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# Mobility-as-a-Service users: insights from a trial in Sydney

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## Abstract

The positive effects that Mobility-as-a-Service (MaaS) is envisioned to have on transport can only be reaped if people are using MaaS. Yet, the understanding of the user perspective on MaaS is incomplete and primarily based on experiments with non-users. To address this shortcoming, this paper reports user experiences from a trial of a high-level MaaS service in Sydney, Australia. Based on questionnaires and interviews, it analyses who participated in the trial and why, and whether the trial experience satisfied their motives. The contribution to the literature on MaaS is three-fold. Firstly, most of the people that participated in the trial were frequent users of both public transport and private cars. This supports the notion that multi-modal travellers are likely early adopters of MaaS and contradicts the fear that MaaS does not appeal to private car users. Secondly, a desire to contribute to innovation and curiosity about MaaS were the main motives for signing up for the trial, which highlights the important role an inviting setting for experimentation, such as a trial, can play in stimulating MaaS adoption. Thirdly, many participants struggled with making the trialled service work for them and on average they seemed to value the support and feedback functions higher than other service features. This underscores the novelty of MaaS, compared to existing service models, and reiterates the notion that more than an app and a few subscription plans is needed to make MaaS useful for users.

**Keywords** Mobility-as-a-Service, MaaS, User perspective, Trial, Mixed-methods

## 1 Introduction

Mobility-as-a-Service (MaaS)—here defined as a type of service that through a joint digital channel enables users to plan, book, and pay for multiple types of mobility services [1]—has in recent years emerged as a hot topic in transport. The core idea is to create links between complementary mobility services, and thus make it easier for people to compile an offering that meets most of their

mobility needs [2]. This is thought to improve the attractiveness of travelling via mobility services, as compared to owning and using a private car. Hence, the introduction of MaaS might trigger travel behaviour changes that are aligned with the global sustainable development goal on safe, affordable, accessible, and sustainable transport systems for all (see [3]).

However, this envisioned impact on transport systems assumes that when MaaS is available, users adopt and use MaaS and that this influences their travelling. A thorough understanding of the user perspective on MaaS is therefore needed to assess the prospects of MaaS [4]. Accordingly, users have been a main topic in the emerging MaaS literature [5]. Still, most studies of MaaS users have surveyed stated preferences of potential users (e.g., [6–8]) rather than actual users' experiences [9]. This is problematic since it is arbitrary to fully comprehend what an elusive concept, such as MaaS (see [10]), might do

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for you without first experiencing it [11]. To address this shortcoming, further dissemination of MaaS users' experiences has been called for [12].

The most detailed account of MaaS users' experiences is arguably from the 2013–2014 UbiGo trial in Gothenburg, Sweden. Drawing on interviews, questionnaires, and travel diaries, four MaaS user types were identified: people that wanted to test living without owning a car; people that wanted to get access to a car without purchasing one; people that wanted a better way to access multiple mobility services; and people that wanted cheaper access to public transport [13]. The participants were at first primarily motivated by curiosity. The curiosity faded away with experience though. By the end of the trial, convenience/flexibility had replaced curiosity as the most dominant motivating factor [14]. Regardless of this shift in motivation, 97% wanted to remain as customers after the trial [15].

Since the UbiGo trial, a few other trials and commercial operations have added to the understanding of the user perspective on MaaS. In terms of who the MaaS users are, a questionnaire analysis of the 2014 SMILE trial in Vienna, Austria, found that the participants were predominantly male and 20–40 years old with a university degree [16]. Furthermore, the majority owned a private car. Conversely, a questionnaire analysis of the ongoing operation of Whim in Helsinki, Finland, found that the average Whim user does not own a car. Both women and people over 50 are underrepresented among Whim users as well though [17]. The analysis of the EC2B trial in Gothenburg, Sweden, similarly found that older people were more reluctant to use the trialled mobility services, but reported an even gender split among the trial participants [18].

Regarding users' motivations for MaaS adoption, the responses to the Whim questionnaire reinforced findings from the UbiGo trial by highlighting price, convenience, flexibility, and the access to different modes of transport as primary drivers [17]. Interestingly, environmental concerns were not reported as an influential factor by either UbiGo participants or Whim customers. In contrast, the analysis of the EC2B trial identified that an outspoken ambition to drive less was one of the participants' main motivators in the initial phase of the adoption process, alongside gaining access to a variety of vehicles, curiosity, potential cost savings, and a wish to support research and development [18].

In summary, the limited empirical evidence on who the MaaS users are and what factors influence their adoption is mixed [9]. Overall, the understanding of the experience of becoming a MaaS user and using MaaS is incomplete [11]. Given the key role of users in MaaS developments [4], MaaS providers' prevailing struggles with attracting

users to their services, and the open question about who's travel needs MaaS can address [19], this warrants more research into the user perspective.

