

Chronicles from the new normal: Urban planning, mobility and land-use management in the face of the COVID-19 crisis

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ABSTRACT

The world is facing new challenges due to the SARS-CoV-2 (Severe Acute Respiratory Syndrome CoronaVirus 2) virus outbreak identified in Wuhan, China in December 2019. The aim of this paper is to investigate and discuss how cities are being managed in the anti-pandemic “new normal”. And this in light of unexpected phenomena such as: the on-going modal shift from public transport to private modes vs the new momentum gained by walking, and social lifestyles dictated by confinement first and now by unregulated behavior, also affecting land use. Add to this unpreparedness of pre-pandemic transport policies and the new emerging opportunities; the fresh directions for research and development, for example in the field of urban mobility management. With the additional goal to contribute to further advance the research, the paper also clearly shows that the crisis can be overcome only by considering different fields of action and by considering our common past.

Introduction

Although pandemics are not unprecedented in human history, the Coronavirus disease (COVID-19) has rapidly mutated through the world into an unprecedented health, economic and geopolitical crisis (Schindler et al., 2020). On 20th January 2020, epidemiologists at the Chinese Centre for Disease Control and Prevention stated that the first cluster of patients with ‘pneumonia of an unknown cause’ had been identified on 21st December 2019 in Wuhan (Khan et al., 2020), a city with more than 11 million inhabitants. Containment measures were soon announced world-wide to counteract the COVID-19 outbreak and obtain an effective spread reduction (Thomson and Ip, 2020). Governments enforced unprecedented executive, legal, and regulatory anti-pandemic response procedures resulting in severe restrictions on citizens’ mobility. Such action had already demonstrated the effects in several scientific studies (Haug et al., 2020). Under the “stay at home” mandate, COVID-19 has changed the world and has heavily impacted on any human activity, both essential and not (Chang et al., 2020).

But every crisis in history has also represented an opportunity, or at least a chance for change (Więckowski, 2020), and the post-pandemic world is expected to be more sustainable, with behavior moving in “green” and responsible directions (Więckowski, 2021), impacting on

lifestyle, mental health, and quality of life (Park et al., 2021).

Moreover, several long-lamented problems during the crisis were exacerbated, due to poor preparedness such as inadequate medical facilities (in number, uneven distribution, low capacity, and lack of resources and stock). Excessive urban population density helped the virus spread; urban transportation systems appeared to be inefficient in supplying safe services to citizens. Added to that was unfamiliarity with remote access to and management of public services and functions, i.e. poor web literacy; citizens’ initial only slight awareness of the epidemic consequences, all typically leading to inappropriate early response opportunities (Schull et al., 2006). All of the above increased the complexity of already-complex urban scenarios, with restrictions and confinement unsettling urban and social structures in a short time (Sharifi and Khavarian-Garmsir 2020, Salama, 2020).

Forced domesticity increased physical distances among people, in contrast to the consolidated trends to compact groups, shortening distances and reducing times. Countries and cities were isolated, like contemporary walled medieval urban areas. To prevent the spread “from the outside”; outdoor public spaces soon became empty, with non-existent social life. In this scenario, neighborhood proximity played a new role, fostered by walking and local shopping as only admitted activities during the lockdown confinement. The 2020 German ADAC

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surveys, both in March and November 2020 stressed how citizens perceived walking as an opportunity and not as a limitation during the lockdown periods (ADAC, 2020). Once the lockdown was lifted and the “new normal” started, these activities continued to gain momentum, thus shedding a new light on the development of urban mobility and land use.

In this new scenario, empirical research available in scientific literature to address potential contributions for all city scales (from urban to building) is still progressing. With the research goal to contribute to such progress and advance scientific knowledge, the paper analyzes the resilience (or lack of it) shown by cities, buildings and mobility (Section 2) during the pandemic and soon after, with a focus on the present situation (Section 3) where the transition towards the new normal is developing and the consequences from the emergency tackled (Section 4 and concluding remarks). All of the above relies on an in-depth analysis of the scientific literature available along with data as materials to corroborate the presented critical elaborations and empirical investigations to shed light on the on-going phenomenon. The primary geographical scope of this study is Italy and more specifically, the city of Rome and other urban areas, this country being one of the first European areas to be hit by the pandemic. However, one of the lessons taught by the pandemic is that European cities faced the same problems and provided very similar responses, with few exceptions, as further highlighted.

Literature review: The city as the COVID-19 arena

Literature on the development of the urban form and structure abounds (pioneered by Mumford 1968; Benevolo, 1996), with seminal analyses on what creates a “good” city form (Lynch, 1984), and the lost sense of wholeness in contemporary settlements (Alexander et al., 1987). Such development responds to problems affecting the social, political and economic contexts (Soma et al. 2018), which can be synthesized in three different city layout patterns: i) walled; ii) industrial; and iii) sprawled. They differ in terms of “borders”. Walls enclosed settlements, enabled controlled access of people and goods and protected the communities from attacks. They are iconic of the local identity of the communities they preserve, which in turn perceive walls with a sense of belonging, in the same way they do with local traditions and lifestyles. In Europe, Middle Age and the Renaissance, walled cities remained active and vibrant until the 19th century, when the Industrial Revolution claimed new areas to accommodate factories and housing for workers, i.e. the suburbs, outside the walled core. Borders lost their physical quality associated with walls in favor of a more “blurred” one: the social division among classes, dictated by income and zoning, with the latter determining the physical and social spaces of the city (Avanesov, 2018). This process progressed until the 20th century, and the relative prosperity after two world wars associated with massive motorization generated more suburbia, up to a point where urban

