



No way back? A survey on changes in travel demand post-pandemic in Norway

Winnie Ma^{*}, Fredrik S. Hoen¹, Trude Tørset¹

Norwegian University of Science and Technology (NTNU), Høgskoleringen 7a, 7034 Trondheim, Norway

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ABSTRACT

Research shows a significant reduction in travel demand during the pandemic. Vaccines are currently distributed, allowing us to go back to pre-COVID-19 life, if that is the case. This study provides insight into changes in activities and travel demand during the pandemic and expected changes after the pandemic.

Our paper presents the findings from a Likert scale survey ($n = 360$) conducted in Norway June–July 2021. We investigate how relocated activities impacted travel behaviour during the pandemic, and prospects of lasting impacts of the pandemic.

The results show that the prevalence of home office and digital meetings, the new normal for many people during the pandemic, will continue to some degree after the pandemic. There is an increased willingness to commute by active modes, while no pronounced increase in car commutes is reported. However, car use is expected to increase for leisure trips; a significant correlation with the demand of more domestic outdoor travel. One out of five states that they will use public transport less often in the future. We may expect more online shopping, although home-deliveries for groceries is not as popular as for non-edible goods—not during the pandemic nor after.

Earlier disruptive events have shown that people tend to adjust back to normal after a while, even if they have stated otherwise. There are certain mid-pandemic habits that go along with political goals and/or employers' interests, implying these might be prolonged into the future.

1. Introduction

The World Health Organization (WHO) officially declared the COVID-19 outbreak a pandemic on March 11, 2020, which resulted in the Norwegian government imposing a national lockdown the very next day. Among the affected were educational institutions, organised events and activities, non-essential workplaces, service industries and other arenas with difficulty following the 1–2 m social distancing rule.

Since then, people have been urged to keep their mobility and social activity level as limited as possible. There have been no restrictions directly on personal travel, only preventive measures that may indirectly facilitate or impede trip making and the mode choice (e.g. offer free parking for private cars, mandatory use of face masks on public transport, and recommendations on social distancing).

Consequently, travel behaviour changed overnight in Norway (Rothe, 2021) with a decrease of commuting traffic, reduced rush traffic volumes, reduced demand for public transport and changes in leisure

traffic. Researchers around the world have reported similar experiences (Beck and Hensher, 2020; Jenelius and Cebecauer, 2020; Barbieri et al., 2021; Abdullah et al., 2020; Shamshiripour et al., 2020; Haas et al., 2020). To understand which changes to expect after the pandemic has become increasingly important. Decreased or altered travel demand in future years can impact the benefits of built and future infrastructure projects, income from tolling and parking, and conditions for public transport operations.

There are numerous studies on the change in travel activity following the pandemic which highlight omitted trips (Abdullah et al., 2020; Forsyth et al., 2020; Haas et al., 2020; Shamshiripour et al., 2020; Jenelius and Cebecauer, 2020), though we would want to know how people compensated for these trips through their activity pattern. These patterns are not easily monitored in a travel survey if the activities are conducted at home. The goal of this study is to identify these changes and see if there are any unified experiences of the willingness to keep these habits in a post-pandemic future (at the time of surveying). These

^{*} Corresponding author at: Institute for Civil and Environmental Engineering at NTNU, 7491 Trondheim, Norway.

E-mail address: winnie.g.h.ma@ntnu.no (W. Ma).

¹ Postal address: Institute for Civil and Environmental Engineering at NTNU, 7491 Trondheim, Norway.

results lay the grounds for further understanding of what people may deem to be beneficial change and what is not—allowing decision makers to take a more proactive stance in the face of a future crisis.

The topic of this paper may be explored by answering these research questions:

1. Which types of activities were undertaken differently during the pandemic?
2. How did they carry out activities differently?
3. Which types of activities will be continued after the pandemic?

Regarding the first research question, the activities included in the survey are hypothesized to alter the travel demand. The second research question gives insight into the adoption of information and communication technology (ICT) during the pandemic, and the investments made to facilitate this, e.g. home office. Regarding the third question, we hypothesize that with new habits and investments in equipment, people might want to continue doing things differently even after pandemic. Our results can help understand the development in travel behaviour in the coming years as it is in the decision makers' interest to get insight into the actual development and measures that aid in reaching their goals (The Norwegian Ministry of Transport, 2017).

2. Literature review

2.1. Impacts on activities and travel behaviour from COVID-19

Travel is derived from activity participation (Timmermans and Ettema, 1997), therefore any change in the choice of activities and locations of activities may induce changes in the mobility pattern. Although the COVID-19 research is novel, some knowledge has been established on the impacts on activities and travel behaviour during the pandemic. Trip rates have declined—especially commute and business trips, but also leisure trips like visits, service trips and entertainment trips (Beck and Hensher, 2020; Jenelius and Cebecauer, 2020; Barbieri et al., 2021; Abdullah et al., 2020; Shamshiripour et al., 2020; Haas et al., 2020; Siemens et al., 2021). Vacation trips by Norwegians were mainly domestic in 2020, 91 % against normal levels of between 60 and 70 % (Tuv et al., 2021). Worldwide, the tourist and the aviation sectors face economic crises (Uğur and Akbıyık, 2020; Abu-Rayash and Dincer, 2020; Forsyth et al., 2020; Haas et al., 2020). In Norway, the number of air passengers were 61 % lower in 2020, and 57 % lower in 2021 than in 2019 (Tuv et al., 2021).

73–78 % of employees and students worked fully or partly from home mid-pandemic, according to findings from Norway, Australia and Ghana (Beck and Hensher, 2020; Bærum Municipality, 2020; Barbieri et al., 2021; Shamshiripour et al., 2020). Commute trips, normally concentrated during peak hours, constituted one third of all person trips pre-pandemic (Hjorthol et al., 2014).