This paper sets out to contribute to the understanding of MaaS users by exploring participants' experiences during a trial that took place in Sydney, Australia, November 2019–March 2020, and which tested a prototype service that encompassed a multimodal journey planner with payment and wallet functionalities as well as monthly subscription bundles and several support and feedback components (cf. high-level MaaS in [12] or level three in the MaaS topology by [20]). Findings from this trial have previously been reported in Hensher et al. [21, 22], Ho [23], and Ho et al. [24, 25]. These papers have focused on what bundles the participants choose to adopt and how this influenced their private car use, thus contributing to knowledge of how MaaS is used and of how MaaS uptake influences travel behaviour. These earlier papers have, however, not analysed the profile of the participants, what motivated them to join the trial, or if the trial experience satisfied their expectations. To investigate these subjects, i.e., the user perspective on MaaS, this paper addresses the following research questions based on an analysis of previously unreported questionnaire and interview data from the Sydney MaaS trial: Who participated in the trial, and why; and how did the trial experience match with the participants' motives?

The analysis departs from Roger's [26] innovation-decision process model, which recognizes that the decision to adopt or reject an innovation is preceded by a series of experiments. Whether imaginary or real, adopters use these experiments to dispel uncertainty about how the innovation can work for them [27]. It is thus reasonable to assume that a main driver to sign up for a MaaS trial is to reduce uncertainty about the trialled MaaS service regardless of whether the trial participant's interest in MaaS is primarily underpinned by hedonic or utilitarian motives (cf. [28]). However, the analysis also acknowledges (1) that motives tend to change across the different stages of the innovation-decision process (e.g., [14, 18]) and (2) that a participant's motivation to join a MaaS trial might not be directly derived from an intention to adopt MaaS or to change travel behaviour. A participant might, for instance, be intrinsically or extrinsically motivated to participate in the trial *per se*. This latter conceptual distinction enables the analysis to complement previous studies on the motives of MaaS trial participants, which mostly have overlooked the role of the trial.

## 2 The Sydney MaaS trial

The Sydney MaaS trial analysed in this paper was funded by iMOVE Australia and planned, executed, and evaluated by a consortium consisting of the Institute of

**Table 1** Offered mobility plans, adapted from Ho et al. [24]

	Pay-as-You-Go	Fifty50	Saver25	GreenPass	SuperSaver25
Monthly fee	AUD\$0	AUD\$50	AUD\$25	AUD\$125	AUD\$25
Public transport discount	–	50% per trip	25% per trip	100% (unlimited)	25% per trip
Ride-sourcing discount	–	AUD\$3 per trip	15% per trip	AUD\$3 per trip <sup>1</sup>	AUD\$3 per trip <sup>2</sup>
Taxi discount	–	AUD\$3 per trip	15% per trip	AUD\$3 per trip <sup>1</sup>	AUD\$3 per trip
Car sharing discount	–	–	15% per trip	–	–
Car rental discount	–	–	–	–	–
Availability	Nov.–Mar.	Dec.–Mar.	Jan.–Feb.	Feb.–Mar.	Mar.

<sup>1</sup> 15% per trip during February

<sup>2</sup> Plus, an AUD\$5 cap for trips up to 5 kms connecting to and from public transport stations

Transport and Logistics Studies at the University of Sydney Business School (ITLS), the Insurance Australia Group (IAG), and SkedGo. The logic behind the trial was to complement the learnings from the undertaken MaaS trials in Europe (see [12]) by leveraging ITLS's previous research on the preferences of potential MaaS users, IAG's existing relations with mobility service providers, and SkedGo's multimodal travel planner TripGo (tripgo.com). In particular, the trial set out to improve the understanding of how the design of subscription bundles affects MaaS uptake and travel behaviour.

The trial was situated in the Sydney metropolitan area, Australia (Greater Sydney). This was deemed an appropriate institutional setting for a MaaS trial for several reasons. Sydney is a comparatively large city (ca 5.2 million inhabitants) with a well-developed public transport system as well as a rich supply of mobility services. At least in theory, this enables the creation of comprehensive MaaS bundles. Yet, the car modal share is fairly high (approximately 70% during weekdays and 80% during weekends [29] compared to cities of similar size in Europe, Asia, and South America (cf. [30])). This indicates that there is room for improvement. Furthermore, the state authority responsible for the public transport system, Transport for New South Wales, has shown interest in new approaches to improving the public transport offering in Sydney [31].

