Role of COVID-19 and motionless communication on expected trends of mobility: an evidence from Italian and Turin data

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Abstract

The 2020 pandemic has been changing for months the everyday mobility of part of the world: we concentrate on one of the first areas hit by COVID-19, soon after China. One of the main elements of change is the consolidation of teleworking, which further prompted motionless communications. The emergency-induced reduction of the systematic travel demand has been counterbalanced by the increased volume of web traffic. As a result, communications which formerly required commuting or travel missions have been regularly performed motionless during the lockdown. All this is known, also by experience. The novelty is that this paper quantifies this phenomenon, with a focus on the city of Turin, Italy, and makes hypotheses on the post-COVID. Local mobility data, so as trends before and during the lockdown are presented, thereafter compared. Implications for the “new normal” ahead are fully elaborated, to reply to a pre-existing research question on the role of motionless communications in the future urban mobility management. Eventually, the paper provides directions to advance and create a reference for further transport policies, within the general research goal to contribute to advance scientific knowledge in this new transportation study topic.

Keywords: Pandemic, Travel Demand, Physical Mobility, Virtual Communication, COVID-19, Turin, Remote Activities.

1. Introduction

Pandemics are recurrent throughout the history of humanity, with strong impacts on people's lives, including their mobility. Once pandemics are over, people’s mobility has always resumed its course after long transition periods. This is what is expected to happen after the COVID-19 health emergency. However, the current situation shows different characteristics compared to the past: on the one hand, for the virus’ spread speed and, on the other, for today’s wide availability of ICT tools and internet-based services, which

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enable communication between people without moving, in a quick and economic way. Despite the enormous negative impacts, a positive element of this pandemic has been that it has allowed to test the capacity and bit-rate of internet networks in a short time and at levels never achieved before.

Since the beginning of the 2000s, at least five main pandemic events can be recorded: the SARS in 2002, the H1N1 flu in 2009, the MERS and Ebola both in 2014, and the recent Chikungunya and Zika viruses in 2016. None of them, however, had the worldwide amplitude of the current one, nor its consequences but, in both previous and current cases, the common factor was the contemporary travel styles which accelerated the spread. Contemporary hypermobility made the difference (Musselwhite et al., 2020). Before the XX century, diseases’ spreading pace was instead slow, according to the transport modes’ performances at that time: the epidemics’ protracted maritime travels in the XVIII century Mediterranean, with “infectious” vessels in continuous search of a port of call. This means that, once, pandemics travelled by steam or on non-motorized vehicles, while now they can spread rapidly through planes and high-speed trains, as well as automobiles and public transport.

The origin of this pandemic and its expansion in China have already been extensively described (Du et al. 2020) and the circumstances facilitating the process highlighted (i.e. excellent accessibility by train and the abundance of flights associated with the New Year holidays in the outbreak city, according to Musselwhite et al., 2020). Consistently, the spread in northern Italy (in Figure 1, with the highways highlighted in grey and the most affected municipalities in red), at its onset (first half of March 2020), suggests how it traveled along the highways in the most severely hit areas (Sebastiani, 2020).

Figure 1: Relationship between COVID-19 spread and road infrastructures in Northern Italy.

This "snapshot" introduces the problem described in this paper: the change in mobility in Italy while the pandemic was raging leading to a total block of people's movements (enforced by a severe lockdown), and the ways to achieve a “new normal” later on, further elaborated.
The lockdown resulted in a massive use of video conferencing, teleworking, remote training, remote diagnostics, all never experienced before, with a consequent drop in the passenger travel demand. Reduced mobility was counterbalanced by increased virtual communication needs. The fact that, as a result of the COVID-19 period, remote communication can consolidate in the near future in many segments of social life is a more than real possibility. This suggests the paper research question: by analysing the impact of virtual communication during the COVID-19 pandemic on the demand for physical mobility, what will be the role of motionless communications once the health emergency is over? The paper tries to answer this question by analysing the two types of communication before and during the COVID-19 period in Italy (one of the most affected Europe’s countries), with a particular focus on the metropolitan area of Turin, in north-western Italy.

Turin is the capital of Piedmont region, a mainly industrial and technologically oriented city of around 900,000 inhabitants, traditionally associated with the major Italian car manufacturer, besides having been capital of the Savoy kingdom for a number of centuries until 1860. Like everywhere in Italy, Turin ceased abruptly any non-basic urban function when the lockdown was enforced at the beginning of March 2020. Since Turin was one of the metropolitan areas with the highest spread rate in Italy, its study is particularly significant for elaborating the effects that the pandemic had on the demand for physical and virtual mobility.

