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Edited by: Taha Rashidi

CHAIR:
ABDUL RAWOOF PINJARI

Abdul Rawoof Pinjari is an Associate Professor in Civil Engineering and the Centre for infrastructure, Sustainable Transportation and Urban Planning (CiSTUP) at the Indian Institute of Science (IISc). He is currently the Chairperson of IATBR. Abdul's research interests include travel behaviour, travel demand analysis, and choice modelling. His current research is on: (a) understanding travel behaviour in complex travel environments characterized by multimodal travel options, different levels of uncertainty and varied information availability for different travel options; and (b) the use of disparate data sources for analysis and planning of new mobility systems in emerging economies. He is also interested in the systematic biases and variabilities people exhibit in perceiving physical quantities (time, distance, etc.) and how these might influence their travel behaviour.

Message from the Chair of IATBR

Greetings!

With great pleasure and enthusiasm, I welcome the readers to the inaugural issue of IATBR NEWS, a periodical initiative spearheaded by Taha Rashidi for disseminating the activities of IATBR and articles on emerging topics in travel behaviour. I am looking forward to reading the articles on the theme of this issue – *Travel Behaviour in the Era of Metaverses* – as they take us to the future of how we might live, work, enjoy, and travel within and between the physical world and the virtual worlds (aka, metaverses) enabled by the emergence of Artificial Intelligence technologies. Such thematic articles of IATBR NEWS can potentially lead us to chart unexplored territories in travel behaviour research. In the rest of this message, I will provide an overview of other recent and upcoming initiatives of IATBR.

The IATBR has long been established as an international organization of scholars, students, practitioners, and public agency professionals interested in travel behaviour research and relevant applications to travel analysis and transport planning. What started several decades ago as a forum to exchange ideas among a small set of researchers has grown into a reputed organization for advancing travel behaviour research. David Hensher's article in this issue will give you an idea of the history of IATBR, including the early origins and the evolution before IATBR. I learned about IATBR 18 years ago and attended my first IATBR conference in 2009, organized in Jaipur by Chandra Bhat and Ram Pendyala. As I learned more about IATBR, I have come to appreciate how it has grown into a truly international, geographically diverse, and inclusive organization. Keeping this spirit, we are planning the following initiatives. First, we plan to expand the IATBR Executive Board to invite and appoint members from regions that are not typically well represented. Second, we plan to connect and collaborate with regional or country-specific professional organizations and conferences to co-organize joint sessions on emerging travel behaviour topics in those countries. Such activities will not only advance travel behaviour research to address topics of relevance to specific regions/countries of the world but also increase the participation of researchers from those regions in IATBR. Along these lines, we recently co-sponsored a special session on the *Future of Behavioural Mobility Sensing in India* at the 6th Conference of the Transportation Research Group (CTRG) of India. We wish to organize a few more such joint sessions at other regional conferences and explore possibilities of collaborations.

While the joint initiatives with a few regional organizations have just begun, we intend to strengthen the existing collaboration with the Transportation Research Board (TRB) of the United States through the TRB Standing Committee of Travel Behaviour and Values (AEP 30). Specifically, two of our Executive Board members – Giovanni Circella and Chiara Calastri – are leading the *International Travel Behaviour* subcommittee of AEP 30. The

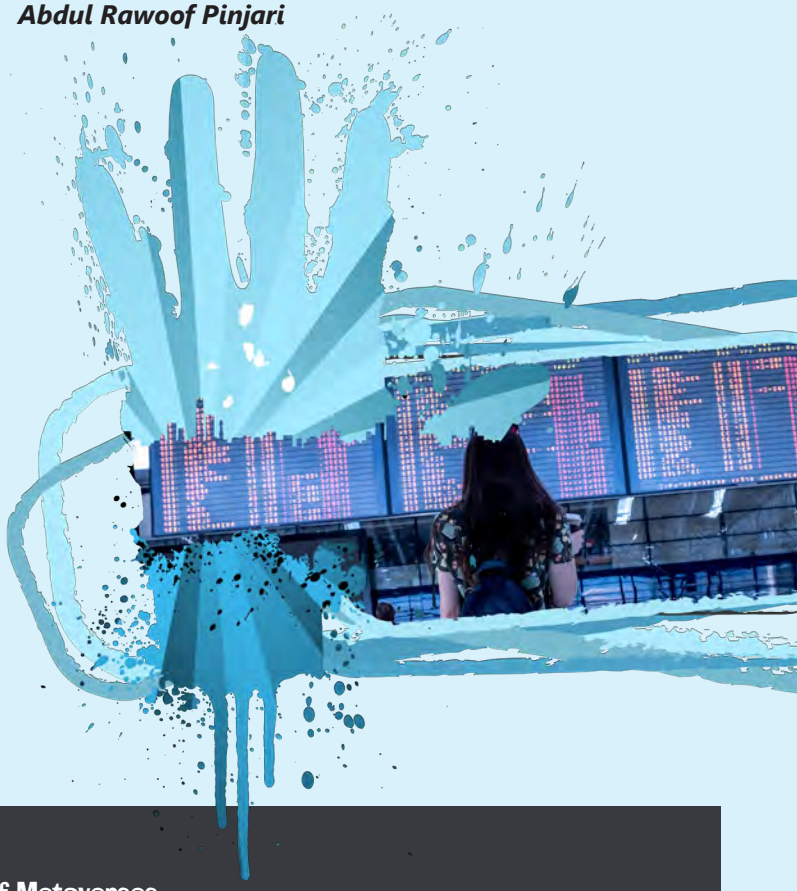
topics in the scope of this subcommittee include travel behaviour issues across the globe, such as travel behaviour in developing and under-developed economies, the diversity and similarity of human activity/travel behaviour across cultures, international comparisons of behavioural responses to policies and shocks, and the transferability of models between different regions.

