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RESEARCH ARTICLE

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From locked-down to locked-in? COVID-induced social practice change across four consumption domains

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ABSTRACT

The COVID-19 pandemic has disrupted everyday living and social practices, prompting questions of whether more sustainable consumption patterns are emerging and the likelihood of their long-term retention. To examine these questions, we apply a practice-based approach to a quantitative study of COVID-driven practice changes in the domains of food, material consumption, housing, and mobility conducted in four global North countries (Germany, Italy, Japan, and the United States). We discuss the trends emerging from our analysis from a sustainability perspective and address the role of social practice elements – materials, meanings, competences – in the establishment and discontinuation of sustainable consumption practices. Observed sustainability gains in specific practices and domains (such as a decrease in material consumption and more sustainable food practices and diets), may be offset by other practices, particularly a renewed desire for air travel and larger housing. The uptake and lock-in of sustainable practices are driven by a combination of meaning and material-related practice elements such as the alignment with interests and personal values; the availability of labor, energy, or time; and the ability to routinize practices. However, new policies to support emerging lifestyle shifts, as well as the development of businesses catering to and encouraging low-impact practices, may ultimately determine the formation of a more sustainable "new normal." We also reflect on the strengths and limitations of using quantitative research methods in studies of sustainable consumption informed by social practice theories.

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Introduction

The role of crises and disasters in accelerating social change and facilitating transitions in socio-technical regimes has long been recognized (Cohen 2020a; Frost 2020; Kivimaa et al. 2021). The COVID-19 pandemic is an example of such a disruptive event, which is likely to have far-reaching impacts with lasting repercussions on production and consumption practices. The pandemic has been playing out as a "real-time experiment in downsizing the consumer economy" (Cohen 2020a, 1), sparking extensive debates about its potential to facilitate a sustainability transition in key consumption domains (e.g., Bodenheimer and Leidenberger 2020; Boons et al. 2021; Brydges, Retamal, and Hanlon 2020; Dartnell and Kish 2021; Echegaray 2021; Goffman 2020; Kanda and Kivimaa 2020; Nemes et al. 2021; Sovacool, Furszyfer Del Rio, and Griffiths 2020). More research is needed to understand whether the pandemic is indeed driving lasting sustainability-oriented changes across countries and consumption areas and to identify and quantify these changes, particularly from a social practice perspective and with large-scale empirical data.

To address these gaps, we investigated COVID-driven changes in social practices related to sustainable consumption in four domains – food, material consumption, housing, and mobility. We employed the concept of social practice elements – materials, meanings, and competences – as described by Shove, Pantzar, and Watson (2012) to examine how practices are established or discontinued, using data

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from a survey administered in February and March 2021 in four countries in the global North: Germany, Italy, Japan, and the United States. We also examine the observed trends from a sustainability perspective and address the role and dynamics of social practice elements in influencing the uptake and long-term retention of sustainable consumption practices. Finally, we reflect on promising areas of practice-oriented policy intervention and detail the strengths and limitations of quantitative research methods in social practice research.

Researching sustainable consumption through social practice theories

Growing concern around the global ecological crisis and the need to collectively shift toward more sustainable lifestyles has intensified efforts to understand how changes in consumption patterns occur (Geels et al. 2015; Sandberg 2021). At the household level, the consumption areas with the most significant environmental impacts are food, housing, and mobility, followed by material consumption (e.g., clothing) (Akenji et al. 2019; Geiger, Fischer, and Schrader 2018; Sandberg 2021). For each of these consumption domains, significant reductions in environmental impact and carbon footprint are possible (Carlsson Kanyama, Nässén, and Benders 2021). The practices associated with these consumption domains, however, arise not only from individual habits, values, and preferences, but also from an array of conflicting concerns and negotiation processes occurring in everyday life, which in turn are influenced by social and physical infrastructures acting as prerequisites to access, provisioning, and use (Sargant 2014).

Studies on the uptake of sustainable consumption practices, however, often focus on individual behavior and decision-making processes, ignoring or underplaying the structural and societal aspects influencing (un)sustainable practices (Batel et al. 2016; Hargreaves 2011). To address this issue, research has started embracing social practice theories (SPT) (Corsini et al., 2019). SPTs, despite their heterogeneity, all foreground practices – rather than individuals or society – as the main focus of inquiry and basic analytical unit (Reckwitz 2002; Shove, Pantzar, and Watson 2012). Consequently, understanding how transitions toward more sustainable forms of consumption occur entail a shift in focus from individual (un)sustainable behaviors to (un)sustainable practices and how they come into existence, take hold, and persist – or disappear – within society (Shove and Walker 2010).

In this article, we adopt the understanding of social practices advanced by Shove, Pantzar, and Watson (2012), which regards these activities as assemblages of three elements – material, competence, and meaning – and their constantly co-evolving connections. First, "material" refers to the physical elements of practices, including "objects, infrastructures, tools, hardware and the body itself" (Shove, Pantzar, and Watson 2012, 23). Second, "competence" is defined as the knowledge – both broad intellectual knowledge as well as skills-based knowledge – required to undertake or complete specific tasks. Finally, "meaning" encompasses emotion, motivation, beliefs, and social norms, namely "the social and symbolic significance of participation" in a certain practice (Shove, Pantzar, and Watson 2012, 23). Practices emerge or change as their elements, or the links between them, build up or break (Hargreaves 2011). This perspective helps to reframe the discussion around the drivers of consumption and to understand how everyday activities are shaped by the interaction between societal variables and individual agency (Kennedy, Cohen, and Krogman 2015). From an SPT perspective, this requires identifying the materials, meanings, and competencies that allow specific practices to "recruit" practitioners (Kurz et al. 2015; Spurling et al. 2013).

Previous research employing SPT to investigate consumption patterns includes some of the areas considered in this study such as mobility (Cass and Faulconbridge 2016), food procurement, and consumption (Leray, Sahakian, and Erkman 2016; Plessz et al. 2016; Tuscano, Lamine, and Bre-Garnier 2021), and household-energy use (Gram-Hanssen 2011; Jensen 2017). So far, however, very few SPT studies have examined multiple consumption areas concurrently, a gap that hinders our understanding of how practices that are interconnected across consumption domains influence each other (exceptions include Forno, Laamanen, and Wahlen 2022; Greene, Hansen, et al. 2022; Hoolohan et al. 2022 in this special issue).

Even less common is the use of quantitative methodologies in SPT research, which tends to be dominated by historical narratives and qualitative approaches (Browne et al. 2014; Halkier and Jensen 2011). This includes SPT studies of sustainable consumption, with a few exceptions (e.g., Browne, Medd, and Anderson 2013; Hansen 2016). Some scholars, however, have highlighted the potential of quantitative and mixed methodologies to capture more systematically how practices are performed within and across populations (Browne, Medd, and Anderson 2013; Browne et al. 2014). Despite the undisputed importance of a rich qualitative examination of practices, quantitative research based on representative samples allows for statistical

generalizations that can expand our understanding of how widespread a practice or pattern of practices is within a population. This is important when attempting to use SPT to inform policy interventions as it allows researchers to make decisive claims and to identify useful indicators to track changes in practices over time (Browne, Medd, and Anderson 2013; Browne et al. 2014; Spurling et al. 2013). In the context of a worldwide pandemic with major impacts on everyday life, employing a multi-country, large sample-size survey to examine practice changes from an SPT perspective takes on added significance.

Disrupting practices and reconfiguring elements for sustainability policy

Disruptive events can induce changes in practices by making normal routines and habits that are performed to meet particular needs no longer possible or desirable, leading to the search for alternatives. The COVID lockdowns altered household routines, rhythms of work and leisure, abilities to travel freely, access to certain materials, and prices of daily necessities. In SPT terms, disruptions can initiate practice changes through fading or emergence of practice elements (Kadibadiba, Roberts, and Duncan 2018), resurrection of practices from the past (Maller and Strengers 2015), purposive experimentation (Hoolohan et al. 2022), or shifts in how time, space, and modality are used or perceived under new conditions (Greene, Hansen, et al. 2022; Forno, Laamanen, and Wahlen 2022). Accordingly, disruptions can act as windows of opportunity for sustainability transitions if practices with smaller environmental footprints can take root.

However, if these sustainable practices are not supported by broader material, cultural and infrastructural shifts, practices are likely to revert to the pre-crisis situation. Boons et al. (2020) identify several conditions and policy interventions that can prevent "bouncing back," such as positive emotional or socio-cultural attachment to new practices and changes in infrastructure, facilities, or equipment that assist in the rejection of old or the uptake of new practices. Policy interventions should be practice-oriented and target the "negative" elements that compose an unsustainable practice or support the positive elements that comprise sustainable practices (Shove, Pantzar, and Watson 2012; Spurling et al. 2013).

To determine which elements could be targeted for practice-oriented policy, identifying practices that have changed during the pandemic and how the elements comprising the practices have changed is essential. In addition, understanding whether the observed shifts in practice are temporary or long-lasting, especially in the context of sustainability, will inform if and how certain elements should be targeted (Boons et al. 2020). For example, material elements, such as the existence of certain infrastructure or the prices of goods, affect the ability of a practice to be recrafted or substituted. Building infrastructure or supplying subsidies are possible material element-focused policies. Competency and meaning elements could be supported through public campaigns, reskilling classes, or community-network building. A policy that targets these elements would build off society-wide shifts in practices experienced during the disruption and "add to and subtract from the 'range of possible performances'" (Spurling and McMeekin 2014, 84). Practice-oriented policy interventions, however, may not be so straightforward (Maller and Strengers 2015). Due to the interlocking nature of practices, seemingly unrelated elements may be quite relevant to how a practice is composed, established, or discontinued (Shove, Pantzar, and Watson 2012). Individual and household socio-economic or cultural differences may also affect how the impact of a change to one element is experienced (Greene, Hansen, et al. 2022).

COVID-induced practice changes and implications for sustainability

The global disruption caused by the COVID-19 pandemic has induced changes in practices with potential impacts on sustainability transitions (Boons et al. 2020). These changes are reflected in the four consumption domains considered in this article, with both positive and negative sustainability implications. Concerning food practices, researchers in countries such as Italy and Spain have found evidence of dietary shifts toward foods with lower environmental footprints (such as the decrease in meat and increase in fruit and vegetable consumption) (Matacena et al. 2021; Rodríguez-Pérez et al. 2020), and toward consumption of more organic and local food (Di Renzo et al. 2020). However, other studies conducted across Europe, Canada, and Australia report the increase in the use of food packaging and single-use items (Nuijten 2020), difficulties in accessing or acquiring sustainable and healthy food (Lee et al. 2021), and increased use of take-out food services and online food shopping (Nielsen et al. 2021; Nuijten 2020). In Brazil, improvements in dietary patterns have been associated with increased time available to devote to home cooking (Tribst, Tramontt, and Baraldi 2021). Self-provisioning (e.g., gardening) also appears to

have gained popularity since the beginning of the pandemic (Mullins et al. 2021).

