theoretical approach to understand everyday practices related to energy consumption. Social-practice theories stem from the work of Bourdieu (1976) and Giddens (1984) and were reintroduced in consumer studies some years ago (see, e.g., Shove & Pantzar, 2005; Warde, 2005) following the argument that hitherto there had been undue focus on conspicuous consumption, and the symbolic and communicative aspects of consumption, at the expense of understanding routinized and ordinary provisioning responsible for the majority of energy use (Gronow & Warde, 2001). The emphasis on bringing practice theories into consumer and environment studies mainly draws on the approach formulated by Schatzki (1996) and further elaborated by Reckwitz (2002). Practices are not viewed as individual acts, but rather as collective actions where the individual can be viewed as a carrier. This understanding of practitioners as carriers of practices can be aligned with the concept of "habitus" from Bourdieu (1998). Habitus describes the embodiment of practices and dispositions and thus explains why we tend unconsciously to repeat structures and collective practices based on what we have learned and been exposed to during our lifetime, from childhood to adulthood. More recent practice-theoretical approaches discuss the elements holding these collective practices together. For an understanding of energy-consuming everyday practices, Gram-Hanssen (2010a; 2010b) has developed an approach that has proven valuable in previous studies, and which includes the following four elements:

- *Know-how and embodied habits:* Includes all the unconscious routines that people might have learned during childhood or later and that they bring with them and perform every day without conscious thought.
- *Institutionalized knowledge and explicit rules:* Includes technical knowledge and cultural understandings of energy consumption and energy saving, thus also comprising the types of knowledge disseminated through information campaigns.
- *Engagements:* Refers to the ends people are seeking to achieve. In relation to everyday life and climate change, the problem is that most often energy-consuming practices are governed by engagements other than environmental considerations. People turn on the computer to work or communicate, but at the same time they generate CO_2 emissions.
- *Technologies:* Refers to washing machines, computers, cars, and many other energy-consuming technologies that have become an inseparable part of most daily practices such as laundering, communication, and transportation. Technologies thus play an important role in constituting the practices related to CO_2 emissions in everyday life.

It is the first element (know-how and embodied practices) that, together with technologies, forms the direct link between practices and energy consumption; it is through our bodily habits ("the way we do things") and our interaction with technology that flows of materials and energy are activated. Concerning an analysis of websites, focus should thus be on whether these tools are able to change consumers' engagements or the knowledge and rules related to everyday practices in ways that influence know-how and embodied habits or the type of technologies that we choose to buy.

Another way to frame the same question is proposed by Wilk (2009) who developed an analytical approach based on practice theory in which uncon-

scious habits and routines can be made "visible" and subject to reflection and discussion through the process of "cultivation." There are many ways to foster cultivation. Other people can make us aware of habits that we do not think about ourselves; we can experience conflicts between different routines that make it necessary to make a conscious choice or adjustment; or—as in this study—media, websites, and advertising can present information that calls common routines into question.

While cultivation denotes the process of bringing habits and routines forward into consciousness and reflection, Wilk uses the concept of "naturalization" to describe "the processes which push conscious practices back into habitus, or keep them from surfacing into consciousness in the first place." Wilk distinguishes between two processes of naturalization: submersive and repressive. In many cases, practices never surface from the realm of unconscious routines (habitus) because they are so widespread and closely associated with our cultural understanding of "normal behavior" that it takes great effort to make people aware that these practices are contingent and can be subject to changes. Examples are the energy-consuming practices related to comfort and cleanliness. For example, highly controlled indoor temperatures and daily showers are perceived by most people as "simple necessities" that cannot be contested. Wilk calls this "submersive naturalization" and by this he means "that the routine remains thoroughly submersed in the habitus." However, we would like to add that submersive naturalization might be better understood as a characteristic of some practices more than as a "process of naturalization." In a sense, what Wilk calls submersive naturalization seems to be a kind of "inertia" related to some practices that makes it difficult to bring them into consciousness and discourse. These habits and practices—and the understandings associated with them—seem to have an almost ontological status, which might also explain why questioning the relevance and validity of such habits is often felt as an attack on one's personal identity and entire way of living.

The other type of naturalization, according to Wilk, is "repressive naturalization," which describes the methods we employ to force a practice back into habitus if alternatives have challenged it or if it is a new practice that we intend to turn into a normal routine. For instance, if we want to change our diet for health or environmental reasons, we are engaged in repressive naturalization. Another relevant example is when people legitimate their rejection of the train as an alternative to air travel with reference to socially acceptable rationales such as saving money and time (see below for a more detailed discussion of this case).