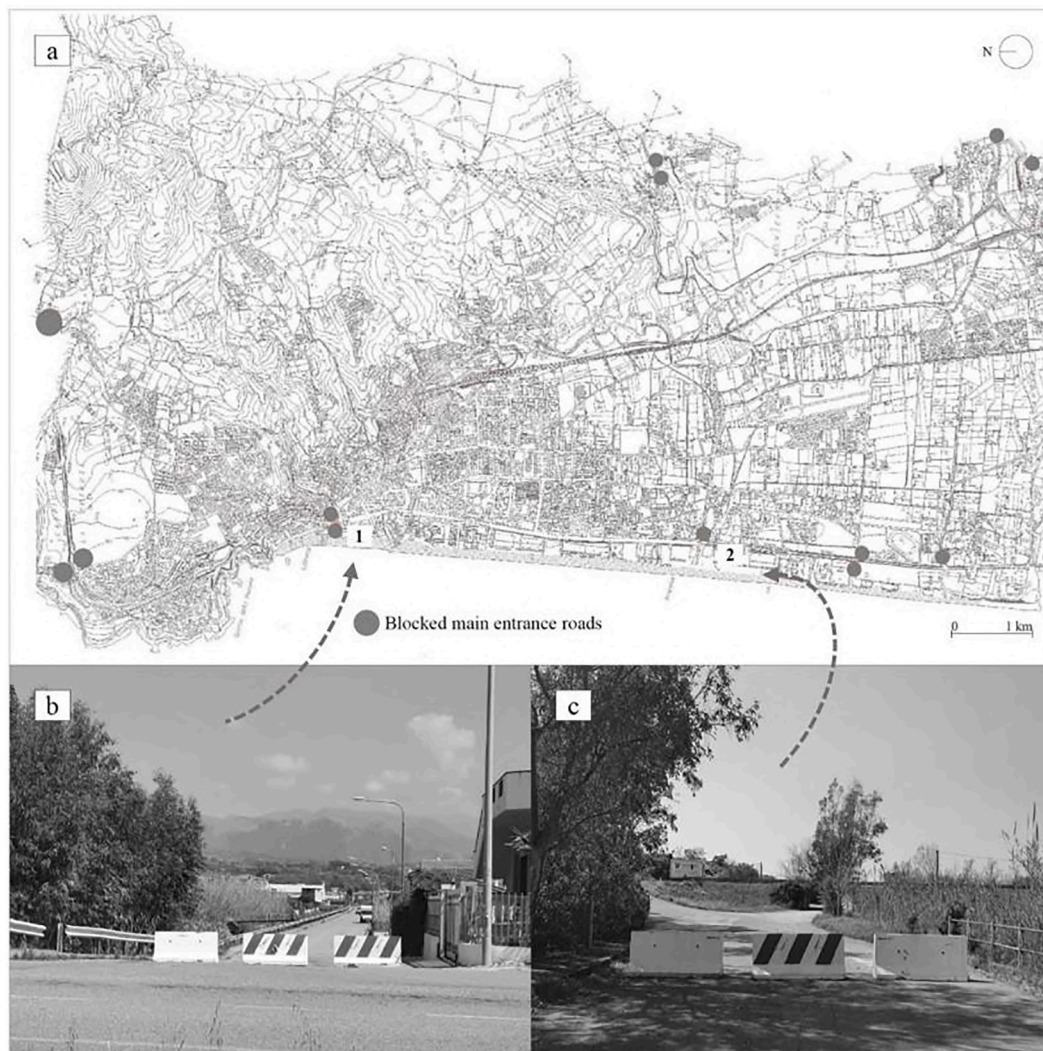


Fig. 1. Blocked main entrance roads map (a) and pictures of concrete blocks placed at the point 1 (b) and point 2 (c), at Scalea, a town in southern Italy (39°48'50"40 N, 15°47'47"04 E).

sprawl made urban borders disappear. The only walls and borders left were either historical landmarks or symbols of isolation due to political will. Therefore, contemporary cities shaped by globalization, digitalization and tolerance to distance have no limits, as evidenced from aerial views provided by the many web-mapping platforms and apps.

All of the above enables one to consider cities as arenas of changes, with borders morphing and disintegrating. And the current pandemic is no exception in this pattern: on March 11, 2020, after which COVID-19 was acknowledged as a pandemic by the World Health Organization, governments started taking action and enforcing measures to protect citizens against the virus' spread. Initial limitations of social contacts dictated by distancing and wearing Personal Protection Equipment (PPEs) soon gave rise to stricter confinement measures, enforcing restrictions to everyday mobility, with exceptions granted for proven vital needs. Cities were soon isolated, with physical borders made visible again: with concrete blocks or police patrols enforced by local authorities along the cities' access roads to avoid people travelling in or out (Fig. 1).

Thus, cities became "walled" again, but without the vibrancy of the ancient communities. Fig. 2 provides one more example of this: It shows a small-size Italian town, Contigliano in central Italy, cordoned-off at the end of March by the regional authorities due to a major local COVID-19 outbreak. The red line in the picture shows the emergency cordon around the urban area which, was also patrolled, and cut off the Contigliano community from the surrounding province, thus strongly evoking the walls of ancient European towns. Mobility was strictly surveyed, allowing only emergency and goods delivery vehicles to enter the built-up area. Any facility (commercial, educational, administrative, etc.) was closed and only short walks around home admitted. This emergency solution was recurrently enforced across Italy, whenever spreading conditions required full isolation of the most affected communities.

Lockdown imposed an abrupt halt to any activity and a dramatic drop in travel demand both giving rise to an unprecedented phenomenon: urban open places or areas soon became empty spaces and the "life between the buildings" went viral (Yabe et al., 2021).

Italy can be a case in point of the lockdown impact on traffic at the beginning of the pandemic. If data on traffic flows are observed during the period March 1 – May 3, 2020, when the restrictions were progressively enforced (Fig. 3), values markedly decreased up to 55%, with a peak of –87% during the Easter holiday period in the first half of April (Enel X, 2020). Moreover, a national survey designed to investigate behavior in cities during the first month of lockdown (i.e. March 2020) revealed that distances of motorized travels (by passenger cars and powered two-wheelers) decreased by one third in average, with longer trips being split into shorter ones on foot (thus walking increasing by 5%

in the modal share, on average). Conversely, transit demand generally halved. The less affluent and/or most vulnerable population (students, unemployed, housewives and the elderly) was the most affected, with mobility reduced up to 80% (AUDIMOB, 2020). These figures, however, are coherent with the lockdown's "stay at home" mandate.

A focus on the major Italian metropolitan areas, Milan and Rome confirms this trend (Fig. 4), although with some differences due to spread trends. Milan and its hinterland were severely hit from the very beginning of the pandemic in March 2020, whereas in Rome (and more in general in central and southern Italy) the magnitude of the phenomenon was more modest and its pace slower. The enforced general lockdown, however, affected both areas in the same way. Once the restrictions were lifted and the spread appeared to be controlled (end of July – August 2020), the traffic patterns coincided with those of the previous year. During Fall 2020, when the spread revamped and the lockdown was enforced on a local basis and with different degrees of confinement according to the local spread severity, Rome experienced milder and shorter restrictions than Milan, as evidenced by the difference in congestion levels during November and December 2020 (TomTom, 2021).

Since for any community, public spaces are always the most valued asset, they constitute the urban "public realm" or the set of spaces within which every citizen can freely move and communicate with his/her peers and can be considered public venues - the area of social engagement (Cuthbert, 2011). The pandemic lifestyles impoverished public spaces of their functions so denying their role (Fig. 5) and the public realm became domestic.

This might seem an oxymoron, but homes had to be converted into centers of public life and technology soon was the only medium for many activities, once associated with systematic travel: commuting to work and schools (both substituted by teleworking and distance learning), and making everyday errands (replaced by home deliveries). This was evidenced in Italy by a prompt rise in the demand for home and mobile connections, with the two major telecommunication providers recording increased traffic volumes, up to 90% (domestic) and 35% (mobile) between March and June 2020 (Caballini et al., 2021). During the lockdown, time spent online by Italians aged between 35 and 54 increased more than 110% than before (Johnson, 2021)

If the issues of equity and social exclusion associated with travel behavior in cities were raised much ahead of the current pandemic (Lucas and Jones, 2012; Schwanen et al., 2015), certainly the resulting web-dependence exacerbated problems for those who could not afford or were in no position to rely on IT technologies to substitute work and the related everyday commute with forced teleworking. The consequences of this situation, however, cannot be analyzed only from the transport policy point of view, but call for more a wider interpretation, as elaborated in the next section 3.

Results: Interpreting the consequences, a threat to sustainability

Now that lockdowns are being progressively lifted worldwide - domesticity, social distancing and behavior based on restricted personal mobility have already left many traces of their passing in our public spaces, although contrasts are evident and all leading to a threat to sustainability.

These can be synthesized into the following key concepts:

- Individual vs collective modal share
- Uncertain role played by transport
- Lifestyle changes affecting urban spaces
- Pedestrian realms vs troubling territories

and elaborated in the next sections.



Fig. 2. The cordon blocking access to the Contigliano urban area, a town in Central Italy, in March 2020 (42°24'45"00 N, 12°46'7"68 E) (Anon 2020).

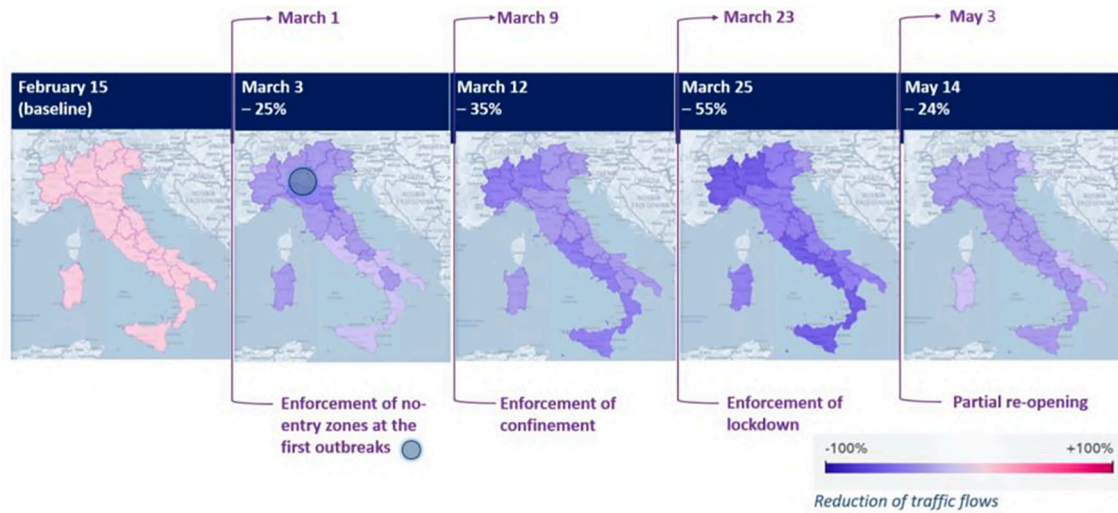


Fig. 3. Traffic flow variations during the development of the first lockdown in Italy, March-May 2020 (Enel X, 2020).