Research on goods consumption during COVID-19 shows evidence of an increase in consumers' awareness of product sustainability and the impact of their own consumption habits across the globe (Esposti, Mortara, and Roberti 2021; MasterCard 2021; Roland Berger GmbH 2021). In terms of more specific changes in purchasing behaviors, most studies have found an increasing trend toward shopping locally (GfK 2021; Esposti, Mortara, and Roberti 2021; MasterCard 2021) or purchasing regional products (GfK 2021). Research from various European countries also clearly indicates a decrease in product consumption across various retail sectors, including clothing, toys, and books (Hodbod et al. 2021; Esposti, Mortara, and Roberti 2021).

Changes have also been observed in the housing and mobility domains. Regarding housing, there has been a reconfiguration in the use of private space, with a shift from public to domestic provisioning and a decrease in the use of shared spaces (Giorgi et al. 2021) that implies an increase in the resource intensity of daily life (Holmes, Lord, and Ellsworth-Krebs 2021). When homes take on functions they did not previously possess (e.g., working, home-schooling, leisure, exercise), more space and potentially larger housing units may be required (Tokazhanov et al. 2020). Some authors have raised concerns over the potential increase of single resident units, due to their higher carbon footprint compared to shared living spaces (Echegaray 2021).

In the mobility domain, the International Civil Aviation Organization (ICAO) observed a drastic worldwide decrease in air travel (ICAO 2022). At the same time, data-analytics companies such as Citymapper saw a decline in shorter distances commuting in cities all over the globe (IEA 2020). Changes in commuting patterns have been influenced not only by enforced restrictions (lockdowns, curfews) but also by the possibility (or acceptance) of remote work (Ando et al. 2021). At the same time, concerns about close proximity to others have decreased public transport use in favor of individual motor vehicles (Anke et al. 2021; Hodbod et al. 2021), but also of bicycles and walking (Anke et al. 2021; König and Dreßler 2021).

Table 1 shows a sample of representative studies that fulfill the following two criteria simultaneously: research explicitly addressing the linkage between sustainability and COVID-related consumption changes (in at least one of the four target-consumption domains) and quantitative (i.e., survey-based) research. The table also shows COVID-related sustainable consumption studies explicitly employing an SPT approach, regardless of the methodology

Table 1. Overview of prior survey-based studies on sustainable consumption practice changes during the pandemic.

		Consumption domain						
Authors	Month and year of data collection (Country)	Food	Material consumption	Housing	Mobility	Sustainability focus	Social practices focus	Survey-based
Esposti, Mortara, and Roberti (2021)	October–December 2020 (Italy)	×	✓	×	✓	✓	×	✓
Janssen et al. (2021)	Spring 2020 (Denmark, Germany, Slovenia)	✓	×	×	×	✓	×	✓
MasterCard (2021)	January–March 2021 (Global – 24 countries)	×	×	×	×	✓	×	✓
Tchetchik, Kaplan, and Blass (2021)	March–April 2020 (Israel)	×	✓	×	×	✓	×	✓
Tribst, Tramontt, and Baraldi (2021)	May–June 2020 (Brazil)	✓	×	×	×	×	✓	✓
Balest and Stawinoga (2022)	April 2020 (Italy)	×	×	✓	×	✓	✓	✓
Boons et al. (2020)	n/a	✓	✓	×	✓	✓	✓	No (review)
Holmes, Lord, and Ellsworth-Krebs (2021)	June–July 2020 (UK)	×	✓	✓	×	✓	✓	No (qualitative)
Hoolohan et al. (2022)	May–July 2020 (France, Germany, Italy, Netherlands, Norway, UK, and Vietnam)	✓	×	×	×	✓	✓	No (qualitative)
Lobach (2020)	April–May 2020 (Sweden)	✓	×	×	×	×	✓	No (qualitative)

Note: The table also shows COVID-related consumption studies employing an SPT approach (regardless of the methodology).

(Balest and Stawinoga 2022; Boons et al. 2020; Holmes, Lord, and Ellsworth-Krebs 2021; Hoolohan et al. 2022; Lobach 2020). Most of the studies listed in the table are limited in scope, both geographically and topically, with only a few quantitatively comparing large populations across different countries and regions, or across different sustainable consumption practices. Some consumption domains, such as food, have also received more attention than others (e.g., use of living space). The timing of studies is also crucial, and many published studies have relied on data collected at the very onset of the pandemic, with long-term practice changes only discussed as predictions. Finally, most of the articles employing an explicit SPT angle are qualitative studies, save exceptions such as Balest and Stawinoga (2022).

To address these gaps, we use a multi-country, quantitative survey-based approach to examine social practice change through the following research questions: (1) How are social practices in four consumption domains (food, material consumption, housing, and mobility) changing as a result of COVID-19 and what are the sustainability implications of such changes? (2) How do material, meaning, and competence elements enable or act as barriers to sustainable practice change? Answering these questions will further our understanding of the dynamics of consumption-practice changes during the pandemic and their potential sustainability and policy implications, as well as advance discussion on the use of quantitative methods in SPT research.

Methodology

Survey design: gauging sustainability

The impact of COVID-induced disruptions on everyday life has been felt unevenly across countries due to different levels of lockdown restrictiveness and country-specific contexts. To capture this diversity in a systematic way while exploring changes in practices, we deemed a large-sample quantitative survey to be an appropriate tool. The survey consisted of questions on practices in the domains of food, material consumption, housing, and mobility. We designed the questions based on existing literature on sustainable consumption in each domain, selecting practices with established impacts on resource consumption that would imply sustainability gains or losses in case of widespread change in how such practices are performed (Sandberg 2021). In 2020, the top four consumption sectors with negative lifecycle impacts on the environment and climate change in Europe were food, housing, mobility, and textile consumption (Duhoux et al. 2022). It is reasonable to expect similar distributions in Japan and the United States, which were also included as part of our study.

Regarding food, there is a high consensus on the importance of reducing the consumption of animal products, especially meat, and moving toward plant-based diets (Hoolohan et al. 2013; Willett et al. 2019). Although other aspects are less clearly established, the literature indicates the following as significant: avoiding foodstuffs transported over long distances, especially by air freight, in combination with eliminating consumption of unseasonal products (Hoolohan et al. 2013; Vargas et al. 2021); choosing sustainably-produced food such as organic products (Cristiano 2021; Rees 2019), even though impacts of these production methods are variable (Poore and Nemecek 2018; Vittersø and Tangeland 2015); decreasing consumption of discretionary products, particularly those rich in saturated fats or sugar such as ultra-processed food (Poore and Nemecek 2018).

The sustainability of food *practices* per se is still severely under-researched, especially in relation to the sustainability implications of public versus private forms of eating (Biermann and Rau 2020). On one hand, out-of-home food consumption may have positive impacts due to increased efficiency in terms of energy use (Spurling et al. 2013). However, research shows that when eating outside of the home people tend to eat more unsustainable food types, especially meat (Biermann and Rau 2020; Pfeiffer, Speck, and Strassner 2017). From this perspective, home-cooking allows higher control over what people eat and better alignment with their values. Finally, the use of food-delivery platforms, which has skyrocketed during the COVID-19 period, has been linked to a significant generation of waste and a high carbon footprint (Li, Mirosa, and Bremer 2020).

In the case of material-consumer goods (such as clothing and electronic devices), a significant decrease in consumption – that is, purchasing fewer newly produced goods – is the most essential requirement for sustainability (Neumann, Franc, and Heinrichs 2014; Sohn et al. 2021) as this reduces the use of natural resources and the environmental and social impacts of production. Among all consumption areas, textiles ranked fourth for their impact on the environment and climate change, third for water and land use, and fifth for their use of raw materials and greenhouse-gas (GHG) emissions in Europe in 2020 (EEA 2022). As for electronics, several studies show that extending the lifetime of devices such as laptops, televisions, and printers is environmentally preferable since the impacts of the production phase outweigh those of

the use phase (Boldoczki, Thorenz, and Tuma 2020; André, Ljunggren Söderman, and Nordelöf 2019; Prakash et al. 2016). Children's toys, books, digital video disks (DVDs), and compact disks (CDs) generally do not cause significant environmental impacts during their use phase, so it is reasonable to assume that for these categories the production phase is likewise the most environmentally harmful. As discussed by Sandberg (2021), there are multiple ways to achieve sustainability goals, including the absolute reduction of product consumption, lifespan extension of existing products, and sharing of goods among multiple consumers, all of which would manifest themselves in our survey as a reduction in purchasing.

The consumer-side environmental impact of housing is primarily connected to energy consumption for heating, cooling, and lighting (Sandberg 2021), and is best addressed by decreasing per capita space consumption (Cohen 2020b; Zanocco et al. 2021). The higher the intensity of the use of space, the more sustainable it can generally be considered in and of itself. However, space-usage practices are better assessed as bundles – meaning the interconnections between practices due to their co-location or simultaneous performance (Pantzar and Shove 2010) – considering possible tradeoffs. In the case of office spaces, such tradeoffs may include a reduced intensity of use of facilities at the workplace, the purchase of new electronic equipment or furniture (Holmes, Lord, and Ellsworth-Krebs 2021), and increased energy consumption (Tokazhanov et al. 2020) due to less efficient building systems at the home compared to the workplace. The overall size of space used, for example, the relative size of homes, is also an important consideration for sustainability, given that smaller homes generate smaller impacts (Cohen 2020b).

In the mobility domain, the most effective sustainability-oriented interventions are a reduction of the total amount traveled by motorized transport modes and the switch from transport modes with high environmental impact per kilometer to land-based public transport or active transport (walking and bicycling). All motorized modes of transport cause noteworthy amounts of GHG emissions, with aviation and private cars causing significantly more emissions per passenger kilometer than rail and road-based public transport (Doll et al. 2020). Active modes of transport usually are considered carbon neutral. Active mobility is preferred over private car use in many other sustainability dimensions as well such as pollution, livelihood in cities, and public health (Moura and Kalakou 2019; Kii and Hanaoka 2003).

Survey design from a social practice elements perspective

The survey questions were designed to gauge whether respondents' practices had changed since the beginning of the pandemic, and, if so, whether the changes had been retained by the time of the survey (February/March 2021 or one year into the pandemic). In the food section, respondents were asked to indicate whether they had (1) already adopted various practices related to food procurement, preparation, and diet before the pandemic, (2) tried and continued during the pandemic, (3) tried and stopped, or (4) never tried. For material consumption, respondents were asked about their frequency of purchase of certain goods prior to and during the pandemic. We then inquired about a range of environmentally or socially sustainable material-consumption practices, particularly whether survey participants had already been performing them before COVID-19 and what changes they tried during the pandemic. For housing, respondents were asked (1) whether they had always used certain rooms in their home, (2) started using them during the pandemic, or (3) had not been using them before and continued not to. We inquired whether they had implemented changes in their housing situation or were planning them, and if so, what these changes were. For mobility, respondents were asked (1) to report their usage of different transport modes before, during, and after (planned) the pandemic and (2) their changes in trip frequency for different purposes and different transport modes.