Half the students in a mid-pandemic Norwegian survey reported that more than 80 % of the lectures were digital (Sivertsen, 2021). In the same survey, 70 % of the students assess traditional lectures as more valuable. 48 % of the students reported struggling with serious psychological symptoms during COVID-19 against 32 % reported in 2018.

Findings from surveys among employees show that the majority, 53–65 %, of workers across all occupations are open to teleworking post-pandemic (Beck and Hensher, 2020; Bærum Municipality, 2020), especially for office tasks not requiring cooperation, and 55–57 % of the workers experienced an increase in productivity at home during the

pandemic (Beck and Hensher, 2020; Bærum Municipality, 2020). 'Making calls', 'high concentration work' and 'routine tasks' are considered more efficient, while meetings are less successful from home (Bærum Municipality, 2020). 88 % report less social interaction with their colleagues. Disadvantages with working from home are more sitting-time, inadequate facilities, and disruptions from family/children (Bærum Municipality, 2020; Shamshiripour et al., 2020).

Looking forward towards a post-pandemic future, 80 % of respondents stated that they wish to use the same primary modes as before the pandemic (Beck and Hensher, 2020; Haas et al., 2020; Bucsky, 2020). The remaining 20 % wish to either increase or decrease certain modes. Car usage is expected to increase although some also state they will use the car less. For public transport it is the opposite, while active modes are expected to increase (Beck and Hensher, 2020; Haas et al., 2020; Bucsky, 2020).

Social distancing has prevented participation in all kinds of social events. It is expected that people want to take up visiting family and friends again, going to entertainment events and gyms. It even seems like people want to engage more in social activities than before COVID-19 (Beck and Hensher, 2020).

2.2. Behavioural changes

While not intended as a complete framework for analysis, concepts from theories of behaviour may enhance the understanding of which changes are more likely to sustain or revert. These concepts may also contribute to explaining the respondents' future expectations for possible behavioural changes, and lastly, shed light on how public policy may interfere to sustain desired behavioural changes.

In a systematic review of theories of behaviour, Kwasnicka et al. (2016) identify five key factors in maintaining new behaviour after an initial behavioural change; (1) motives for maintaining new behaviour, (2) self-regulation, (3) habits, (4) resources and (5) environmental and social context.

Motives (1) are guided by identity, and a change in identity may drive the propensity to continue the new behaviour. An individual who adopts the identity of a cyclist instead of a car driver is more likely to continue preferring bike over car rides. When motivation decreases, self-regulation (2) plays an important role in continuing new behaviour, for example by persisting in using the bike on a rainy day instead of resorting to the more comfortable alternative, car driving. As the behaviour is repeated, the development of a new habit (3) takes place and the need for self-regulation decreases—though repeated effort and placing limits and restrictions on oneself over time may lead to a lack of motivation (Kwasnicka et al., 2016).

Habits may form through repeated behaviour over time when the behaviour becomes natural. In forming habits, positive reinforcement is a key factor. To trigger the habitual behaviour, retrieval cues are important. Not all behaviour transforms into lasting habits, and in many cases maintaining new behaviour requires endurance and hard work. In continuing the new behaviour, access to physical and psychological resources (4) are important. Further, the social and environmental context (5) influences the need for internal resources. Social norms and rules are strong governors of behaviour, and individuals often adopt behaviour which are approved by the social groups they belong to (Kwasnicka et al., 2016).

Changes in the environmental context may disrupt current habits and provide possibilities in developing new behaviours. According to Sheth (2020), important changes include changes in the social context,

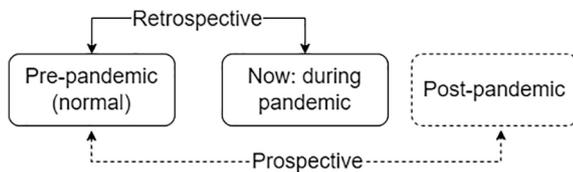


Fig. 1. A visualization of the two different time frames in the survey; first the retrospective, then the prospective.

technological breakthroughs, new rules and regulations, and lastly, major crises such as natural disasters, terror attacks, and global pandemics (including COVID-19). During the pandemic, lockdown, social distancing, and other temporary regulations have “generated significant disruption on consumer behaviour” (Sheth, 2020). In coping with this new reality, the consumers have adopted new skills and technologies, and learned to use them in new, creative ways. This may result in a modification of future consumer habits (Sheth, 2020).

While the possibilities for change are apparent, the long-lasting effects are not given. For example, it was expected that the Olympic Games in London would cause a temporary increase in traffic, concentrated at very specific times and locations, which would put pressure on key transport hubs. The preparations involved traffic management and investments in infrastructure. Significant changes in travel behaviour were observed during the games, especially regarding re-timing and re-routing of trips, but the changes soon relapsed after the games ended. The long-term impact of the changes was small even among those who had stated an intention to sustain changes in travel behaviour after the games ended (Parkes et al., 2016).

A study of commuters in Italy during a temporary reorganizing of the transport system showed resistance, especially among car drivers, to adapting travel behaviour despite significant reductions in convenience. This resistance is partly explained by how car drivers identify themselves with driving (Lattaruloa et al., 2019). Kontou et al. (2017) studied how commuters were affected by the total disruption of the traffic system after the hurricane “Sandy” in New York. The disruption caused significant changes in commuting patterns, including travel times and telecommuting, lasting up to 30 days before returning to normal. A study of the passenger journeys following the bombings of the London Underground in July 2005 found evidence of reduced travel activity lasting up to one year, partly due to increased awareness and perceived risk of using the Underground (Prager et al., 2011).

While most of the disruptive events studied were temporary and only lasted weeks or months, some of the restrictions imposed during the COVID-19 pandemic in Norway stretched almost two years before they were repealed.

Decisions made with a time horizon of a year or more may be substantially different from ones with a time horizon of a few weeks. Examples are upgrading a room into a permanent home office, investing in a holiday lodge or electric bicycle, or even moving residence location due to better opportunities of teleworking. Some of these decisions may then have consequences for daily routines and travel behaviour long after returning to a post-pandemic scenario.

