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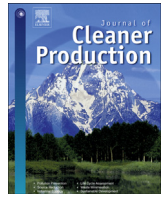
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Attentive, speculative experimental research for sustainability transitions: An exploration in sustainable eating

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ABSTRACT

The critical role of everyday practices in climate change mitigation has placed experimental approaches at the top of the environmental policy agenda. In this paper we discuss the value of behavioural approaches, practice theories, pragmatic tinkering and speculative thinking with respect to experimentation. Whereas the first two have been much discussed within sustainability science and transition research, the notions of pragmatic tinkering and speculative thinking radically broaden the scope of experimental research and its contribution to sustainable everyday practices. Pragmatism brings to the fore the need to coordinate multiple practices and understandings of good eating, as these may clash in practice. Through this lens, the value of experimental research lies in revealing frictions that need to be resolved, or tinkered, in practice. Speculative experimentation, in turn, refers to the power of experiments to challenge the experimental setting itself and force thinking about new possibilities and avenues. We investigate the value of all four approaches in relation to our experiments with sustainable eating in the Finnish and Nordic context. Our elaboration justifies the need to broaden the conception of experimental research in order to capture the multiplicity of sustainable eating. Hence, we call for attentive, speculative experimental research aimed not only at testing solutions for sustainable everyday practice, but also at reflecting on the practice of experimentation itself.

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1. Introduction

Experiments and experimental cultures are being increasingly called upon to test and invent solutions to wicked sustainability problems. They are seen as a dynamic means not only to develop novel technologies, but also to get new actors involved (e.g. Heiskanen et al., 2015; Schot and Geels, 2008; Smith et al., 2016). The critical role of everyday practices in climate change mitigation has raised experiments in sustainable eating, energy use and mobility as key arenas of invention (Devaney and Davies, 2017; Laakso, 2017; Liedtke et al., 2015; Marres, 2009). The expansion of experimentation to everyday life and practices opens new avenues for research (Jalas et al., 2017; Mylan, 2015) and may alter the meaning of experimentation itself.

In the transition towards sustainable everyday living, behavioural approaches have attracted increasing attention (Godfray et al., 2018; Just and Gabrielyan, 2016; Lehner et al., 2016; Reisch et al., 2017; Whitehead et al., 2018; Hukkinen (2016)). The latest developments in the behavioural sciences regarding slow and fast, rational and intuitive cognitive processes (Kahneman, 2011) have brought about a boom in experimental research on how to influence behaviour by nudging the fast, intuitive cognitive processes in our everyday decision making (Thaler and Sunstein, 2008). These behavioural experiments rely largely upon classical experimental design, where an intervention is made to gain tested knowledge on cause-and-effect relationships (for reviews see e.g. Broers et al., 2017; Nørnberg et al., 2016; Wilson et al., 2016).

Another prominent body of research on everyday life transitions has been practice theories. Theories of practice draw attention to agency and the demand side in understanding societal transitions, whilst also paying attention to their historical and structural constituents (Schatzki, 2002; Shove et al., 2012; Spaargaren et al., 2012; Warde, 2016). Rather than individual behaviour, they advocate social practices as a key unit of analysis. Theories of practice show

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that any enduring change in everyday life requires the reconfiguration of a complex set of interlinked elements and their recurring performance. In this body of research more attention to experiments and experimentation has also been called for (Devaney and Davies, 2017; Jalas et al., 2017; Laakso, 2017). The proponents underline that only by testing sustainability solutions in practice, and by the practitioners, can their functioning and relevance be guaranteed (Botero and Hyysalo, 2013).

These two currently much debated approaches to everyday behaviour and practices offer significantly diverging approaches to experimentation and experimental research on sustainability transition. The premises and possibilities of experimentation widen even further when we bring into the discussion the views of pragmatic thinking (Mol, 2002, 2010) and speculative experimentation (Stengers, 2010). These two approaches have been little discussed in relation to sustainability transitions. They stem from science and technology studies and complexity thinking and highlight the performative role of experiments and experimentation (Callon, 2009; Law, 2004). The former sees experimentation as a key feature of any practical problem-solving situation; the latter suggests experimentation to be crucial in envisioning alternative, yet-to-be capacities of practices.

In sustainability studies, more conceptual clarification has been called for regarding the premises and use of experiments in societal transition and research (Ansell and Bartenberger, 2016; Caniglia et al., 2017; Hildén et al., 2017). In that methodological discussion, the specifics of experimentation in everyday life have, however, gained less attention. In the present study we set out to investigate the value of behavioural approaches, practice theories, pragmatic tinkering and speculative thinking, and ask what horizons they open for experimental research. We evaluate in detail how the various experimental approaches allow radically different issues to be revealed, investigated and acted upon.