Following this line of thinking, it is relevant to focus on how change and continuity in practices can be understood from a practice-theoretical perspective. This includes looking at the balance between routinization and reflectivity as well as ways to understand the role of new technology and infrastructure in introducing change in consumer practices (Gram-Hanssen, 2011). Thus, the main question is to what extent websites like the one studied here actually support changes in practice. This has a number of related subquestions. One is to what extent the website engages people already interested in changing habits versus those not previously interested. Do these websites even reach those with the most environmentally harmful consumption practices? Another question is whether there are different aspects of everyday life where people are more or less reluctant to change their habits and what the causes might be for this resistance. Finally, the reaction of people to the underlying idea of the website, and to the idea that they should feel responsible for their personal carbon footprint, also holds interest. Behind this question is the understanding that practices are not decided and performed by individuals as much as individuals are carriers of practices.

The Website "Map My Climate"

In December 2009, Copenhagen hosted a large United Nations-sponsored climate-change conference. Many different parts of Danish society and numerous organizations and companies were engaged in related campaigns and activities during the months leading up to the event. The Map My Climate project analyzed in this article was one of these initiatives. The cornerstone of this effort was the publicly funded website Map My Climate that enabled visitors to calculate their personal carbon footprint.[1] The website included a so-called "quick test" that allowed users to enter their personal consumption within seven overall categories: heat, electricity, automobile transportation, nonfood commodities, air travel, use of second home, and food. If so inclined, users could also create a detailed and more accurate profile of their energy-consumption practices in the "detailed climate profile" section. Based on this information, the website provided users with tailored recommendations on how to reduce energy consumption in the so-called "my slimming treatment" section. Finally, users could compare their personal carbon footprint with the climate scenarios developed by the Intergovernmental Panel on Climate Change (IPCC) and view potential outcomes of climate change in different

[1] See http://mapmyclimate.dk.

Table 1 Income distributions in 2009 in selected Danish municipalities compared with the national average as percentage of population (Statistics Denmark, 2011).

Annual Income	National Average	Copenhagen	Kalundborg	Hørsholm
< €20,000 (US$25,000)	26	28	25	22
€20,001-32,299 (US$25,000-40,000)	25	26	27	18
> €33,300 (US$40,000)	49	46	48	60

areas of Denmark with regard to increasing temperatures and flooding.

Launched during the summer of 2009, the website was still running three years later at the time of the preparation and publication of this article. The project sponsors developed a cooperative relationship with the Danish Broadcasting Corporation (DR) that entailed promotion of the website in radio and television programs. DR also had a version of the "quick test" on its own website and this feature enabled users to compare their carbon footprint with famous people from the media.

Methods

Evaluation of the website included both quantitative and qualitative methods. The quantitative part of this study used a counter to monitor the number of website visitors and a questionnaire accessible from the website. The qualitative facet included three focus groups with invited participants. The two approaches were complementary, as the survey provided information about overall tendencies in users' interpretation of the website, while the focus groups offered detailed insight into these interpretations.

Users visiting the website could access the Internet-based survey via a link called "Tell us about your consumption." Survey participants were eligible to win a photovoltaic-powered mobile phone charger and were informed that their answers were part of a research project evaluating the website. The survey was open from mid-October to mid-December, 2009. A total of 220 respondents completed the survey, and most of them provided an email address allowing us to contact them two weeks later with a link to a follow-up questionnaire. Ninety-nine users completed this subsequent survey. The first questionnaire included questions on the duration of each user's website visit, how it had influenced them, their attitudes and knowledge about climate change and everyday practices before the visit, and some questions about their socioeconomic status. The follow-up questionnaire further inquired whether users had actually changed any practices to reduce their carbon footprint or whether they thought they would do so in the future.

More than 14,000 users visited the website during the months of October, November, and December of 2009; thus only approximately 1.5% of these individuals answered the questionnaire. Furthermore, the respondents were self-selected, so caution is needed when interpreting the survey results. In the analysis, we describe the respondents' main socioeconomic characteristics and discuss to what extent generalizations can be made on the basis of the survey.

The focus groups were carried out in three different communities: a wealthy suburb north of Copenhagen (Hørsholm) where focus-group participants were approached in the higher income neighborhoods with detached housing, a district characterized by modest incomes from the inner part of Copenhagen municipality, and nonurban residents from a provincial town (Kalundborg) with an average income distribution. Income distribution from the three municipalities is shown in Table 1.