While the research on travel behaviour changes during the pandemic has boomed, the future activity patterns and belonging travel behaviour is less studied. Our approach is one attempt to explore which of the behavioural changes might remain after the pandemic.

3. Method and sample

3.1. Questionnaire

The 5-point Likert scale survey was designed to reduce response burden, and was approximately 5–10 min long.

The survey consisted of three parts. The first covered respondents’ background information (gender, year of birth, occupation, employment status during the pandemic and postal code). The next two parts collected information for two different timeframes, retrospective and prospective, on three major categories: 1) work related activities, 2) activities during spare time, and 3) shopping. As such, we have asked about work/education (including business trips), leisure activities including visits to friends and family and shopping trips, which constitutes most of the travel purposes for private trips in the National Travel Survey from 2013/14 (28 %, 30 % and 27 % respectively) (Hjorthol et al., 2014). The survey was structured such that work- and education-related questions were solely introduced to respondents working full-time, part-time or were students.

In the retrospective part of the survey the respondents were asked to compare their present activity pattern to their pre-COVID-19 activity pattern, while in the prospective part the respondents were to state their expected post-pandemic activity pattern compared to pre-COVID-19 levels (Fig. 1). The post-pandemic situation was explained as the virus being under control, minimal risk of getting infected and all restrictions from the government removed.

The two timeframes include similar questions, except the prospective part which had additional questions on mode choices. Questions on mode choice during the pandemic were not included in the retrospective part as the general trends may be found in a considerable number of studies.

3.2. Recruitment and sample

This paper presents the results collected through a self-assisted web-based survey in the period of June–July 2021. The data was mainly collected by distributing paper flyers with printed QR-codes in private mailboxes. In hindsight, the increased usage of QR-codes for contagion control during the pandemic has probably worked in our favour making more people familiar with QR scanning in general.

A pilot survey of 37 respondents was carried out in March 2021. No major changes were made to the survey after the pilot aside from an adjustment in the gender question. About 80 % of the respondents were recruited through flyers distributed in their mailboxes, while the rest were recruited through direct recruitment. The survey had an incentive mechanism in the form of a single prize raffle worth about 200 Euros.

Information was also collected on leave of absence during the pandemic (fully, partly, still on leave or back from leave), but the number of people on leave were not substantial with 1.9 % currently on leave, 5 % back from leave, 1 % lost their job and 1 % not wishing to declare. Analyses regarding these categories have therefore been omitted.

The survey sample, although recruited as evenly as possible, cannot be regarded as demographically representative of the entire population but rather as indicative of the general experience during this whole pandemic (Table 1). It is also worth mentioning the advantage of having the same respondents answer the two different timeframes which eliminate some uncertainty in comparing the results (since the same respondent would hopefully interpret the Likert-scale the same way for both timeframes). Occupational status for the 19 % ‘Other’ is unknown but they might be self-employed or freelancers (not employed).

Table 1
Socioeconomic characteristics in the population and the survey with number of respondents.

Categories	Norway	Percentage sample	n
Total	100 %	100 %	360
<i>Gender</i>			
Female	50 %	53 %	168
Male	50 %	47 %	150
<i>Age group</i>			
15–17	4 %	3 %	10
18–24	9 %	14 %	49
25–34	14 %	22 %	80
35–44	13 %	14 %	52
45–54	14 %	15 %	55
55–66	14 %	20 %	71
67–74	8 %	7 %	25
75+	8 %	3 %	11
<i>Occupational status</i>			
Full-time	53 %	56 %	201
Student	6 %	16 %	57
Pensioner	17 %	11 %	40
On leave, other	–	5 %	17
Part-time	17 %	4 %	16
Pupil	6 %	4 %	16
Disability leave	11 %	4 %	13
<i>Occupation</i>			
Office job, research, administration	51 %	34 %	73
Other	–	19 %	41
Healthcare	3 %	17 %	37
Industry, agriculture, craftsmanship	17 %	9 %	19
Education and kindergarten	5 %	8 %	18
Restaurant, stores, taxi, goods delivery	18 %	8 %	17
Higher education	6 %	6 %	12

3.3. Data analysis

The dataset was cleaned and analysed using the open-source program R. A regression analysis was conducted using a constructed, discrete variable with range -1, 0 and 1 based on the Likert scale. The Likert alternatives ‘substantially less often’ and ‘less often’ were valued -1, ‘unchanged’ to 0, and ‘substantially more often’ and ‘more often’ as 1. The two ordered alternatives were grouped into one based on the idea that the variation of actual habitual changes among respondents stating these two alternatives were less than the difference in habitual change between the opposites, the ‘less’ and ‘more’ responders.

4. Results

In this section we present the main results of the study in a descriptive manner. The aggregated results are presented first, thereafter disaggregated results by the respondents’ background characteristics (gender, age, and occupation status) are presented. In the presentation of our results the term ‘share’ is short for ‘percentage share of respondents’. The Likert-alternatives ‘somewhat’ and ‘substantially’ are aggregated unless stated otherwise, e.g. substantially more often and somewhat more often are referred to as ‘more often’.

4.1. Work and education related activities

4.1.1. Work and education: retrospective (comparing mid- and pre-pandemic)

In general, the usage of online platforms for work and educational

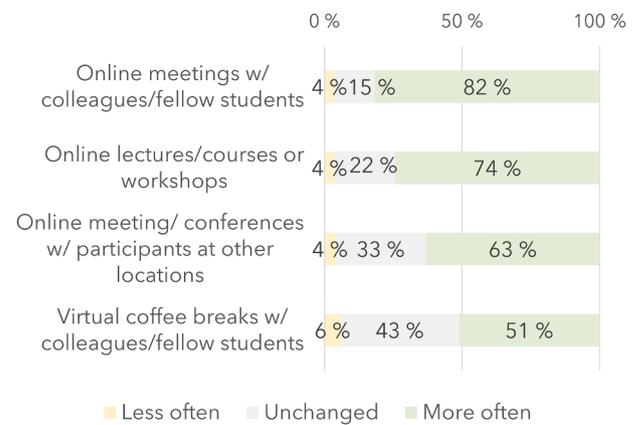


Fig. 2. Shares of respondents experiencing an increase or decrease of work-related activities mid-pandemic. Results from question "For the following activities, what have you done more or less of? Compare your last week with a typical week pre-COVID" (N = 274).