The MaaS service that was tested during the trial was named Tripi. In terms of technology components, the Tripi service included a smartphone app, an admin dashboard, and back-office servers. The dashboard enabled the trial team to manage mobility plans and invoices, while the participants could search, book, and pay for the included mobility services via the app: public transport (Transport for New South Wales), car rental (Thrifty), car sharing (GoGet), ride-sourcing (Uber), and taxi (Cabcharge). While information integration was implemented for all mobility services, the Tripi app did not integrate payment for all services. For instance, a linked

smart card (Opal) was included in the trial starter pack, which the participants used to pay for public transport trips. The app, moreover, featured a mobility wallet function that allowed the participants to view the details of the mobility plans, their current credit balance, and their transaction history. During the first month of the trial, participants were only offered a Pay-as-You-Go option. As the trial progressed, four mobility plans were introduced, see Table 1. In exchange of a monthly fee, these plans gave the participants trip-based discounts on the included mobility services.

In addition to the technical features and the mobility plans, the trialled service encompassed a significant level of support. Core support activities included introducing the participants to Tripi (and to MaaS), supporting them during the onboarding process (which required the participants to sign up for all mobility services individually), and checking in with them throughout the trial. The support was provided via face-to-face meetings and via digital platforms. Furthermore, at the end of each month, the participants received a monthly bill and a breakdown of the cost per mode during the past month as well as individualized information on how much each of the available mobility plans would cost in the following month, assuming a similar travel pattern as the previous months.

In terms of participants, it was decided to focus on IAG employees based in Sydney. Since the trial team had well-established communication channels and trust with this group, it lowered the marketing challenge. As IAG has a workforce of over 8,000 who reside and work throughout Greater Sydney, the group was also judged to be large and diverse enough for finding 150 participants to invite to the trial, which was the target number.

### 3 Data collection and analysis

In July and August 2019, participants were recruited via e-mails and posts at IAG's internal communication system as well as via flyers, seminars, and in-person advertising at the lobbies of IAG's Sydney offices. These efforts

**Table 2** Primary data sets analysed in this paper

	Ex-ante questionnaire	Pulse questionnaire	Mid-trial interviews	Ex-post questionnaire
When	Prior to the trial (July–August 2019)	During the trial (after each trial month)	During the trial (February 2020)	After the trial (April 2020)
What	Multiple-choice questions, open-ended questions, and Likert-scales	Open-ended questions and a Likert-scale	Interview guide with general themes and sample questions	Multiple-choice questions, open-ended questions, and Likert-scales
Target group	IAG employees that primarily worked at a Sydney office (~8000)	Trial participants	Trial participants	Trial participants
Incentive	None	None	None	AUD\$50 gift card
Responses	n = 226 <sup>1</sup>	n = 111	n = 27	n = 70
Response rate	N/A	24% <sup>2</sup>	30%	77%
Traceability	Linked to participant ID	Anonymous	Linked to participant ID	Linked to participant ID

<sup>1</sup> Whereof 91 participants, 93 eligible non-participants, and 42 non-eligible non-participants

<sup>2</sup> Given that 91 participants had five opportunities to fill in the questionnaire

resulted in 226 IAG employees registering interest to participate by completing an online questionnaire. This ex-ante questionnaire comprised two sections. The first section, which had 15 questions, aimed at establishing who the respondents were, including household data and how they currently travelled. In the second section, which had six questions, the respondents were first asked to watch a video introducing the MaaS concept. Then, they were queried to what extent different features of MaaS appealed to them and about their interest in joining the trial.

Of the people that filled in the ex-ante questionnaire, 184 were deemed eligible for the trial (81%), based on which IAG office they worked at and what type of smart phones they used (the trialled app only was available for iOS). The eligible respondents were also ranked based on their reported interest in MaaS and the trial. To ensure a high retention rate, and based on the assumption that likely early MaaS adopters will be interested in the MaaS concept, the 150 respondents with the highest total 'MaaS interest scores' were invited to join the trial. Following significant onboarding support, 91 people entered the trial and used the included mobility services at least once.

During the trial, the participants reported their experiences to the trial team through two principal tools: an online pulse questionnaire and short interviews. Both tools aimed at capturing the current mood of the participants and to provide insights on how to improve the trial offering. The pulse questionnaire contained four questions about the trial experiences and was presented to the participants through the Tripi app once a month. In total, it received 111 responses. The mid-trial interviews (n = 27) were conducted at the beginning of February. The interviewees were selected to mirror the participants'

choices of mobility plans. Thus, six interviewees had only used the Pay-as-You-Go option, twelve had subscribed to a mobility plan, and four had switched between several bundles. The interviews were audio recorded and automatically transcribed. The transcriptions were then analysed to identify recurring themes in relation to the trial, the trialled service, and the participants' experiences.