The flagship activity of IATBR has been (and will continue to be) the triennial conferences on travel behaviour research. These conferences have become the 'go-to' conference for most travel behaviour researchers worldwide. At the same time, we are aware that many students, researchers, and practitioners from various parts of the world may not get the privilege to attend the conference for various reasons, including funding constraints, geopolitical situations, and the evolving public health situation. Recognizing this, the IATBR conference organizers in the past have enabled provisions such as discounted registration fees and country/region-specific paper sessions. The recent initiative of IATBR online seminars (spearheaded by Charisma Choudhury in 2021) also helped several researchers and students from various parts of the world to attend the talks by the winners of IATBR's Eric Pas Dissertation Awards. We plan to continue such virtual activity in various forms to allow the involvement of those who cannot otherwise attend IATBR events. This could be, for example, a series of talks and a panel discussion on travel behaviour research in a specific region of the world. Another session could be on a futuristic theme on which the IATBR NEWS has recently published articles. Of equal interest are classic yet fundamental questions such as how perceptions and attitudes are formed and shape (and get shaped by) human activity/travel behaviour.

Some of the above initiatives are well underway, thanks to our past Chair, Kostas Goulias, the wonderful members of the IATBR Executive Board and other volunteers, while some are in the planning stages. Those interested in these initiatives are welcome to join us in the efforts. Finally, we hope to see many of you at the 16th triennial conference of IATBR in Santiago, Chile, being organized by our colleagues from Pontificia Universidad Católica de Chile (PUC), in December this year. You need to be there to see why we call these conferences our flagship events!

Warm Regards,

Abdul Rawoof Pinjari



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EDITOR: TAHA RASHIDI

Taha Rashidi is an Associate Professor in Transport Engineering at the School of Civil and Environmental Engineering at UNSW and a member of the Research Centre for Integrated Transport Innovation (rCITI). Dr Rashidi is currently leading research into the interconnectivity between travel behaviour and time use and the potential of new mobility technologies to influence this paradigm as well as working on an industry partnership project with GoGet to undertake research on autonomous driving. Dr Rashidi is also examining the capacity of social media data to complement existing data resources as part of the development of an integrated multi-level modelling framework to demonstrate the relationships between land use and transport systems and the consequences this has for city planning and travel behaviour more broadly.

Travel Behavior in the Era of Metaverses

IATBR NEWS is already born and is missioned to bring futuristic visions and mindboggling ideas to the attention of travel modelers around the world. Unlike the old days when academics were missioned to innovatively generate ideas and explore the feasibility of these ideas before they get adopted by the industry to translate the idea into knowledge and then practice, start-ups and entrepreneurs joined the mission of producing novel and adventurous ideas where they generate, explore and implement ideas technologies and tools, on an expeditated path with a high risk of failure. At the same time, the reward of success is significant motivating entrepreneurs and investors to consider risking their resources in technology-savvy innovations. The consequence of this paradigm shift of innovation generation procedure is the flow of futuristic ideas that academics have not sufficiently studied (at least not by all relevant areas of science), or they are delayed until the phenomenon is already failed or succeeded by a few start-ups. One of these ideas is the emergence of virtual worlds called metaverses. IATBR NEWS will be published every six months in which selected short articles on the topic will be published in it, in addition to publishing information recent and future activities of the community of IATBR.

In this issue, we invited researchers, scientists, and practitioners to describe, criticize, support, or challenge ideas around the travel behavior of people occupied by use cases of metaverses, where avatars of people are used to visualize virtual reality social connections. In this world, people might travel less often (or more often, and this be an exciting ground for debates), and preferences over the real and virtual mobility options might experience a revolution. The necessity of having AI-empowered decision support applications for metaverses can result in an unprecedented lifestyle for the real world including people, societies, and the environment.

This issue promotes evidence-based discussions and arguments provoking critical, creative, and lateral thinking about the requirements and consequences of a world full of metaverses. Such metaverses are not simply used for gaming purposes but are expected to facilitate an AI-empowered lifestyle supporting meetings, e-commerce, and online education. Ignoring the hardware requirement of a world full of metaverses, we want to examine the costs, benefits, and impact of virtual realities becoming intertwined with the real world. The lens through which we want to explore this futuristic world is travel behavior, decision making, and infrastructure planning topics. Further, related topics are big data and cloud computing technologies expected to expedite the advent of metaverses. However, the relevant topics are not limited to this limited list of suggestive areas.

AUTHOR: DAVID HENSHER

Professor David Hensher is Founding Director of the Institute of Transport and Logistics Studies at The University of Sydney; a Fellow of the Australian Academy of Social Sciences; recipient of numerous awards including the 2009 International Association of Travel Behaviour Research (IATBR) Lifetime Achievement Award and the 2019 John Shaw Medal which honours an industry champion who has made a lasting contribution to Australia's roads. In 2021 an annual prize was established and named in honour of David for best paper in transport demand modelling at the Australasian Transport Research Forum (ATRF). He has published over 700 papers in leading international transport and economics journals as well as 18 books. He has over 62,000 citations of his contributions in Google scholar. Research.com, a leading academic platform for researchers, released the 2022 Edition of the Ranking of Top 1000 Scientists in the field of Economics and Finance and David is #1 in Australia. In 2020 David's latest book was published a book on MaaS: Hensher, D.A., Mulley, C., Ho, C., Nelson, J., Smith, G. and Wong, Y. (2020) Understanding Mobility as a Service (MaaS) - Past, Present and Future.