We explore the potential of the different approaches to experimentation in relation to sustainable eating. More specifically, we focus on attempts to reduce excessive consumption of meat in affluent, Western diets. The reduction of meat consumption has been identified as critical not only in mitigating climate impacts, but also in combating major health problems (McMichael et al., 2007; Tukker et al., 2011). The challenge has been taken seriously in the Nordic nutrition recommendations, which boldly integrate climate and nutritional goals in their definition of sustainable eating (NCM, 2012; see also Fischer and Garnett, 2016). In Finland and Sweden public food services have had a key role in guiding healthy eating through free school meals and employee-supported workplace lunches. The latest Finnish nutrition guidelines recommend (NNC, 2014, 2017) that schools and workplaces should not only offer nutritious and healthy food for all, but also support children, teenagers and adults in practicing sustainable eating as part of their everyday lives. Despite these goals and efforts, however, meat consumption in Finland has not notably fallen (Natural Resources Institute Finland, 2018) while, globally, the consumption of meat continues to increase unsustainably (Godfray et al., 2018).

These pressing challenges offer a fruitful setting to investigate what experimental research can offer for inventing, testing and opening up sustainable ways of eating. We draw on a series of experiments in school and workplace restaurants where we tested and sought practical solutions for sustainable eating. While highlighting the value of different approaches to experimentation, the experiments underscore the need to broaden the conception of experimental research in order to capture the multiplicity of sustainable eating. We start by introducing the different approaches and then discuss them in relation to the experiences gained from

our empirical experiments in sustainable eating. The results suggest that in addition to testing solutions for sustainable eating we need attentive, speculative experimental research that generates discussion on the practice of experimenting itself.

2. Four approaches to experimentation in sustainable eating

2.1. Nudging behavioural change with controlled experiments

In behavioural science, nudging refers to a subtle design of the context of choice in a way that mobilises the unconscious mind and alters human behaviour in a predictable manner (Thaler and Sunstein, 2008). The notion of nudging is based on the differentiation between cognitive processes that are fast, automatic and intuitive and those that are slow, deliberate and conscious, introduced by Kahneman (2011). The fast, intuitive processes largely guide our daily routines, whereas the slow processes rely on much greater deliberate cognitive effort and are employed when making decisions on important choices in life. Importantly, proponents of nudging see these dual processes as interlinked and argue that we should better acknowledge the significance of fast, intuitive thinking in the policies guiding our behaviour.

Nudging departs from the model of rational choice, which supposes that individuals use all available information to make decisions. As information campaigns for healthy eating have largely proven ineffective, experiments in nudging are now booming. Experiments have been carried out to test the effects of choice architecture, default choice, rewarding and social norms on eating behaviour (for reviews see e.g. Broers et al., 2017; Nørnberg et al., 2016; Wilson et al., 2016). The experiments mostly follow a classical experimental design where the environment is tightly controlled in order to reveal and isolate cause-and-effect relationships (Ansell and Bartenberger, 2016). The factors investigated are carefully set beforehand and a randomized control group is set for comparison (Dehue, 2001). Interestingly, the most popular places for nudging interventions have been school, university or workplace canteens, which offer an easily controllable environment for experiments. They also represent settings where choices on what to have for lunch are made in a highly intuitive, automatic manner.

Findings from the experimental trials are, however, mixed (Broers et al., 2017; Nørnberg et al., 2016; Wilson et al., 2016). The trials have often been one-off, targeted at particular groups and their effects have been hard to detect. In real-life settings the effects tend to be muddled with other interfering variables. In the controlled experimental design context, interfering factors are usually considered negatively as noise or a distraction. The focal interest on individual behaviours inhibits integrating into the explanation the often unintended, cumulative – and even changing – factors arising from the context. Such a stance also makes behavioural experiments unable to reflect on how they co-participate in enacting behavioural change. This point is being raised by an increasing number of social scientists who insist that behavioural change policies – including nudging experiments – should be opened up to democratic control (Evans et al., 2017; Selinger and Whyte, 2011; Wilkinson, 2013). Nudges work by influencing the intuitive, non-deliberative cognitive processes of individuals, and while experiments are designed to test that assumption, the public or the target audience cannot be engaged in the design or evaluation of the experiment. In addition, following the principles of controlled experimental design, the researcher is supposed to stay external to the experiment to minimise bias (Ansell and Bartenberger, 2016; Dehue, 2001).

The dual model of cognition, however, insists on combining intuitive and reflective cognitive processes in behavioural change approaches. In line with this, policy-oriented behavioural

approaches stress that simultaneous interventions on multiple levels are needed to achieve enduring behavioural change (Michie et al., 2011). Such policy applications question the relevance of classical experimental design in gaining knowledge about behavioural changes in complex everyday life settings.

2.2. Integrated elements of practice as targets of experimentation

In contrast to individual behaviours, theories of practice advocate social practices as a key unit of analysis and a target of intervention (Mylan, 2015; Schatzki, 2002; Shove et al., 2012; Spaargaren et al., 2012; Warde, 2016). These theories underline that changing the choice architecture alone is insufficient for achieving enduring changes in everyday practices. Instead, a complex set of interlinked elements and performances needs to be reconfigured. Practice theories have been developed largely as a response to behavioural but also to cultural approaches in analysing everyday life and consumption. They draw on science and technology studies, emphasizing the complex ways by which technologies guide or get anchored in everyday lives.