To understand how new sustainable practices were established and locked-in and unsustainable practices discontinued, we then asked respondents to give reasons for changes and continuities in each of these practices, designing the response options to reflect materials, competences, and meanings underpinning the performance of practices (Browne et al. 2015). An "other" option was included to allow respondents to indicate reasons not captured by the predefined options. The purpose was to collect a dataset that would not only enable us to understand how (un)sustainable consumption practices emerge, are substituted, or dissolve, but also to gain insights into which practice elements enable or are resistant to recrafting. In formulating the responses, however, we had to speculate on and select the (potentially) most relevant answers and assign them to material, meaning, and competency categories (Figure 1). We did this in an iterative manner, based on previous literature published pre– and during the pandemic.

In the mobility and housing section, we also asked respondents about their intentions when the impacts of the pandemic were no longer felt in daily life, such as the factors that would enable them to

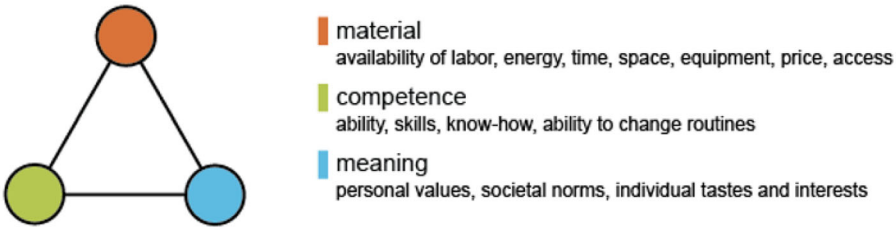

Figure 1. Elements of sustainable consumption practices as defined for survey design. *Note*: Adapted from Shove, Pantzar, and Watson (2012).

Table 2. Survey countries, sample period, and Government Response Stringency Index.

Country	Survey period	Government Response Stringency Index at the time of survey administration (100 = strictest response)	Ranking (1st = strictest)
Italy	March l0 to March 15, 2021	84.26	10th
Germany	March 10 to March 12, 2021	77.78	12th
USA	February 25 to March 7, 2021	66.21	57th
Japan	March 5 to March 15, 2021	45.37	l23rd

Note: Adapted from Ritchie et al. (2020).

use public transport or bicycles more often. Compared to the other two domains, mobility, and to some extent housing, were more directly and strongly affected by regulations such as curfews, lockdowns, and travel restrictions. As regulations and policies are not well represented by the three elements introduced by Shove (Gossen and Kropfeld 2022), we had to adjust our approach in these sections. We chose to include intentions because in some instances they give a glimpse into what supports or impedes practice change; for example, the perception of safety and hygiene may be important in determining the future use of shared modes of transport.

Survey administration and data analysis

The survey focused on four global North countries: Italy, Germany, Japan, and the United States. These nations were chosen because they experienced varying degrees of COVID-19 stringency measures, calculated through the Government Response Stringency Index (Table 2), which represents the extent to which restrictions were imposed (such as school and workplace shutdowns, closure of public transport, stay-at-home requirements, and other controls on movement and travel) during the period when the survey was administered. The ranking indicates how severe measures were in comparison to other countries at the time of the survey. Germany and Italy had the most restrictions, the United States implemented mid-level measures (due to the nature of the survey it was not possible to include regional variations), and Japan had the least stringent controls. The survey sample included 1,000 people from each country, selected among respondents aged 18+ years living in the country and with Internet access. The sample was representative of age, gender, and household income, allowing for generalization and comparison of findings. Detailed socio-economic characteristics of the respondents are shown in Tables A3–A8 (see supplementary material).

The questionnaire was administered online by a market-research institute from the end of February through the middle of March 2021 (Table 2). The timing of the study is an intrinsic limitation of this research but this situation has been a factor for most research conducted since the onset of COVID-19. Since the pandemic has been occurring in waves, peaking at different times and with different intensities, as well as the fact that lockdown conditions and restrictions have differed between countries and over time within the same country, it was challenging to choose the most appropriate moment to administer the survey. In addition, there likely are effects on people's mindset toward pandemic-bound lifestyles that are not captured by the stringency of mitigation measures (for example, people's approach to everyday-life practices was likely different at the beginning of the pandemic compared to one or two years into it).

Another potential limitation of the survey is the need to have the same question set across four countries, which implies that the results may not reflect intrinsic baseline differences due to socio-cultural, geographical, or other aspects. We addressed this issue by having native speakers check the survey content to ensure it was appropriate for each country's context while remaining comparable. Finally, it is challenging to establish when practices can be considered "locked-in." Compared to studies conducted at the beginning of the pandemic, however, data for this research were collected one year after its onset which ensured enough time for new practices to be attempted and either retained or abandoned, allowing for some level of confidence in interpreting the results.

As this is the first study of a series to investigate a large quantitative dataset, the results section is meant to offer a general overview of the data based on both descriptive and inferential statistics. To test for differences in the responses between the countries, Pearson's Chi-squared-tests (χ^2) were performed, using Cramer's V (φc) as an effect-size measure to indicate the association between two variables. Cramer's V ranges in value from 0 to 1. If respondents' answers were completely unrelated to their home country, the effect size would be 0. Values under 0.2 represent negligible to weak association, those between 0.2 and 0.4 moderate association, and those higher than 0.4 strong association (Kotrlik and Williams 2003). The data displayed in the tables are color-coded, with a darker color representing a higher percentage of respondents choosing that option.

Statistical analysis of quantitative data can also reveal the existence of practice bundles both within and across consumption domains, as well as the profiles of practitioners who changed or did not change their practices. Due to the large volume of data collected and the need to first introduce the results based on descriptive statistics, we plan to present such analyses in subsequent works.

Results

The results section is organized into two subsections: the first discusses practice changes in each of the four consumption areas, while the second addresses factors enabling or hindering the establishment, continuation, or abandonment of practices. To make the article more accessible to researchers interested in only one of the consumption areas, we have structured the results by consumption domain. A comparison across domains can be found in the discussion section. All tables referenced in the text with a number preceded by the letter "A" are included in the supplementary material. In the text of the article, we only include data displays showing the most significant results.

Changes in consumption practices

Food practices and diet

Baseline. Regarding pre-COVID food-procurement and preparation practices, Germany stood out for the significantly higher percentages of respondents who indicated that they were growing their own food (38%) and ordering food directly from a local farm or through a community-supported agricultural (CSA) scheme (34%, compared to other countries indicating percentages between 6% and 20%). Germany also had the highest share of people who reported being interested in home cooking or food processing (60%; Table A9). As for respondents' diets before the beginning of the pandemic, Germans displayed the highest level of consumption of local, domestic, organic, and vegetable/vegetarian products, but also of some types of foods associated with negative sustainability outcomes such as out-of-season produce and imported fresh produce. A large share of respondents in all countries was consuming highly processed foods (47% on average for Germany, Japan, and the United States, 36% for Italy) and meat (65% on average) before the pandemic and continued to do so at the time of the survey. Respondents from Japan and the United States were also less likely to eat organic products regularly compared to Italians and Germans (Table A10).

During COVID-19. A relatively high percentage of respondents indicated that they had been taking a greater interest in cooking meals or processing food at home since the onset of the pandemic (Figures 2 and 3). In Italy (32%), the United States (29%), and Germany (21%), respondents started and continued to cook more during the pandemic, while fewer did so in Japan (13%). During this period, ordering food directly from a local farm or through a CSA was an alternative practice that German and Italian respondents (16% and 11%, respectively) indicated in higher percentages compared to those in the United States and Japan. The lockdown also allowed some study participants to try growing their own food, with the highest percentage being in Italy (10% indicated that they tried and continued this practice) (Table A9). Regarding diets, Germany and Italy were remarkably similar in terms of change patterns: in both countries, more than 20% of respondents reported eating larger volumes of local and organic products as well as more fresh vegetables and vegetarian/vegan food compared to before the pandemic. At the same time, study participants in these countries started eating less out-of-season produce, imported fresh produce, highly processed foods, and meat. For example, 30% of Germans and 24% of Italians cut their consumption of highly processed foods. Results from Japan and the United States are more ambiguous and the percentages of people who changed their food-consumption patterns are overall lower. For the United States, the only change reported by more than 20% of respondents concerns the increase in fresh vegetables and vegetarian/vegan food. (Table A10).

Japan stands out for being the only country whose study participants reported a sharp increase in the consumption of highly processed food (21%),

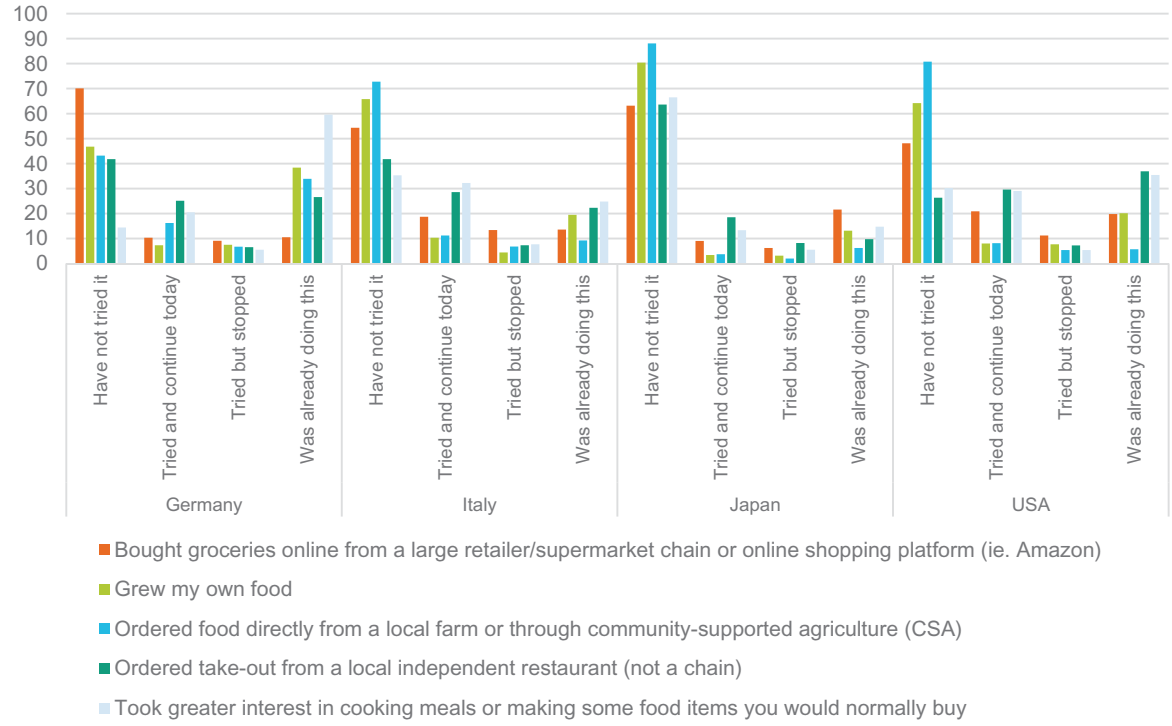

Figure 2. Reported changes in respondents' household-food practices since the beginning of the COVID-19 pandemic.