The Evolution of the Traveller Behaviour Series before IATBR

In June 9-13, 1973, Peter Stopher (today Emeritus Prof ITLS Sydney) and Arnim Meyburg (Cornell University) decided to run an international conference titled "Issues in Behavioral Demand Modeling and the Evaluation of Travel Time" at a private school facility in South Berwick, Maine. I remember it well since I messed up the dates and arrived one day early and slept on the patio all night. We were arranged alphabetically in rooms with my neighbours Ian Heggie and Stein Hansen, with Dave Hartgen across the corridor. Fifty researchers (including a few committed State and Federal US government bureaucrats) attended by invitation only and the conference was sponsored by the TRB (through James A. Scott) committee on traveller behaviour and values. The historical impetus came out of a growing interest in the valuation of travel time savings, with many notable contributors having recently completed PhDs on the topic (Stopher, Lisco, Lave, Hensher, Bruzelius, Paaswell, Hartgen, and Talvitie). However, the journey had commenced with a widening of themes such as attitudinal data, aggregation problems, policy issues, traders versus non-traders, and structure of disaggregate models. I remember meeting Frank Koppelman, who was still undertaking his PhD research on aggregation (presented in a workshop I chaired) and who was to present a summary of the PhD recently completed by Moshe Ben Akiva (who did not attend). Michael Beesley, the Guri of value of time in those days (and my mentor), was present, as was Reuben Gronau, who had undertaken the best research on the topic in the US (but in a long-distance and aviation focussed context). The conference papers were published as TRB (1974) Behavioral Demand Modeling and Valuation of Travel Time, Special Report, 149, Transportation Research Board, Washington, D.C.

The appeal of the first conference was its workshop focus with a commissioned resource paper for each workshop. There were no other papers unless someone had one to offer for information only. So successful was this conference that a second one was arranged in May 1975 at Asheville, North Carolina, titled 'Second International Conference on Behavioral Travel Demand', again run by Peter Stopher and Arnim Meyburg. This conference continued in the workshop format and began the broadening of participants with a number of notable contributors (Dan McFadden, Jordan Louviere, Steve Lerman, Moshe Ben Akiva, Peter Jones, Andrew Daly, Bob Dial, Ken Small, and many from the first conference). There was great excitement in the air as there was interest in integrating multiple discrete choices into a coherent framework linked to random utility theory for the first time. We were struggling with joint estimation, and the focus was very much on sequential estimation. The papers and workshop reports were published in Stopher, P.R. and A.H. Meyburg (Eds.) (1976) Behavioral Travel-Demand Models, Lexington Books, Lexington.

The third conference was hosted in Australia by myself (in Tanunda South Australia in 1977), with, dare I say, some initial hostility from certain folks who thought Australia was incapable of hosting a big international

conference (we proved them very wrong), with a preference to stay in the USA. The Third conference opened up a truly global interest, and we actually managed sponsorship to fund every attendee (airfare and accommodation). This was where we brought together notable researchers from across the globe, which led to offers of jobs and movements across the Atlantic. There were many new ideas at this conference, and especially the new concept of inclusive value (or logsum or expected maximum utility) was presented independently by Dan McFadden and Andrew Daly. Andrew had developed his ideas with Stan Zachary in the UK and presented at a conference in London I contributed to hosted by the then DoE (the late Geoffrey Searle). Claims of originality pervaded that time, and eventually, there was a recognition of the UK's contribution through reference (to this day) to the Daly-Zachary-Williams formula. Huw Williams had quietly been working on this topic and indeed was annoyed about how certain folks in the USA claimed originality which turned out to be untrue. Some of you reading this short piece will remember this highly charged discussion. The volume was growing, and this one, all of 855 pages, was published as Hensher, D. A. and P.R. Stopher (Eds.) (1979) Behavioural Travel Modelling, Croom Helm, London.

The themes were broadening, and after the fourth conference in Grainau (Germany) in 1979, there was talk of formalising an Association. Some of us were opposed to this since there was a concern that it could end up looking like a stock standard paper presentation conference given the growth in the interest to attend. It was put in the too-hard basket until it was revived by Aad Ruhl (A Dutch bureaucrat) at a meeting held in Washington DC during the fifth conference (convened in 1982 in Easton, Maryland by Steve Lerman). I remember it well (I was there) as a number of us met at a hotel with Aad. It is best described as a very hostile meeting with some notables, such as the late Dave Hartgen losing his temper with Aad. Let us not provide any more gory details other than to say that Aad got his way and in April 1985, Aad chaired a conference in Noordwijk, Netherlands, where the name became, for the first time,'1985 International Conference on Travel Behaviour" or as an association called IATBR. The conference numbering was now in a mess since this conference lacked a numbering in order (almost as if AaD was starting again!), and following on from that in France, there was no recognition of the actual fifth conference held in Maryland in 1982. The Aix-en-Provence, France conference in 1985 was titled the fifth conference incorrectly after having had six conferences prior to 1985.

From 1987 on, there was an acceptance of the IATBR setting and growth in its brand name. While the heritage had produced a phenomenal pedigree, there was a sad and slow move away from a fully workshop focussed conference series which was what made it so special. Today with a burgeoning of papers, it has transformed the series into a different product. It was this transformation that resulted in the late Jordan Louviere, amongst others, starting up the invitational series on choice modelling as a way of preserving the magical workshop formula, and I took the format into the establishment of the International Conference Series of Competition and Ownership of Land Passenger / transport (with my co-founder the late Michael Beesley, which commenced in 1989 and is still active every two years today (https://thredbo-conference-series.org/).