Most practice theorists view social practices as constituted by some combination of recognizable elements. For example, Elizabeth Shove (Shove et al., 2012, p. 82) defines practices as consisting of a 'relatively consistent, relatively enduring integration of elements': materials and infrastructure (e.g. dining hall), competences, know-how and skills (e.g. recipes and cooking techniques) and cultural meanings (e.g. the social and symbolic significance of meat in cuisine). Schatzki (2002) further suggests that practices can be seen as coordinated 'entities' that are reproduced – or reconfigured – through concrete 'performances'. This dynamic keeps practices alive, allowing also their renewal. Similarly, Shove et al. underline, that '[i]f specific configurations are to remain effective, connections between defining elements have to be renewed time and again. This suggests that stability and routinization are not endpoints of a linear process of normalization. Rather they should be understood as ongoing accomplishments in which similar elements are repeatedly linked together in similar ways' (Shove et al., 2012, p. 24). The elements of practice, hence, co-constitute one another, but also change in relation to one another. This understanding of processual change departs from the behavioural approaches suggesting that the unit of analysis 'may undergo metamorphosis over time and change meaning' (Shove et al., 2012, p. 144).

Practice approaches have informed burgeoning empirical investigations on daily eating and food consumption (Brons and Oosterveer, 2017; Halkier and Jensen, 2011; Torkkeli et al., 2018; Warde, 2016). Experimentations in sustainable eating have also gained momentum (Devaney and Davies, 2017; Laakso, 2017; see also Strengers and Maller, 2015). The results from these experiments stress that any intervention in sustainable eating should target the integrated elements of practice in order to disrupt the recurring patterns of eating (see also Mylan, 2015). In the case of vegetarian food in schools, this would mean, in addition to introducing new foods to the menu, also disrupting the cultural meanings of meat eating. Practice theories show that interventions supporting plant-based eating are likely to generate resistance. Such resistance is, however, valuable: it illuminates the path dependencies in normalised ways of eating, opening them up for public deliberation (Warde, 2016). In this manner, practice approaches also benefit from failed or less successful experiments (Heiskanen et al., 2015). Any reconfiguration of the integrated elements of practice is, in any case, likely to take time and require recurring performances at multiple sites (Southerton, 2013).

Practice theories underline, importantly, that experimentation with sustainable everyday living cannot overlook the practitioners:

they are the best experts of their lives (Botero and Hyysalo, 2013; Jalas et al., 2017). Their active participation in experimentation is a prerequisite for making new practices meaningful. Such a position departs radically from the controlled design model endorsed by the behavioural approaches. Practice approaches see researchers both as critical interpreters and active interventionists. The task of the former is to stay alert and reveal the path-dependencies in our everyday practices, while the latter should try to disrupt them in a meaningful manner.

2.3. Pragmatism suggests tinkering as a form of experimentation

Pragmatism has long sought practical solutions to societal problems (Dewey, 1924/2016). Pragmatic approaches have lately been mobilised by theorists seeking to address the complexities of everyday life and knowledge production (Law, 2004; Mol, 2002). In their studies on health care, Annemarie Mol et al. (2010) have drawn attention to practical tinkering as a specific form of attentive experimentation.

Mol stresses that what is conceived as good eating can be strikingly complex (Mol, 2010; see also Heuts and Mol, 2013; Mol, 2013). In school dining, for example, good food should be nutritious, but also inexpensive. Most importantly, good food gets eaten and provides children with enough energy for the school day. A peaceful environment offering a pause during the day's work and a possibility for choice may improve the experience of the food and support sufficient eating. Climate policy targets also encourage good food to be sustainable. Mol reminds us that different ideas of good food can coexist, but sometimes they clash – 'giving rise to ongoing tension or a victory of one alternative over the other' (Mol, 2010, p. 216). Good eating is always based on compromises between ideals.

By attending to the tensions between different goods causing friction in daily practices, Mol offers a new perspective on experimentation. In attentive experimentation, practitioners are the prime experimenters. By intervening, research can help identify the tensions between different goods and, by so doing, contribute directly to the improvement of practices – or, as Mol calls it, tinkering (Mol, 2010, p. 227; Mol et al., 2010, p. 13). Tinkering, based on compromises, could easily be interpreted as adjustive and conservative. Mol, however, stresses that tensions never go away: they just need to be handled. Tensions and frictions should be understood as sensitising devices that allow the re-evaluation of practices. A persistent willingness to tinker is thus essential in achieving change: 'crucial for good care, then, are those who feel the tensions between different goods as they cause frictions in daily practice' (Mol et al., 2010, p. 228). That is the radicality of attentive experimentation.