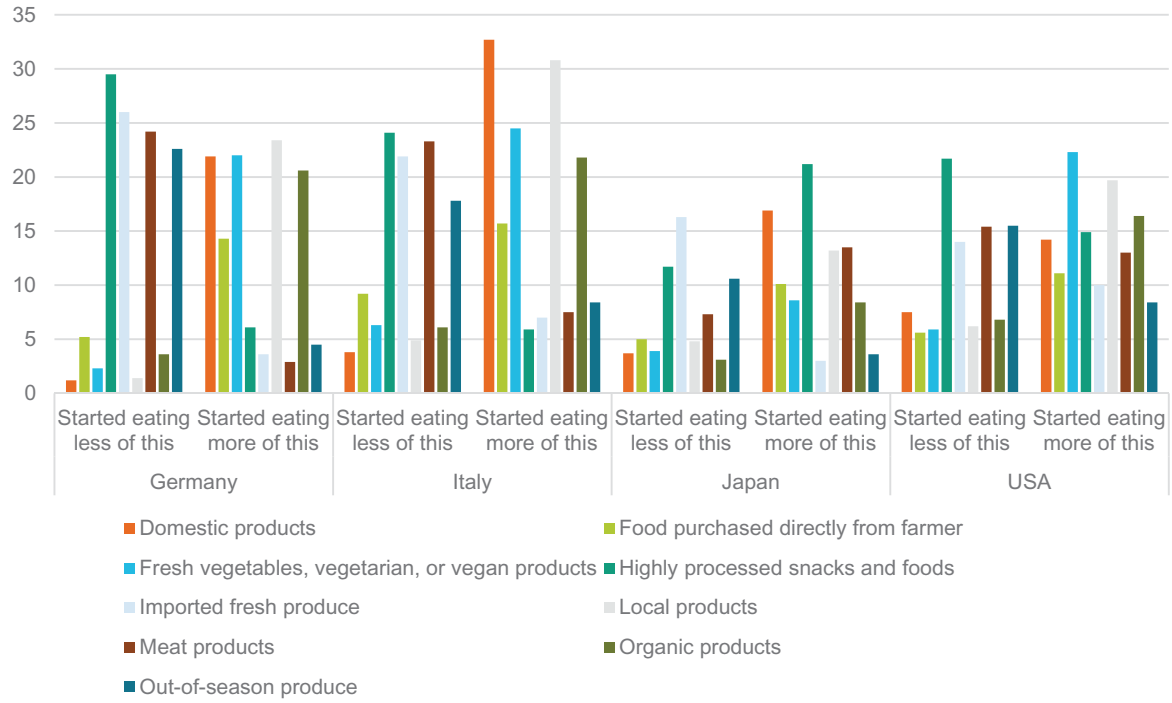

Figure 3. Reported changes in respondents' consumption of selected types of food products since the beginning of the COVID-19 pandemic. *Note*: The figure does not show respondents who were already consuming or not consuming these products.

while meat consumption decreased less compared to the other three countries. A sizable percentage of respondents in all four countries also started buying groceries online from larger retailers or online-shopping platforms, especially among study participants from the United States (21%) and Italy (19%) (Tables A9 and A10). The practice of ordering take-out meals from local independent restaurants gained significant followers in the United States, Germany, and Italy (28% of respondents on average) (Table A9).

Despite all effects being statistically significant ($p < 0.001$), significant country associations were found only for a few responses, namely, "Took greater interest in cooking meals or making some food items I would normally buy" ($\varphi c = 0.444$) and "Bought groceries online from a large retailer/supermarket chain or online shopping platform

($\varphi c = 0.538$; Table A9). While Japanese respondents were comparatively more likely to start preparing their own food during the pandemic, Germans were most unwilling to buy groceries online. "Ordered food directly from a local farm or through a CSA" ($\varphi c = 0.237$) also showed moderate association, with Germans being more likely to have tried and continued the practice or to have already been engaged in it during the pre-COVID period.

Material consumption

Baseline. Before the pandemic, Italian respondents were frontrunners in purchasing material goods of all categories regularly, whereas noticeably fewer Japanese counterparts reported purchasing material goods compared to the other three countries (Table A11). Clothing and accessories were the most popular category, with more than 50% of Japanese and approximately 80% of Germans, Americans, and Italians making regular clothing purchases. Differences in this baseline between countries were only moderate ($0.09 < \varphi c < 0.26$) for the dvarious categories. Germans were more likely to report engaging in sustainable practices across several categories; for example, more than 50% of respondents indicated looking for products with a long lifespan. In Japan, the regional/local focus was particularly strong, with 26% of respondents reporting an effort to purchase goods from local stores and 21% preferring locally or regionally produced goods (Table A12).

During COVID-19. As a result of the pandemic, respondents reported changes in their purchasing habits across all material-goods categories. Except for Japan, the tendency to purchase less always outweighed the tendency to purchase more goods in all categories, with the notable exception of online-entertainment services (Table A11). The category "clothing and accessories" showed the most significant decrease, ranging from 70% (Italians) to 41% (Japanese). In Italy, Germany, and the United States approximately one-third of respondents purchased fewer electronic devices than before.

Overall, practice changes were particularly dramatic in Italy and the United States, where at least one-quarter of the respondents in every category (except online-entertainment services) related purchasing less than they had before the pandemic. Japanese study participants reported the fewest changes. The levels of association between mid-pandemic purchasing behavior and country, however, are low ($\varphi c < 0.2$ for all categories), indicating no strong differences between countries. In other words, while country characteristics and lockdown strictness did not play a large role, at the individual level nearly half of all respondents changed their purchasing behavior.

Importantly, most of the people who purchased fewer material goods reported that they did not miss the items they had purchased regularly before the onset of the pandemic, especially in Germany (56–90%) and Italy (52–77%) across the categories (Figure 4). Italy also had the highest percentage of study participants who had tried new sustainable consumption practices since the beginning of the pandemic and continued them at the time of the survey (Figure 5, Table A12), with on average 19% of respondents. Japan, by contrast, had the highest percentage of people who did not make any changes and the lowest percentage of people trying and continuing new practices, at an average of 8% across all categories. Germany and the United States (on average 13% across categories in both countries) were consistently in the middle. Across all four countries, people were most likely to have started looking for goods with a long lifespan, less plastic packaging, could easily be repaired, and available for purchase in local stores. The data show a moderate level of association ($\varphi c = 0.219$) between countries and the likelihood to look for products with minimal plastic packaging. The categories related to clothing were

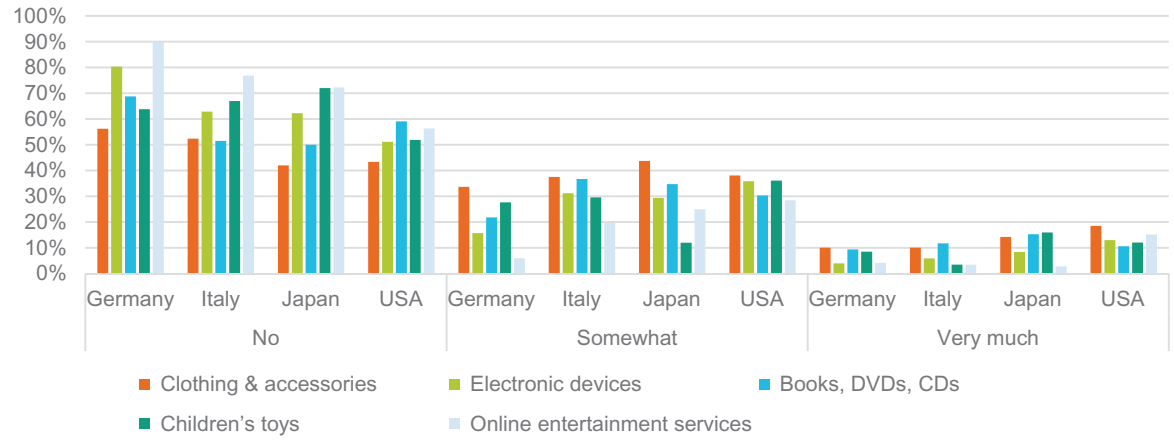

Figure 4. Do you miss the items you have purchased less since the start of the COVID-19 pandemic? *Note*: Asked only of respondents who reported purchasing less for each category.

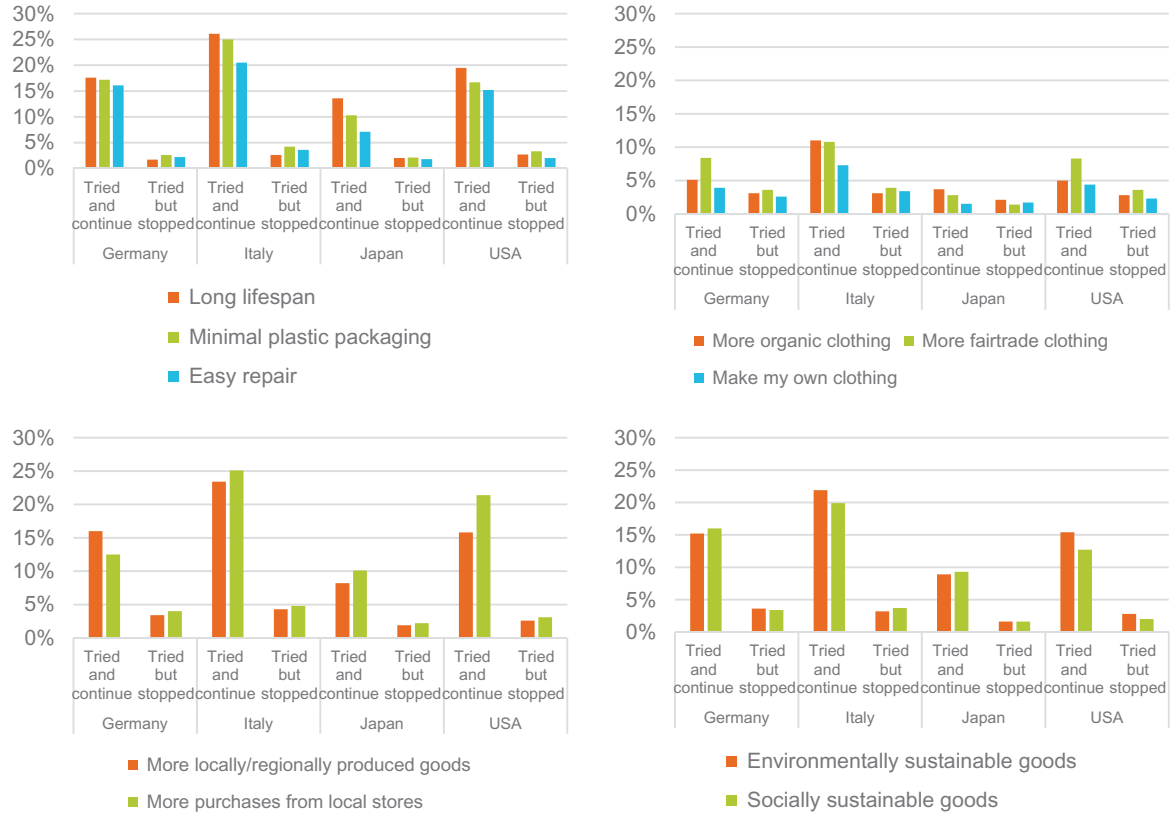

Figure 5. Regarding the discretionary material goods you purchase, have you made any of the following changes to your habits since the start of the COVID-19 pandemic? *Note*: Graphic shows only the answer categories "Tried this change and continue" and "Tried this change but stopped." A complete list of answers and responses can be found in Table A12.

least likely to involve sustainability-oriented changes, an observation that may, however, be related to the overall lower consumption of clothing and accessories during the pandemic. Across all categories and countries, most people who made sustainability-oriented changes reported continuing them into the present.