Following the early closure of the trial in mid-March 2020 due to the onset of COVID-19 related travel restrictions, the participants were invited to fill in an online ex-post questionnaire. An AUD\$50 gift card was offered as an incentive. The 24 questions covered the participants' general experiences of the trial and their views on specific components of the trialled service. It also investigated how the trial had influenced the participants' travel behaviour, and how these were likely to change in the future. 70 of the 91 participants filled in the ex-post questionnaire (77%).

The results from the ex-post questionnaire were linked with the results from the ex-ante questionnaire as well as with the participants' choices of mobility plans and their testimonials during the mid-trial interviews. This enabled an analysis of relationships between ex-ante statements, experiences during the trial, and ex-post statements. Insights from this exercise were, moreover, compared with the insights from the pulse questionnaire, to determine who participated in the trial, and why, and how the trial experience matched with the participants' motives. These findings are outlined in next section, while an overview of the analysed data sets is provided in Table 2.

## 4 Results and analysis

### 4.1 Who participated in the trial, and why?

The gender ratio for the participant group was evenly split between females and males (52% females), which

resembles the distribution in Greater Sydney [32].<sup>1</sup> 70% of the participants were between 25 and 54 years old, whilst no one was above 64 years. In contrast, the proportion of the Greater Sydney population aged 65 years and older is 14% (ibid.). Furthermore, none of the participants had any disabilities that affected their ability to use public transport, whilst 18% of Australians have a disability [33]. One can therefore assume that the participant group was less constrained in their mobility choices than the general population.

In terms of household composition, the bulk of the participants lived in households with more than one adult (90%).<sup>2</sup> About half of these households did not include children. In other words, 42% of the participants lived in households with multiple adults and no children. In Greater Sydney, 29% of the households are defined as either couples without children or as group households [32].<sup>3</sup> Thus, there was an overrepresentation of households with multiple adults and no children among the participants.

95% of the participants had a valid driver's license, and all but one participant lived in a household in which at least one person was allowed to drive. As only 83% of the population aged over 16 in New South Wales hold a driver's licenses [34], non-license holders were slightly underrepresented among the participants. 62% of the participants lived in households that typically used one private car, while 30% lived in households that typically used multiple private cars. In Greater Sydney, 85% of occupied private dwellings have at least one registered motor vehicle garaged or parked at their address, whilst 49% have several registered vehicles [32]. Thus, there was an overrepresentation of single-car households among the trial participants.

Regarding travel behaviour, 45% of the participants reported that they used a private car 3–5 times a week or more frequently. The corresponding number for public transport was 90%. A large majority of the participants (82%) used both private cars and public transport on a weekly basis, whilst the use of other modes was limited. 76% rode a bicycle less than once a month or never. The corresponding number for taxi, car share, and car rental were 64%, 90%, and 99%, respectively. The exception was ride-sourcing, which 62% used monthly. In total, 24% of

the participants used both public transport and at least one type of car services on a weekly basis, see Table 3.<sup>4</sup>

In terms of why they participated, 43% of the participants that filled in the ex-post questionnaire reported a desire to contribute to an IAG initiative as their main motive, see Fig. 1. This was followed by curiosity (24%), more streamlined access to transport (15%), and potential cost savings (15%). A more detailed understanding of the motives can be traced from the ex-ante questionnaire in which 63 of the participants offered further reasoning. Regarding the desire to contribute to an IAG initiative, a few participants mentioned that they specifically wanted to help IAG explore new business opportunities within mobility. Still, many also reported a will to support an initiative that might improve transport more generally, e.g., *"I would love to be part of a project that can ease some congestion, save some money for the family and save the environment."* Thus, the participants' desire to contribute by participating in the trial seemed to stretch beyond just helping their employer. A few participants, furthermore, mentioned that they wanted to reduce carbon dioxide emissions from their own traveling as well.

Regarding curiosity, the participants stated that they were interested in new technologies and MaaS in general as well as in how different features of MaaS would work in practice. Likewise, they were curious to whether the trialled service could help them identify new ways to travel and how it might influence their travel habits, e.g., *"I'm intrigued and curious to see what new options there are for me. I rarely use my car but need it for certain events. I want to see how this app could change the way I get around."* Some participants even stated that they were hoping that the trial would disprove the assumptions that currently guided their travel choices.

Several of the 63 participants that commented on their motives in the ex-ante questionnaire also wrote about being tired of juggling several mobility apps simultaneously, e.g., *"App swapping is annoying, comparing prices between Uber and Ola is annoying, checking Google Maps then making sure I have my Opal card then making sure I check Google Maps again then ordering an Uber because I became late through so many apps is annoying."* In general, the participants were intrigued by the potential of added convenience with regards to choosing between and paying for different modes of transport and appeared to find it more important than the potential of reduced travel expenses, e.g., *"cost savings are nice, but the convenience is much more valuable."* Nonetheless, some participants brought forward the appeal of potential

<sup>1</sup> A comparison with the entire group of IAG employees in Greater Sydney would arguably have been even more relevant, but neither demographic information nor travel statistics this group was available to the authors.