2.4. Speculative experiments offer sites for engagement and empowerment

Instead of problems to be overcome, the frictions that exist regarding what constitutes good eating can be celebrated as outcomes that can help in coming up with completely new ways of organising and approaching sustainable eating. Such a prospect arises from the idea of experimentation as a form of speculation, a lesser-known way of conceiving experimentation in sustainable transition studies (but see Gabrys, 2014). The notion stems from the philosophy of Isabelle Stengers, originally in the context of scientific experiments, and her critical examination of the causal explanatory model applied in behavioural change experiments.

Stengers (2010) stresses that a good scientific experiment enhances the abilities of the research object to 'speak' and 'resist' so that it reveals its character to the experimenter. The resistances of

Table 1
Summary of the four theoretical perspectives on experimentation.

Approaches to experimentation	Theoretical background	Experimental design	Knowledge generated by experimentation	Position of researcher and participants
Nudging behavioural change	Behavioural science	Controlled One-off intervention	Tested knowledge on causal relationships of factors influencing individual behaviours	Participants unaware of experiment Researcher as an unbiased, external observer
Interventions in integrated elements of practice	Theories of practice	Real-life everyday practices Recurring of performances	Processual knowledge on integrated elements of practice and their potential for reconfiguration	Participants as experts of everyday practices Researchers as critical interpreters and active interventionists
Practical tinkering	Pragmatism, complexity theory	Real-life practices as multiple and complex Continuous experimentation	Pragmatic knowledge for problem solution Identification of frictions between multiple goods	Participants as pragmatic problem solvers Researchers facilitate problem solving by identifying frictions between multiple goods
Speculation	Philosophy of science	Open, hesitant Experiment as a participatory event	Speculative New avenues of action and innovation Ethical reflection on experimentation	Participants as capable of imagining and creating new framings Researchers active in creating empowering situations for speculative thinking

the experimental objects are valuable because they ‘force thinking and feeling’ in ways that controlled outcomes never do. A good experiment makes the experimenter hesitate; and hesitation opens up the possibility for the creation of genuinely new knowledge (see also Gabrys, 2014). Stengers underlines that outcomes of experimentation should always stay uncertain and open up speculative possibilities.

Experimentation as speculation also suggests that good experimental settings are empowering (Stengers, 2010, p. 22). Good experiments should allow both researchers and participants to engage in the construction of knowledge and generate questions that allow re-evaluating and re-imagining of what, for example sustainable eating, is or might become. Here the key to success is ‘empowerment of situations’ (Stengers, 2010 p. 21) rather than people as such. Empowering situations are those that challenge and encourage those who are gathered to think and invent, and extend the debate and views beyond what has been thinkable and doable.

Speculative experimentation extends our understanding of experimentation compared to the approaches offered by behavioural sciences, theories of practice, and pragmatic tinkering. It suggests that experimentation is simultaneously a sensitising device to uncertainties and possibilities that are not yet plausible, and a collective site in which new paths can be opened up. Less directed towards management of behaviours, speculative experimentation enables attention to the ‘generative and yet-to-be capacities of practices’ possibly enabling communities to generate new practices, configurations and ways of being (Gabrys, 2014, p. 105). Political scientist Noortje Marres (2009) has stressed, further, that through their capacity to engage and facilitate interaction, experiments in everyday life not only help to resolve sustainability problems, but articulate problems related to experiments themselves. Taking this into account, it is even more important that experimental settings are designed so that they can make ethical questions related to sustainable eating as well as to their experimentation visible and open for deliberation.

2.5. Summary of the differences and potential of the four approaches

The different theoretical approaches reviewed here expand our understanding of sustainability experiments and their methodology (Table 1). The behavioural change approaches promote experimentation as a way of gaining tested and proven knowledge about the factors influencing individual behaviours. Practice theories, in contrast, highlight the integrated elements constituting everyday practices – their path dependencies and potentials for reconfiguration. Pragmatic tinkering highlights the need to coordinate

multiple and sometimes clashing practices and understandings. Through this lens, the value of experimental research lies in revealing frictions that need to be resolved in practice. Speculative experimentation, in turn, refers to the power of experiments to challenge the experimental setting itself and foster thinking about new possibilities. It brings experimental research into the political realm more powerfully than the other conceptions, emphasizing the empowering characteristics of and ethical reflections on experimentation.

The alternative approaches propose completely different specifications for experimental design and the knowledge generated. Consequently, the role of researchers and participants alters. Behavioural approaches stress that the researcher should stay as objective and external to the situation as possible, whereas the other approaches underline the active role of the researcher in interventions. The speculative approach takes the most activist stance by encouraging researchers to create empowering situations that allow speculative thinking. Similarly, the role of the participants changes as well. Both practice theories and the pragmatic approach emphasise participants as being the best experts and problem solvers in everyday situations. In speculative experimentation the participants are encouraged to envision beyond pragmatic resolutions.