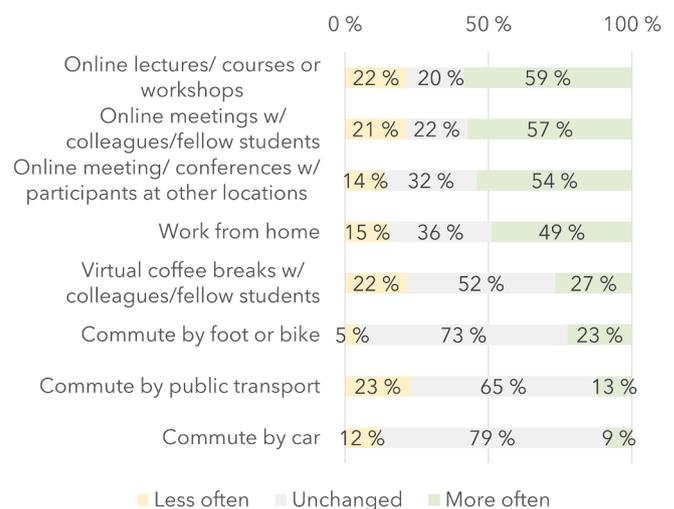


Fig. 3. Percentage share for predicted work-related activities in a post-pandemic future. "For the following activities, what do you think you will do more or less of? Compare a hypothetical post-COVID week with a typical week pre-COVID" (N = 274).

purposes has increased for almost all students and workers (n = 274) during the pandemic. Activities like meetings and lectures/workshops have the highest share of 82 % and 74 % respectively and having a virtual coffee break has become more regular, (see Fig. 2).

Across all ages the changes of digital work-related activities are very similar. The age group 18–24 has the biggest share of those who shifted from onsite to online platforms. This share decreases with age.

Looking at occupation status, the students have the highest share of individuals (91 %) experiencing increased digitalization during the pandemic. Among full-time workers this share is at 72 %, and 50 % for part-time workers.

Among the occupational groups, ‘restaurant, stores, taxi and goods delivery’ businesses have the smallest share of digital shifts at work, showing a range of 30–40 percentage-points less than the average results in Fig. 2. Workers in healthcare differ from the average on some aspects, but not as much as those in the ‘restaurant...’ businesses. This is expected for both occupations as their line of work usually require their physical presence.

4.1.2. Work: prospective

In the second part of the survey, the respondents were asked to compare their expected post-pandemic habits to pre-pandemic levels. For work related activities, there are four activities which more than half of the respondents are planning to keep after the pandemic. These are online lectures/workshops, online meetings with people (in close vicinity or in other regions), and the case of working from home, see Fig. 3.

The results on commute habits show an interesting self-assessed prediction, where 23 % of respondents (of students and workers) expect to increase their use of active modes (walking and biking) post-COVID-19. Only 5 % of respondents expect using active modes less frequently.

4.1.3. Work: elaborations on future work expectations

The respondents were offered the possibility to fill in any prospective predictions for the post-pandemic work life which was not covered in the questionnaire. Among the predictions is the return to physical meetings with colleagues or customers. It is still believed not to be a complete return as some telecommuting will be continued. Several respondents highlight the potential flexibility in teleworking. Other effects of telecommuting mentioned are the propensity for more ‘clean desks’ compared to personal assigned desk spaces, and that new types of public transport tickets should be offered for those not commuting often enough to qualify for a quantity discount per trip (e.g. monthly period pass).

4.2. Leisure activities

4.2.1. Leisure: retrospective

48 % of the respondents report an increase in outdoor activities (Fig. 4). This is expected due to the reduced risk of infection outdoors compared to indoors. At the same time, 24 % have experienced the opposite. This may be explained by the postponing and cancellations of several outdoor contact-sports (e.g. football, kid activity clubs). Relatively new activities like digital performances (45 %) and digital workouts (28 %) have risen in popularity. The largest decreases are in vacations domestically and abroad, as well as in visits to/from friends and family. 51 % have reduced their domestic overnight trips. At the same time 24 % have stated an increase, indicating that people are quite divided in their handling of the pandemic.

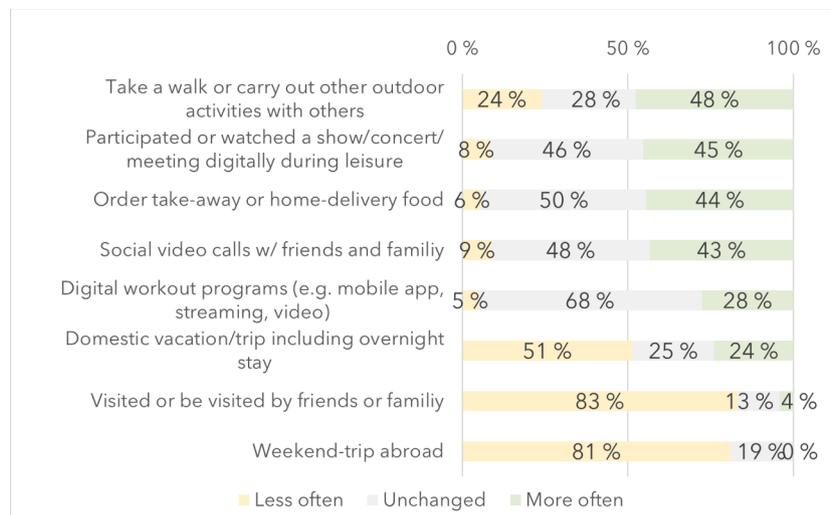


Fig. 4. Shares of respondents experiencing an increase or decrease of leisure-related activities mid-pandemic. "For the following activities, what have you done more or less of? Compare your last week with a typical week pre-COVID" (N = 360).