These different locales were chosen to secure a diverse social profile of the participants. For each focus group, 40–50 letters were mailed out to chosen neighborhoods and the residents were contacted by phone afterward. In total, this procedure recruited ten initial participants. Especially in Copenhagen, we encountered recruitment problems and therefore used local personal networks to supplement our pool of respondents; however, only "friends of friends" of the researchers were contacted to ensure that the researchers had not met the participants beforehand. Despite the risk of bias, we ended up with a diverse group of respondents in Copenhagen, including participants with no or a short-term education as well as with a long-term education. However, the Copenhagen group was comprised of a significant subgroup of university students made up of five of the thirteen participants.

Altogether, eighteen participants took part in the focus groups (ten females and eight males). In Copenhagen, all thirteen confirmed attendees showed up. In Hørsholm, only two of the seven confirmed attendees appeared due to a snowstorm, and in Kalundborg only three of six confirmed attendees were on hand. Because of these circumstances, the focus groups partly took the shape of a semistructured qualitative interview, particularly in

Hørsholm. Nonetheless, all three focus groups brought important insights, and accordingly, together with a commitment to a tight timeline, we decided not to further reschedule the focus groups.

The focus-group participants were a diverse assemblage with regard to age, socioeconomic characteristics, and family situation. None of them worked professionally on energy or environmental issues or were active members of grassroots activities or environmental nongovernmental organizations (NGOs). The participants in general expressed positive attitudes with regard to the relevance and importance of the climate problem, with none voicing extreme positions that could be characterized as climate-change denial. According to a 2010 survey, 90% of the Danish population agrees that global warming is a human-induced phenomenon (CONCITO, 2010).

The aim of the focus groups was to provide detailed descriptions of how users experienced the website and to what degree the information on it encouraged them to reflect on their own everyday practices and the possibilities of saving energy and reducing their related CO_2 emissions. According to Halkier (2008), the design of focus groups depends on whether analytical attention is primarily on the content (participants' personal stories and descriptions) or on interactions among the participants (normative negotiations between participants concerning wrong or right behavior). In this study, the main focus was on the content, as we wanted the interactions to generate detailed descriptions of participants' individual experiences with the website. However, we also intended to create space for normative discussions in situations where they seemed particularly important with respect to motivation (or lack thereof) to change daily behaviors.

Discussions in the focus groups were structured around three overall themes: 1) the participants' prior interest in climate change and their personal carbon footprint; 2) their experience with the website; and 3) how and to what degree the website had made them think about their own habits and motivated them to change routines. Each focus group lasted about 100 minutes and was moderated by two of the project researchers (one male and one female). The moderators' written notes and audio recordings of the discussions form the empirical basis for this portion of the study. The content of the discussions in each focus group was summarized and organized according to the three overall themes and later analyzed for differences and similarities among the participants' personal accounts, as well as across the three different focus groups. This evaluation also included an analysis of the negotiations among participants on normative issues. Quotations from the focus groups have been translated from Danish into English by the authors and all participant names are pseudonyms.

As described above, the empirical material does have certain limitations, including the self-selection of the respondents in the survey and the limited number of people participating in some of the focus groups. These caveats partly relate to the difficulties of identifying and contacting website visitors. However, because there is little previous research in this area, our results can be of interest and provide inspiration for future investigations despite the empirical shortcomings.

Results and Analysis

The following two subsections present in turn the results and analysis of the quantitative and qualitative material. Both types of data are then brought together in a general discussion on how websites can facilitate changes in everyday practices.

Analysis of Quantitative Material

As noted above, during the months of the survey (October to December, 2009), 14,000 users visited the Map My Climate website. However, these visits were not evenly distributed throughout the three months. Table 2 shows the distribution of the majority (more than 12,000) of these visits, namely those who visited the "quick test" version of Map My Climate on the DR website. The activity peaks in October and December and these months coincided with the periods when DR advertised the website in its programs. This shows that strong promotion can be useful in motivating people to take such action, but that interest quickly fades.

The 220 completed questionnaires give some insight into the sociodemographic profiles of website visitors. The respondents were relatively equally distributed by gender (48% male and 52% female). There was a strong overrepresentation of middle-aged people with a corresponding underrepresentation of younger and older people; 66% of the respondents were between 30 and 49 years old (com-

Table 2 Number of unique visitors to the "Quick Test" version of Map My Climate on the website of the Danish Broadcasting Corporation, DR.