The first twleve conferences 1973-2003

	Year	Location	Title	Reference
1	June 1973	South Berwick, Maine	Issues in Behavioral Demand Modeling and the Evaluation of Travel Time	TRB (1974) *Behavioral Demand Modeling and Valuation of Travel Time,* Special Report, 149, Transportation Research Board, Washington, D.C.
2	May 1975	Asheville, North Carolina	Second International Conference on Behavioral Travel Demand	Stopher, P.R. and A.H. Meyburg (Eds.) (1976) *Behavioral Travel-Demand Models*, Lexington Books, Lexington.
3	April 1977	Tanunda, South Australia	Third International Conference on Behavioural Travel Modelling	Hensher, D. A. and P.R. Stopher (Eds.) (1979) *Behavioural Travel Modelling*, Croom Helm, London.
4	July 1979	Grainau, Germany	Fourth International Conference on Behavioural Travel Modelling	Stopher, P.R., A.H. Meyburg and W. Brög (Eds.) (1981) *New Horizons in Travel-Behavior Research*, Lexington Books, Lexington.
5	October 1982	Easton, Maryland	Fifth International Conference on Travel Analysis Methods	TRB (1983) *Travel analysis methods for the 1980s*, Special Report, 201, Transportation Research Board, Washington, D.C.
6	April 1985	Noordwijk, Netherlands	1985 International Conference on Travel Behaviour	Rijkswaterstaat (1986) *Behavioural Research for Transport Policy*, VNU Science Press, Utrecht
7	October 1987	Aix-en-Provence, France	Fifth International Conference on Travel Behaviour	International Association for Travel Behaviour (Ed.) (1989) T*ravel Behaviour Research*, Avebury, Aldershot.
8	May 1991	Quebec, Quebec	International Conference on Travel Behavior Research	Stopher, P.R. and M. Lee-Gosselin, (Eds.) (1997) U*nderstanding Travel Behavior in an Era of Change*, Pergamon, Oxford.
9	June 1994	Valle Nevado, Chile	Seventh International Conference on Travel Behaviour	Ortuzar, J. de Dios, D.A. Hensher, and S. Jara-Diaz (Eds.) (1998) T*ravel Behaviour Research: An Update*, Pergamon, Oxford.
10	September 1997	Austin, Texas	Eighth International Conference on Travel Behavior Research	Mahmassani, H. (Ed.) Pergamon, Oxford.
11	June 2000	Goldcoast, Queensland	Ninth International Conference on Travel Behaviour Research	Hensher, D.A. and J.King (Ed) *The Leading Edge in Travel Behaviour Research*, Pergamon, Oxford.
12	September 2003	Switzerland	Tenth International Conference on Travel Behaviour Research	Axhausen, K. (Ed) *Moving Though Nets: The Physical and Social Dimensions of Travel*. IATBR, Elsevier.

AUTHOR: ALI NAJMI

Dr. Ali Najmi is a research associate at the Research Centre for Integrated Transport Innovation (rCITI), the Civil and Environmental Engineering Department, UNSW. He received his Ph.D. from the University of New South Wales, Australia. Ali's focus of research is on the development of shared mobility systems as well as activity-based model systems. Also, he is experienced in mathematical programming and model calibration. Ali is the recipient of *2020 Eric Pas Dissertation Award* Honorable Mention from Association for Travel Behaviour Research (IATBR) Executive Board for his highly original dissertation. He is also the recipient, *Pyke Johnson Award* in 98th *Annual meeting of Transportation Research Board*, 2018, and the *Faculty Postdoctoral Writing Fellowship* from the University of New South Wales in 2019. In 2017, he was also the winner of *Transportation Research Board Analytics Contest*, 2017OUtreach.

Are we ready to face the new challenges posed by the metaverse world?

There have always been vital revolutions that have influenced human behaviour. Examples include urbanisation, the invention of the machine, and the advent of COVID19. Another emerging technology that will create significant buzz around the globe is proclaimed to be the concept of metaverse powered by 5G and 6G on which a collision of physical and virtual worlds will be created. People will outfit their avatars to explore virtual landscapes in the metaverse venues. Although these virtual worlds may seem to be in the distant future, we are witnessing the initial stages of how the metaverse affects the way humans interact with technology. Customised avatars, offices and homes equipped with multi-dimensional gadgets and self-driving cars allow people to mirror their daily routines and interests in the virtual world by blending the sensations of their physical behaviours with a range of choices offered in the metaverse. The Metaverse will significantly affect travel behaviours and travel demand structure. Thus, to live in the virtual age, the transport community should arm themselves by predicting the potentials of the metaverse, exploring its influences on the transport domain, and finding solutions to address the changes.

In the virtual age, daily routines will be affected by the formation of virtual relationships, purchasing digital real estate, virtual shopping environments, and meeting friends at virtual events; thus, the metaverse can permanently change many businesses, working procedures, shopping, recreational activities and travel behaviours. For example, many people will work from home, attend their work meetings, and go shopping with their avatars; these alter their demand to travel and consumption patterns. On the other hand, many retailers will assign a significant portion of their business efforts to digital shopping in the metaverse while their depots, consolidations centres and warehouses located in metropolitan areas.

The transition to the virtual age will result in significant changes in four areas 1) activity pattern, 2) land use, 3) traffic congestion, and 4) car owner-

ship. The impact of the metaverse on physical mobility and daily life routines (activity patterns) will be considerable. As space-time constraints will no longer play any significant role, traditional behaviour patterns and physical limitations will lose importance, with new forms of interaction and behaviours appearing. Thus, new activities can be materialised, and many physical activities can be replaced with their virtual counterparts. Regarding land use, the closeness between workplaces and home locations and between the retail stores and their warehouses will no longer be necessary. Also, the importance of locating businesses in city centres and dense urban areas will be diminished. The changes in activity patterns, digitalisation of shopping and new land-use formation will change the congestion pattern across cities. For example, these will end up with itemised orders and massive delivery volumes reliant on physical distribution systems and the growth of conventional courier and parcel services. Thus, the scale of last-mile logistics will be transformed by the growing role of parcel deliveries; the potential scenario is that the congested urban areas will be occupied by vans and Utes delivering online orders. Car ownership and dependence, as the spatial and temporal configurations of social and economic participation in society, will be reduced; however, autonomous vehicles will be in the spotlight as they provide a mobile space that integrates work, entertainment, and other functions. There is also chance for a new class of vehicles, so-called semi-autonomous vehicles, to emerge that can be driven remotely from an augmented reality pod by a qualified driver. Note that there are other aspects of transportation, such as tourism, socialisation, and leisure activities, on which the impact of the metaverse is currently highly unclear.