2. Physical and virtual mobility, the pre-COVID-19 trends

As well-known, communication with movement can be motorised or non-motorised; the former has nearly one century of history. The time that human beings have devoted to travelling has been approximately constant over time. In the 1970s, the so-called "travel time budget", that is, the average amount of time that people use daily to move, seemed established; this budget, according to some studies in the literature, is about an hour per day (Marchetti, 1988; Marchetti, 1994; Kellerman, 2012; Dalla Chiara et al., 2016). Some authors estimated that even centuries ago, the travel time budget was an hour a day. Although a lot has changed since, people seemed in the last years to continue to spend roughly the same amount of time on mobility, traveling more kilometres than in the past at higher speeds. This has been made possible by technological progress in the transport sector, which has allowed to build ever faster means of transport. However, in the last years we are witnessing a reduction in the growth of motorized mobility: Zahavi’s theory (Zahavi, 1972) to explain past trends seems no longer applicable today. A crucial role in this slowdown of physical mobility is certainly due both to “sustainability” concepts and to the ICT and internet-based services mass use, which may represent an alternative to physical travel. Several studies have already analysed the relationship between ICT and physical mobility (Rodrigue, 2020; Van der Waerden et al., 2019; Konrad and Wittowsky 2018).

For about ten years, a new trend has been emerging in the transport sector: the preservation of motorised mobility in most industrialised countries. Figure 2 highlights that over the past fifteen years the number of road passenger-kilometres has slowed down, stopped or even decreased (Dalla Chiara and Pinna 2014) in several developed countries. Along with the increase and convenience of ICT technologies, additional main reasons regard the conservation of the infrastructural supply, with the main exception of high-speed railways in some areas of the world, enforcement actions aimed at containing road accidents, cost of fuel, sometimes regulations on driving licenses, car ownership
saturation, socio-demographic factors, and the road traffic itself associated with the scarce use of personal time while driving. Moreover, negative externalities due to the urban growth are more and more orienting many cities towards more sustainable transport policies.

Figure 2: Passenger transport by Road in some developed Countries, 1970 – 2018 (Japan until 2009).
Source: OECD 2020a.

An ever wider community of people can take advantage of all forms of virtual mobility made available by technology, both in terms of services and equipment (tablets, laptops and latest generation mobile phones). This allows, among other things, to work remotely, to buy from shops without having to go in person, to book travel sitting on the sofa, to manage personal relationships via e-mail and video calls, to manage bank current cones through home banking and, in some cases, interact with public administrations. The impacts of ICT on physical mobility are numerous but difficult to quantify with certainty: the major effects regard travel replacement, the possibility of carrying out activities during physical travel, the redistribution of people and freight transport (in terms of time,
place, transported goods and carrier) and the generation of new mobility options (Rodrigue 2020).

The magnitude of fixed and wireless broadband subscriptions provides an indication of the number of connections supplied to users by network operators. Figure 3 plots the development of broadband subscriptions in some OECD countries per 100 inhabitants. In Italy, from 2009 to 2018 the number of fixed and wireless broadband subscriptions increased by 38.4% and 360%, respectively.

![Figure 3: Fixed (left) and wireless mobile broadband (right) subscriptions per 100 inhabitants. Source: OECD 2020b.](image)

3. **Physical and virtual mobility trends during COVID-19 in Italy and in the city of Turin until Summer 2020**

In Italy, the mobility of people during the COVID-19 health emergency underwent rapid and drastic changes, according to the lockdown progressive enforcement. The restrictions timeline can be reconstructed as follows:

- March, 8: lockdown initial enforcement (phase 1) in some provinces of Northern Italy (in Lombardy, Piedmont and Veneto regions);
- March, 11: phase 1 further enforcement across Italy;
- May, 3: ending of phase 1, at national level;
- May, 4: gradual resumption of working and commercial activities (phase 2).

Figure 4 shows the change in trips, divided per purpose, in Italy and in some Italian regions, from March 6 to April 17, 2020, taking the week of January 27-February 2 as baseline (when no restrictions were enforced, yet). Travels associated with non-basic purposes recorded the highest decrease, especially affecting retail (partly replaced by e-commerce), leisure, access to public Zahavi s and stations. Travels to purchase essential goods (meds or food) decreased in a milder way: 34% in average, with peaks during the weekends. The 63% average reduction in systematic travel (i.e. to workplaces) was compensated by a massive use of telework. The only travel type that increased (+ 32%) was that generated by students and off-site workers to return to their places of residence. In general, travels were reduced by 80-85% by April 30, compared to the reference value (i.e., the median value related to a given day of the week, for the period of five weeks running from January 3 to February 6 2020), with only an inevitable 15-20% demand left.
Private traffic flows in the main Italian metropolitan areas began to decrease slightly from mid-January to February 20 (on average -25%, with -40% in Milan and -20% in Rome), probably due to citizens' concerns about the development of the pandemic. This resulted in an average 90% drop during phase 1, with a more marked reduction in Milan, since close to the areas of the first outbreak, and lesser in cities as Rome or Florence. (Figure 5).