Month	Number of Visitors
October 2009	5596
November 2009	1250
December 2009	5502
January 2010	181
February 2010	70

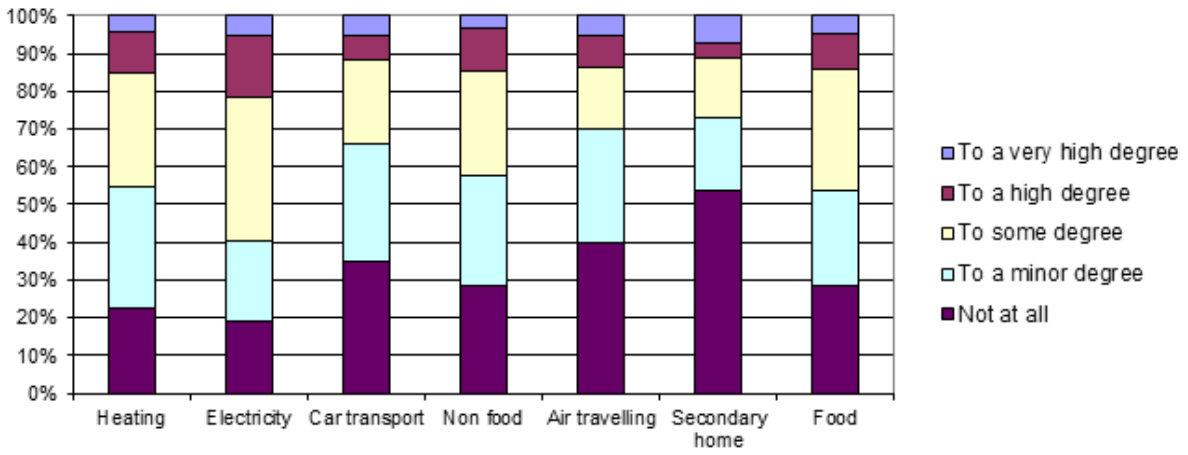

Figure 1 Survey respondents' answers to the question: "Do you think the website will make you change habits related to…" (the seven consumption areas)?*

*n = 220 in this portion of the study.[2]

pared with 34% of the Danish population). Furthermore, there was an overrepresentation of relatively wealthier persons, as 61% of the respondents had an annual before-tax personal income of more than 300,000 DKK (approximately €40,000 or US$50,000) compared with only 37% of the general population. Similarly, employed respondents were overrepresented, with 77% of the respondents gainfully employed (compared with 53% of the population overall) while 65% lived in detached homes (compared with 60% of the population).

When discussing to what extent this self-reported group represents all 14,000 users, we assumed that those completing the questionnaire were among the most interested in the subject (including an interest in winning a photovoltaic-powered mobile phone charger) and had the largest amount of spare time. With these assumptions, we would not have expected an overrepresentation of those who are employed, have high incomes, or are in a particularly busy phase of life, which may suggest a general overrepresentation of this population among the website's visitors. It can also be argued that this is the most relevant target group for communication related to climate change and sustainable consumption, since it has the highest level of energy consumption and thus CO_2 emissions (Gram-Hanssen et al. 2004).

The respondents were asked to identify their levels of knowledge and interest in energy conservation and CO_2 emissions. Fifty-five percent indicated that prior to their website visit they had had a very high or a high degree of knowledge about possibilities for reducing CO_2 emissions. This proportion can be compared with a 2010 survey that showed that only 43% of the Danish population agreed with the statement that they had "sufficient knowledge about how I can contribute to a reduction in the emission of greenhouse gases" (CONCITO, 2010). Thus, respondents considered themselves well-informed about the subject before visiting the website, a point that raises questions about the extent to which the website succeeded in reaching "ordinary people," one of the campaign's original goals.

Most survey respondents did not spend much time on the website: the first third indicated that they remained on it for less than five minutes, the second third between five and ten minutes, and the last third more than ten minutes. Assuming that the survey respondents are among those website visitors most interested in the climate-change issue, this result indicates that the majority of the 14,000 visitors have probably spent less than five minutes on the website. The survey respondents were furthermore asked to evaluate the effects of the website: whether it provided them with new knowledge about climate change and CO_2 emissions, encouraged them to do more to reduce the impacts of their lifestyle, and provided new knowledge about personal actions. For all three questions, the majority indicated that the website had succeeded in these goals to some or a great extent.

We were interested in developing an understanding with respect to which of the website's seven consumption areas users were most and least inclined to make changes. Figure 1 illustrates that respondents were most disposed to engage with electricity con-

[2] While use of second homes shows the largest percentage of people refusing to change habits, this includes many people without a second home, and thus unable to make changes.

sumption and least prepared to change their air-travel practices. These differences between consumption areas will be developed further in the focus-group analysis below. Furthermore, a logistic regression analysis showed no statistically significant correlation between variables pertaining to respondents' socioeconomic background such as gender, age, and income, and their answers regarding inclination to change behaviors.