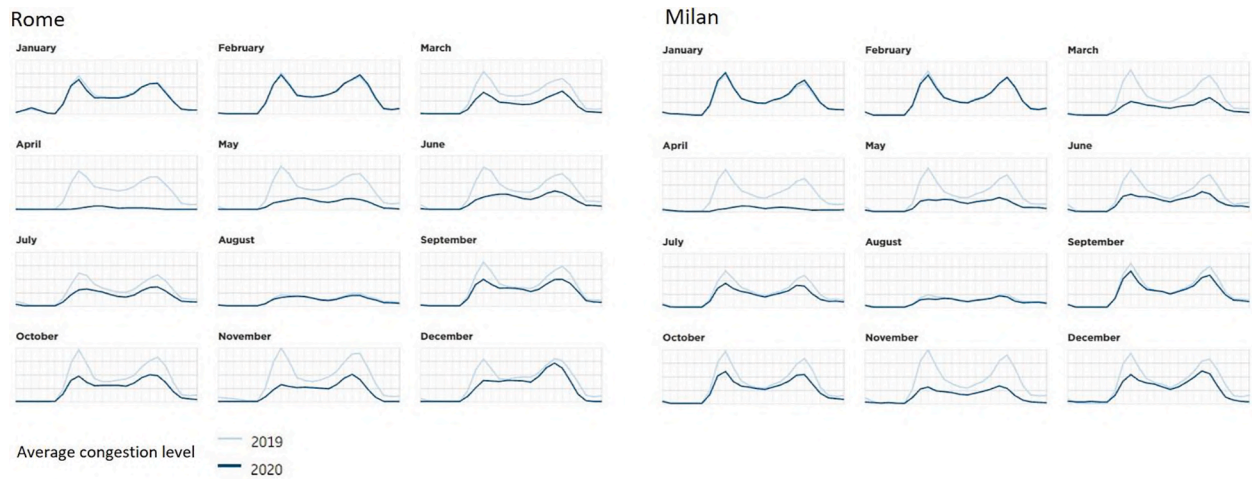


Fig. 4. Average congestion levels in Rome and Milan in 2019 and 2020 (TomTom, 2021).



Fig. 5. San Marco Square in Venice prior and during the 2020 lockdown (Cipriani, 2020).

Individual vs collective modal share

Scientific literature stresses a massive return to passenger cars, which have again become the prevailing mode in many cities, due to citizens' fear of Covid spreading on transit services (Corazza and Musso, 2021).

Fear is comprehensible and could be expected, although statistics clearly indicate that the magnitude of the outbreaks onboard urban transit modes is way below that of other long-distance transport modes (Gravert et al. 2020; Maogui et al., 2020) - and not even comparable to those detected in other social environments like schools, offices, and

healthcare facilities (Shibayama et al., 2021). But, at the same time, it is worth noticing that no restrictions to passenger cars were enforced during the lockdowns and after; on the contrary, in some cases “strictness” led to “permissiveness”. Rome can be a case in point: the city center is usually preserved by traffic problems by a Limited Traffic Zone which was relaxed during the crisis.

Municipalities, in the awareness of the overall inadequacy and unpreparedness of public transport to compete with passenger cars in the transition towards the new normal, directed local demand towards *individuality*, but with different approaches. At the end of the first wave (first half of 2021), in many cities local streetscapes were reshaped to accommodate non-motorized modes, in an attempt to provide a fast solution to transit services’ lack of competitiveness and attractiveness (Combs and Pardo, 2021). Plans to accommodate pop-up bike lanes were launched: for example, in Rome and Milan (22 miles for the latter according to Barbarossa, 2020). In Berlin they converted parking lanes and in Paris had the ambitious goal to extend the city network up to 400 miles (Kraus and Koch, 2021). On the same page was Oakland, California, where the local “Slow Street Program” enforced the temporary closure of some lane corridors to support safe, distant physical activities (Pond-Danchik et al., 2020). London, one of the first cities to launch temporary lanes (Topham, 2020), is in the process of dismantling them since motorists and retailers claim they are worsening congestion (Lydell, 2020). Micromobility appeared to be one more resource, but in general this cannot be considered a structural response on a near horizon to compensate transit shortcomings, either. Although much appreciated by the public, micro-mobility raises issues of short operational range, risks associated with sharing spaces with other modes (Hensher, 2020) and especially pedestrians’. This is highlighted further in section 3.4, regarding conflicts in infrastructure management, thus challenging the right to the public realm (Chen, 2021).

However, at the very beginning, this approach was hailed as a way of coping with emergencies and at the same time supporting the pre-pandemic mobility visions in many cities, driven by the need to comply with the sustainability requirements. But the long-term effects can already be seen, because orienting demand towards “solo” driving leads to: fostering passengers cars’ role in the modal share; conveying the concept that it is better to travel alone rather than with others (thus favoring bikes and scooters over car sharing and pooling, and transit); creating inequalities as transit becomes the option of the “car-less” (i.e. the elder, the vulnerable and the less affluent members of the community) and not of the “car-freed” users.

Uncertain role played by transport

Strict restrictions on travel and individual mobility of citizens have been adopted to contain the spread (Chinazzi et al., 2020) because such interventions demonstrated their positive effects in China (Jia et al. 2020; Kraemer et al., 2020). In Italy, the pandemic seemed to have traveled on highways, as in Fig. 6, (as first observed by Sebastiani et al., 2020) at its inception in the northern region of Lombardy (Usueli, 2020; Micheli et al., 2021), and from here to the nearby Emilia Romagna



Fig. 6. Spatial-temporal spread of COVID-19 along highway E35, in the Northern Italian regions of Lombardy and Emilia Romagna, in 2020.

region. If the timeline reported in Fig. 5 is considered in light of the progressive enforcement of the lockdown (from an initial few areas in Lombardy at the end of February 2020, to more areas in Emilia Romagna in the first week of March 2020, up to the nation-wide lockdown on March 9), the relevance of the road network in the virus spread can be better understood, and especially the pivotal role played by the ancient Roman road *Via Emilia* in spreading the virus across the nearby Emilia Romagna region (Maietti et al., 2020). The same pattern was observed on a national scale, in an epidemiological-spatial model (Gatto et al., 2020), and also corroborated by a binary-response model and logarithmic regression model proposed by studies currently in progress.

This is also corroborated by the observation of data on vehicular flows on both Lombardy and Emilia Romagna highways (Fig. 7), according to which average daily traffic decreased by 60% and 54 % respectively in March 2020, if compared to the previous month (ANAS, 2020). This means that in the last week of February and until the general confinement of March 9, traffic volumes were still high, with people traveling freely. Moreover, in these weeks, rail passenger service was also strongly reduced, and virtually ceased in the two weeks after. By mid-March, the national rail company operated only 6 out of the regular 104 daily services along the high speed corridor Rome-Florence-Bologna-Milan, whereas the private high speed operator suspended the service on the same corridor. The reduced rail supply can also partly explain the around 10,000 vehicles still traveling in Lombardy and around 7,000 in Emilia Romagna, during March 2020. With the occupancy rate sampled approximately as 1.45 passengers per vehicle (EEA, 2015), this means that 14,500 and 10,150 individuals travelled daily in those weeks, with very low occupancy rates.