<sup>2</sup> None of the participants lived in the same household.

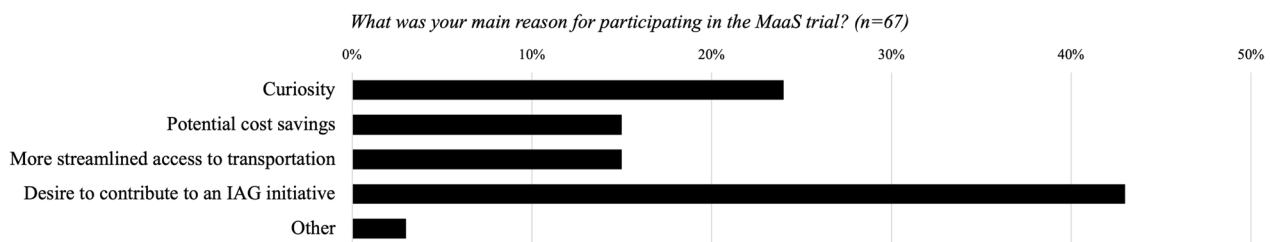
<sup>3</sup> Group household is here defined as a household consisting of two or more unrelated people where all people are aged 15 years and over [49]

<sup>4</sup> We were unable find any comparable travel behaviour statistics for the general population in Greater Sydney.

**Table 3** Characteristics and travel behaviour of the participants (n = 91)

<b>Gender and age</b>		
	34 years old or younger	35 years old or older
Male	11 (12%)	33 (36%)
Female	23 (25%)	24 (26%)
<b>Household composition</b>		
	No children	One or several children
One adult	8 (9%)	2 (2%)
Several adults	38 (42%)	43 (47%)
<b>Private car use and public transport</b>		
	Do not use private car weekly	Use private car weekly
Do not use PT weekly	0 (0%)	1 (1%)
Use PT weekly	15 (16%)	75 (82%)
<b>Car service<sup>1</sup> use and public transport</b>		
	Do not use car services weekly	Use car services weekly
Do not use PT weekly	1 (1%)	0 (0%)
Use PT weekly	68 (75%)	22 (24%)

<sup>1</sup> Car services encompasses taxi, ride sharing, car sharing, and car rental in this case

**Fig. 1** Reasons to participate in the trial

cost savings too, e.g., “transport costs in Sydney are only increasing. I’m keen to look at new ways of transporting myself and my family to try and keep costs down”.

In summary, the participant group consisted of able-bodied, working-age individuals in Greater Sydney that for the most part used a combination of private cars and public transport to travel. Compared to the general population in Greater Sydney, they were more likely to hold a driver’s licences but less likely to own multiple cars. The most frequently mentioned motive for participating in the trial was a will to contribute to the development of a service that might help their employer excel while also making the transport system more sustainable. The participants were, moreover, frustrated with juggling several mobility apps and keen to learn about how MaaS could

improve their traveling in terms of convenience, emissions, and travel expenses.

#### 4.2 How did the trial experience match with the participants’ motives?

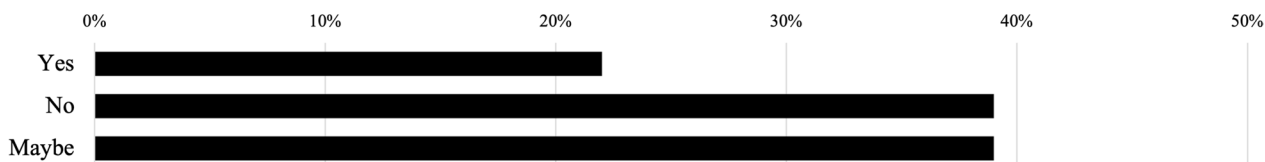
In the anonymous pulse questionnaire, some participants expressed how much they relished contributing to the development of the trialled service, e.g., “Love being a part of something new!!” while others made positive remarks in relation to the trial process, e.g., “[I like] how the trial is trialling new things every month it’s interesting to see different ideas and offers”. The participants also showed interest in the future of the trialled service and many of them were eager to offer their advice on how it could be further developed to better meet user needs.

*If the MaaS trial offering was to become a commercially available product, would you purchase it? (n=67)*



**Fig. 2** Willingness to become a customer

*Overall, do you think the MaaS trial decreased your CO2 emissions? (n=67)*



**Fig. 3** Impact on carbon dioxide emissions

During the mid-trial interviews, several participants, moreover, explained that they were proud of participating in the trial and happy with the trial experience thus far. Hence, on a general level, the trial seemed to satisfy the participants’ desire to take part in the development of a new type of service that could benefit IAG and society.