Considering the short time that users visited the website and that they overall were quite knowledgeable and interested beforehand, it is surprising how many of them believed that the visit induced them to change their practices. This very positive evaluation is, however, open to reinterpretation on the basis of a follow-up survey completed by 99 users two weeks later. More than half of them (58%) recalled only in part or not at all their visit to the website, and for all consumption areas the majority (51–64%) indicated that they had not changed any practices since their visit. However, it is worth noting that for heating, electricity, and food more than 20% reported that to some or a high degree that they had changed behaviors after their visit. Again, it should be noted that these results are based on those respondents who answered the survey and who can be assumed to be among the most interested visitors to the website. The survey gives no indication about what these changes might have entailed.

Analysis of Focus Groups

The focus groups showed remarkable support for the idea of calculating one's individual carbon footprint. None of the participants questioned the relevance or legitimacy of quantifying CO_2 emissions related to one's personal consumption habits. Also, none of the respondents found it difficult to grasp the underlying idea of connecting individual practices with CO_2 emissions and future climate change. This observation indicates that the understandings and ideology behind concepts such as political consumption and ethical or green consumerism have become widespread and naturalized in Denmark.

The conceptual foundation of green consumerism emphasizes consumers' individual responsibility for the environmental and social consequences of their consumption and for making informed choices among alternative products on the market. Thus, it is assumed that consumers have the capacity and power to choose environmentally friendly products and to reduce the environmental impacts of their personal consumption practices. Green consumerism is an integral part of the turn from producer-oriented to consumer-oriented environmental policies and the concurrent rise of the concept of ecological modernization that took place in Europe and elsewhere during the 1990s (Christensen et al. 2007).

As already indicated, the website is designed in accord with an individualizing approach to environmental problems that emphasizes consumers' personal responsibility for handling these issues. Even though the focus-group participants did not question the general relevance and legitimacy of this approach, they did point out a number of challenges in relation to the reliability and usefulness of the information on the website. These issues can be divided into two categories: the first concerns the technical details behind the calculation of the carbon footprint (e.g., underlying assumptions, method of calculation, data quality) and thus deals with the question of dependability—whether one could trust the results. The other category relates to how responsibility for mitigating climate change can or should be allocated, asking whether it is fair to delegate to individual consumers primary responsibility for reducing CO_2 emissions related to personal consumption. Despite the latter type of comment, the participants did not query the underlying premise of the individualized approach. Rather, they reflected on what constituted a fair distribution of responsibility instead of the relevance of calculating one's personal carbon footprint. In the following subsection, we present a more detailed analysis of the two types of commentary.

Reliability of the Website

Many of the focus-group participants were surprised in particular by the level of CO_2 emissions from their consumption of nonfood commodities. However, this observation also gave rise to a critical discussion about the procedures used for calculating the carbon footprint of such goods. Basically, the algorithm was predicated on users' annual expenditures on nonfood commodities either as the total amount of money (in the "quick test") or divided into a number of subcategories like clothing or information and communication technologies (in the "detailed climate profile"). The participants questioned the existence of a simple relationship between the amount of money spent and the quantity of CO_2 emissions. They mentioned examples of very expensive, but not necessarily "CO_2 heavy," products such as customized bicycles.

A similar point of critique was raised with respect to the calculation of CO_2 emissions as a result of consuming food. Most participants found the number of predefined options insufficient for choosing a meal that corresponded to their daily diet. Also, some participants compared the CO_2 emissions of different meals and found that the results were inconsistent with their expectations. For instance, a meal

based on fish was more CO_2 intensive than a meal organized around minced meat. This "finding" prompted them to question the reliability of the results, and they would have preferred that the website had included additional explanations of these otucomes.

In general, the focus groups showed that the participants interacted with the website in a critical-reflexive way. They questioned the underlying assumptions and calculation methods and also interrogated how the website collected information about their daily habits and consumption. In several cases, the participants expressed circumspection about the reliability of the results, especially those that seemed counterintuitive with pre-existing views (i.e., results that contradicted their prior knowledge, understandings, or habits). Thus, unforeseen information seems in most cases to trigger critical reflection regarding the quality and reliability of data and calculation methods. For some users, this process of critique resulted in a desire for further information. However, unanticipated information might, on a long-term basis, play a role in inducing changes in everyday practices, a point that we take up in more detail later.

As discussed, the participants related the information on the website to their own everyday experiences, established understandings, and prior information from other sources. Dealing with a complex phenomenon, such as the relationship between individual consumption and emissions of CO_2, opens up a "Pandora's box" of details and uncertain knowledge. From a design perspective, some degree of simplification and delimitation is necessary to create an accessible website; thus, designers need to "black box" some of this complexity. However, the critical-reflexive user will often surmise the existence of the underlying complexity that has been "hidden" and this will induce uncertainty regarding reliability.