Housing and use of living space

Baseline. Even though typical home setup, size, and ownership vary between countries, many homes across all four countries had non-essential rooms.[1] An average of 50% of respondents (between 39% in Japan and 60% in the United States) had an extra bedroom, 33% (between 22% in Japan and 45% in Germany) an office, 23% (between 11% in Germany and 36% in Italy) an extra living room, and 38% (between 3% in Japan and 63% in Italy) more than one full bathroom. Before the pandemic, many of these spaces were underutilized (used less than once a week); most notably, extra bedrooms in Germany and Japan were used less than once a week in 71% and 80% of the cases, respectively (Table A13).[2]

During COVID-19. About three-quarters of respondents across countries reported spending much more or slightly more time at home since the pandemic started (Table A14). With the associated changes in everyday working, living, and recreating practices, the number of underutilized spaces within homes has modestly decreased, particularly in the case of offices. During the pandemic, 18% of respondents on average started using office space that was previously underutilized, while 10% of respondents who had an extra bedroom, 12% who had an extra living room, and 8% who had more than one full bathroom started using them regularly. This implies that many of the existing non-essential rooms were still not being regularly used under pandemic conditions. At the same time, only a small percentage of respondents who did not have these kinds of rooms in their homes wished they had them (Figure 6, Table A13).

The pandemic also motivated between one-sixth (in Japan) and one-fourth of respondents (in the United States) to at least consider a change in their housing situation, with an average of 3% already having moved and 5% having decided to move (Table A15). In all countries, the most important reason for respondents who had moved, had decided to move, or were considering moving was the desire for a larger home (48% on average).[3] Only a relatively small percentage of respondents (12%) intended to find a smaller home (Figure 7, Table A15). Likewise, in all countries, the percentage of study participants who wanted to share a home with more people was lower than those who wanted to live alone or with fewer people (Table A16).

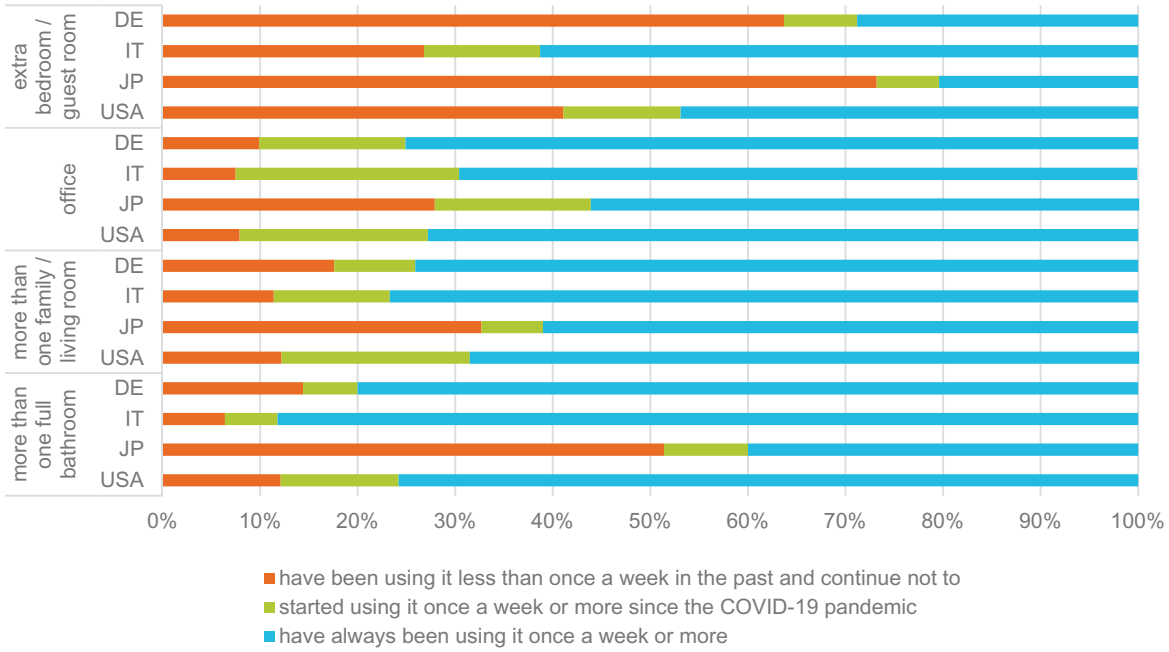

Figure 6. For those who have these rooms within their homes, have you been using them more frequently since the COVID-19 pandemic?

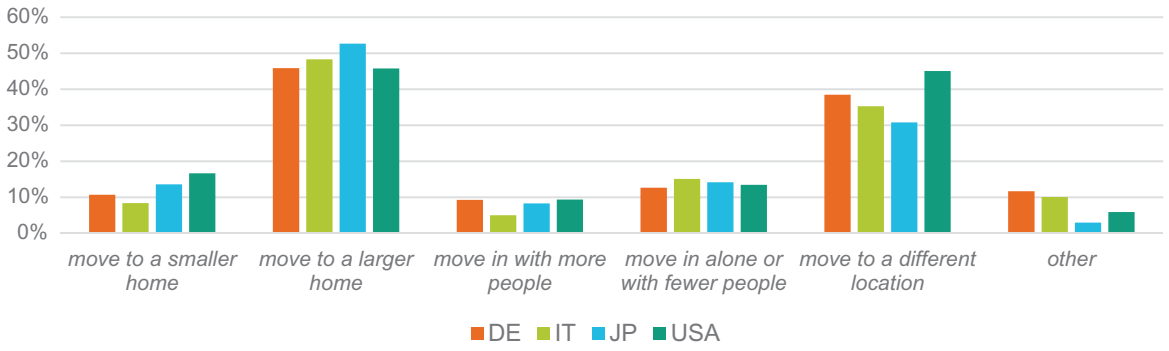

Figure 7. What kind of change in your housing situation are you considering, have you decided to make, or have you made?

Relocating to a municipality of similar or same size was the most popular option in all four countries (42% on average). This was followed by people who expressed a desire to move to a smaller or more rural municipality (35%) while moving to a larger or more urban municipality was the least popular option (24%). The main driver for these choices in all four countries was a preference for the lifestyle in the new location (Table A17).

Mobility

Baseline. Before the pandemic, similarities between Germany, Italy, and Japan in the self-reported regular usage of different transport modes (modal split) were stronger compared to the United States (Table A18). On one hand, walking was more common in these three countries (61–79%), and a significant share of respondents also used bicycles (30–42%) and public transport (31–41%) regularly. On the other hand, in the United States, regular walking (38%), cycling (11%), and the use of public transport (13%) were much less pronounced. These differences in the use of transport modes between countries were relevant for walking, cycling, and using personal vehicles and public transport ($0.24 < \varphi c < 0.36$). For shared and unshared transport services and airplanes, however, these differences were negligible. Respondents from European countries also displayed more multimodal transport behavior; on average, German and Italian study participants reported 2.5 different transport modes that they used at least once a week while Japanese indicated 2.0 and Americans only 1.6 ($F(3, 3996) = 154.4$, $p < 0.001$).

During COVID-19. The pandemic influenced the frequency and purpose of trips (Figure 8, Table A19), causing a reduction in mobility in general and changes in the use of transport modes (Figure 9, Table A20). Possibly due to the degree of lockdown stringency, the highest reduction of mobility across all trip purposes could be observed in Italy with a net average reduction of 58%. Trips in Italy were mainly restricted to shopping and errands at the

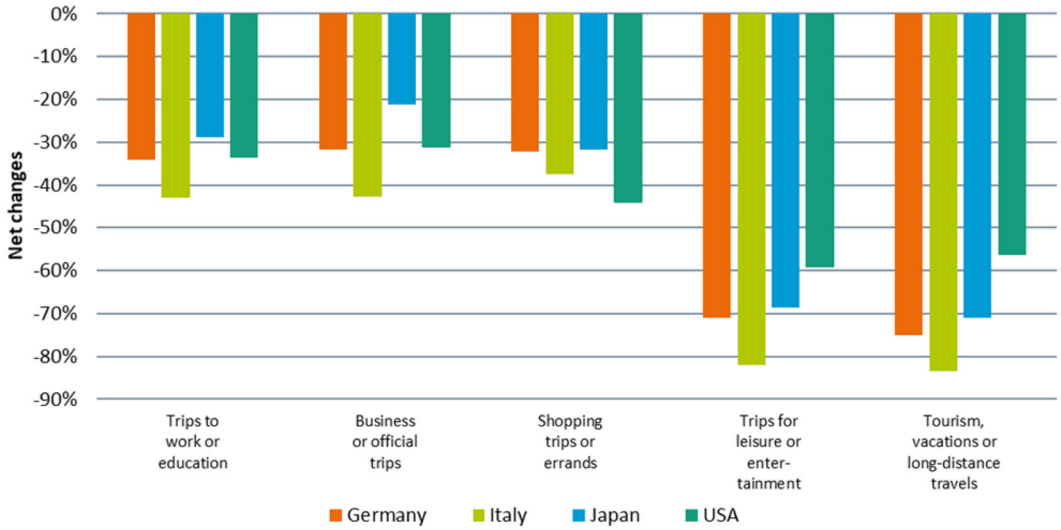

Figure 8. How has the frequency of your trips with the following purposes changed since the COVID-19 pandemic? *Note*: Data reported in the figure represent net changes.

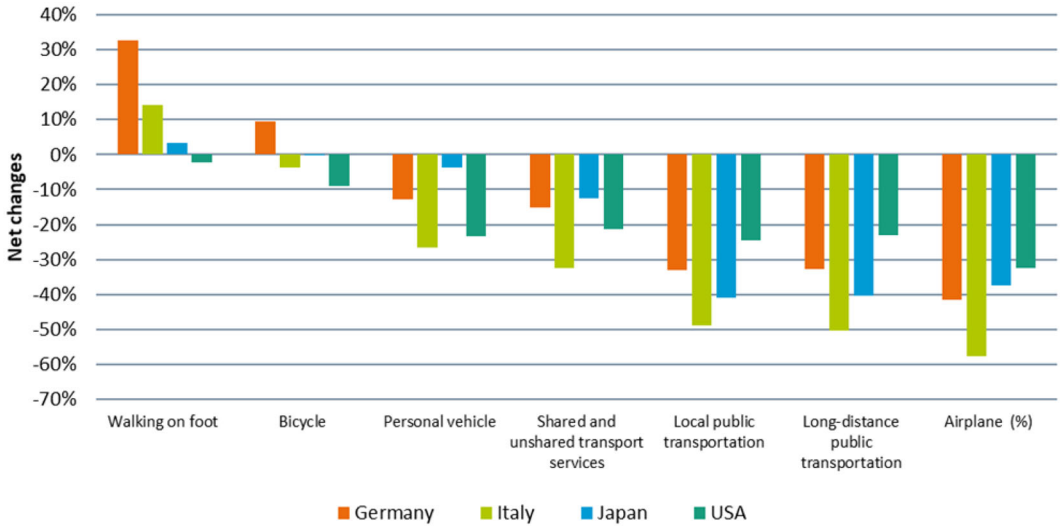

Figure 9. How has your use of the following transport modes changed since the COVID-19 pandemic? *Note*: Data reported in the figure represent net changes.

time of the survey, while Japanese respondents had comparably fewer restrictions and reported the lowest reduction in mobility (44%; Table A19). The most distinct change in trip purposes concerned leisure trips and tourism, which displayed the strongest decrease in frequency (up to −83% net changes for both categories in Italy).[4] A smaller but still sizable percentage of people (net 29–44%) cut back on their job/education- and shopping/errands-related mobility, with a large share of those who reduced their job/education-related trips almost stopping completely.