The pandemic also influenced the modal choice: since the beginning of the lockdown, Italian citizens favoured automobiles over public transport, due to social distancing requirements and the spread fear. In Rome, private traffic decreased by up to 78% compared to -90% of public transport. At national level, pedestrian mobility has decreased by 75%. Cycling was affected likewise. Turin can be an emblematical example: the sensors installed on the main bike routes of the city recorded 67% and 73% reductions, during working days and weekends respectively, from February 23 (before the emergency) to March 29 (5T, 2020a). This can be explained by the fact that some of these bike routes connect the universities’ main areas in the city, which at that time were closed. Maritime and air services have also been drastically reduced to basic ones (Osservatorio Maritime Economy SRM, 2020). Furthermore, many transport service operators, not only in Italy, in that period provided only basic services (Hausler S. et al., 2020).
On May 3, 2020, at the beginning of phase 2, travels were largely resumed across Italy, although public transport was far from reaching the pre-pandemic demand; access to transit stations went from -76% to -45% in the period from April 17 to May 29 (Debernardi, Ferrare and Beria, 2020). Figure 6 shows the trend in the use of automobiles and pedestrian mobility in the city of Turin from January 13 to July 16 2020, evidencing the mobility rising trend. However, global mobility has not yet reached the quo ante levels: errands and journeys to workplaces are increasing, but on average traffic is still -70% compared to the pre-COVID-19 situation (Figure 6).

The data of the city of Turin collected through inductive loop sensors allow to describe the specific, and continuous local traffic trends. Focusing on the first three days of phase 2 (from Monday, May 4 to Wednesday, May 7 2020) and comparing them with the same...
days of the previous week (when the lockdown was still fully enforced) and with those from May 2019, a sharp drop in mobility can be observed. This occurred in terms of:

- average travel mileage (-5.8 km during phase 2, which represents -48% in May 2019);
- service (-84% passengers * km, corresponding to 197 million against 941 million at the beginning of 2020 and 1,210 million in 2019); and traffic flows (-36% compared to those recorded on 2019 working days), with a 50% reduction in peak hours 2019 (7.00-9.00 a.m. and 5.00-7.00 p.m.). However, traffic flows compared to the previous week increased by 35%, in particular + 39% in the morning peak hour and + 68% in the evening one (Figure 7).

Figure 7: Car traffic in the City of Turin: comparison between 2019 and 2020.
Source: 5T, 2020b.

Trips within the city centre, where a restricted traffic zone is enforced, decreased by up to 60% compared to the same days in 2019, although + 47% was recorded in the comparison of the previous week. Parking lots occupancy is no exception: in the 34 public facilities a 42% decrease compared to 2019 was observed, while practically no changes occurred (-2%) in comparison with the previous week.

Cycling seems to be the only increasing travel option between the two analysed weeks in 2020: 18,000 records collected compared to 4,000 in the last lockdown days, corresponding to a + 335% increase on average, with +478% in the morning peak hour and + 460% in the evening one. Nevertheless, these figures are reduced by 52% if compared to the 2019 situation. However, the relevance of these data, recorded during phase 2, is to be associated with the observation that many bike paths connect the university premises, where no activity has been resumed, yet.

As regards virtual mobility, since the beginning of phase 1, the main Italian telecommunication company has recorded an overall 90% increase in volumes on the fixed network and an increase greater than 30% on the mobile one. Another major telecommunication operator showed a 35% increase on mobile communication and a 40% increase on the fixed network. Likewise, one more company recorded a 30% growth in data and a 40% in voice over mobile, in addition to + 55% in data on the fixed network.

Since the Coronavirus emergency started, the use of the Internet by Piedmont citizens has grown by 20% compared to the same period in 2019 and by 50% compared to the
month of January (Top-IX Consortium, 2020). The most common web search engine reached + 45%, while the most famous social media + 42%. During the lockdown, the significant peak in internet traffic demand was reached and the associated increase in the use of recreational platforms evidences the attractiveness of this type of entertainment among the public at home.