Comparative studies find substantial differences among various Internet-based carbon-footprint calculators. For instance, a study of six such calculators from the United States, the UK, and Ireland demonstrated that the estimated annual carbon footprint for the same type of three-person household varied between approximately four and nine tons per person, showing a high degree of inconsistency among different tools with regard to total household footprints (Kenny & Gray, 2009). Similarly, a comparative study of ten United States-based calculators found that, given comparable inputs for individual behavior, the results varied by up to several metric tons of CO_2 per activity (Padgett et al. 2008). The authors further note that these inconsistencies may be due to different calculating methodologies and conversion factors. However, Internet-based calculators "frequently lack the level of transparency needed to understand the reasons for these variations," a point of criticism similar to the one put forward by several focus-group participants.

Allocation of Responsibility for Mitigating Climate Change

Questions pertaining to who has foremost obligation for reducing CO_2 emissions—governments, industries, municipalities, or individual consumers—were recurrent in all three focus groups. The website's attention to individual consumers' personal responsibility for mitigating climate change raised these questions. For instance, several of the participants lived alone and felt it particularly difficult to achieve significant reductions in their personal carbon footprints as they could not benefit from "sharing" their consumption of heating, lighting, and so forth. Therefore, they regarded it as unfair to be compared with persons living in households with two or more members. Another example was that of tenants who had limited possibilities for influencing their personal heat consumption, as decisions regarding energy improvements were a matter for the housing association or the landlord.

This is a manifestation of the principal-agent problem of uneven distribution of responsibilities and benefits between agents that has been widely discussed from the perspective of organization theory (see, e.g., Eisenhardt, 1989). A noteworthy expression of this problem is when the tenants pay the heating expenses while the landlord is responsible for investments in energy-efficiency improvements, making it unattractive for building owners to invest in energy renovation. Moreover, participants from rural areas criticized the website for not taking into account that people living in the countryside generally have both a higher need for transportation and limited access to public alternatives. A final example concerns the producer-consumer relationship, as several participants questioned the fairness of including the carbon footprint of, especially, nonfood commodities in their personal CO_2 emissions as the consumer role enables very limited influence on the energy optimization decisions of manufacturers.

Again, these reactions show how the focus-group participants approached the website from a critical-reflexive perspective. Many felt that mitigating climate change entailed a shared and collective responsibility at least equal to the responsibility shouldered by individual consumers. Also, several respondents thought that they would be more inclined to reduce their personal carbon footprints if society, as represented by the government, municipalities, companies, and so forth, were doing more.

Changes in Habits

To explore the new insights the website has provided, we asked the participants whether some of the information had surprised them. Their answers and the subsequent discussion highlighted that, besides the carbon footprint of nonfood commodities, the footprint of food consumption and heating were especially unexpected. However, this newfound awareness did not necessarily result in changes in behavior. Only one participant explained that she and her family had altered their diets after visiting the website, and this was primarily due to her husband who, according to the respondent, was very interested in environmental issues. With regard to heating, most of the homeowners reported that they had already done much to improve the energy efficiency of their homes, while most of the tenants, as mentioned above, felt it was difficult to influence their heating consumption.

Though a visit to the website had limited direct impact on daily practices, many respondents thought that the suggestions about how to reduce consumption and emissions were inspiring. Several also intended to implement at least some of the recommendations, for instance recycling glass, taking shorter showers, and turning off appliances running on standby electricity.

However, participants generally dismissed more extensive recommendations such as eating less meat or reducing car and air travel. In the focus group in Copenhagen, our respondents had a detailed discussion regarding the possibility of reducing their number of flights by choosing other transportation options. This was generally rejected for economic and time-related reasons as well as because of the lack of appealing alternatives. Respondents thought that travel, for instance by train instead of airplane, would be both much more expensive and time-consuming. As a 30-year-old male student explained, he would prefer the airplane as long as "the very CO_2-consuming [means "producing"] alternative is cheaper than the little CO_2-consuming alternative." The focus groups thus confirmed the finding from the survey that transportation, and especially air travel, is the consumption area that consumers are least inclined to reduce.

Even though the website seemed to have had a limited impact on users' daily habits and their motivation for changing them, several survey respondents explained that it had been interesting to learn how ordinary consumption and different habits affect their carbon footprint. Many of them reported that this had been an "eye-opening experience," which made them more aware of the relationship between their daily habits and climate change. And, as one of the participants explained, to change habits, people "need to be bombarded from many sides." This indicates that communication by websites, as part of broader information dissemination from other media, might play a role in a long-term strategy to change the elements of engagements and institutionalized knowledge. In the long run, such measures might, in combination with infrastructural and technological adjustments, pave the way for more comprehensive behavior change.