The survey also assessed the changes in trip frequency in relation to transport modes (Table A20). Respondents in all countries reported using private vehicles less frequently, resulting in a net effect of −27% in Italy, −23% in the United States, −13% in Germany, and −4% in Japan. The use of airplanes plummeted in a similar fashion and dropped by a net effect of between −32% (United States) and −58% (Italy). It is unclear, however, whether the observed reduction in car use was the result of less mobility in general or of a switch to more sustainable transport modes such as cycling or walking. Both the use of local public transport (net changes −25% in the United States to −49% in Italy) and long-distance public transport (net changes −23% in the United States to −50% in Italy) declined drastically in all countries. For cycling and walking, we found mixed effects. While in Germany and Italy responses indicated a significant increase in walking (net changes in Italy were +14% and in Germany were +33%), in the United States and Japan the number of people walking more versus less balanced each other out. Interestingly, cycling increased overall during the pandemic only in

Germany (by 10%), while in other countries this mode of travel decreased from −0.3% (Japan) to −9% (United States).

Establishing and discontinuing practices

Food practices and diet

For respondents who tried and continued a new food-procurement or preparation practice, the main reasons enabling them to continue were a combination of meaning and material-related practice dimensions – the alignment with interests and personal values; the availability of labor, energy, or time; and the ability to routinize the practice (Tables A21–A23, A10).[5] For example, for German study participants who began cooking more, interest level (56%), availability of time and labor (42%), and alignment with daily routine (36%) were cited as primary reasons. Similarly, among enablers allowing people to eat more of certain foods (Tables A24–A26), reasons related to the meaning (conforming to one's tastes, interests, and values) and material (ease of acquisition, reasonable price) dimensions were the most common responses in all countries (Table A26). For example, among respondents who started eating more local food (Table A26) the most common answers were "Kept my interest/I prefer this" for Germany and Italy (52% and 38%) and "Became easier to acquire" for the United States and Japan (48% and 46%). The second most common choice was "Conforms to my personal values" for Germany and Japan (48% and 33%), "Became easier to acquire" for Italy (36%), and "Kept my interest/I prefer this" for the United States (38%). We can observe a similar interplay and mutual reinforcement of meaning and material elements concerning the consumption of domestic, organic, fresh, and vegetarian food/vegetables, as well as of food purchased directly from a farmer.

The reasons behind the increased consumption of foods that are considered detrimental from a sustainability perspective were less clear. In the case of highly processed foods, competence-related reasons such as necessity or changes in a household situation, appeared more often, together with those pertaining to the material dimension (ease of acquisition, reasonable price). This finding suggests an interplay of material and competence elements, as people likely started eating more highly processed foods when they lacked or lost the opportunity to cook/eat healthier food or could not afford to do so.

For others, establishing sustainable food procurement and preparation practices was difficult, due to material and competence-related dimensions (Table A21). High cost prevented Japanese (39%) and Germans (36%) from ordering directly from farmers or through a CSA. Gardening and growing food required too much labor, energy, or time for many study participants in all countries, although to different degrees (from 40% in Japan to 20% in Italy), or respondents lacked the skills or knowledge to perform the practice. Also, many did not have the proper space or equipment (from 26% in Japan to 39% in Germany). The reasons for discontinuing specific practices after trying them were essentially the same as those for not trying them at all (Table A22).

Material factors, such as price and access, made the shift to more sustainable food consumption difficult among respondents who chose the option "Was not eating this regularly and I still don't" (Table A25). On one hand, organic products, for example, were considered expensive by more than half of respondents in all countries (up to 70% in Germany), and food sourced directly from a farmer was deemed difficult to acquire by more than 40%. "Unsustainable" food types, on the other hand, were generally not consumed for meaning-related reasons, such as non-conformity with one's personal values or needs or lack of interest in a specific food. Similarly, the responses given by people who decreased their consumption of certain food items compared to before the pandemic (Table A24) show that a decline in consumption of "more sustainable" food types was generally associated with material and competence dimensions. Organic products, for example, were perceived to have become more expensive in all countries (from 75% in Germany to 42% in Japan) or harder to acquire. Food purchased directly from a farmer also became more difficult to acquire and/or more expensive. The reasons why people started avoiding unsustainable food types were less clear, but in the case of highly processed foods, the expressed rationales were mainly related to meaning (e.g., "Lost interest or did not like it anymore," "Does not conform to my personal values").

Material consumption

For those who tried a change to their practices and continued to maintain it, meaning-related reasons appeared to play the largest role in motivating and establishing changes in material-consumption practices.[6] Conformity with personal values (meaning) was the most important enabler or motivator for change, although its importance varied between countries. Averaging across all practice changes, 46% of Germans, 42% of Japanese, 36% of Italians, and 29% of Americans cited conformity with personal values as a motivator for change. After meaning, material elements were most relevant as change enablers. For Italians and Americans, the

expectation that a change in practice would lead to better value for money was particularly important ($\varphi c > 0.2$ for purchasing organic or fairtrade clothing, as well as locally or regionally produced products). To some degree, respondents expected their practice changes to lead to superiority in terms of function, especially in Germany and Japan. For the most part, respondents did not consider superiority in terms of looks, style, or appearance as a major motivator for change, nor did most of them continue their changes simply out of necessity. The extra availability of labor, energy, or time due to COVID-19 played the largest role in motivating practice changes in Japan ($\varphi c > 0.2$ for making one's own clothing) (Table A27).

For respondents who tried a change but stopped, material concerns such as goods being too expensive or requiring too much labor, energy, or time, prevented sustainable consumption practices from becoming established. Beyond that, reasons were quite varied between practices and countries, with few clearly recognizable patterns emerging from the data. For study participants who did not make changes in their practices, meaning-focused answers such as "Just not interested or don't need such a product" was the leading reply, making up between 29% and 71% of responses depending on country and item. Averaging this feedback across all practice changes showed a clear difference in the importance of lack of interest or need between the countries, with the United States and Japan being the highest (61% and 57%, respectively) and Italy and Germany the lowest (46% and 39%, respectively; Table A28). These numbers suggest that overall interest in more sustainable products and practices is greater in the two European countries than in the United States and Japan, an interpretation that is supported by findings in the other sections and by respondents' own assessments (see respondents' sustainability values, Table A29).

Housing and use of living space

We observed similar general trends associated with the use of living space in all four countries, with some exceptions. Around one-quarter of respondents felt that their homes had become too small since the COVID-19 pandemic. Despite the large number of underutilized rooms described in the previous section on housing, only one-sixth of respondents (between 12% in Germany and 22% in Japan) felt that there were rooms in their homes that they did not need (Table A30). Consequently, the pandemic drove almost half of respondents to look for larger homes when planning a move, increasing their per-capita living spaces. This upscaling was motivated primarily by material-related elements: increased space requirements for undertaking personal and recreational projects (46% on average) and to work or study (44%), followed by a general feeling that the home had become more important (43%). Those who at least considered moving to a smaller home were driven mainly by a decreased need for space (56% on average), reduced cost (50%), and a desire to cut down on maintenance and cleaning (48%).

Concurrently, respondents who wanted to live in smaller households (with fewer household members) outnumbered those who wanted to live in larger households (with more members) in all countries, primarily in search of more privacy or calm (62% on average). This, again, may lead to a statistical increase in per capita living space (since more kitchens, bathrooms, and hallways are needed when used by fewer people; Table A31).

Among respondents who were not considering a change in their housing situation, around 80% said that their home served their needs well in Germany, Italy, and the United States, compared to only 62% in Japan. The second most important reason in all four countries was "I don't want to move" (38% on average), followed by "I can't afford to move" (23%; Table A16).

Mobility

Concerning intended mobility changes after the pandemic (compared to before its onset), we observed opposing trends. A large share of respondents expected a change in their mobility practices after the end of COVID-related restrictions (from 60% in the United States and Italy to 72% in Japan). One prominent reason behind the intended changes was the expectation to work or study from home more often after the end of the pandemic due to the normalization of remote work and online meetings (between 22% in Japan to 28% in the United States; Table A32). These adjustments in working routines require both material (office space and equipment – either one's own or provided by the employer) and competence (suitability of the job to remote work and related skills) elements. This trend is reflected by an overall intended decrease in trips to work and education (net changes −2% in Japan and the United States to −6% in Italy) and a decrease in business or official trips (net changes −4% in Japan to −11% in Germany, the United States, and Italy) after the pandemic (Table A19).

Meaning-related aspects played an important role as well, with both positive and negative sustainability implications. A significant share of respondents who reported plans to change their mobility practices in Germany (27%), Italy (24%), and the United States (18%) also planned to travel shorter distances

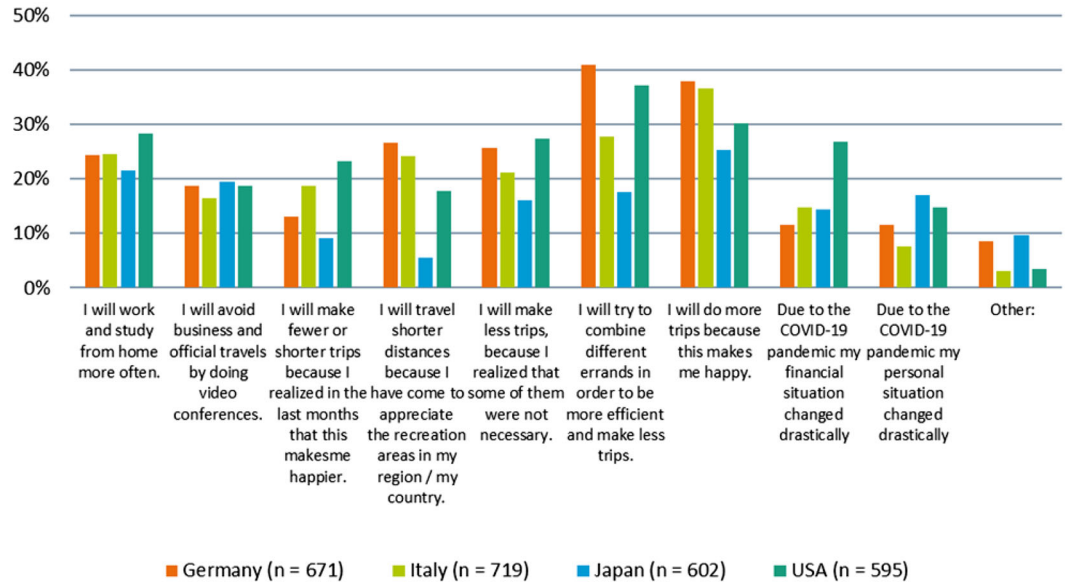

Figure 10. Why do you suppose that your mobility behavior will be different after the end of COVID-19-related constraints than before?

for leisure, out of a newfound appreciation for more local recreation areas and destinations (Figure 10, Table A32). In addition, study participants in Germany, Italy, and the United States also planned to reduce unnecessary trips and to combine errands more efficiently (Germany 41%, United States 37%), out of a fresh understanding for their time (meaning). At the same time, however, respondents expected to significantly increase their leisure and entertainment trips as well as long-distance travel. Net changes of between 9% (Italy and the United States) and 24% (Germany) of study participants planned to take more vacations and long-distance trips after the pandemic (Table A19), a trend that respondents largely justified by the realization that traveling made them happy (between 25% in Japan and 38% in Germany; Table A32).