Therefore, the transport community faces new challenges and concerns about the emerging transport demand and supply changes. Immediate steps must be taken in this regard. Experts' opinion regarding the perception and behaviour of people and their attitudes and habits in virtual landscapes is a significant effort that needs to be conducted. This requires designing and running surveys to capture the changes in the taste and behaviour of people doing their activities, about existing ideas and develop and extend understating about possible policies for the future in the metaverse. Finding the level of dependencies between doing activities in the metaverse and physical mobilities, and as a result, their influences on travel patterns is another challenge for the transport community.

AUTHOR:
MARTYNA FIDLER

'Martyna Fidler is a postdoctoral researcher at the Institute for Transport Studies at the University of Natural Resources and Life Sciences in Vienna. Her main research area focuses on the exploration of human behaviour in traffic situations from the perceptual, cognitive and neural perspectives by the employment of virtual reality and physiological data

Physical travels on the verge of extinction in the era of Metaverse?

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Metaverse means departing from physical presence towards the virtual one, bringing several implications for transport systems, not only in the volume and purpose of trips but also in the design of physical transport infrastructure and transport network as a whole. One of the largest expected shifts in travel behaviour patterns is the atrophy of commuting. A decrease in work-related trips, observed on a global scale due to the COVID-19 pandemic, is accompanied by a fast-paced development of an appropriate digital infrastructure soon to be incorporated into Metaverse[1]. Video-conferencing platforms are expected to not only replicate the physical spaces but also outperform them due to their digital functionalities. It will accelerate the phenomenon of *digital nomads*, individuals working mainly

1 Roach, J. (2021). *Mesh for Microsoft Teams aims to make collaboration in the 'metaverse' personal and fun.*[online] https://news.microsoft.com/innovation-stories/mesh-for-microsoft-teams/ (Accessed: 19/4/2022).; Smidvik, H., Planting Mollaoglu, E., Bergeling, E., & Olsson, F. (2020). Digital solutions replacing academic travel during the corona pandemic–what can we learn?.; Curry, D. (2022). *Microsoft Teams Revenue and Usage Statistics (2022).* [online] https://www.businessofapps.com/data/microsoft-teams-statistics/ (Accessed: 19/04/2022).

online and independently from any specific location[2]. Their number in the U.S. alone tripled since 2018 reaching 15.5 million in 2021[3]. This form of work diminishes the population pressure in megacities[4] and has the potential to transform transit networks. Less demand for public transport can increase its costs and reduce provision in the long run, which will deteriorate the accessibility for disadvantaged groups and aggravate social exclusion. Alternatively, in line with creative destruction theory, Metaverse-based teleworking will replace current transit with a more flexible on-demand micro-transit where autonomous vehicles will play a substantial role[5], as supported by recent evidence from multiple European cities[6]. This will offset the inefficiency of current rigid transport systems and allow for achieving sustainability goals[7]. Furthermore, with the decrease in business trips, most of the journeys will belong to a leisure sphere, which will require a redesign of transport hubs to emphasise entertainment and comfort[8].

The uptake of *Metamobility* is anticipated to differ among generations. The highest adoption is expected among younger generations, with a report showing that about 50% of surveyed Millennials and Gen Z adults plan to embrace Metaverse in work in the coming years[9]. Beyond, Metaverse provides room for bravado and testing one's limits in precarious situations[10]. This is now embraced by car manufacturers who aim to improve navigation and threat detection[11]. Hence, Metaverse can paradoxically increase on-road safety in real life through a better understanding of one's reactions and more accurate predictions. For older generations, Metaverse offers convenience and safety by removing physical barriers of real-life travelling and allows for meeting those who live far or are no longer alive, giving a sense of immortality[12]. Nonetheless, data shows that the interest in virtual environments among adults born between 1940 and 1980 reaches 20%[13]. Only if Metaverse becomes mainstream does it have the potential to improve the well-being of older generations by tackling isolation and addressing long-standing challenges of transport services.

The metaverse is capable of transforming the dynamics of social interaction. Still, also it has the potential to shape the transport of tomorrow, where people may abandon the seemingly archaic idea of physical travel altogether.

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The Automation of Transport Planning

There have been two seemingly inescapable trends regarding the history of technology: automation grows overtime and technology changes at an increasingly rapid pace. From factory floors to automated cars, now analyst shops and board rooms, automation disrupts and optimizes. As has been widely observed, automation has already long passed the point where it is displacing only physical work to an ever greater impact on intellectual activities. This has caused vast disruptions to processes, labor markets and broader human experience in virtually every field of human endeavor.

However, due to the increasingly rapid change of technological capability, we have begun to enter an even greater disruption quite quickly. The next step in the physical and intellectual procession, is emotional or value activities. Here, too, automation is taking hold. One way of characterizing this process is the digitization of ethics itself. This has already clearly noted in the vast amount of ethics of AI work which is well underway.

Transport planning, which drives vast sums of infrastructure investment globally, deployment and management of mobility technology and underpins the regulation which impacts human life on a daily basis, is not immune to these realities. Therefore, transport planning will also be increasingly automated, even far more than it already is. Activities which engaged numerous planners, economists and engineers for months will be accomplished in hours through pervasive data and emerging algorithms. This can be viewed negatively and criticized, but history has shown that it is likely futile to stand in opposition to automation. Rather, the best course of action is to shape how it proceeds.