Can Websites Facilitate Practice Change?

Wilk's (2009) concepts of cultivation and naturalization can help to illuminate some of the dynamics with respect to how users interpret, handle, and use the information provided by the website. Again, the focus-group discussions on air travel are particularly relevant. Some participants were surprised by the carbon footprint of this transportation mode and how much it determines their personal CO_2 emissions. Thus, the information provided by the website induced them to reflect on their own travel in a new light and represented a process of cultivation. However, as mentioned earlier, the participants were generally very reluctant to change their mobility practices, especially in relation to holiday travel. They mentioned alternatives such as buses or trains, but rejected them as expensive, time-consuming, and inconvenient. The participants seemed to justify their rejection of these options by referring to a number of widespread and well-established rationalities and ideals in modernity: the faster the better (time efficient), the cheaper the better (economically beneficial), and the more convenient the better (comfort enhancing). This is an example of repressive naturalization, where a practice (in this case air travel), which has been made subject to critical reflection and discussion, is actively forced back into the realm of unconscious routines (habitus) by, in this instance, reference to established rationalities and cultural norms. Another example was the tendency by participants to question the reliability of the output generated by the website (especially the results that the participants perceived as contradicting their own habits). Besides being a relevant and appropriate attitude toward new and controversial information, this can also be interpreted as a way of "disarming" the critical potential of the information, and thus another example of repressive naturalization.

The focus-group discussions about air travel also included an example of submersive naturalization, which relates to deeply (culturally) embedded practices that are difficult to bring into consciousness and, if pointed out by others, are responded to as a personal attack. Interestingly, none of the participants considered the possibility of choosing holiday desti-

nations more proximate to Denmark to avoid travelling by airplane, which apparently was not within their "horizon of possibilities." When the moderator later mentioned this option, it was immediately dismissed with arguments such as "travelling by air is a pleasure thing that I'm definitely not going to cut down on" and "it should not be [felt like] a punishment to save CO_2." Suggesting the possibility of limiting the range of holiday destinations due to environmental considerations seemed to challenge basic lifestyle assumptions and evoked one of the most passionate reactions during the focus groups.

This outcome is in line with Caletrío's (2012) findings of a general refusal among tourists to limit holiday miles due to environmental considerations. As he notes, leisure travel "is an issue of great symbolic and personal value widely perceived to be an essential part of contemporary lifestyles." This immediate rejection prevented the focus-group participants from further reflections about their choice of holiday destinations and thus exemplified how some practices remain unconscious, or unexamined, through submersive naturalization. The focus groups suggested that holidays are associated with deeply rooted cultural ideas such as freedom and enjoyment, and that strong emotional engagements are associated with the practice of being on vacation. Holidays and air travel occupy a special status in modern everyday and family life, making them the consumption area survey respondents are least inclined to change. This probably relates to the status of holidays as a break away from daily life and, for many, a highly valued time for "family togetherness." In 2010, the Danish population had 4.4 million long-stay (at least four nights) holiday trips to foreign destinations, and 59% of these trips were made by airplane. Eighty percent of the holiday trips were to destinations within Europe (with Spain being the most popular holiday destination, with 13% of all trips), while only 20% were outside Europe (Statistics Denmark, 2012).

These findings suggest that if part of the aim of communication about climate change is to open for discussion deeply rooted practices that have strong emotional engagement, it is necessary to develop a more sophisticated approach than just quantifying and visualizing the environmental impacts of the practices and suggesting simple alternatives. This tactic risks an emotional "backlash" and a flat refusal as being unreasonable or too radical. An alternative might be to combine information about the size of the environmental impact with a more elaborated discussion about how, for instance, some of the same qualities such as relaxation, time together with family members, or new experiences can be achieved in other less CO_2-intensive ways. This approach would build on the idea of "decoupling" these elements of engagement from the practice of travelling to a holiday destination by airplane and instead "reconnect" these elements with other less CO_2-intensive holiday activities. It would acknowledge that practices are constituted by different elements, including emotional engagements, and to change them it is necessary to combine institutionalized knowledge, such as information about the energy intensity of different modes of transportation, with initiatives directed at the other elements holding practices together. In this case, the institutionalized knowledge could be combined with visualizations of how some of the same qualities (engagements) of air travel-dependent holiday practices could be achieved through other holiday forms. In their study of the development and reinvention of the practice of Nordic walking, Shove & Pantzar (2005) show how elements of practices can circulate and be reconfigured in new ways that represent a reinvention.