The transport modes with the highest expected increase after the pandemic were bicycles and private cars (Table A20). Italian and German respondents were the most likely to anticipate an increase in walking (28% in Germany, 36% in Italy) and cycling (21% in Italy, 23% in Germany). In all countries, the post-pandemic establishment of alternative transport modes such as bicycles was hindered primarily by material elements, such as heavy car traffic and lack of appropriate bicycle infrastructure (connected to the need for more and safer bicycle lanes) (Table A32). Post-pandemic bicycle use, however, is likely to be strongly dependent on the pre-pandemic practices characterizing the four countries. More than half of American respondents were not using a bicycle before the pandemic and were not planning to do so afterward, a considerably higher percentage than in the other three countries ($\varphi c = 0.251$; Table A32). Given that the share of people able to ride a bicycle is quite similar across countries (e.g., 96% in Germany (ROSE Bikes GmbH 2016) and 94% in the United States (Chalabi 2015)) this is likely an issue of difference in meaning and material aspects associated with the practice.

Concerning measures that would encourage respondents to start using public transport again after the pandemic (Table A32), hygiene measures played a central role in all countries, although for Germans lower fares were still the most important. A pattern similar to that observed for cycling also applies to the use of public transport: almost half of the American respondents, for example, stated they were not using public transport before the pandemic and would not do so afterward ($\varphi c = 0.302$). Japan, by contrast, had the highest acceptance of public transport. A mixed picture emerges for future expectations concerning local and long-distance public transport: while a higher percentage of German and Japanese respondents envisaged using them more often rather than less often, the opposite was true in Italy and the United States (Table A20). Again, the differences among countries are statistically significant ($p < 0.001$), but small ($0.1 < \varphi c < 0.2$).

Discussion

Sustainability impacts

Practices in the four consumption domains have been affected by the pandemic and lockdown measures in different ways, with consequent differences in their sustainability implications. Food and material consumption display what may be overall positive effects from a sustainability standpoint while

housing and mobility show a more ambiguous mix of potential outcomes. Regarding food practices, the results reveal modest ongoing changes in food procurement and preparation – despite differences between countries – with home-cooking being the most widely adopted new practice, as also confirmed by previous research (Balest and Stawinoga 2022; Hoolohan et al. 2022; Nielsen et al. 2021; Tribst, Tramontt, and Baraldi 2021). The sustainability implications of this practice change, however, are hard to gauge. More substantial and influential changes can be observed in the composition of respondents' diets. Overall, significant percentages of people in the four countries started consuming greater amounts of food types that can be considered positive from a sustainability standpoint (less meat, more local/domestic, and organic), a finding supported by other studies (Janssen et al. 2021; Rodríguez-Pérez et al. 2020). In our research, a significant percentage of respondents also decreased their consumption of food that can be considered detrimental (meat, highly processed products, imported and out-of-season produce), although some other works show opposite trends (e.g., Janssen et al. 2021).

The pandemic also had noticeable effects on self-reported patterns of material consumption across all four countries, with between a quarter and more than half of respondents reporting changes in their purchasing habits across all non-essential material-goods categories. Only online-entertainment services saw an increase in consumption, similar to earlier studies (Esposti, Mortara, and Roberti 2021). Without further information on which activities were replaced by this increase in online entertainment, it is difficult to assess its sustainability impact. For all other consumption categories, respondents in all countries reported fewer purchases, especially in clothing and accessories, matching prior findings (Esposti, Mortara, and Roberti 2021; Hodbod et al. 2021; Cambefort 2020). Given the significant negative environmental impacts of the production phases of these goods, we see the reduction in the purchase of newly produced goods as a shift toward more sustainable practices. Significantly, most of the people who purchased fewer material goods reported that they did not miss the items they had bought regularly before the onset of the pandemic, corroborating earlier research (Hodbod et al. 2021; Esposti, Mortara, and Roberti 2021; Cambefort 2020). In all countries, especially Italy, respondents used the pandemic as an opportunity to try out new sustainability-oriented practices, such as seeking goods with longer lifespans. This matches other studies (MasterCard 2021), which found that Italians had a higher awareness of their environmental impacts, a finding that may be connected to the longer and stricter lockdowns that Italy experienced in comparison to the other three nations.

In the housing category, the pandemic experience has induced changes that may ultimately have more negative than positive effects from a sustainability standpoint. Unlike the other consumption domains discussed in this article, housing-related choices are long-term decisions associated with appreciable lock-in effects. With the significant increase in time spent at home in all countries, a modest share of respondents has indeed started using underutilized rooms in their homes more regularly. This type of densification of space-usage patterns in private homes, however, cannot be universally considered as a sustainability gain, since it is part of larger practice bundles that may involve tradeoffs elsewhere, such as less densely used spaces at the workplace, as suggested by quantitative research on mobility patterns (Rahman, Thill, and Paul 2020). Additionally, 22.5% of respondents on average reported that they had moved, decided to move, or were considering moving, mainly due to an increased need for living space (Table A15), a finding confirmed by earlier research in European and American contexts (Just and Plößl 2021; Ewald et al. 2021; Stanton and Tiwari 2021). Both the desire to live with fewer people and a decrease in motivation to share spaces with others reduce the demand for shared types of housing that have the potential to reduce per-capita living spaces and to decrease land, resource, and energy consumption for the construction and operation of buildings, as described, for example, by Sandberg (2021) and Daly (2017). This represents a clear indication that post-pandemic housing practices could become less sustainable, although, again, these changes need to be considered in the context of practice bundles, including changes in commuting practices.

Mobility saw significant pandemic-related changes concerning trip frequency, distribution between trip purposes, and transport modes. Unsurprisingly, leisure trips and tourism showed the strongest decrease in frequency, followed by job- and education-related trips. In all countries except the United States, a higher share of people started walking more and bicycle use also increased, which is in line with the findings of Anke et al. (2021) and König and Dreßler (2021). Both developments can be regarded as beneficial for the reduction of GHG emissions in the transport sector. Although the use of shared modes of transport plummeted, the use of private vehicles decreased as well, but not as drastically (e.g., Anke et al. (2021), and Hodbod et al. (2021)). The relative shift from land-based public transport to private car use poses a threat to

mobility transformation efforts made so far. Similarly, recent figures of constantly growing air travel-passenger numbers (IATA 2022) refute expectations for a long-lasting drop in air travel. The pandemic however also led to a new appreciation and possible lock-in effects for making fewer trips for errands and shorter trips for leisure and recreation. Additionally, respondents in some countries expected to walk and cycle more after the end of the pandemic. The potential sustainability gains created by local and home-centered lifestyles connected with active travel modes and fewer long-distance trips, however, might be offset by the relatively high percentages of respondents in all countries that expected to use private vehicles and planes more often. In all countries but Japan, long-distance travel surged when it became possible to travel again (IATA 2022). Hence, it appears that the pandemic may be contributing only in limited ways to a transformation to more sustainable transport practices.

Practice dynamics

The examination of factors enabling or hindering practice change based on Shove, Pantzar, and Watson's (2012) practice elements shows a similar level of complexity. The results highlighted the importance of meaning-related aspects (conforming to one's tastes, interests, and values) as enablers of the recrafting or substitution of practices, which was especially evident in the food, material-consumption, and mobility domains, although material elements (particularly price and accessibility in the case of food and material consumption) also played a role. In the housing sector, material needs and wants induced by the increase in time spent at home indicated that work and leisure-related practices were recrafted to focus on home-bound routines (Hoolohan et al. 2022). In the case of mobility, infrastructure (material) improvements, such as better and safer cycle lanes to encourage bicycle use, appeared especially important for practice substitution away from automobile use and locking in more sustainable practices in the future. Certain material and meaning elements proved particularly resistant to reconfiguration, despite the opportunity the pandemic represented. For material consumption, many respondents stated that they simply did not see a need for more sustainable products (meaning) or that these products were too expensive (material). Similarly, for housing, the increased desire for space for recreational and work/study-related activities, as well as an increased importance of the home, signifies that material and meaning dimensions are significant barriers to sustainability-oriented changes.

It is unclear whether lockdown severity influenced the degree of practice changes, but respondents in Japan – who experienced fewer restrictions than elsewhere – tended to report the fewest changes in practices among the four countries and were least likely to try new practices. However, we were unable to confirm or refute the existence of a correlation between lockdown severity and the uptake of more sustainable practices. By contrast, "baseline" (pre-COVID) differences in practice among countries, which are variously related to materials (e.g., infrastructure), competencies, and meanings (e.g., identification as environmentally conscious individuals) are likely to have significantly facilitated or hindered recrafting and/or substitution of practices. For example, on one hand, the existence of a well-developed cycle-lane network in Germany likely encouraged and enabled the substantial increase in bicycle use in the country. On the other hand, a high percentage of American respondents had not been using public transport or bicycles before the pandemic and were not willing to start using them no matter the measures taken to improve the related infrastructure (see also Greene, Ellsworth-Krebs et al. 2022). This outcome contrasted with the other three countries where the use of public transport and bicycles was already more common and accepted before COVID-19, leading to a higher likelihood of the (re)uptake of these practices during and/or after the pandemic. These findings align with prior research on "practice memories," as emergencies or disaster events can trigger the re-emergence of past practice performances (Lindsay et al. 2022; Maller and Strengers 2015). Similarly, the strongest instances of recrafting or substituting of sustainable food practices and extinction of practices related to superfluous material consumption tended to occur in countries where the uptake of such practices before the pandemic was already high and in which a higher percentage of people saw themselves as environmentally conscious (Germany in particular, followed by Italy) (Table A29). Japanese respondents, who generally showed fewer and more moderate changes in practices, also scored lower in sustainability attitudes.

An important consideration arising from the results is that although some of the observed changes appear positive or negative from a sustainability standpoint, the consumption practices that have emerged or been reinforced are complex, making it hard to gauge their net contribution to more sustainable patterns (Holmes, Lord, and Ellsworth-Krebs 2021). This can be attributed to the interconnection of practices, as conveyed by the concept of practice bundles (Pantzar and Shove 2010). For example, remote work might imply a decrease in car

use and more time allocated to food preparation, but also drive the need for larger living space as more people require a home office. The complexity of practice interaction and patterning is also difficult to assess through descriptive statistics alone, an issue that we will address below.