The first key part of shaping the emergence of automated transport planning is that we must embrace the **digitization of ethics** to ensure automation is done well (i.e., in the interest of the human experience). We must make explicit the things we value as a society in terms of mathematical quantification. Digitize our values as fully and deeply as we can, so that the techniques will consider them. If we get this aspect wrong, the emerging automation of planning will scale oppressive systems rapidly and massively to the detriment of all.

Second, digital experiences, such as metaverses, have the promise of mixed realities that can enshrine or oppress individuality. In theory, the former can be elevated. We must increasingly **value individuality in our planning procedures**. Again, there is research underway but the field must significantly accelerate and find novel ways of quantifying the value of individuality.

A key component of valuing individuality is the emerging range of lifestyles that result from technological advances such as metaverses. The physical and digital are increasingly merged which enables increasingly niche interests and a focus on mobility that is geared towards personal aesthetics and preference versus generic population-wide obligation. Long gone will be the days that entire societies could be grouped simply into work-trips and non-work-trips. While some individuals may increasingly live digital lifestyles, there will remain the need for physical mobility of people and goods particularly for an increasingly connected world (all requiring evolving the behavioral modeling of transport usage). In addition to lifestyle range is the possibility of tailoring costs to individuality as well. Mobility is in its transition from product (i.e., mode) to service to resource. As a result, the exact personalized mobility consumption needs of the individual will increasingly be accountable (i.e., personalized microtolling). Again, ethics is critical. Personalized mobility resourcing could create vast inequities or it could enable a far more sustainable system all depending on the underling ethical thinking employed in the planning and design of the emerging mobility framework.

At a juncture, transport planning must quickly navigate the immense pressure of the two converging trends of automation and technological pace. This requires even greater collaboration and a willingness to embrace and lead change.

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Activities in the metaverse: the what, when, where, who, why and how

The metaverse, a hypothetical computer-mediated immersive virtual environment in which users interact with one another in real-time and parallel to the physical world, has recently attracted significant attention.[1] People are expected to shift various activities to the metaverse.[2] Given the fundamental premise that travel is a derived demand, a sizeable shift of activities to the metaverse may substantially impact transport systems and land use. The option to perform certain activities virtually and from anywhere may affect travel demand and the location choices of households, businesses and other entities. While a dystopian vision of the metaverse includes the physical isolation of individuals and deserted public places, the metaverse also holds opportunities for reducing strain on transport systems, lowering transport-related energy consumption and limiting transport externalities.

Numerous pressing questions must be answered to adequately plan for the duality of the physical world and the metaverse. For example, what are the attributes of activities likely to be shifted to the metaverse? When, where, and under what circumstances do people choose to engage in an activity in the metaverse instead of the physical world? Who are the users of the metaverse? What behavioural mechanisms cause people to use the metaverse for certain activities? With whom do people participate in activities in the metaverse? Is there a scope for hybrid activities that take place both in the metaverse and the physical world? How does the metaverse affect activity scheduling at the individual level as well as across physical and virtual social networks?

In sum, the potential advent of the metaverse raises many questions about which travel behaviour researchers should be concerned to support the design and operations of future-proof, human-centric and efficient trans-

1 See e.g. Sheridan, E., Ng, M., Czura, L., Steiger A., Vegliante, A., and Campagna, K. (2021), Framing the Future of Web 3.0, Research Report, Goldman Sachs.

2 See e.g. Hennig-Thurau, T., Aliman, N., Herting, A., Cziehso, G., Kübler, R., and Linder, M., The Value of Real-time Multisensory Social Interactions in the Virtual-Reality Metaverse: Framework, Empirical Probes, and Research Roadmap (April 21, 2022). Available at SSRN: https://ssrn.com/abstract=4090014 and the literature cited therein.

port systems. Methods for modelling and simulating travel behaviour need to be adapted and extended. Appropriate survey methods with high external validity for collecting individual preference data need to be identified.

A potential research plan may look as follows. A possible starting point for an analysis of the behavioural implications of the metaverse is a stated preference survey in which respondents are asked to select their preferred mode out of a set of several options (such as in-person, videoconferencing, non-immersive metaverse, fully immersive metaverse) to participate in an activity characterised by specific attributes. Furthermore, behavioural changes could be investigated in an intervention study in which subjects are given the option to pursue certain activities in the metaverse. Alternatively, surveys could be employed to analyse people's subjective expectations regarding the likelihood of their own behavioural changes under various circumstances in the presence of the metaverse. These surveys could be coupled with practical demonstrations of the metaverse. In terms of mathematical models for explaining and predicting behaviour in the metaverse, the understanding and representation of the formation of preferences for hypothetical alternatives need to be advanced. Besides, research on the behavioural implications of the metaverse will likely benefit from general advances in activity-based modelling and simulation, especially with respect to activity location choices and social network effects.

The results of this research may have various implications for policy and planning. Depending on the direction and magnitude of the detected effects, a paradigm shift in the design and operations of transport systems may be required. Provided that a non-negligible share of the population is found to be willing to shift activities to the metaverse, the question arises as to how these preferences should be considered in long-term transport and land use planning and the appraisal of transport infrastructure investments. In addition, strategies for exploiting the metaverse for reducing transport-related externalities and energy consumption should be considered and developed. Also, an increasing adoption of the metaverse raises the question if and how universal accessibility of the metaverse should be warranted.

AUTHOR: BILAL FAROOQ

Growing up in Pakistan, Bilal Farooq was always taking things apart. "I have some pretty remarkable engineers in my family," he says. "One of them brought me a computer. I treated it like the TVs, telephones and cassette players I had come across, and opened it right up. I always wanted to know how things work internally."