The same pattern can be found in other regions in central and southern Italy (among these the Rome area), although more moderately, due to the minor severity of the spread.

A first interpretation could be that the process originated in those areas where population density, travel needs and income levels are higher, which are specific characteristics of the Northern Italy regions. In these areas, the 2019 yearly income per capita is around 35,000 Euros vs the national average of around 28,500 Euros; the 2019 average motorization rate (as [(vehicles/inhabitants)*1000]) is slightly higher than the national average, respectively 781 vs 776 (ISTAT, 2020; ACLI, 2020).

And this last point could raise a typical question whether the same would occur in areas where transport relies more on rail rather than on rubber-tired modes, thus slowing down the space-time progression of the spread. But in this case, replies rest upon a paradox and uncertainty.

The paradox is that, if the analyses and data above mentioned are considered, it seems that the virus traveled by car on highways and motorways; and that “solo” driving, i.e. traveling by passenger cars, that now seems to be perceived by the public as a solution, was probably one of the means which favored the initial spread, also because of the progressive reduction of the rail services. Moreover, the phenomenon concerning the public favor for “solo” driving also calls for some further elaboration. The above mentioned ADAC survey also revealed that, when asked about the travel option to adopt when back to “normal” life, the majority of interviewees (68%) stated that they would resume driving, whereas just 50% would resort again to public transport (ADAC, 2020). Not much different was the result from a survey to assess the impact of the pandemic on new car purchase in China, in February 2020: among the respondents who had no car and were willing to buy one, 72% reported as the main reason “driving can reduce the chance of infection”, whereas those already owning one were convinced that passenger cars and powered two wheelers would prevail over public transport, due to the public general poor trust in transit (IPSOS, 2020). This general sentiment (Thomas et al., 2021; Ozbilen et al., 2021) was soon corroborated by facts. The first examples of return to normality available, however, was that of Wuhan, with most commuters resorting to passenger cars when going back to work (Fig. 8).

Rome was no different, when just on the first partial reopening day

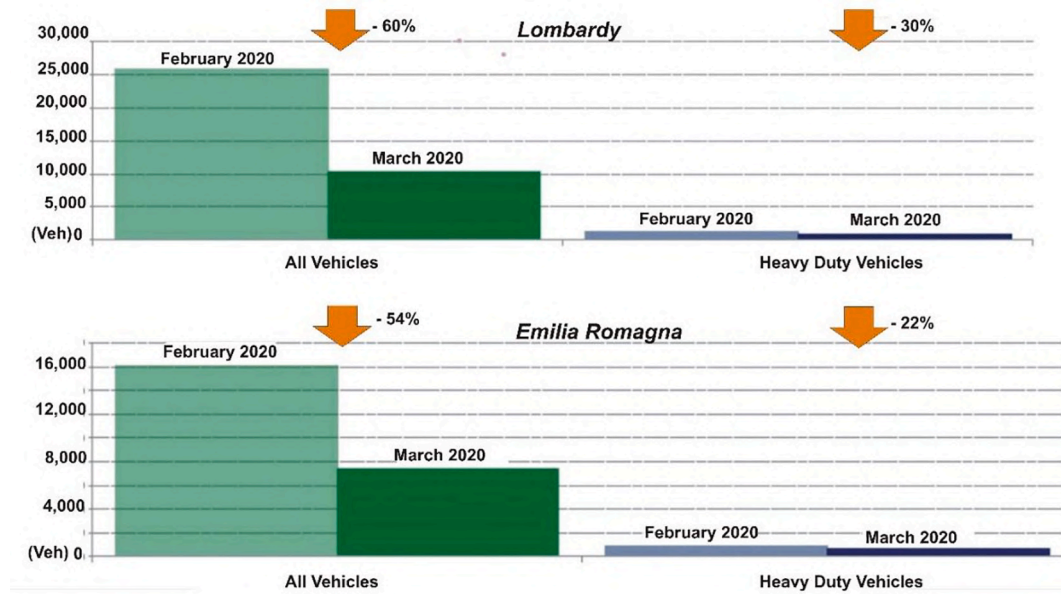


Fig. 7. Average daily traffic flows in Lombardy and Emilia Romagna regions, in February and March 2020 (ANAS, 2020).

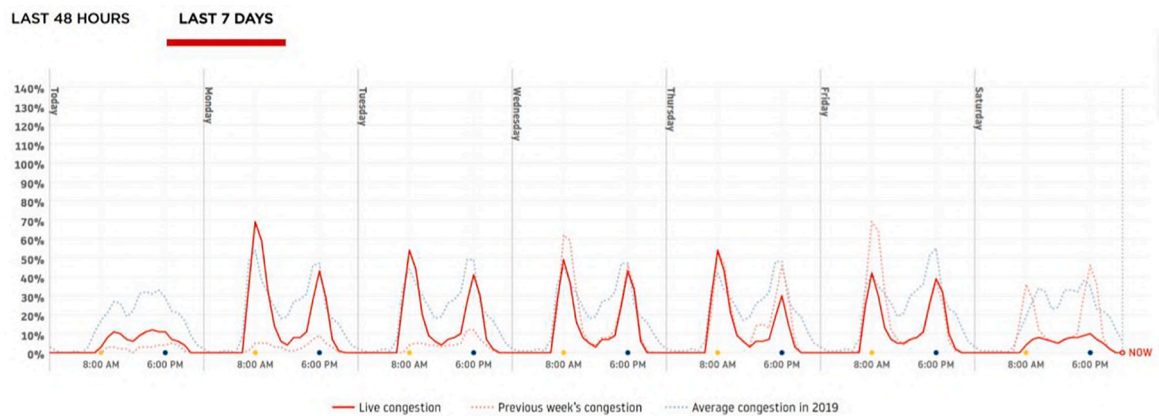


Fig. 8. Congestion levels in the city of Wuhan, second week of May 2020 vs 2019 (TomTom, 2021).

after the first wave lockdown (May 4, 2020), an increment of 230,000 passenger cars over the day before was recorded (De Ciccio, 2020). Fig. 4 confirms this preference towards “solo” driving also in Milan, and if the trends in June, July and August 2020 are observed (the months “in-

between” the first and the second pandemic waves in Italy, when most of the restrictions were lifted), traffic flows virtually coincide with those of the previous year. Still focusing on Rome as an example, reporting traffic levels in the week 22–28 October 2021 (Fig. 9), show that congestion is

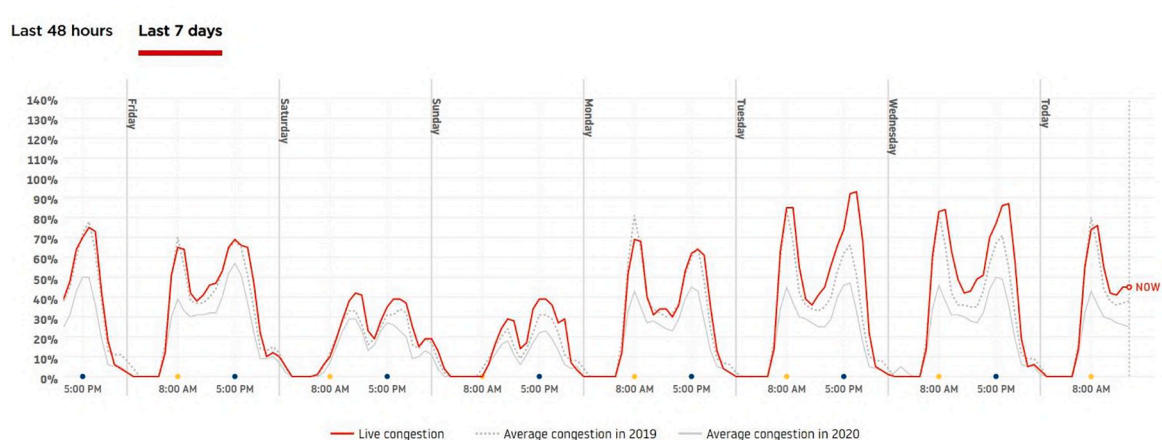


Fig. 9. Congestion levels in the city of Rome, the week 22–28 October 2021 (TomTom, 2021).