More women than men had increased their use of digital workout resources and social video calls, with a gender difference of 15 percentage-points. For the rest of the activities there were no apparent differences between the two. Without knowing the prior level of the activities, it is not possible to conclude if the overall activity level during the pandemic is higher for one group than the other.

Per occupational status, the ones with the biggest share of reduced activity level regarding walks or outdoor activities are pensioners, and persons with disabilities. These groups may have reduced their activity level to avoid risks which could compromise their health status.

4.2.2. Leisure: prospective

For half of the leisure activities more than 50 % of the respondents do not plan to make changes in their activity level (see Fig. 5). The rest of the respondents are almost evenly divided between more and less often.

A clear aggregated direction is seen in domestic vacation trips (46 %

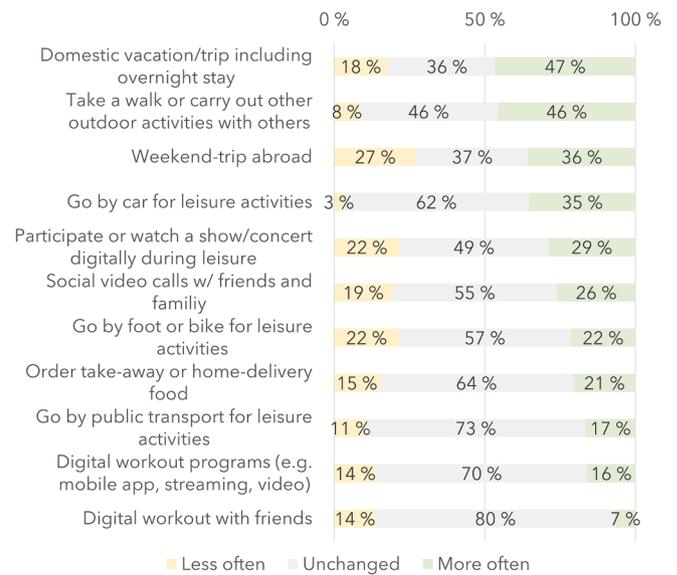


Fig. 5. Share in predictions of post-pandemic leisure activities. "For the following activities, what do you think you will do more or less of? Compare a hypothetical post-COVID week with a typical week pre-COVID" (N = 360).

Table 2
General linear regression model with ‘planned post-pandemic weekend trips abroad’ as the dependent variable. Significant codes: ‘****’, 0.001, ‘**’, 0.01, ‘*’, 0.05.

Control variable	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-0.033	0.093	-0.35	0.73
Weekend trip abroad (mid-pandemic)	0.001	0.101	0.01	0.99
Domestic vacation trip (mid-pandemic)	0.007	0.051	0.14	0.89
Domestic vacation trip (post-pandemic)	0.298	0.057	5.19	3.6e-07****
Take a walk or other outdoor activity with others (mid-pandemic)	0.058	0.052	1.10	0.27
Take a walk or other outdoor activity with others (post-pandemic)	0.051	0.069	0.74	0.46

Table 3
General linear regression model with ‘planned post-pandemic trips to shopping centers’ as the dependent variable. Significant codes: ‘****’, 0.001, ‘**’, 0.01, ‘*’, 0.05.

Control variables	Estimate	Std. error	t-value	Pr(> t)
Went to shopping centers (mid-pandemic)	0.1602	0.0735	2.18	0.0299*
More online shopping (mid-pandemic)	0.1043	0.0737	1.42	0.1577
More online shopping (post-pandemic)	-0.3729	0.0808	-4.61	5.6e-06****
Used home delivery for non-edible goods (mid-pandemic)	0.1345	0.0835	1.61	0.1082
Plan to use home delivery for non-edible goods (post-pandemic)	-0.2911	0.1001	-2.91	0.0039**

hypothesized, but we did not find statistical evidence for this.

Some activities show differing responses. For weekend trips abroad, 27 % expect fewer trips while 36 % expect an increase. There is no indication that domestic trips/activities during the pandemic (as due to travel restrictions abroad) influence people’s post-pandemic plans for weekend trips abroad, see Table 2. People who plan to travel domestically more often also plan to travel abroad more ($p < 3.6e-07$). The ‘travel bug respondents’ do not plan to reduce any travel activity—they wish to do more of everything.

The planned use of active modes is divided, see Fig. 5. A majority of people (57 %) expect leisure activities by foot and bike to stay on the same level as pre-COVID-19, while the rest either plan a reduction or increase. Even though many experienced an increase in digital activities (concerts, video calls, workout) during the pandemic, the shares who expect to continue this in post-pandemic future are substantially lower.

4.3. Shopping

4.3.1. Shopping: retrospective

During the pandemic, a general trend in shopping behaviour was to avoid crowds by reducing the number of trips as well as shifting the time of shopping errands (63 %) (see Fig. 6). 28 % went grocery shopping less often. Further, only 11 % used more grocery home-delivery, compared to 39 % using more home-delivery for non-edible goods. There was expected that shopping trips for non-essential goods like clothes and electronics could be replaced by online shopping, while grocery trips would remain “offline” as a function of its’ high immediate demand.

The data also indicate clearly that there is a huge reduction in trips to shopping centres. This is understandable as these places often house stores that offer non-essential products. During the period of data collection, the only measures of infection control at shopping centres were recommendations to use face masks and maintaining social distancing.