Methodological considerations on using quantitative tools to inform social practice research

Based on this exploratory study, we found that while there are challenges in using quantitative approaches to study changes in social practices, quantitative data gathered from large-scale surveys can give a broad picture of practice change. While qualitative methods, such as diary studies or interviews, provide in-depth insights into the performance of specific practices, these methods are not well-suited to show how widespread certain practices are and what drives their change on a larger scale. Representative survey data allows us to make generalized claims about patterns of distribution and prevalence of practices (Browne, Medd, and Anderson 2013; Browne et al. 2014) and can also provide a useful foundation for guiding subsequent qualitative studies by highlighting meaningful or unexpected results which can be further examined through qualitative methods. Following our study, for example, it would be interesting to investigate which conditions enabled Italian respondents to try and continue more sustainability-oriented practices compared to respondents in the other three countries. Another option would be to start with a qualitative study and use the results to design a larger-scale quantitative survey. It is also worth noting that, as the pandemic created similar disruptions, a quantitative approach was useful to capture broad dynamics within and across countries by asking the same set of questions to a large representative sample within a short period of time.

Nevertheless, using surveys to study social practices also comes with some challenges. Surveys require the use of relatively limited sets of predetermined questions and responses, which can only partly account for the complexity of how practices change. Furthermore, designing the response options according to the three social practice elements was not always a straightforward process and can suffer from bias in the formulation of questions and in the translation of practice elements into survey items. While some responses can be clearly understood as referring to one element (e.g., "Conforms with my personal values" is associated with meaning) others are more ambiguous. For example, "Finding/purchasing such a product required too much labor, energy, or time" could be understood as being related to competence, but also to material (i.e., objective lack of time) or even meaning (in the sense that the product was not worth enough to the person to warrant spending time, energy, or labor in procuring it), depending on the subjective interpretation of respondents (and researchers). Using quantitative surveys limits the possibility of further questioning respondents about the reasons behind their responses and uncovering the more nuanced aspects of practice change. Quantitative surveys do not allow us to investigate how cultural differences and understandings of practices among countries and people – harder to capture than socio-economic variables – influence the performance of practices and the material, meanings, and competencies associated with them. Furthermore, when quantitative analysis of social practices is limited to descriptive statistics, exploring how practices are interlocked in a straightforward manner is difficult. Advanced statistical analysis is necessary to fully examine how diverse practices are related and interconnected, a task that this research team plans to undertake in follow-up work.

Despite these shortcomings, one of the most promising aspects of using quantitative tools to study social practices is that they can offer measurable insights into the dynamics of practice change that can only be inferred through qualitative approaches. Furthermore, large-scale quantitative surveys, especially if used as part of longitudinal studies, can help track the evolution of practices (and practitioners) over time, capturing "both the patterns of performance-of-practice across populations and snapshots of practices-as-entities" (Browne et al. 2015, 206).

Toward practice-oriented policy: emphasizing practice elements

The results also help to identify the practice elements that could be targeted to facilitate the establishment of more sustainable practices. It is interesting to note that the way specific elements are perceived or experienced is different across individuals and households. For example, from a material standpoint, the lockdown provided some respondents with more time or labor to take up gardening or home cooking, while for others the time and labor these requirements proved to be excessive, and the practice was discontinued (Table 3). Similarly, for some study participants, the reduction in mobility and travel was a welcomed change to the meaning of mobility practices, while for others it was resisted. These examples point to the complex socio-economic and cultural contexts relevant for

Table 3. Summary of how practice elements contributed to the establishment or discontinuation of selected practices associated with the four consumption domains.

	Elements linked to …	… establishing a practice	… discontinuing a practice
Food practices & diet		Home cooking, gardening	
	Material	More time and labor	Time and labor requirements too high; Lack of space, equipment
	Competence	Alignment with daily routine	Lack of skills
	Meaning	Sustained interest, alignment with values	
		Purchasing and eating local, organic, vegetarian foods or directly from farmer	
	Material	Made easier to acquire	High costs, difficult to acquire
	Meaning	Sustained interest, preferred	
		Purchasing and eating processed foods, meat	
	Material	Easy to acquire, cheap	
	Competence	Changed routines	
	Meaning		Misalignment with values, interest
Material consumption		Acquisition of sustainable clothing, electronics, media, toys, online entertainment	
	Material	Better quality, lifespan, ease of repair; availability of time	Time and labor requirements too high
	Meaning	Alignment with values: desire to reduce environmental impact, support equity	Lack of interest
Housing and use of living space		Adapting to living with/using limited space	
	Material	Realization of less need for space, desire to reduce costs, maintenance, cleaning	
	Meaning	Peace/calm with smaller home, fewer people	
		Living in larger homes/spaces	
	Material	Need for more space for work, projects, studying	
	Meaning	New values: home becoming more important	
Mobility		Less mobility/work from home	
	Material	Office space, equipment for remote work	
	Competence	Suitability of remote work	
	Meaning	Decrease in business trips; appreciation for local travel/leisure to reduce travel; appreciation for efficient use of time	Desire for more leisure/ entertainment after lockdown; desire for longer distance travel
		Walking, bicycling, use of public transport	
	Material	Availability of infrastructure	Lack of infrastructure; high prices
	Meaning	Socially/culturally acceptable	Not socially/culturally acceptable; hygiene issues
		Automobile/airline use	
	Material	Reliance on existing infrastructure	
	Meaning	Socially/culturally acceptable	Desire for more leisure/ entertainment after lockdown; desire for longer distance travel

practice-oriented policy interventions. What is still missing from this analysis is how elements and practices are interlocked and bundled, as well as how intervening in one place may create unforeseen pressures on these interconnected relationships. More analysis is required to understand these relationships and feedback loops.

What emerges from the results, however, is how the role of the pandemic as a catalyst for a sustainability transition in consumption practices will in large part depend on whether practice-oriented policy interventions can be developed and implemented (Balest and Stawinoga 2022). The challenge for policy makers in navigating the complex and highly interconnected post-pandemic landscape is to find ways to support sustainable lifestyle shifts that accurately interpret emerging practices and new interlocking practices. The increased acceptance of remote work, rejection of superfluous material consumption, and desire for more living space, for example, suggest that lifestyles centered around one's home and neighborhood may become more viable for a significant portion of the population in the surveyed countries. To support sustainable consumption practices associated with these lifestyles, local and national policies should aim to: (1) adapt elements to make practices that have emerged in the wake of the COVID-19 pandemic more sustainable, (2) help to lock-in newly emerged practices and replace less sustainable ones, and (3) change how practices in different domains of consumption are linked (Spurling et al. 2013).

To achieve these policy aims, local and national governments should promote or strengthen community-based or localized systems of provisioning, while at the same time grounding them more firmly in democratic practices and circular economy models (James et al. 2021; Mylan, Holmes, and Paddock 2016; Sardeshpande, Rupprecht, and Russo 2021; Zollet et al. 2021). The reduced desire for superfluous material consumption indicated by this research suggests that local hubs for peer-to-peer production and for sharing, renting, or repairing goods, for example, could reduce material consumption and further develop an ethic of sufficiency (Dartnell and Kish 2021). Legislative changes, to enforce design for repairability and the availability of spare parts (e.g., the demands of the European Union's campaign "Right to Repair") would only strengthen and synergize with the drive for limiting overconsumption.[7] To counteract the desire for larger homes (while reducing the number of desks required in corporate offices), shared neighborhood-office spaces for teleworkers could be an option (Giorgi et al. 2021; Kaklauskas et al. 2021) locking in more sustainable mobility practices and reducing mobility overall (Shokouhyar et al. 2021). These spaces can be provided by supporting the adaptive reuse of existing buildings, especially those which might have lost their function during the pandemic, re-examining land-use regulations to promote mixed uses and ownership, improving Internet connectivity, providing or enhancing bicycle and pedestrian infrastructure, and creating more spaces to grow food at the community level. Implementing policies to support localized provisioning and work-leisure integration can also address material barriers such as lack of time or access to certain resources (e.g., land, labor). New projects and businesses that cater to specific sustainable practices that have emerged in the wake of the pandemic will also need to be developed, made visible, and strategically incentivized.

Conclusion

This study has provided a broad, multi-country overview of consumption-related practice changes resulting from the COVID-19 pandemic and discussed their sustainability implications from a policy perspective. The pandemic forced a decrease in consumption and stimulated public discourse on the urgent need for action to reduce climate and environmental impacts, but the desire to return to a pre-pandemic "normal" is also strong. This study reflects this contradictory and unique situation. Shifts toward sustainable food practices and a decreased desire to engage in superfluous material consumption are positive signs that more sustainable lifestyles might emerge after the pandemic, but some of these positive changes may turn out to be short-lived or counteracted by higher demand for larger homes, nonpublic means of transport, and a return to air travel.

This research also confirms the usefulness of quantitative approaches to studying social practice change. The large dataset generated by the study provides an overview of changes to everyday practices in four high-consumption countries. Further statistical analysis is needed to examine different facets of practice change. The relationships between socio-demographic variables and practice changes, for example, require targeted investigation, as the pandemic has exposed the differentiated capacity people have to adopt sustainable consumption practices and further highlighted inequalities along lines of gender, income, occupation, and local infrastructure (Barker and Russel 2020; Power 2020; Whelan et al. 2021). Through clustering and pattern analysis we also hope to shed light on the interplay of practices within practice bundles both within and across consumption areas (Pantzar and Shove 2010; Shove, Pantzar, and Watson 2012). The findings presented here also provide a basis from which future longitudinal studies might be conducted to reveal further shifts in practices and to provide evidence of practice lock-in over time.

Notes

1. According to the Better Life Index prepared by the Organization for Economic Co-operation and Development (OECD), the average home contains 1.8 rooms per person in Germany, 1.4 in Italy, 1.9 in Japan, and 2.4 in the United States. Household sizes vary between 2.48 (mean) in Germany and 3.01 in Italy. Only 25.7% of Americans reported living in apartments while about 60% do in each of the three other countries. In Japan, 72.8% rent, 55% do so in Germany, 36% in the United States, and 16.1% in Italy.
2. The percentages reported here represent the sum of the answer options "have been using it less than once a week and continue not to" and "started using it once a week or more since the COVID-19 pandemic."
3. Respondents were asked to check all answers that applied for all questions regarding reasons to consider moving.
4. Net changes equals share of respondents that increased their trip frequency minus the share of respondents who reduced their trip frequency.
5. The data reported in the following sections refer to subsets of respondents. In some cases, especially those referring to respondents who "tried and continued" or "tried but stopped" the results are based on a small number of cases, so we invite caution when attempting to generalize the results (see Tables A16–A17, A21–A28).

6. Respondents were asked to check all answers that applied for all questions regarding barriers and enablers.
7. See https://repair.eu.

Ethical approval

The survey was conducted under ethical approval by the home institution's research ethics committee (RIHN2017-1).

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