even higher than in 2019 (Tom Tom, 2021). Until the same week, passengers travelling on the five major urban rail lines (surface and underground) are slightly less than 75% of the demand volumes recorded prior to March 2020 (Roma Mobilità, 2021). One might argue that the modal split in Rome not being in favor of transit, with 60% passenger car; 20% transit; 18% walking, 2% bike (Deloitte, 2020), and the local motorization rate of around 830 (according to ACI, 2021, calculated as $[\text{number of motorized vehicles}/\text{number of inhabitants}] \times 1000$, including senior and infant population), one of the highest in Europe, and virtually unchanged for 15 years (Musso and Corazza, 2006), then such “new normal” revamping of passenger cars could be expected. It would be probably so, and not only in Rome, but also in other Italian urban areas with similar features; but the magnitude of this phenomenon would certainly have been minor, if transit operators could have clearly conveyed the message that transit facilities and environments were safe. This introduces the second issue to consider, that of the uncertainty.

The uncertainty is that there are no consolidated statistical data to corroborate the role of transit and long-distance rail travel in slowing down or accelerating the spread. It is undeniable that alarms associated with traveling by collective modes, as the origin of outbreaks or possible risky environments, are grounded on a very limited amount of studies, if compared with those focusing on other collective environments, as previously noted. For example, according to the French national public health authority, in October 2020 transport-related clusters accounted for 1.2% cases in France, way below the level observed at kindergartens and migrant care facilities, and similar to that observed at correctional facilities (Santé Publique France, 2020). Out of 377 COVID-19 clusters in China studied by Yang et al. (2020), 79 % were family-associated, while transport accounted for 2%, with just 6 clusters detected. Focusing on occupational settings, a study in 15 EU/EEA countries and the United Kingdom stressed that the number of transport-related clusters was not significant, with just three clusters (3, 4 and 8 individuals), involving employees from a taxi/private car service company and two long-distance transport companies (coach and railway, respectively) (ECDC, 2020; Shybayama et al., 2021).

Even among these studies, those focusing on urban transit are even fewer for several reasons: the transit environment is different from long-distance travel as there are no assigned places, on-board travel time might be extremely variable, passengers move from one door to another when boarding and alighting, thus making contact-tracing operations extremely difficult. As a result, the number of those infected while traveling is underestimated in the national statistics as records mostly include transport workers and not the entire community of travelers (Shibayama et al., 2021).

This uncertainty is one more element of threat to sustainability which goes hand in hand with the “solo” driving trend highlighted in the previous section. Passenger cars are favored in the “new normal” because there are no consolidated studies either to debunk the myth of risks associated with transit travel, nor to corroborate it. As a result, travel demand is oriented by sentiment rather than by knowledge and there are no clear messages to convey the idea that transit *per se* is safe. If two among the pillars of sustainability are: i) citizens’ education and information, and ii) responsible participation in the management of the common good, for urban mobility both have recently been supplanted by the tendency to be emotional in everyday travel choices.

Lifestyle changes affecting urban spaces

If all of the above is considered, the modal shift in favor of passenger cars is not surprising and the new scenario implies some structural changes in urban land use, with real estate as a leading trend. It has been observed how demand for real estate in central areas has progressively fallen, in favor of less expensive and dense suburbs (Ramani and Bloom, 2021). This is due to a mix of factors, among these: teleworking, household reduced incomes due to the pandemic-generated

employment crisis and consequently more modest lifestyles (Di Renzo et al., 2020; Valensisi, 2020), plus the desire for a proprietary green area to cope with the just-experienced confinement restrictions. But currently there is no evidence as to whether this “migration to suburbia” will consolidate and become post-pandemic structural. The lessons from sustainability are that revamping urban sprawl means massive driving, tolerance to distance, with consequent increased air pollution and land consumption. One might argue that teleworking will avoid systematic commuting, as everyday life will be shaped by domesticity and proximity, possibly with the city centers visited by “suburbians” during the weekends for non-systematic purposes, which may lead to an increase of secondary trips for leisure shopping (Riggs and Appleyard, 2020). It is hard to tell whether this will be a harbinger of more carpooling or carsharing, or in general more paratransit and transit, as long as shared vehicles are perceived as risky environments (Tarasi et al., 2021).

Moreover, as often in the urban phenomena, the displacement processes are more complex and the likely scenarios would be that of teleworking for one or two days a week, thus bringing back the problems associated with urban sprawl. However, it can also be considered that permanent teleworking might require additional organizational efforts (Barbour et al., 2021).

In the transition towards normalcy, however, the policy opportunities seem to be still coping with the transit unpreparedness and as a result they are mostly directed to promote fast solutions like micromobility. However, as anticipated in section 3.1 when describing the problems associated with pop-up lanes for non motorized modes, micromobility (bikes, kick-scooters and the like) this requires modifications of the current infrastructure layouts in order to create safe walking conditions for the most vulnerable users (Bielinski and Wazna 2020; Turoń et al., 2019). But the adaptation of existing infrastructures is a long-studied problem, especially in conflict areas like crossings and intersections in general, not only because of safety reasons (typically the erratic behavior of pedestrians), but also due to the scarcity of space. If temporary lanes for bikes are difficult to implement, even more so is the design of permanent infrastructure and circulation schemes, for example counter-clockwise circulation reserved for cyclists at intersections, or “roundabouts” (i.e., external roundabouts for cyclists with or without bike lanes, Fig. 10a or Fig. 10b, respectively). These should be designed after a proper quantitative assessment of the risk of collision between motor vehicles and two-wheelers in order to compare different solutions and identify the best strategy (Cantisani et al., 2021). This also explains the hype on pop-up lanes as riding strips, far from being designed and implemented as full bike networks.

Pedestrian realms vs troubling territories

From all of the above it is clear that the virus redefined individuals’ relationship with domestic and public spaces, leading to need more of both. It is also clear that public spaces have been partly adapted, affecting any type of urban environment: from the old historic centers, with compact networks of streets and alleys, to more contemporary areas. If, for the former, the multifunctional use of the “dado” areas and narrow sidewalks might constitute a hindrance to social distancing, for the latter a similar problem is posed by scaffolding, dumpsters, etc. Thus, the introduction of more functions, as those further described, does not improve the quality of the streetscapes.

A typical example is represented by the need to accommodate micromobility. This niche option has been hailed for its potential in enabling more environmentally-conscious riding even before the pandemic, thus already impacting on passengers’ travel choices and behavior (Shaheen and Cohen, 2019) in a very modest way. It represents a significant modification of urban mobility patterns (Jones et al., 2016) that could require new infrastructures for parking and charging (Turoń and Czech, 2020), none of which has been properly addressed during the “new normal” (Fig. 9 a to c), in light of escalated operations. In Italy, this escalation was originated by the Ministry of Transport decision, soon