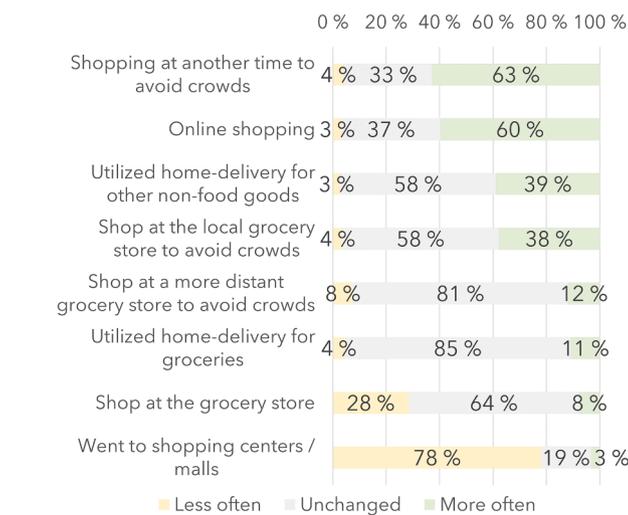


Fig. 6. Share in evaluated mid-pandemic activity level regarding shopping activities. Results from question "For the following activities, what have you done more or less of? Compare your last week with a typical week pre-COVID" (N = 360).

report more), outdoor activities (46 % report more), and car use (35 % report more). A general linear model shows that planned car use for leisure is correlated with planned outdoor activities ($p < 4.6e-06$), but not with planned domestic vacation trips ($p = 0.96$) (table not included). In the context of Norway, areas outside the perimeter of urban landscapes are almost exclusively accessible by car. A post-pandemic mode shift from other modes (especially public transport) towards car use was

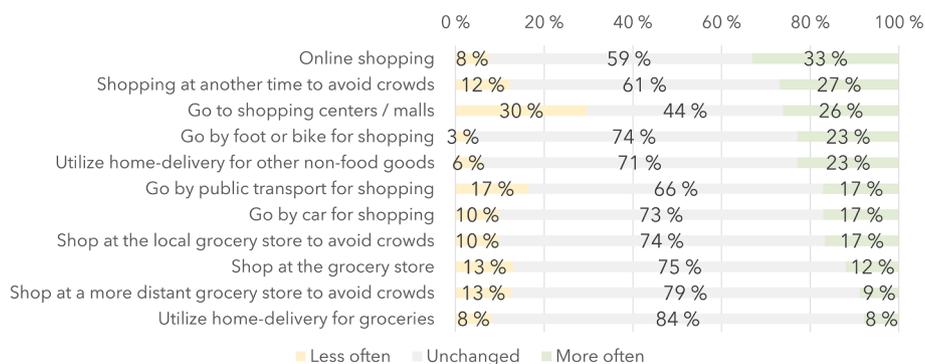


Fig. 7. Share in predictions of post-pandemic shopping activities. "For the following activities, what do you think you will do more or less of? Compare a hypothetical post-COVID week with a typical week pre-COVID" (N = 360).

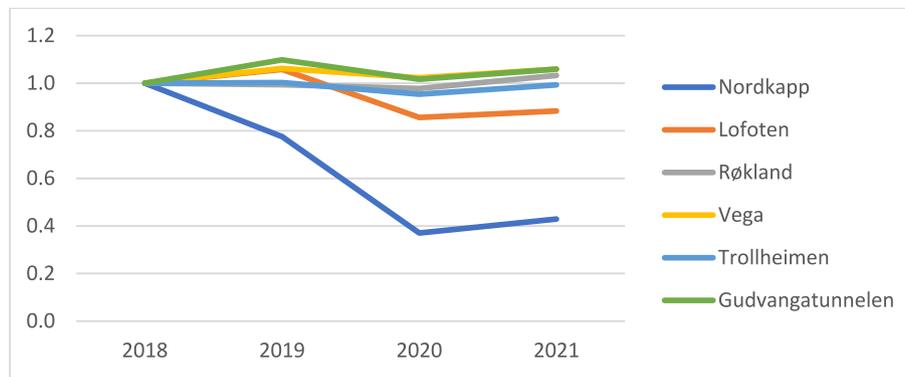


Fig. 8. Relative development in traffic (AADT) to some tourist attractions in Norway.

4.3.2. Shopping: prospective

The planned changes for shopping related aspects are much more moderate than for work and leisure activities; for all activities except one, the majority plan to make no change. The shopping activities that most people expect to do more often are online shopping (33 %), change timing of shopping to avoid crowds (27 %), order more home-delivery for non-edible goods (23 %) and use active modes more for shopping purposes (23 %), (see Fig. 7). The most inconsistent pattern concerns shopping centres, where big shares of respondents either plan to go more often or less often. There are other activities with equal shares of respondents reporting ‘more often’ and less often’—though for those it is not expected any considerable changes.

To better understand the changes in expected use of shopping centers, a general linear regression was conducted using other shopping habits as control variables, see Table 3.

The results show a strong negative correlation between post-pandemic trips to shopping centers and both post-pandemic online shopping and home-delivery of goods. There was also a slight positive correlation with an individuals’ experience with shopping centers during the pandemic. There is no correlation between post-pandemic demand of shopping centers and the mid-pandemic experience with more online shopping or more home delivery. It is notable that future intention is more clearly correlated with intentions of other related activities than the reported experience with the same activities.

5. Discussion

In this discussion mainly the third research question will be addressed, as the first and second was elaborated in the results section. The questions we sought to answer were:

1. Which type of activities were conducted differently during the pandemic?
2. How did they carry out activities differently?
3. Which type of activities are to be continued after the pandemic?

A recap of the two first research questions—during the pandemic there was an apparent increase in use of ICT regarding work and school related activities, an increase in online shopping and home-delivery. On the other hand, there were reductions in number of shopping trips (grocery and other goods), and adjustments were made to grocery trips to avoid crowds. There were big reductions in any long-distance trips domestically and abroad, and also in visits to family and friends. There are notable shares of respondents that reported changes in outdoor activities. The reduction may be explained by the cancellations of several outdoor contact-sports (e.g. football, kid activity clubs), while an increase is due to the reduced risk of infection outdoors compared to indoors activities.