With a few exceptions, such as the carbon footprint of heating and food consumption, it was the general experience among the focus-group participants that the website did not provide much new information or many novel recommendations. In this regard, the respondents' experience reflects the findings of the survey, which showed that a majority of the users considered themselves already well-informed about the subject before they visited the website. This observation is in line with the observation by Hobson (2001) that the low public uptake of recommendations for more sustainable behavior most likely cannot be ascribed to an "information deficit" in relation to environmental issues.

The focus groups indicated that the reason for this low uptake was partly related to the question of who should be responsible for reducing energy consumption. The question of guilt and responsibility kept returning in the discussions, showing its salience. The website, however, was poorly designed with regard to qualifying this discussion, as it almost entirely reflected the ideas of green consumerism, stressing consumers' individual responsibility. With this one-sided emphasis, the website easily brought the user to a situation of victim-blaming and created a feeling of powerlessness. For instance, living in a society that is increasingly car-dependent, people might find it very difficult to imagine a life without a private automobile. The individual's need for transportation and choice of means are highly determined by infrastructure and urban planning, and this raises the question of who should be responsible for reducing CO_2 emissions.

Participants' interaction with the website had more in common with an "active debate" (Hobson, 2001) than with a passive appropriation of information. Active debate is a type of engagement that

"contests the truth and values of the knowledge being presented...and makes use of the knowledge that exists and is mobilised from each individual's own life and experiences" (Hobson, 2001). In this way, active debate represents a more engaging form of knowledge appropriation through which the individual relates new knowledge to the specific context of his or her own everyday life. This observation supports the active uptake of new knowledge and, as a result, the likelihood that this knowledge will inspire the individual to make changes in his or her everyday practices.

The design of websites for promoting sustainable behaviors should take this observation into account and be crafted to serve as an "interlocutor" that qualifies and inspires the user's reflections on complicated issues rather than only communicating facts about climate change and behavior. For instance, information about the carbon footprint of different activities such as heating could be accompanied by open-ended questions or statements indicating nuances and complexities related to changing practices of heating and, by so doing, invite the user to further reflection. The principal-agent problem experienced by many tenants in relation to saving energy for heating could be highlighted and thus open for users' reflections on questions pertaining to the allocation of responsibility (in this case between tenants and landlords) and perhaps also provide ideas about how to handle this challenge. And even if the user cannot make practical suggestions, his/her reflections would still have provided a more elaborate understanding of the issue and perhaps, in the long run, increase political pressure to find institutional solutions to the principal-agent problem.

Another example is the previously discussed dilemma surrounding air travel, where facts about CO_2 emissions could be accompanied by questions or statements that invite the user to reflect on what determines his/her decision to travel abroad by airplane and whether some of these objectives could be achieved through domestic holidays, such as staying in a summerhouse or travelling to neighboring countries instead of more distant destinations. These examples surely need much more elaboration, but we hope that they indicate how this kind of website could be improved to involve users more actively in engaged and informed reflections about the relationships among everyday practices, carbon footprints, and possibilities for behavior change.

Conclusion

This article's main aim has been to evaluate the extent to which web-based carbon calculators can influence knowledge and meanings that help govern CO_2-producing practices in the everyday life of households and to give recommendations for the design of the next generation of carbon calculators. Even though the empirical material is limited and only includes one specific carbon calculator used in Denmark, our findings have broader relevance, especially as this type of evaluation is rare and the number of carbon calculators is growing. Also, our findings might inspire future studies needed for a better understanding of what role carbon calculators could play in the transition to a low-carbon everyday life.

Our survey results indicate that primarily individuals already interested in sustainable consumption use the website. This is not necessarily undesirable, as this group may need continuous inspiration and reaffirmation to continue being among the "frontrunners" in changing practices. However, website designers should be aware that already knowledgeable users will probably be their main audience for the foreseeable future and acknowledge that various target groups may require different types of information.

Another finding related to the design of the carbon calculator is that it reflects prevalent individualized understandings consistent with notions of political consumption or green consumerism. By deploying this approach, the Map My Climate website failed to open up a more detailed and nuanced discussion of, for instance, the balance between personal and collective responsibility. Without this dimension, the website seems to leave many users with a feeling of victim-blaming or powerlessness, and they simply dismiss the recommendations as irrelevant or too radical. Thus, ecological footprint websites should be designed to encourage or empower users to strive for and act toward collective solutions, for instance through a political process, in part to avoid outright rejection. Our findings suggest that the design of such websites should focus on engaging users in an "active debate" about the relationships between CO_2 emissions and everyday practices and the possibilities and limitations in relation to changing these practices.

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