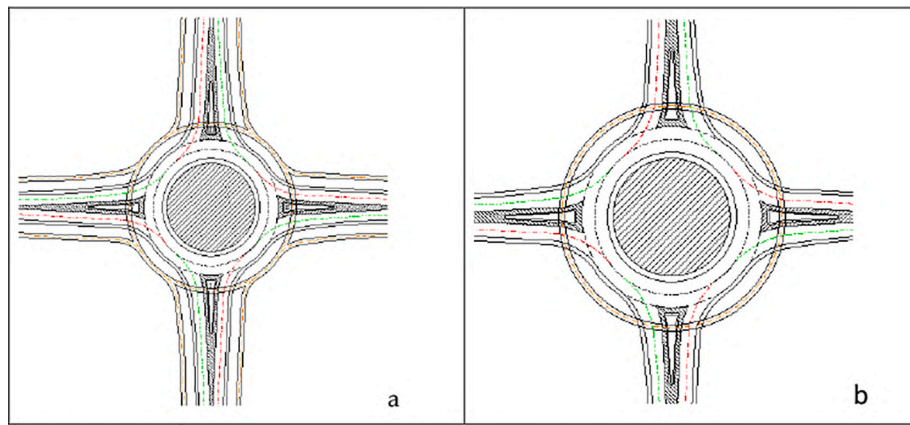


Fig. 10. Road intersection with roundabout a) with bike lanes on the arms; b) without bike lanes on the arms.

after the end of the pandemic's first wave, to subsidize the purchase and use of electric scooters and kick-scooters, and electric bikes, in the attempt to keep bus occupancy consistent with the social distancing requirements, and discourage the use of passenger cars. Prior to the pandemic, sharing scooters or bikes was a "niche" paratransit supply just in few major metropolitan areas in Italy, sometimes with unprofitable operations, as in the case of Rome. Thanks to the subsidies, micro-mobility rocketed in every urban area, with more operators and more options. In Rome, for example, since the end of the first wave, the number of operators progressively increased up to six, supplying rental electric kick-scooters, and two more for electric scooters, plus a minor one supplying rental bikes, in agreement with the municipality. Each electric kick-scooter company operates a free-floating service with fleets up to 1,000 vehicles, with variable rates. From the Autumn 2020 wave onwards, however, the supply soon appeared to be overestimated: the novelty wore off, road accidents involving kick-scooterists were continuously reported by the local press, new shutdowns and telework, problems with random parking, poor control over the service quality were all contributing factors that made the service less and less appealing (Corazza and Musso, 2021).

Nowadays, it is easier to spot parked vehicles than leased in operation (Fig. 11), with random parking still a problem, especially in the central areas. This required the enforcement of a specific "geofencing" system to avoid parking too close to landmarks.

These parking problems are also going to affect more recent walkability analyses and assessment procedures (Appolloni et al., 2020; Corazza et al., 2020), which will necessarily call for a revision to cope with this emerging paratransit type and its occupancy of the pedestrian realms.

Such revision is also urgent if one more trend is considered, i.e. that to occupy street areas for commercial purposes. Sidewalk cafes and the

likes are no new functions in the streetscapes of many cities; but during the pandemic and soon after, social distancing requirements highlighted the unsuitability of many indoor facilities (typically eateries) to safely accommodate customers. Resorting to outdoor areas to cope with that seems an intervention shared in many European countries, also because in many areas like Spain, Belgium, France, this was already a tradition for many cafeterias and restaurants. So it was also in Italy, where a national law was specifically enforced to help retailers in the recovery process, granting subsidies and concessions in the use of public land, with municipalities free to decide the size of the outdoor area to concede to each retailer (between 35 and 50% of the indoor area, in the majority of cases). There are no official data on the total surface involved, but local press stresses the large exploitation of this opportunity in every Italian city and in some cases estimates the areas granted for free, with Rome granting about 65,000 sqm (Guardascione, 2021) and Milan up to 130,000 sqm (Papi, 2021).

Rome, again, can be a case in point. The municipality granted free occupancy of parking lanes and sidewalks to those commercial facilities with no sufficient indoor areas to ensure social distancing, to install outdoor seating areas. If this was initially conceived as a temporary measure (as the law strictly mandates), its reiteration way beyond the emergency is creating several problems, and among these, the reduced revenues for the municipality due to the conversion of pay-for-parking on-street lots not yet perceived at a general level. However, even though the parking charge is rather low in Rome (1 Euro per hour), and considering that each granted outdoor facility occupies at least two parking lots (Fig. 12), and even assuming a very modest-revenue scenario (just 2 h paid per each lot) prior to the pandemic, an average missed yearly income of around 1200 Euros per granted facility can be easily estimated. As this opportunity was granted to every type of eatery, pub, bar and cafe, these being virtually present in every street of the

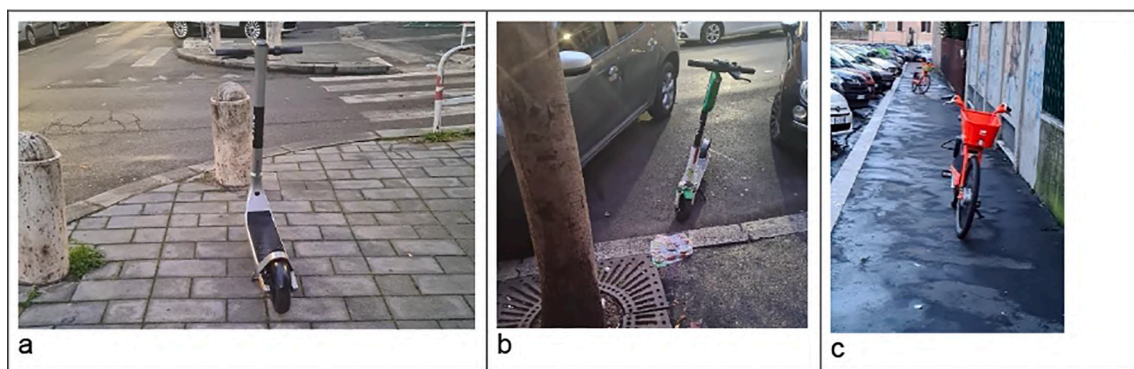


Fig. 11. Kick-scooters a) on sidewalks b) on lots reserved for cars; c) bikes on sidewalks.