Farooq calls this approach "learning through curiosity," and it still drives him today. After earning a master's in computer science – a new field at the time – he pursued a doctorate in transportation engineering. He knew little about it, but he was intrigued by the overlap between computer and transportation networks.

Now a Canada Research Chair in disruptive transportation technologies and services, Farooq's spirit of inquiry animates his work in traffic flow simulation and prediction, connected autonomous vehicles, and urban congestion.

eXtended Reality Adoption and Travel Behaviour Research

Toronto Metropolitan University

Virtual worlds, as well as digital twins of our world, are rapidly gaining interest among researchers, employers, the e-commerce industry, and marketers well beyond the initial adopters, i.e., the gaming industry. The key reasons for such interest are the immersiveness, engagement opportunities, easy scalability, high degree of realism, ease of use, connect-from-any-where nature, and a high degree of responsiveness. Some of the key underlining enablers include 3D scanning technologies (e.g., Lidar scanner and 3D stereo camera), graphics software (e.g., Unity and Unreal) and hardware (e.g., Oculus and Vive), information and communication technologies (ICT)—especially the 5G networks that enable low latency and high bandwidth on the move, and artificial intelligence that can understand and anticipate the participant's behaviour and provide a high degree of engagement and realism. It is expected that these representations of reality, also commonly known as mixed reality or eXtended Reality (XR), will become ubiquitous in the coming years.

There are several recent examples where XR has been adopted by the research community to study travel behaviour in controlled environments, especially in cases where the choices and scenarios are entirely new (e.g., pedestrian interaction with automated vehicles). While the validity of XR to observe unbiased travel behaviour has been investigated to some extent, a systematic and comprehensive analysis is needed to evaluate the capacity of XR to observe travel behaviour. Furthermore, the experiments designed and conducted in XR are usually labelled as stated preference

experiments, which may not be the right label. XR experiments involve respondents making actual decisions, usually involving physical movement (e.g., walking or picking up an object), which is more than intention and more synonymous with actual decision making. Thus, there is a need to define and characterize these new types of experiments and their relationship to conventional stated and revealed preference experiments.

The ubiquitous adoption of XR by consumers in the near future has several direct and indirect implications on travel behaviour. XR can potentially collapse space to a single point (most probably the home location) due to warping space in the space-time activity diagram, theoretically resulting in zero travel. While the probability of this scenario is next to zero, practically, there are several potential activities whose location may move into XR environments. Looking at the changes in travel behaviour during the recent pandemic, work, education, shopping, recreation, and leisure travel activities are the most attractive candidates for moving into XR environments. Therefore, several interesting research questions arise. Who will be the earlier adopters of this move, and if embracing XR is a factor of personal preferences, features of XR environment, and/or type of work, education, shopping, and recreation activities? Will embracing XR be a complete or partial move for an individual, what factors will define this move, and what will be the resulting activity participation pattern? XR usage is expected to impact vehicle ownership, home location, and personal travel patterns. Will travel time saved by not travelling to work induce travel for other activities? Will the urban sprawl and move to rural and small towns increase due to XR-ization? What will be the consequences of travel surveys and activity-based travel demand models?

No matter how XR is scaled up and commercialized in the coming years, the field of travel behaviour research should be prepared for some more exciting times!

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Kara Kockelman holds a PhD, MS, and BS in civil engineering, a master's in city planning, and a minor in economics from the University of California at Berkeley. She has been a professor of transportation engineering at the University of Texas at Austin for 24 years, and is Associate Site Director of the NSF Industry-University Cooperative Research Center for Efficient Vehicles and Sustainable Transportation Systems. She has received an NSF CAREER Award, Google Research Award, MIT *Technology Review* Top 100 Innovators Award, Vulog's Top 20 of 2020 Influential Women in Mobility, and various ASCE, NARSC, TRF, and WTS awards. She recently served as President of the North American Regional Science Association and sits on the Eno Center for Transportation's Advisory Board. She has authored over 200 journal articles (and two books), and her primary research interests include planning for shared and autonomous vehicle systems, the statistical modeling of urban systems, energy and climate issues, the economic impacts of transport policy, and crash occurrence and consequences.

Metaverses are not as lifechanging as one may predict

In the article "The Metaverse Will Never Happen", Joel Stein noted:

I wrote a 2015 Time magazine cover story on virtual reality titled "The Surprising Joy of Virtual Reality — And Why It's About to Change the World." I did not actually believe it was going to change the world other than in the broadest sense, much like how this Medium column will change the world in that the world now has one more Medium column. But my editors figured "Virtual Reality... Meh" wouldn't sell subscriptions.

I have never used the word Metaverse (till now!). And I do not use an Avatar. (It is really me in our meetings.) I also have not worked from home since COVID-19 commenced. I realize that many workers (and students) do, but I find it unproductive and largely unhealthy (for our institutions, students, and wider society). I also have been asking for online meetings and conferences for a decade before the Pandemic. Traveling long distances is hard on each of us and on the planet.

While my husband chooses to work from home, our twin teenagers and nearly all their friends have access to car keys and head out 2 to 3 times a day to visit friends, dine out, attend school, play sports, lift weights and enjoy concerts. We worry about their safety and the future of our shared climate. We own a Tesla 3, Prius, and Rogue. And we do not expect to be buying any new vehicle that is not all-electric. We hope the same goes for everyone reading this article.

Alas, there are a LOT of embodied emissions in all vehicles – including planes, trains and buses. And in our homes, roadways, sidewalks, and office buildings. Most emissions and traffic violations go unchecked. And too many people- and planet-saving policies do not yet exist (like credit-based congestion pricing via GPS dongles, upzoning of all single-family parcels, camera-based enforcement of critical traffic laws, and taxes on carbon and particulate matter).