3. Experimentation in practice: sustainable eating in Finnish workplaces and schools

Examples from our sustainable eating interventions further demonstrate the value of the different approaches to experimentation. Firstly, we tested various means of promoting sustainable eating at the lunch restaurant of the Finnish Environment Institute (SYKE).¹ We collaborated with the service provider, a major Nordic food service company, in the planning and evaluation of promotional measures. In 2015, the restaurant introduced a ‘climate lunch’ label (Pulkkinen et al., 2016) to assist customers in choosing the most climate friendly foods. The following year the restaurant changed its strategy to nudging. They altered the choice architecture by putting vegetarian dishes first in line and developing new vegetarian dishes. We gathered feedback from the customers at several points and distributed the results back to the kitchen for further development. We carried out a survey and focus group discussions after the introduction of the climate label and the nudging interventions (Kaljonen and Lyytimäki, 2016). In addition,

¹ SYKE is a governmental research institute with around 600 employees. All of the authors are affiliated with the institute. See <http://www.syke.fi/en-US>.

we monitored the changes in the use of food ingredients by the kitchen and estimated their climate impacts on a yearly basis from 2014 to 2017.

Secondly, we experimented with sustainable eating at three Finnish schools in collaboration with their food service providers. During our study, two rural and one urban school introduced a free, daily vegetarian option to the school menu, as promoted by the new recommendations for school meals (NNC, 2017). We monitored the consumption of vegetarian food after the change in each school and conducted a survey of all pupils immediately after the introduction of free vegetarian options to gauge their responses. We then opened up the experiment to more thorough deliberation by inviting secondary school pupils (aged 13 to 15) to evaluate vegetarian food and to design their own school menus. We also organised tasting demos engaging pupils in thinking about alternative protein sources with the help of gaming. Throughout the school experiments we fed the results back to the kitchen to further the development of sustainable school food.

3.1. Nudging environmental researchers towards sustainable eating

The experiences from the SYKE restaurant highlight the appeal of nudging in guiding eating behaviour. According to our survey, customers paid little attention to the information offered by the climate label in their lunch choices (Kaljonen and Lyytimäki, 2016). Rather, the customers explained in the focus group sessions that the taste, smell and appearance of food – and their past experiences of them – guide their decision on what to have for lunch. The justifications of the customers resonated with the automatic, intuitive, embodied cognitive processes emphasized in nudging approaches.

The customer feedback prompted the SYKE restaurant to invest in the taste, versatility and availability of vegetarian food. This decision was supported by the strategic moves at the corporate responsibility programme of the restaurant giving more emphasis to nudging as a way to support sustainable and healthy eating. The environmental researchers welcomed the efforts and investments put into vegetarian food and plant-based eating at the restaurant. One woman in her fifties expressed her astonishment during the second round of focus group discussions: 'I found it mind-blowing that vegetarian food was served first in line; that it was no longer a given that meat comes first; that now it went the other way around'. Many also stressed that the vegetarian food had improved and become more diverse. The versatile, tasty vegetarian dishes had persuaded many to eat more vegetarian meals. Based on these successes, the kitchen decided to further increase and diversify its offering of vegetarian dishes. Meat was, however, still served daily.

Our estimation of climate impacts, based on food purchase data,² showed no significant change from 2014 to 2017 (Fig. 1). When we focused on separate food items, we could detect that the use of vegetables and pulses had increased. The major decrease in the use of meat took place only in 2017 when the kitchen significantly increased its supply of vegetarian dishes. This shift was, however, accompanied with a greater use of dairy products in the 'not too light' vegetarian recipes. This trade-off resulted in little change in overall climate impact.

The long-term results show that a notable reduction in meat consumption was achieved only after a substantial investment in vegetarian dishes. Meat carries such cultural weight in our eating

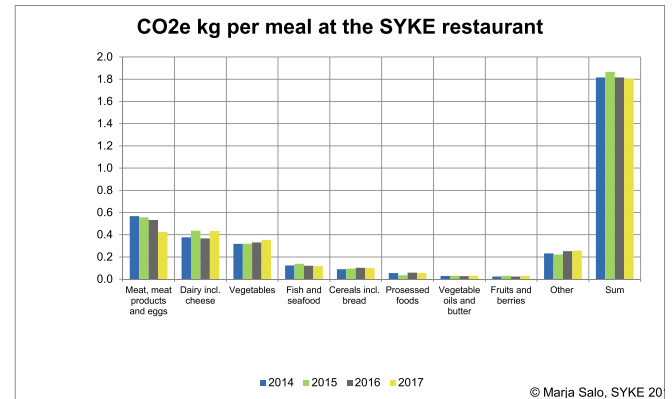


Fig. 1. Estimated CO₂e kg per meal at the SYKE restaurant 2014–2017.

practices that only slight nudging was ineffective at changing eating preferences. The results offer a critical interpretation of nudging as a sole, separate means of changing behaviour. Rather, it reveals how changes in eating appear far more dynamic, fine-tuned and long-term. The nudging experiment at the SYKE restaurant encouraged the kitchen to tinker and re-coordinate their food supply.