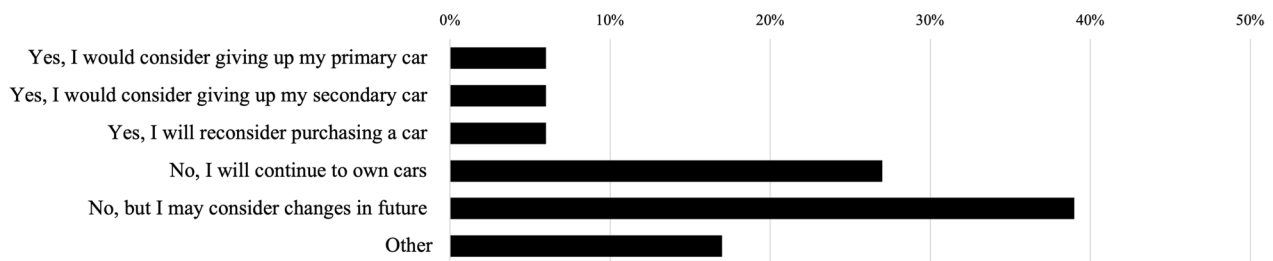
The participants, moreover, provided feedback in the anonymous pulse questionnaire which indicated that the trialled service met many of their expectations, e.g., *“This is a great service – please continue it and roll it out further!”*. When asked to name what they liked the most about it, three common themes were: the convenience of having everything in one place, e.g., *“I like being able to have an app that looks at a range of different transport methods to my destination. I have discovered new bus routes I didn’t know about”*; the monthly bill that made paying for transport easier and provided a better overview of transport costs, e.g., *“even though I got ‘sticker shock’ when I started, I now appreciate the total view of my transport”*; and the provided discounts, e.g., *“I have tried to use as many of the services as possible and got a great discount when using Thrifty recently.”* Quite a few therefore mentioned that they hoped that the service would be continued after the trial. This wish was reflected in the ex-post questionnaire; 82% of the participants stated that they would have purchased the trial offering would it be available after the trial, see Fig. 2.

The trial also seemed to please some of the participants’ hopes to discover ways to improve their travelling. Still, most participants did not believe that their travel behaviour had changed significantly due to the trial experience. Only 22% of the participants that filled in the ex-post questionnaire thought that the trial had decreased their

carbon dioxide emissions, see Fig. 3, and the interviewees could usually not recall any noteworthy changes in their travelling during the mid-trial interviews. The participants also reflected over the limited behaviour change in the pulse questionnaire, e.g., *“I find it isn’t changing my modes of transport yet—so whilst it is giving me awareness of the impact of my choices, it hasn’t translated to behaviour change”*. The comments in the pulse questionnaire indicated that the trial failed to address the contextual factors that constrained the participants’ travel behaviour, e.g., *“I don’t use the Tripi app very much due to my routine travel patterns during the week, and reliance on my car (with baby seats) at the weekend”*. In some cases, the service was also mismatched with expectations on ease of use, comprehensiveness, and personalization. Frequent areas of complaint regarding it included: that the monthly bill had to be separately handled, the lack of mobility plans that matched their needs, that some modes were either missing or not fully integrated, and various shortcomings that made the Tripi app inferior to other journey planners.

Despite the limited travel behaviour changes, as perceived by the participants, several participants reported to be *“thinking more about how I travel and the options I can use”* in the pulse questionnaire. 17% of the participants that filled in the ex-post questionnaire even noted that the trial experience had influenced their position on car ownership, see Fig. 4. The trial might therefore possibly contribute to travel behaviour changes further down the road. The mid-trial interviews, moreover, indicated that the trial had influenced their participants’ travelling in ways that they neither regarded as significant, nor influenced their modal split, but still could have

Has participating in the MaaS Trial changed the way you view car ownership? (n=70)



**Fig. 4** Impact on position on car ownership

consequences for the transportation systems. Subscribers to the GreenPass mobility plan (see Table 1) mentioned that they had “*relaxed a bit*” in their choice of public transport mode and time of travel during the trial. The standard public transport payment system (Opal) has daily, weekend, and weekly caps. It also prices different modes as well as peak and off-peak trips differently. The GreenPass mobility plan, which included unlimited public transport use, eliminated these policies, and thus effectively reduced the public transport authority’s ability to influence how the participants used public transport.