4. Future mobility scenarios after COVID-19

The change in mobility patterns in the last decade can be seen as the combined result of motorized and virtual mobility and the COVID-19 pandemic has highlighted even more the potential of ICT tools in morphing behaviours. It is the responsibility and prerogative of the transport engineering sector to reinvent motorized mobility in order to guarantee a new transport cycle based on conscious, efficient and safe mobility to decrease congestion phenomena, energy consumption and emissions.

Such a change in physical mobility can be guaranteed by an even greater use of ICT technologies, i.e., virtual communication, higher than pre-COVID-19 levels even if not as during phase 1 of the emergency. Private motorised mobility needs to be improved, by increasing the use of ITS, promoting connected vehicles and adopting greener fuels. Assumptions of static, exogenous consumer preferences can strongly bias the market potential results for advanced environmentally-friendly technologies (Axsen, Orlebar and Skippon, 2013), especially for new concept of connected and green vehicles, with assisted driving. This requires ICT, sets the bases for automated driving, and inevitably relies on interconnected vehicles. It should be recalled that interconnected has the original meaning of “intelligent”, from the Latin *inter-lego*, which means “I link with or through” or “I read through”, thus inferring the ability to read between the lines, in other words of being intelligent.

All this implies a very broad and long-lasting path for ITS, in this context intended as interconnected and also intelligent transport systems, where motionless communication is permitted on vehicles, so as to allow travellers to be connected remotely. This is also necessary to prevent physical mobility from being partially outranked by virtual one, relying on ICT use. In this perspective, ITS can allow a common future of collaboration between transport and communications.

In some cases, this reinvention of transport systems in an ITS context has already begun: there are already road vehicles which have computerised equipment on-board and continuous vehicle monitoring, with the aim of achieving automated driving. This equipment necessarily includes a black box, in Europe, a consequence of the compulsory introduction of e-calls, since 2018, and integration with motionless communication, which is partially or wholly independent of oil-derived fuels.

These issues lead to another relevant point, which has been left for further research in the transport and ITS context, as it is beyond the scope of this paper: the interconnection of vehicles introduces a new concept, which could not have been pursued in the past. So far, vehicles have been used because their physical positions are known at a given moment; this could be a car parked close to one’s own house, which can be used since it is there; it could be a train arriving at a station, according to a timetable, compliant with one’s own needs. ITS now allows the physical position of a vehicle to be known not only through direct experience, its ownership, or a timetable, but also through information. One can know that a sharable vehicle is available next to one’s office and is free to be used. Therefore, should the ownership of a vehicle be renounced in order to use a shared and connected one, according to reliable information concerning its physical position and
availability? This issue opens the market towards Mobility as a Service - MaaS, especially in urban contexts, where mobility and the number of vehicles are at a maximum, in terms of frequency and density, and travellers use services for transportation, such as public transport and car or bike sharing, rather than availing themselves of personal vehicles.

MaaS might imply that the production of private vehicles could change in the future as the result of the introduction of a shared economy of vehicles, where the buyers would typically be large companies or public administrations. ITS can be the key to the evolution, but if ITS is a tool for this evolution, the economy will most probably increase to satisfy new modern needs, mainly aimed at providing more leisure time for travellers (through assisted and autonomous vehicles), respect the environment (through green vehicles) and the possibility of interacting with other people or working while traveling (through connected vehicles).

According to all of the above, some possible answers to the research question about the role of motionless communications once the current emergency will be over, can be drawn, as follows:

- Motionless communications proved to be an effective resource to manage everyday work tasks during the pandemic; therefore, they will certainly be more and more included in the business and corporate culture to reduce travel costs, since telework performances proved to be equal or even superior.

- The current experience will pave the way for further exploitations of motionless communications in other everyday activities: goods distribution, education, leisure. However, their extent and affordability without becoming detrimental to social life are unclear

- The spread fear is pushing again people towards the massive use of the personal automobiles. Motionless communications can help reverse this trend by turning teleworking into a regular option and contribute to reduce commuting, with clear environmental benefits.

- Motionless communications affected thus far the most affluent strata of the society, or at least those most familiar with the web literacy, as evidenced during this pandemic. To increase inclusiveness, motionless communications should also include access to health care and other welfare services to those who have poor travel options and are still computer-illiterate.