3.2. Boys against veg: cultural meanings of meat revealed

Practice theories remind that the use of meat in our diet will not change unless all elements in eating, materialities, capacities and meanings evolve in relation to one another and integrate anew. Our school food experiments, in particular, demonstrated the significance of cultural meanings related to meat. In the two rural schools, boys were seemingly reluctant to taste the new vegetarian lunch options on offer (Fig. 2). The most vocal boys in the class also reacted strongly against the vegetarian food during our menu-making sessions and tasting demos. In one of the schools a group of boys explicitly came to 'defend meat' in the tasting demo. 'Do you have anything against the fact that we think minced meat is the best', they asked the girls in the group. One boy even refused to participate in the demo, and one of them, after tasting the foods declared that 'I might get used to the taste, but I like meat and that's what I eat no matter what'.

Such resistance reflects the cultural meanings of (meat) eating and their relation to identity building. Although some girls also refused to taste the vegetarian protein sources, the boys' loud self-expression suggests they felt it necessary to defend or assert their

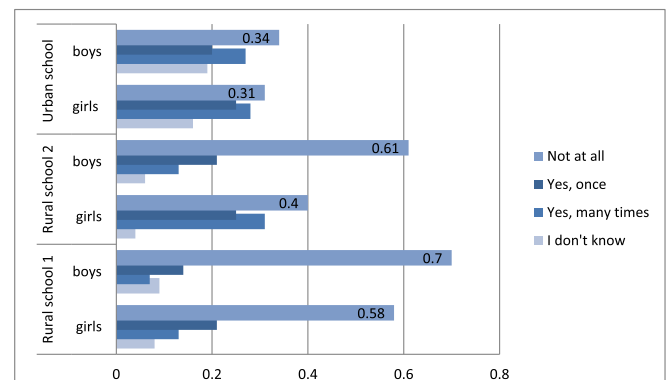


Fig. 2. Did you choose the vegetarian option for lunch this week? Survey results from the three schools. n 235 = rural school 1; n 204 = rural school 2; n 356 = urban school.

² We combined the purchase data, i.e. volume of ingredients and products purchased and used to prepare lunches and combined it with GHG intensity data to estimate the emissions of meals served. We used GHG intensities from the Foodweb-tool (Aan et al., 2013) in our calculation.

right to be a meat-eater, and perhaps also their masculinity. In western cuisine, meat eating is heavily linked with masculinity and its normativities (Rothberger, 2013). Experimentation with the vegetarian food in the schools, and with the teenagers, made these linkages loudly apparent.

Experimentation can, however, also intervene in reconfiguring or loosening cultural meanings. This, in fact, happened during our tasting demos. The teenagers were more open to protein sources that were completely new to them, such as lupin tempeh, fava beans and crickets, and learned to appreciate some of them due to their taste and new meanings that were attached to them (e.g. roasted tempeh resembling potato chips), as an exciting experience (crickets) or because they were linked to rural livelihoods (locally grown fava beans). The tasting demos were, however, one-off events and a real widening of cultural meanings would require recurring exposure. At the urban school, the boys' reactions were much more open and accepting compared to the two rural schools (Fig. 2), and the reactions of the male environmental researchers at SYKE were similarly positive. This may indicate that some reconfiguration of affluent (urban) food practices is already taking place (see also Bakker and Dagevos, 2012; Vainio et al., 2016).

3.3. Milk vs vegetarian: reconciling various goals through compromise

The introduction of a free vegetarian option on the school lunch menu caused friction in the kitchen as well, clashing with other goals set for school dining. In one of the schools, for example, the head of the kitchen refused to place the vegetarian options on the same service line as 'normal food'. Offering both options side by side would have required relocation of the milk dispensers. She interpreted this to have been against the nutritional guidelines and the EU school milk programme, stating that fat-free milk should be easily on offer for the children. The kitchen head compromised by investing in a new service line and offering vegetarian options next to 'special diets'. Unfortunately, this did not invite pupils to experiment with vegetarian food and the consumption of vegetarian meals remained moderate during the first months (Fig. 3, rural school 1).

The tinkered compromise actually enforced the conventional frame prioritising milk as an important nutritional element in school food. This was partly due to the physical limitations in providing smooth access to food. We observed similar challenges also in the urban school. During the environmental week that we organised at the school, the kitchen re-organised access to vegetarian options on all lines instead of just one. Consumption of

vegetarian meals increased (Fig. 3, urban school, November 2017). The increase was likely due in part to our awareness-raising efforts. However, student-union members suggested afterwards that providing easy access to vegetarian options should be made a permanent solution. The kitchen staff admitted that this would be ideal, but practically impossible because of the limitations of the service line and the practices of the kitchen.

Even though the kitchens have not yet developed good solutions to these problems, the experiments made visible the frictions between increasing the supply of vegetarian food and ensuring the provision of adequate nutrition and smooth access to service lines. In addition, the experiments have triggered new processes of tinkering and attentiveness that are already changing and challenging the existing practices at the school kitchens. They have also made pupils attentive to sustainable eating and prompted their participation in designing school dining.