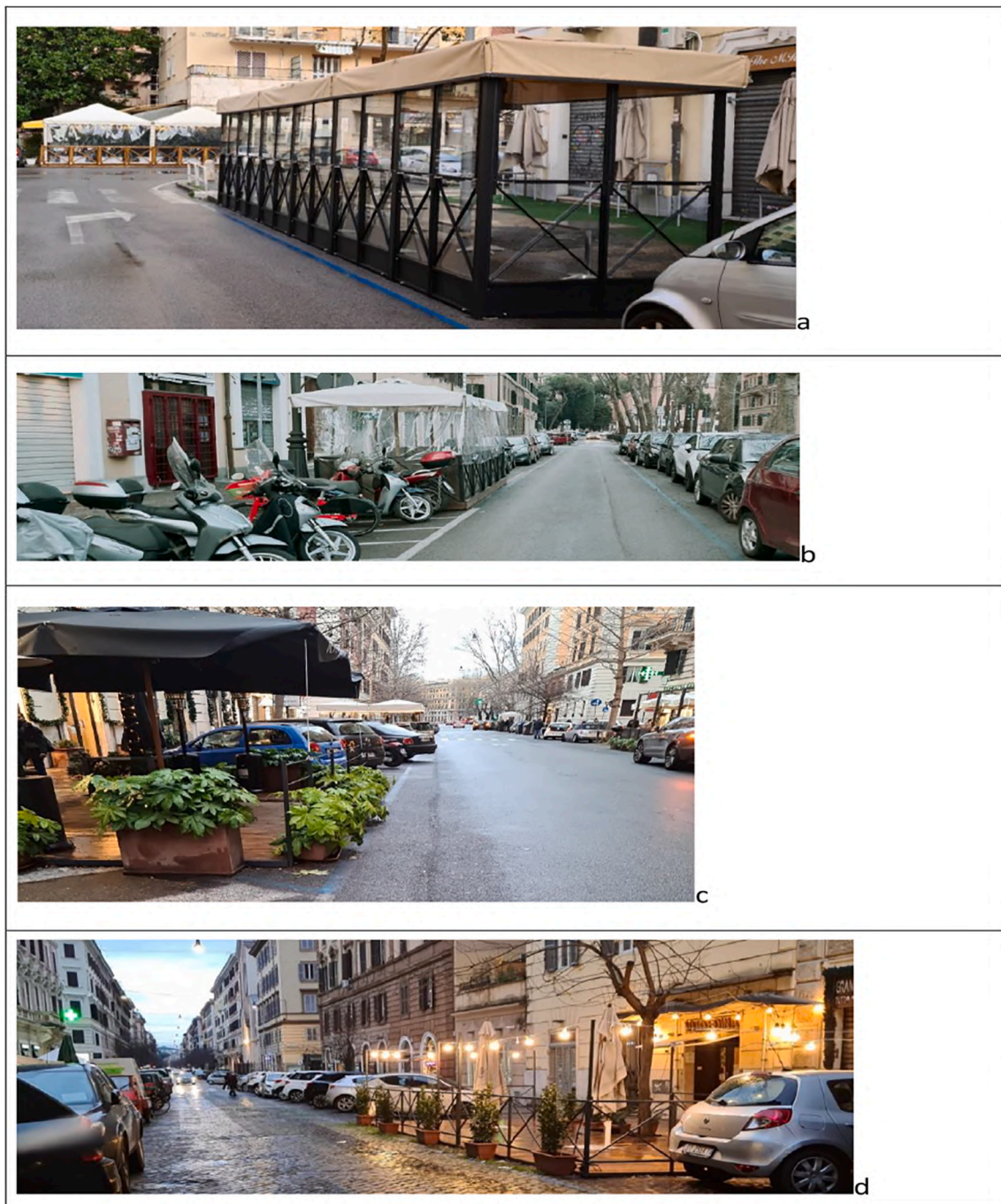


Fig. 12. Example of outdoor seating facilities.

consolidated city (in Fig. 10a, there is just one example of one outdoor facility in front of the other), and this being an opportunity largely exploited by shop owners (more than 60% of those eligible, according to De Cicco, 2021 reporting data supplied by the major national retailers association “Confcommercio”), the extent of the economic loss for the municipality is rather intuitive.

But the economic problem seems a minor issue if compared to other problems. After the majority of confinement measures have been lifted (including the local 10 pm – 5 am curfew), the possibility to stay (finally again) together, “al fresco” dine, drink and hang-out increased local nightlife as never before. This resulted in constant all-night occupancy of streets and squares by young people, with daily-recorded episodes of violent gathering phenomena, fueled by excessive drinking. As a countermeasure, the local police started enforcing closures: when gatherings

formed, the street or the square was closed. When the phenomenon (called “*mala movida*”) became routine, most popular hang-out squares were simply closed in advance. This was not enough, as nightlife shifted to less popular areas, with the same possibility to buy drinks. As a result, “*mala movida*”, as the virus, spread across the whole city, and since early Summer 2021 new, large COVID-19 outbreaks have been detected in several pubs with outdoor facilities. More specifically, the 2021 UEFA European Championship celebration in Rome contributed to an increased spread occurring from the second half of July to the first two weeks of August 2021 (for which a daily average increase of infected was recorded of around 400 units). Not much different was the trend observed in other Italian cities for the same reason and timeframe.

Moreover, granting free occupancy of parking lots was not associated with the enforcement of countermeasures to ensure safety from road

accidents. As it can be seen from Fig. 10, there are no safety separations or barriers between carriageways and the outdoor facilities, which led to increasing the severity of road accidents whenever occurring close to these facilities and affecting the seated customers, as repeatedly reported by the local press.

What could be initially assumed as a simple road management issue has turned pedestrian realms into troubling areas, a kind of new territories, unexplored, for which new regulations, design criteria and social rules have still to be developed.

Discussion: Taking the Best from the Worst or Changing Priorities?

The spread of COVID-19 and the associated health emergency belong to the “catastrophe” concept (as defined by Amson, 1975), i.e. a sudden transition from one state to another, such as a “jump”, or from a process to another with a new morphological structure. At the end of this emergency, the situation will change and we will need to be ready and flexible especially in order to help the most socially affected people (a lesson to be learnt over many years (Schull et al., 2006)). New ways to adapt and use shared places, from public restrooms to restaurants, classrooms, hallways, public transport vehicles, and sidewalks are to be studied. At the same time, problems which now seem hard to solve will probably lose momentum: typically, difficulties in adapting transit supply to social distancing, and/or staggering shifts, will be no longer priorities as soon as the vaccination programs are completed and herd immunity possibly reached.

Lifting social distancing requirements will probably be more beneficial to transit operations where companies acted according to three recurring trends: i) *Reduce*: e.g. seats availability, capacity, with supply decreased and even halted; ii) *Arrange*: opening windows, mandating masks, sealing driving areas, and iii) *Avoid*: in line with the imperative “do not touch”, by improving contactless functions, automatic operation of button-operated doors, etc. - all very different responses to a single problem, none of them deemed to become structural in the near horizon.

Therefore, getting out of this crisis will not occur rapidly and it will be the result of steps with a gradually increasing sense of re-belonging to the built environment accompanied by a new sense of freedom. Communities are going to take stock of how the crisis has disrupted the strategic decision-making framework for organizations and to build a new one to look beyond. When the health crisis will be overcome, this “new normal” will not be just a return to the pre-COVID-19 conditions: the pandemic response is accelerating several transformative processes that might be hard to reverse. Financial and technological disruptions of the past 30 years demonstrated there are parts of society’s fabric (e.g., long-lived infrastructures, complex regulatory frameworks) that are difficult to change quickly. However, the way of living in the city and consequently its use will substantially change. The shortcomings of urban centers will clearly emerge (e.g., health and transportation services) and new forms of social poverty will appear (Chowdhury et al., 2020). The pandemic has already shown that inequality affects those strata of the population without “choice” opportunities. The most affluent decided the travel mode and behavior to adopt, and choose whether to stay home or commute, drive or ride, thus revealing the binomial of the new poverty: poor web literacy and little modal choice. Citizens, in the past twenty years, have progressively learned that sharing was better than owning, but car ownership seems now revamping no longer as a status symbol but as an opportunity to avoid pandemic risks. This means that, probably, in the next future, some key areas in transportation studies will have to give way to new approaches, based on less “pure” theoretical modeling and more social analyses. A provocative question could be: “is it worth developing advanced transportation systems, e.g. autonomous vehicles or hyperloops, in the awareness that only few strata in the communities will be able to use them?”. There is no need to answer, if it is considered that during the pandemic those who have paid the highest toll were the more

vulnerable, uneducated or not informed on how to use basic PPEs. Thus a first direction could be to switch priorities, also under the environmental point of view. A typical example can be represented by the last decade Research and Development (R&D) efforts to manage energy for transit. Areas of innovation were and are energy-saving on board, by creating “sealed” travel environment to minimize heat losses during stops (Musso and Corazza, 2015) and increase of electrification in transit fleets (Bousse et al., 2018). With the safety need to improve the air quality on-board and increase the fresh air uptake within vehicles, as well as the urgency to retrofit older vehicles to this end, such an approach to energy management is no longer urgent in the “new normal” and R&D should probably direct efforts to import technologies for on-board air quality (from the aircraft sector, for example) and adapt those to transit vehicles.

Priorities might change also in other areas, not less important and close to mobility management, as the case of the pandemic-generated waste. The use of PPEs and the increasing demand for single-use plastic objects has generated an increase of plastic pollution (Parashar and Hait, 2021; Jirawattanasomkul et al., 2021) that should be managed with innovative waste management (Adyel, 2020). Therefore, building materials are required to give both technical and environmental responses to tackle COVID-19-generated effects (Klemeš et al., 2020).

Innovative sustainable approaches to recycle biomedical plastics waste in order to substitute traditional building materials are being studied (Mohan et al., 2021).

Building materials, in general, commonly derive from primary raw materials processed with high energy consumption. Their use caused, through the years, detrimental effects on the environment (e.g., depletion of abiotic resources, both elements and fossils, waste production, emissions of pollutants). The implementation of the “sustainability” concept in building design and material manufacturing forces researchers to develop alternative and less contaminant solutions to produce and use green materials (Moretti and Caro, 2017). This is much more urgent now to address the new challenge for dismantling PPEs during the COVID-19 pandemic (Adyel, 2020; Nowakowski et al., 2020; Shammi and Tareq, 2020; Singh et al., 2020).