Furthermore, in the ex-post questionnaire, almost 40% of the participants that had opted into a mobility plan (n=41) said that this had caused them to use the discounted modes more frequently, while 41% said that the mobility plans had made them more cost aware. Correspondingly, they reported potential cost savings as the main reasons for adopting a plan (76%). 12% even reported that they had travelled more frequently in total since adopting a mobility plan. Yet, the participants also stated in the ex-post questionnaire that the mobility plans had not contributed much to their behaviour changes during the trial; the median score for its contribution was 3 on a five-point scale that stretched between ‘a great deal’ (1) and ‘not at all’ (5),  $SD = 1.5$ . Hence, the self-reported data on the influence of the mobility plans on travel behaviour are mixed and somewhat contradictory.

A clearer finding was that the mobility plans, despite including discounts and being continuously revised during the trial, did not match all participants’ needs. At end of the trial, about half of the participants (54%) had subscribed to a plan other than Pay-as-You-Go. Low use of the discounted modes (21%), not being able to estimate travel needs (20%), and price (11%) were reported as reasons for not opting into a mobility plan in the ex-post questionnaire.<sup>5</sup> During the mid-trial interviews, the

interviewees added working from home regularly, relying exclusively on either public transport or walking for the work commute, not wanting to subscribe to on-demand services, the irregularity of travel patterns during the holiday season, and that it would take too much effort to review the mobility plans as reasons for staying with Pay-as-You-Go. 58% of the participants that filled in the ex-post questionnaire would have opted into a mobility plan for the following month if the trialled service would have continued.

With regards to the Tripi app, the participants’ median score on the multimodal journey planner’s contribution to behaviour change during the trial was even lower than for the mobility plans (4 out of 5,  $SD = 1.2$ , as compared to 3 out of 5,  $SD = 1.5$ , 5 indicating ‘not at all’). The mid-trial interviews revealed that many participants hardly used it; competing products were preferred, partly due to habit, but also due to not liking the design and/or functionality of the Tripi journey planner. Likewise, 58% of the participants that filled in the ex-post questionnaire said that they used the mobility wallet function once a month or less. Thus, although the one-stop booking, one-stop payment, and multi-modal journey planner features on average were ranked as very appealing in the ex-ante questionnaire, the average participant did not seem to find the Tripi app particularly value adding, which several participants also commented on in the pulse questionnaire, e.g., “*I don’t really see how it adds anything beyond what I already get through TripGo.*” Still, 53% of the participants that answered the ex-post questionnaire said that they were either likely or very likely to continue to use the Tripi app if it was available after the trial.

In contrast, the interviews and questionnaire responses indicated that the participants were almost one-sidedly positive towards the feedback and support features of the trialled service. For instance, the mid-trial interviewees

<sup>5</sup> 44% picked “other”, indicating that the choices were mismatched with the actual reasons for sticking with Pay-as-You-Go.



spoke keenly about how much they appreciated the time that the trial team spent on onboarding each participant (in many cases one-by-one), as opposed to more generic emails and instructions as they envisioned on beforehand. Furthermore, several interviewees expressed how happy they were about how the attached information in the monthly bill brought them greater clarity of their transport costs. These opinions were also reflected in the pulse questionnaire responses. Overall, the support from the trial team seemed to add to the positive trial experience, e.g., *“The support team are superstars!”*, while the monthly feedback seemed to reveal cost outlays and impacts that the participants had not previously realized, e.g., *“The emissions email was very effective in motivating me to use more public transport especially when combined with a plan offer.”*

In summary, the trial satisfied the participants' desire to take part in the development of a new type of service that could benefit both their employer and society. Although most of the trial participants did not feel that the trial changed their travel behaviour to the extent they hoped for before joining, the trial helped them get a better overview of their transport costs, explore new travel options, and, in some cases, reduce their spending. The participants were therefore, on average, happy about their trial experiences and interested in becoming regular customers of the trialled service even though many of them struggled with fitting it to their own circumstances during the trial. In terms of service attributes, the participants liked the convenience of having one plan, one bill, and one app for mobility. They also appreciated all the support from the trial team and the feedback that was attached to the monthly bills. In contrast, the average participant's interest in specific features of the trialled app, such as the multi-modal journey planner and the mobility wallet, was lukewarm.

## 5 Discussion and conclusions

Three contributions to the literature on MaaS can be elicited from the results. Firstly, most of the people that signed up for the trial were frequent users of both public transport and private cars. This strengthens the notion that people that already travel with multiple modes are likely early adopters (e.g. [35]), but contradicts the fear that MaaS does not appeal to car owners and frequent car users (e.g., [36, 37]). Rather, 82% of the people that registered interest for the trial had daily access to cars. The overrepresentation of single-car households, moreover, corroborates results from stated preference experiments (e.g., [38]) and supports the idea that MaaS could be positioned as a competitor to 'the second car' (e.g., [39]). On the other side of the coin, the complete lack of participants with disabilities that influence their travelling

underscores previous assertions that MaaS in its current form(s) is not available and useful for all (e.g., [19]).