3.4. Gourmets go vegetarian: articulating new possibilities

Our surveys and group discussions revealed that teenagers in all three schools asked for more spicy food. They argued that spices should be made available in the dining hall and made concrete suggestions for more spicy dishes. In one of the schools this led the head of the kitchen to reframe vegetarian food – not as the sustainable and healthy alternative – but as the tastier one. She started to convey the message back to the pupils: 'if you want to eat more spicy food, go for vegetarian'.

Rather than collecting just data about the pupils' preferences, our experiments acted as sites for collective thinking, speculation and exchange. Spicing up school food resonates with many practices in the kitchen, thus being an example of various goals becoming newly coordinated and tinkered with. Vegetarian food can be spicier when alternative meals are available for those (e.g. smaller children) who dislike spicy food. Realizing this freed the kitchen to find a solution to tastier vegetarian food and to some of the pupils' preference for spicy food. Previously, they were forced to prepare a single meal for all children.

The example demonstrates that the experimental setting, including both the new optional vegetarian dish and the engagement of the pupils, led to the empowering of the whole situation, encouraging the kitchen staff to rethink school food. We do not yet have long-term evidence of how the shift from a nutritional to culinary framing worked in terms of increased consumption of vegetarian food. However, all ready now, it has succeeded in opening up a new horizon for thinking about school food.

In one of the pupils' menu design sessions the new, more versatile school food was put strikingly to the test. In the sessions we asked the pupils to choose dishes they liked. The weekly menus were supposed to meet the criteria set by the nutrition recommendations and to include one Veggie Day as well as vegetarian alternatives to meat and fish. One group of pupils wanted to provide an alternative dish option also for the Veggie Day, even though normally only one vegetarian option was offered. The head of the food service commenting on the menus immediately gave the green light to the pupils' idea: 'For sure you can have two vegetarian alternatives on that day!' In addition to giving us insights into what kinds of (vegetarian) food the pupils like or dislike, the menu-making session created a setting in which the conventions of school food were made explicit and questioned. This can also be interpreted as a step forward in the path of not seeing vegetarian food as an 'other' option to the 'normal' (meat). The exercise encouraged the pupils – and also the kitchen staff – to think about vegetarian food in more diverse ways. Experimenting with vegetarian food may hence carry a potential of changing school dining in a much broader sense.

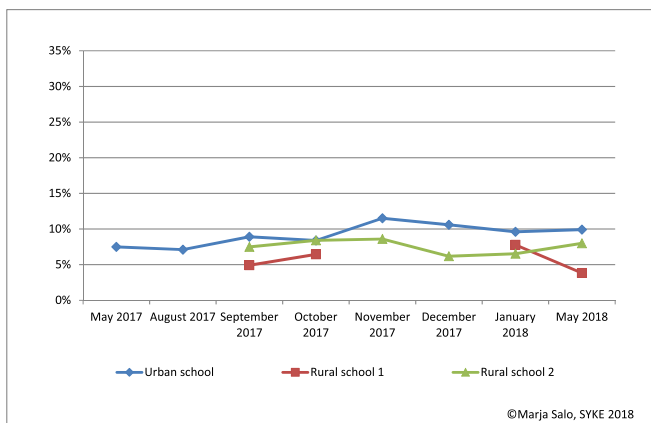


Fig. 3. Share of optional vegetarian meals of all meals consumed at the three schools.

3.5. Questioning the goals of experimentation: ethical concerns raised

Our school experiments also evoked concerns. In particular, some teachers and parents questioned the emphasis on vegetarian food. Some parents at the urban school contacted us and asked for caution: teenagers easily interpret food and eating in black and white terms. If they switch to being full vegans, complete re-organisation of cooking, shopping, eating – and the whole of daily life at home – would be required. These warnings of the potential consequences of the interventions highlighted the ethical considerations related to experimental research. Such was also the case with teachers in one of the rural schools who were worried about the girls' eating. They raised concerns about girls becoming vegan because they want to lose weight or without necessarily understanding the extra effort required to ensure the vegan diet has sufficient nutritional value. Concerns about pupils skipping lunches were also raised. These concerns made explicit and challenged the political implications of our experiments, suggesting that we should also seek ways of encouraging teenagers to eat properly at school.

The politics of experimentation was also targeted by some parents and teachers who questioned our focus on vegetarian food from the perspective of food production, arguing that it would be more important to experiment with locally sourced food. In addition, some teachers questioned why we did not talk more about animal welfare with the pupils and considered that approach to be more powerful in reducing meat eating.

The concerns raised call for sensitivity and caution when experimenting with sustainable eating, especially when dealing with teenagers' and children's eating.

4. Discussion

The collective that formed around the sustainable eating experiments – the kitchens and food service staff, our colleagues dining at the SYKE restaurant, the pupils and their teachers and parents, and we researchers – all learned from the experimentation, albeit different things. The lessons learned complement our understanding of the studied four approaches to experimentation (Table 2).