The recent efforts towards reducing pollution from building materials (e.g. Durastanti and Moretti, 2020), merge with the needs to respond to the environmental emergency from COVID-19 recycling pandemic waste (e.g. disposable filtering masks as in Battegazzore et al., 2020). Therefore, on-going studies are testing unconventional building materials, from used PPEs or pandemic waste. Shredded face masks have been added to recycled concrete aggregate for road applications (i.e., bottom layers of pavements, according to Saberian et al., 2020); medical waste could be used for soil modification/stabilization (Tang et al., 2020); polypropylene fibers from single-use face masks have been added to concrete mixtures (Kilmartin-Lynch et al., 2021); likewise, for microplastic fibers (Fadare and Okoffo, 2020); a new composite using PPE waste has been tested to produce construction blocks, wall panels and interlocking blocks (Mohan et al., 2021). Therefore, a construction chain can emerge stronger after the pandemic emergency and contribute to totally decarbonize the built environment by 2050 (Selvaranjan et al., 2021), with a significant impact of building materials on achieving a variety of goals and targets according to the supranational Sustainable Development Goals (Secher et al., 2018; Omer and Noguchi, 2020). This also demonstrates that re-use might become a stronger direction in the post pandemic R&D strategies.

One more example of priority changes can be represented by the approach to walking in transport policies. For very long time, walking was considered a secondary mode, and often defined ancillary to the motorized ones. Recently, its promotion to “active mode” has generated a moderate acknowledgement for walking in the mobility policies, but still it is far from being considered as central. But the pandemic restrictions experienced have shed a new light on walking, as an essential mode for the confinement of everyday life, and citizens have started appreciating the benefits of having everything within walking distance

from home. This propensity is far from the hyped “15-minute city”, which again poses problems of equity for those who live in sprawled, monofunctional areas, and thus confined within them. Enhancing walking is not only a “salutogenic approach” to urban lifestyles, but can replicate the vibrancy of the walled cities and shape the life in common without the excesses highlighted in section 3.4.

Transport policy directions

If all of the above is considered, transport policies in the short term will be oriented to manage this transition towards the “new normal” and/or consolidating it, the duration of this phase being still uncertain. This means to keep on adapting transport supply still according to the *Reduce, Arrange* and *Avoid* mandates until social distancing and other medical requirements will be no longer needed. At the same time, urgent intervention will be required to dismantle functions and habits generated by the emergency and the assumed “convenience” due to the pandemic circumstances, as the permissiveness towards private modes and the “solo” attitude or the emergency-dictated use of the public realm. This will imply the enforcement of stricter control actions, the removal of subsidies, corporate worklife reorganization like the introduction of staggering shifts, the design of proper communication means, which as proved to be inappropriate (Diaz et al., 2021) to inform and make aware citizens that these habits are neither sustainable, nor affordable. As said, aside from the need to generate more and more awareness among the public, none of the above will be structural. But transport policies’ long-term course of actions will move from here and from the lessons learnt during the pandemic. The first is to conceive new forms of preparedness as this pandemic has proven that time can be a barrier. The pandemic is lasting way above any other emergency situation after World War II. Prior to this pandemic, preparedness (for whatever type of management of public affairs) was conceived to cope with relatively short events, of which the duration was predictable (natural disasters) or already largely experienced (social conflicts, economic crises, etc.), with problems of stocking goods, limitation of human resources, people immediate safeguard (evacuation, rescue, etc.) operated by special forces. From this pandemic on, preparedness will also include the awareness that some goods cannot be stocked to be used when emergency calls (e.g. transit fleet); human resources might be organized as usual but without using conventional workplaces (with mobility demand dropping as never before). Protection is long-term and partly relies on the personal capability to act according to public health directions. Along with an updated concept of preparedness, long term policies shall be targeted to resume the path towards sustainable mobility in cities (Schmidt et al. 2021); this will be challenging because behavior, thus far, have been dictated by fears grounded on sentiments rather than knowledge and awareness and brought public opinion back 30 years or more, at the greening of the environmental-consciousness. As said, communication will be pivotal in this process, to convey the idea that “solo” driving is not the solution, transit and walking are excellent modes to move around, micromobility might be useful but cannot be an ersatz for driving. This means to quickly resume the sustainable mobility course of actions started before the pandemic and keep on progressing under the old motto: “provide incentives to attract passengers to collective modes and disincentives to use private cars” (Vuchic, 1999). The last point to consider is equity and the transport policies of the future will be called upon to place the right emphasis on that. The most vulnerable among those already vulnerable, i.e. those who did not have a choice, have paid the highest toll. The lesson to learn, here, is to develop “universal” mobility solutions like pioneered in the Design for All studies and practice. If a mobility policy accommodates first those who not have a choice (among these, elders, physically and mentally challenged people, children, the illiterate, the immigrants, the less affluent citizens), operations and benefits will be really for all.

Concluding remarks

It is too early to predict the extent and duration of the crisis generated by this pandemic, nonetheless its socio-economic toll cannot be overlooked. The issues thus far highlighted show how the current pandemic is generating problems far beyond the urban mobility management sphere they were initially framed within. These, if unsolved, might result in the long run in threats for the sustainability concept. At the same time, any crisis has its impetus and research can exploit this opportunity. The example of the introduction of new technologies to manage air quality on board transit fleets evidences such new avenues to explore for R&D. In this new normal, cities will progressively adapt to face the post COVID-19 emergency. Decision-makers will be called to revise current policies in the field of public spaces, mobility and waste management. For what strictly concerns transport policies, priorities and visions will have to revolve more than ever around two of the keywords, previously mentioned: equity and preparedness. The pandemic lesson stressed inequalities, leaving opportunities just for the more affluent; this happened because policies in urban mobility management did not contemplate countermeasures to enable everybody to travel safely. As a result, passenger cars are revamping, complementing services to transit are supplied without actual integration with it, and land use is adapted to that without a vision, but just to accommodate temporary measures. The challenge is to quickly reverse this trend by starting from the opportunities provided in the “aftermath”. Promising directions come from walking which can gain more momentum as travel options, but also for its potential in reshaping the life in common.

The implications of all of the above both for researchers and practitioners are clear. Medical knowledge dictated directions directly (social distancing, PPE requirements, etc.) and indirectly (demand orientation towards private modes) to manage mobility in cities; although grounded on emergency and urgency. These have been accepted and applied without assessing actual consequences, especially in the long term. This implies a careful evaluation of the interventions derived from the pandemic at different levels. At national political level, once the emergency will be over, decision-makers will be called to evaluate the consequences of fostering “solo” behaviors and reverse the trend by rebalancing modal shares towards collective modes (Corazza and Musso 2021; Yang et al., 2021). The challenge, in this case, is to win again the trust of our citizens, which in turn paves the way towards more field of actions. At research level, more studies and field tests are required to corroborate the fact that public transport can be a safe environment if passengers’ behavior are correct and appropriate, with new opportunities to develop advanced knowledge, thanks to the joint effort of expertise from medical, transport planning and management, social sciences, communication fields. Likewise, for pandemic waste management, to solve consequences from PPE use. This can no longer be postponed, so different strategies are being developed to reuse or recycle biomedical plastics waste in order to substitute traditional building materials. Thus multidisciplinary will be the key in this approach, and will also guide practitioners when planning and designing operations and infrastructure, to accommodate new social functions in the street-scape. A last point to consider is the major attention to adaptations. The pandemic emergency and urgency has shown that there was no time to develop new vehicles, new spaces, new equipment, and that the only resource was to adapt current assets (fleets, facilities, staff) and behavior, to give new impetus to redesign and reuse the public realm according to new social functions, and recreate a new renaissance for our cities, no longer “walled”.

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.

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