- Transit is probably the worst affected travel option by this pandemic, also thanks to the motionless communications opportunity. One more reason was certainly its unpreparedness and lack of experience in managing the emergency. Thus far, research has been mainly focused on improving fleets management and control, within well-known fields as predictive maintenance, energy management or eco-driving for bus fleets (Musso and Corazza 2015, Corazza et al. 2016). But the lesson learnt will probably pave the way for more innovations dictated by anti-spread measures: touchless options, more flexible on-board layouts, advanced HVAC systems, etc. The challenge for transit innovations is to keep the pace with current developments in all areas of motionless communications since these proved to be, like passenger cars, the main competitor in the everyday mobility, and to convey the idea that transit is safe and for all.
5. **Future mobility scenarios after COVID-19**

The confinement measures implemented during the COVID-19 emergency have been able to lead to a structural change in the mobility of people in the post-COVID-19 period: limiting individual mobility to a few hundred meters around home has significantly reduced the use of automobiles and public transport, changing the usual mobility patterns. The observation of the drastic reduction of traffic, accidents and pollution in cities once again show how much human activities affect the surrounding environment.

After the emergency of phase 1, phase 2 took advantage of the ongoing crisis, trying to maintain the positive effects deriving from forced domesticity and transforming them into resources to accelerate the path towards more sustainable urban mobility, at an environmental and social level, although economic incentives and funding are needed to meet current and urgent needs (Di Giuseppe, 2020).

Mobility is gradually recovering and a transition to the "new normal" is underway. The mobility demand should be managed and monitored on the basis of social distancing and other anti-spread requirements to guarantee safe travel experiences. Failing to provide safe travel conditions will inevitably result in solo driving and a return to car-based lifestyles. This has already been evidenced by the observation of traffic in the city of Wuhan where, after the emergency, most commuters resorted to the family automobile when going back to work. This goes hand in hand with the observed decrease in public transport ridership (Park, 2020), with low ridership expected to last (Chandra, 2020). Thus, commuting is another specific problem to be addressed if the massive return to passenger cars is to be avoided: the challenge is to provide safe travel options within quality standards.

Telework, which during the pandemic allowed people to continue their work, can probably become an alternative or complement to previous work patterns, due to some advantages (increase in productivity in some contexts; reduction of transport costs for workers; reduction of rent, energy and cleaning costs for companies, etc.). Remote work will likely generate a reduction in physical mobility and an increase in connections between people, in turn generating a greater demand for communication. Whether this new induced demand will be met with or without physical mobility is still to be evaluated. An example: business trips, if systematically replaced by web meetings, could significantly affect the demand for air and rail traffic, but at the same time increase the demand for connectivity.

How the new normal can achieve satisfactory levels of sustainability, considering that private cars seem to be the preferred mode in post-COVID-19 is one more issue to address. The reduction of pollution, congestion and accident rates during the pandemic cannot be considered an achievement, as the toll paid was unaffordable, and in the end the success too far to claim. Estimations stressed a 36% of the emissions from surface transport by the beginning of April, within a general reduction of 17% if all the emitting sources are considered, and once lockdown is lifted emissions are going to rise again, though their reduction is strongly addressed in many countries by policies related to new powertrains and electrification. But, if compared to the Paris COP 21 mandate, these percentages might seem even modest and the efforts to generate them disproportionate: to stick to the global average temperature increase to 1.5 °C, a general emissions yearly reduction rate around 7.5% is required, until 2030 (Le Quéré et al., 2020).

At the same time, scientists observed that pollution could have played a possible retroactive effect on the lethality rate of COVID-19 virus in Northern Italy, one of the most polluted areas in Europe (Rugani and Caro 2020). However, consolidating
teleworking may help, in the long run, to mitigate the magnitude of accidents, congestion and its negative effects on the environment, and reduce travel stress, provided not to generate more physical travel demand.

In the new normal more impetus could be given to co-modality or multi-modality options and foster MaaS, paving the way for the introduction of cleaner vehicles and more electrification. Therefore, a possible scenario could foresee a reduced private mobility complemented by a higher quality transit supply and integrated by new paratransit options (electric kick-scooters, hover boards, segways, mono-wheels, etc.). In this vision, walking and biking can become more relevant as both meeting social distancing requirements, and necessary to implement MaaS services.

Transport policies are called to make all of the above real, but much also depends on the national political commitment, necessary to convey the idea that the spread risk on public transport can be greatly reduced if personal protective equipment is regularly implemented and social distancing duly met.

The change in mobility in the last fifteen years can be seen as the combined result of motorized and virtual mobility: the COVID-19 pandemic has highlighted even more the potential of ICT tools in the ability to replace and/or modify behaviours of physical mobility.

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