Our experimentation with nudging concretised the problems related to the assumption that sustainable dining can be promoted by cognitive means and by giving information about the environmental impacts of food choices. This did not work, even in the case of highly environmentally aware customers, such as environmental researchers (cf. Grankvist and Biel, 2001). However, our experimentation in the SYKE restaurant did not prove nudging as an efficient solution, either. The reduction in meat consumption occurred only after the kitchen prioritised vegetarian recipe

development in their supply. Our nudging experiments were, however, successful in the speculative sense: they challenged and eventually also forced us to develop a more dynamic approach to experimentation with sustainable eating.

Extending our approach with practice theories showed us that the use of meat will not change unless all of the different elements of our eating practices evolve and integrate anew. We were forcefully confronted by the cultural meanings and material infrastructures normalising meat eating in the schools. The teenagers either resisted or supported vegetarian options as part of their identity building, which was culturally anchored. In addition, the arrangement of the service lines favoured meat and milk as the main nutritious foods. Such path dependencies do not change easily; rather, their breaking up requires recurring performances and interventions in multiple elements of practice.

Understanding experimentation as tinkering led us to explore the frictions confronted in more detail. It allowed us to identify compromises that make it possible to reconcile different goals and practices for sustainable eating. However, our school experiments point out that tinkering with compromises does not always lead to major transformations, but rather to small amendments and adaptations of existing practices. Therefore, we also need speculative thinking that can support the articulation of new possibilities and ways of thinking about sustainable eating.

Importantly, speculative experimentation involves empowerment of the settings in which sustainable dining is practiced and talked about. Experimentation is thus not just a way of testing what would work in real life situations or identifying the problems that slow down transformation, but a site of engagement (see also Marres, 2009) that potentially alters the ways in which food is configured. Our sessions aimed at gathering information on pupils' eating preferences offered opportunities for exchange between the pupils and the kitchen staff. This exchange led to new interpretations about the position of vegetarian food at the schools, not as the 'other' to 'normal' meals, but as a diversifying factor. Although we do not yet know whether this change in thinking will support sustainable dining in the long run, it has already opened up new horizons for sustainable school dining, such as offering vegetarian food as a more diverse and tasty option. In the meantime, the change might increase the teenagers' interest in eating school lunches. As a consequence, the multiple goods of school dining might become coordinated anew.

5. Conclusions

The critical role of everyday practices in climate change mitigation offers novel openings for experimental research. Our exploration of four alternative theoretical and methodological approaches calls attention to the different premises and outcomes of behavioural, practice-oriented, pragmatic and speculative ways to

Table 2
Learning gained from the different experiments in sustainable eating.

Approaches to experimentation	Learning gained from experimentation with sustainable eating
Nudging behavioural change	Automatic, intuitive behaviour important in guiding daily eating behaviour. Not enough alone to achieve enduring changes in eating practices.
Interventions in integrated elements of practice	Resistance to vegetarian food anticipated due to cultural meanings attached to meat. Path-dependencies in recurring everyday practices are hard to break, in particular when they interlink all elements of practice.
Practical tinkering	Multiple goods related to food raise tensions in the transformation towards sustainable eating. Tinkering with compromises easily leads to minor amendments and adaptations of existing practices.
Speculation	Experimentation valuable in creating events for collective engagement and opening new horizons of thinking about sustainable eating. Feed-back loop to real-life practices important in making speculation reality. Encourages ethical reflection on sustainable eating and its multiple dimensions.

experiment. Testing of the different approaches in the context of sustainable eating underlines the need to broaden the conception of experimentation in research. On the basis of our exploration, we call for more attentive and speculative experimental research aimed not only at testing out solutions for sustainable everyday practices, and eating, but also at reflecting on the practice of experimentation.

Reflection on the practice of experimentation helped us to open up new horizons in thinking about sustainable eating. In the context of workplace and school dining it meant not only seeing experimentation as a way to gain knowledge about the premises of sustainable eating behaviour and practices, but also approaching experimentation as a means to become attentive to frictions as they are confronted in the practice of eating and preparing good food. In this way, attentive experimentation can help improve practices. In addition to attending to frictions, realising the speculative nature of our interventions sensitised us to the genuinely new approaches to sustainable eating required to overcome barriers.

Attentive and speculative experimental research invites us to diversify the role of research and researchers and to understand the multiple ways in which research intervenes in sustainable eating and the settings in which it is practiced. Rather than taking a normative stand, attentive and speculative experimentation calls for hesitation to allow space for genuinely new knowledge to be created. Researchers should stay alert to the multiplicities and resistances raised by their experiments – and also keep others alert to them. We see this as anything but a modest responsibility. Researchers might need to revisit the normativities guiding their research and the experimental settings they create. In sustainable school food this meant attending more carefully to the diversity of food and practices.

With these notions, attentive and speculative experimentation radically extends the contribution of experimental research to the transformation of sustainable everyday practices. These perspectives also underline the need to learn more systematically from failed experiments – as it is these ‘failures’ that uncover the critical path dependencies guiding everyday practices and the frictions caused by overlapping goals and practices. Failures can assist us in speculating and building more attentive experiments in the next phase.

Declarations of interest

None.

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