5.1. Main findings

The results show that most people do not wish to change from their pre-pandemic habits. Even though many chose digital activities (concerts, video calls, workout) during the pandemic, the shares who expect to continue these after the pandemic are substantially lower. Activities for which the majority expects changes are working more from home, increase the utilization of digital platforms at work/school and spend more time outdoors. Some plan to do more leisure activities for which they need to use the car, commute less by public transport, do more online shopping, shop at different times to avoid crowds, and utilize more home-delivery services for non-edible goods. Our findings are in line with similar studies that predict the post-pandemic habits to consist of more meetings online, telework more, commute more by active modes and less by public transport (Beck and Hensher, 2020; Haas et al., 2020; Bucsky, 2020).

5.1.1. Expected changes in where people work and attend lectures

During the pandemic we have seen improvements in software, equipment, and skills for online meetings/lectures. The motivation to continue online activities may be explained by convenience and increased flexibility. Additionally, people’s expectations regarding online activities may have changed during the pandemic. Providing online solutions for e.g. meetings and lectures has become the rule rather than the exception (environmental and social context). In addition, most people have the necessary resources available—a laptop with access to internet. Many have also formed a habit of using tools like Teams and Zoom on a regular basis.

On the other hand, for people to benefit from and contribute to these online activities over time, they have to pay attention and engage. This might require a change in attitude (identity) and self-discipline (self-regulation) compared to participating in physical settings with other people present. If people think of digital meetings, lectures, and workshops as poor substitutes for their in-person physical counterparts (motives), it will become difficult to continue with these digital activities, even when people are motivated by convenience. This may also affect the social and environmental context of this “digital habit” as it makes it more difficult for organizers to defend arranging such digital events, which additionally will affect the continuation of this habit.

The role of motives and self-regulation in continuing online activities such as meetings, workshops, and lectures, are also present from the viewpoint of the organizers of such activities. For example, it is easier for a lecturer that embraces the format and possibilities of online teaching to continue online teaching, than for someone who prefers the traditional lecture, and experiences adapting to an online setting as just another increase in the workload.

Hence, we might see a semi-comeback of physical meetings and lectures, but we expect a substantial share of them will be replaced or accompanied by online versions.

5.1.2. Expected changes in leisure and shopping activities

Many leisure activities conducted both indoors and outdoors have been postponed or cancelled during the pandemic, resulting in the build-up of suppressed demand, especially social activities and vacations.

Based on the result we might expect a tendency to overcompensate, especially within activities that were only available online during the pandemic. On the other hand, a change in behaviour requires more than good intentions. As an example, people who before COVID-19 regularly attended concerts and other cultural happenings, and viewed themselves as culturally active, may not identify with this as strongly as before (motives). Going out requires planning, preparations and effort that are perhaps no longer routinized (habits). Resources, e.g. social contacts with an overview of the cultural happenings, may not be available anymore. Changes in life situations during the pandemic, e.g. moving, or having children, may have caused different priorities and different expectations from the environment (environmental and social context) that do not fit well with the intention of an increased participation in cultural activities.

From this point of view, a damper is put on the rebound effect. It is likely to take time before activities that were reduced during the pandemic (cultural activities, restaurant visits, using public transport, shopping trips) will reach former levels, if they ever will.

Activities that increased during the pandemic, and potentially would last, are the somewhat overlapping categories domestic vacation trips, car dependent leisure trips and spending more time outdoors.

A low share of respondents reported having used home-delivery of groceries. A possible explanation for this is that the grocery stores were not shut down like other locations, and therefore not forcing people to use alternative means to grocery shopping. Another explanation is that there is a much higher immediate demand for groceries than any other non-essential products. Still, 28 % of the respondents reduced their grocery shopping frequency during the pandemic, but it was not replaced by home-delivery.

Shopping centres experienced a dramatic reduction in customers during the pandemic, also after the early lockdown phase. We expect that shopping centres faces harder competition from online shopping.

5.2. Implications for transport demand and recommendations on transport policy

Online meetings, workshops and lectures that replace physical attendance have the possibility to reduce travel demand. One potential benefit of flexibility in where and when to work could be that traffic peaks are more evened out, requiring lower capacity on the road network and on the public transport service. This could potentially postpone investments towards capacity on transport infrastructure and should be monitored closely. Another impact might be that people rely on the possibility to work from home and move to more rural areas, which again make them more car dependent. An employee that occasionally work from home would maybe not invest in the ordinary period tickets, so the public transport providers should offer new types of tickets or broaden the service to attract new and keep the same passengers.

The share of people walking or cycling on their commute trips are generally low in Norway, but 23 % state they will do it more often after the pandemic. This could be explained by the increasing sales of electric bikes (often a more viable solution than regular bicycles in the context of Norway's hilly topography), and their wish to keep healthy habits. It takes some self-control to continue or initiate, thus we expect only a minor increase in commutes by active modes. The aftermath of the pandemic will probably hit the airline companies and the public transport companies the hardest. Traffic volumes on the roads will most likely eventually go back to normal levels.

Norwegians have certainly discovered Norway as a destination for vacation, hiking and other leisure activities, and most of these trips are carried out by car. National traffic registrations indicate a minor drop in

average annual daily traffic on typical tourist traffic roads in 2020, but these have increased in 2021 and will probably return to previous levels or higher in 2022 (Fig. 8).

Reduced car traffic in the cities and more trips by active modes go along with political goals and should be encouraged by supporting safe and efficient infrastructure for active modes. However, the reduction in car traffic seems temporary, and given the reluctance to use public transport, the authorities should control car use through parking regulations, tolling, access control as before the pandemic, and subsidize public transport to avoid service reductions.