Secondly, the most frequent motivation for signing up for the trial was a will to support the development of a service that might help their employer and make transport more sustainable, followed by a curiosity about MaaS and how the trialled MaaS service could improve their traveling. These motives reinforce previous findings on early MaaS adopters' motivations (e.g., [14, 18]). The widespread will to contribute to innovation among the participants also highlights the importance of the setting in which MaaS is introduced. If a MaaS service is linked to something that potential adopters believe in, are committed to, or want to be associated with, and is provided in a setting that supports experimentation, this will likely benefit the adoption rate. In this case, the inviting setting for MaaS experimentation was a trial sponsored by the participants' employer. It is thus reasonable to believe that similar motives can be leveraged to promote MaaS adoption in other MaaS trials and in cases where MaaS is offered to employees. However, the importance of the setting surrounding MaaS services for creating awareness and interest about them and for supporting experimentation arguably has implication for the broader discussion about MaaS dissemination too.

Thirdly, many participants struggled with making the trialled service work for them. On average, they seemed to value the offered support and feedback functions higher than the new features included in the app. This speaks to the novelty of MaaS, compared to existing mobility services, which further reinforces the advantages of analyses of actual user experiences versus stated preferences experiments with non-users (e.g., [11]). In this case, many participants seemed to enter the trial with misconception about MaaS despite having been thoroughly introduced to the concept. It also supports the notion that more than an app and a set of mobility plans is needed for a MaaS offering to be useful for users (e.g., [18, 40]). Nonetheless, the support and feedback features were labour-intensive. To pave the way for economically viable MaaS operations, more resource efficient, yet personal, solutions for interacting with users would be needed.

All in all, the analysis reveals both strengths and weaknesses with using trials as a tool for promoting MaaS uptake. MaaS trials can draw interest to MaaS and enable experimentation, which are important steps toward adoption [26]. Yet, trials are often expensive to run, short-lived, and do seldomly address the contextual factors that constrain travel practices [41–43]. In this trial, the participants experienced limited behaviour changes despite going in with ambitions to try new ways of travelling. Due to the high car ownership rate among the

participants and in Sydney, a probable reason for this discrepancy between motives and perceived outcomes is the lock-in effect of car culture and established car-based travel habits versus the short trial period (see [44, 45]). To promote more substantial travel behaviour changes, future MaaS trials should include interventions to break car use habits and be long enough to motivate the participants to invest in new behaviours. However, based on the experience to date, MaaS trials seem unlikely to suffice in this regard. Consequently, there is arguably a need for new approaches to support potential adopters in experimenting with MaaS, which imitate the advantages of trials but amend their drawbacks.

The participants' experiences, moreover, point toward a mismatch between the utopian visions of MaaS and the usability of available MaaS services. Although generally happy with the trial experience, the trialled service prototype did not come across to the participants as either "the single most powerful tool to decarbonise transport for future generations" (whimapp.com/about-us), or "the biggest transport revolution of the twenty-first century" (skedgo.com/what-is-mobility-as-a-service-maas/). Some participants seemed repelled by this oversell. Hence, this study raises the questions that perhaps more nuanced descriptions of MaaS that create more realistic expectations are needed?

Like the previous studies of MaaS users, this work has limitations. Most importantly, the trialled service prototype embodied only one example of MaaS. Subtle changes to either service design, target group, and/or context could significantly alter the users' experiences. Thus, one must be careful in generalising the findings reported herein to all MaaS operations. They are likely transferable to comparable trials though (see [46]), i.e., trials of high-level MaaS service prototypes with likely early adopters in metropolitan areas akin to Sydney. The findings are, furthermore, based on questionnaire data and interviews; data sources that are subjected to self-reporting bias and known to have limitations in estimating travel behaviour changes (e.g., [47]). The reported study should therefore preferably be complemented with analyses of how distinct MaaS services in other contexts are used as well as with analyses that combine objective and subjective data sources. To enhance contextual understanding of user experiences, the subjective data should ideally be collected through methods that cater for close interaction, and, if possible, cocreation (see [48]) between researchers and MaaS users.

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#### Author contributions

GS contributed to the design of the trial and led the analysis and writing processes; DH and CH jointly led the design of the trial and the data collection strategy and contributed to writing and editing; CB undertook data cleaning, performed preliminary analysis, and contributed to writing and editing.

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#### Availability of data and materials

The questionnaires, an overview of the questionnaire results, and a report of the interview findings can be provided on request.

#### Declarations

#### Competing interests

The authors declare no competing interests.

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