I do not think traffic levels on our roadways will noticeably decline due to Metaverse access and web-based meetings. Cell phones make travel more productive, and vehicle automation lowers "driving" costs. Motorized travel

per capita today is about the same as before COVID-19 began (at least in the US). Of course, most of us expect fewer shoppers at brick-and-mortar stores, as people shift to online purchases. We expect more delivery vans and freight movement in our neighborhoods and around the globe. I hope Americans will continue to leave their homes every day for exercise and human interaction (at local gyms and parks, nearby swimming pools and trails, job sites and schools). And I expect they will leave for groceries, coffee shops, and restaurant dining. I suspect that only the most introverted will prefer a computer or Metaverse existence to stretching their legs and availing themselves of direct human contact at places rather far from home.

While graduated licensing has kept our teens safer and curbed some late-night driving, COVID-related restrictions have largely ended. And while teens often settle down to play Fortnite with one another (remotely), their phones and apps mean they have friends at almost any high school in the region and in multiple states and nations. As a result, many of their social trips are very long. I expect our children and their children will be traveling long distances for work (and pleasure), essentially making up for any lower day-to-day travel the Metaverse and Pandemic posed. I expect that full automated vehicles (AVs) will only make most "long-distance" travel (e.g., 50- to 500-mile one-way trips) longer (with air dominating in markets beyond 600 miles). I hope we can quickly pivot to congestion management and smaller vehicles (via emissions taxes, parking fees, e-bike incentives) and dynamic ride-sharing (for all trip distances). It is hard for me to see a world worth living in if motorized travel goes unchecked.

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Make the best out of the trip to Chile

The IATBR 2022 Organizing Committee is eager to see you all in Chile and once again bring together the travel behaviour research community. It has been a long wait since we last met in Santa Barbara, but now the IATBR Conference is only a few months away. For many of you, coming to Chile will mean a long trip. It might even be your first time in South America. The IATBR Conference will mark the beginning of the summer in the Southern Hemisphere, so it will be the perfect opportunity to enjoy a glimpse of everything Chile has to offer.

Just by looking at a map, you might realize that Chile has many diverse travel opportunities, with its long and narrow geography. Chile is a country of amazing contrasts and colours from its deserts in the north to its glaciers in the south. You can hike in the Andes Mountains and swim in the Pacific Ocean on the same day! In Chile you can find pretty much any landscape you can think.

As you know, the IATBR Conference will take place in Santiago, a vibrant city with museums, historic architecture, shopping centres, family activities, a varied culinary scene, and nightlife. And, of course, top-quality wine. You will have the opportunity to enjoy many of these attractions during the IATBR Conference. If you have some days to spare before or after the IATBR Conference, here are my recommendations on where you should go.

San Pedro de Atacama (1,200 Km to the north of Santiago, 2-hour flight to Calama)

Within the Atacama Desert (the driest desert in the world) is this small town that, despite its size, has a lot to offer. You can visit geysers at dawn, explore salt flats, float in lagoons, climb volcanoes, relax in hot springs, cycle around the desert, understand why a group of flamingos is called a "flamboyance", enjoy the sunset in the moonlike Valle de la Luna, and be amazed by the cosmos in an astronomical observatory. What else can one ask for?

Valparaíso (100 Km to the west of Santiago)

This coastal UNESCO World Heritage Site is the second largest metropolitan area of Santiago and one of the main seaports in the South Pacific Ocean. Valparaíso is known for its bohemian culture and gastronomy. Its New Year's parties are legendary! You can ride funiculars and cable cars to explore the city's different hillside historic districts, visit museums (poet Pablo Neruda's house is a must), or simply enjoy a beach day in the nearby Reñaca and Viña del Mar. Warning: swimming in the South Pacific Ocean might be colder than what you would expect!

Easter Island (3,200 Km to the west of Santiago, 5-hour flight to Hanga Roa)

In the easternmost point of Polynesia, you will find Rapa Nui (as it is called by the locals), one of the most remote inhabited islands in the world. Easter Island is known worldwide for its monumental head statues called moais. Little oral history remains from the XIV Century cultures that built the statues, so they remain a mystery for you to explore. Enjoy Polynesian culture and dances, relax at Anakena beach, snorkel the bay, eat great tuna and just have a wonderful time in what Rapa Nui people call "the navel of the world".

Torres del Paine (2,000 Km to the south of Santiago, 4-hour flight to Punta Arenas)

This National Park lies in Patagonia, on the southern edge of the world. Here you can experience trekking circuits that are regarded as some of the best and most beautiful in the world. You can also ride horseback, navigate the glaciers, and enjoy the landscapes. If these activities are not for you, then you can simply disconnect yourself from emails, work, and research. Finish 2022 by reconnecting with nature. If you are lucky, you might come across some penguins on your adventure!

If you are planning on extending your trip to other nearby countries, be aware that South America is a big and diverse place that has a lot (really a lot) to see. To get a taste of the continent, I would suggest:

- The cosmopolitan Buenos Aires, in Argentina. A city that combines rich architectural and cultural heritage, buzzing nightlife, great shopping, a vibrant arts scene, and extensive parks.
- The traditional Cusco, in Peru. The gateway to the ancient Inca citadel of Machu Picchu, one of the New 7 Wonders of the World. Besides, Peruvian cuisine might be the best in South America.
- The vibrant Rio de Janeiro, in Brazil. Does Rio need any introduction? Famous beaches, friendly people, extraordinary parks, breath-taking views, great party scene, and football… Rio has it all.
- The fun Cartagena, in Colombia. A colourful city that appeals to all travellers, combining a historic Old Town, idyllic beaches by the Caribbean, and vivid nightlife.

I am certain that you will have a great time in December, see you all in Santiago!