More domestic vacations and weekend trips possibly by car lead would lead to more traffic on main and rural roads. Though, if this car choice would be modal shift from plane trips, then there might be an emission reduction in total.

6. Conclusion

The results of this study indicate that the activities with the biggest appeal of continuation are teleworking, having online meetings at work, spend more time outdoors, travel more domestically, use the car more during leisure time and use active mode more. As to prevent a potential increase in car use for leisure trips, decision makers may take the opportunity to implement measures that deter car use and increase access to alternative modes.

We predict an increase in the flow of goods related traffic post-pandemic compared to prior the pandemic, as people state a preference for more online shopping and home-delivery of these goods. This trend could be foreseen independently of the pandemic, so the decision makers are certainly aware of this.

This discussion on facilitating habits post-pandemic is hypothetical. It is known that new habits after a disruptive event may not necessarily persist. However, the results of this study do not cover disruptive short-term events, but rather a long-term one that may have forced people in making alternative, viable choices in their activity patterns.

Policies can better meet the expectations of the people which in these instances are more flexible work arrangements like teleworking, improved bike and pedestrian infrastructure and increase attractiveness of public transport. New experiences and knowledge facilitate lasting changes, and if choosing differently are in line with political goals and employers' interests, there is no way back!

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

- Abdullah, M., Dias, C., Muley, D., Shahin, M., 2020. Exploring the impacts of COVID-19 on travel behavior and mode preferences. *Transp. Res. Interdiscip. Perspect.* 100255.
- Abu-Rayash, A., Dincer, I., 2020. Analysis of mobility trends during the COVID-19 coronavirus pandemic: exploring the impacts on global aviation and travel in selected cities. *Energy Res. Social Sci.* 68, 101693.
- Barbieri, D.M., et al., 2021. Impact of COVID-19 pandemic on mobility in ten countries and associated perceived risk for all transport modes. *PLoS One*.
- Beck, M.J., Hensher, D.A., 2020. Insights into the impact of COVID-19 on household travel and activities in Australia – the early days of easing restrictions. *Transp. Policy* 99, 95–119.
- Bucsky, P., 2020. Modal share changes due to COVID-19: the case of Budapest. *Transp. Res. Interdiscip. Perspect.* 8, 100141.
- Forsyth, P., Guiomard, C., Niemeier, H.-M., 2020. Covid-19, the collapse in passenger demand and airport charges. *J. Air Transp. Manage.* 89.
- Haas, M.D., Faber, R., Hamersma, M., 2020. How COVID-19 and the Dutch 'intelligent lockdown' change activities, work and travel behaviour: evidence from longitudinal data in the Netherlands. *Transp. Res. Interdiscip. Perspect.* 6.
- Hjorthol, R., Engebretsen, Ø., Uteng, T.P., 2014. 2013/14. National Travel Survey – Key Results. *Transportøkonomisk Institutt, Oslo*.
- Jenelius, E., Cebecauer, M., 2020. Impacts of COVID-19 on public transport ridership in Sweden: analysis of ticket validations, sales and passenger counts. *Transp. Res. Interdiscip. Perspect.* 8.

- Kontou, E., Murray-Tuite, P., Wernstedt, K., 2017. Duration of commute travel changes in the aftermath of Hurricane Sandy using accelerated failure time modeling. *Transp. Res. A: Policy Pract.* 170–181.
- Kwasnicka, D., Dombrowski, S. U., White, M., Sniehotta, F., 2016. Theoretical explanations for maintenance of behaviour change: a systematic review of behaviour theories. *10(3)*, 277–296.
- Lattarulo, P., Masucci, V., Paziienza, M.G., 2019. Resistance to change: car use and routines. *Transp. Policy* 74, 63–72.
- Bærum Municipality, 2020. Working from Home – Employee Survey. Sandvika: s.n.
- Parkes, S., Jopson, A., Marsden, G., 2016. Understanding travel behaviour change during mega-events: lessons from the London 2012 games. *Transp. Res. A: Policy Pract.* 92, 104–119.
- Prager, F.G.R.B.A., Lee, B., Winterfeldt, D.V., 2011. Exploring reductions in London underground passenger journeys following the July 2005 bombings. *Risk Anal.* 31 (5), 773–786.
- Rothe, J. S. (2021). Nesten 40 prosent færre kollektivreiser i 2020 (SSB). [Online] Available at: <https://www.ssb.no/transport-og-reiseliv/artikler-og-publikasjoner/nesten-40-prosent-faerre-kollektivreiser-i-2020> (Accessed 30 March 2022).
- Shamshiripour, A., Rahimi, E., Shabanpour, R., Mohammadian, A., 2020. How is COVID-19 reshaping activity-travel behavior? Evidence from a comprehensive survey in Chicago. *Transp. Res. Interdiscip. Perspect.* 7 (3).
- Sheth, J., 2020. Impact of COVID-19 on consumer behavior: will the old habits return or die? *J. Bus. Res.* 117, 280–283.
- Siemens, R.A., Henning, M., Poeske, A., Trier, M., 2021. Covid-19 and its effect on trip mode and destination decisions of transit riders: experience from Ohio. *Transp. Res. Interdiscip. Perspect.* 11 (2).
- Sivertsen, B., 2021. Students' Health and Wellbeing Survey. s.l.: s.n.
- Timmermans, H., Ettema, D., 1997. Activity-based Approaches to Travel Analysis. Emerald Group Publishing Limited, s.l.
- Tuv, N., Fredriksen, K., Rydjord, M., 2021. Koronaåret i 10 grafer (SSB). [Online] Available at: <https://www.ssb.no/helse/artikler-og-publikasjoner/koronaaret-i-10-grafer> (Accessed 7 April 2022).
- Uğur, N.G., Akbiyik, A., 2020. Impacts of COVID-19 on global tourism industry: a cross-regional comparison. *Tour. Manage. Perspect.* 36.