
# MOBIS study:
# A review of common reported issues

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# MOBIS study: A review of common reported issues

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## Abstract

The advent of mobile GPS tracking apps offer new possibilities in transport survey methods, making it possible to collect continuous and detailed data of individual mobility over long periods of time. This additionally allows for more elaborate study designs such as incorporating near real-time feedback to the participants. However, all these moving parts come with potential issues. The MOBIS study is a mobility pricing field experiment that was carried out over the past several months in the German- and French-speaking parts of Switzerland, using a GPS tracking app to record the movements of over 3'500 people, each over a two-month time span. Each participant received tailored information over the course of the study to ensure the study was carried out according to plan. In addition, a help-desk allowed participants to ask questions and communicate any issues that might have occurred during the study. This paper analyzes the questions and feedback received from the participants during the study. The goal is to inform future studies of common reported issues as well as unexpected cases that need to be considered to ensure better planning and resource allocation related to communicating with study participants.

## Keywords

MOBIS, GPS tracking, mobility pricing, emails, help-desk

## Suggested Citation

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# 1 Overview

## 1.1 The MOBIS study

The MOBIS study ((IVT, 2020), (MOBIS, 2019b)) is a large-scale mobility pricing field experiment that was carried out over the past several months in the German- and French-speaking parts of Switzerland, using the "Catch-My-Day" GPS tracking app developed by MotionTag (2020) to record the movements of participants, each over a two-month time span.

A total of 90'965 people living in urban agglomerations in both the German- and French-speaking parts of Switzerland were invited to participate in the study through an invitation letter written in German, French and English and sent by post. If interested, they were asked to first complete an introductory online survey designed to filter them based on certain inclusion criteria and to collect transport-related opinions from the general population. Around 22'000 people completed this introductory survey and 7'000 qualified for the tracking study. Of those, 5'466 registered to participate in the MOBIS study.

The 8-week GPS tracking period consisted of two consecutive 4-week phases, an observation and treatment phase respectively, followed by another online survey. The participants received weekly reports of their mobility behaviour by e-mail, which during the observation phase only included tracked distance by transport mode, as all study participants were treated equally during this phase.

During the intervention phase, the study participants were randomly assigned to one of three treatment groups (pricing group, information group and control group) and thus some of them received supplementary weekly information on estimated external costs by transport mode and by type of externality. In addition, the pricing group were given a monetary incentive based on the external costs (time loss in congestion, health damages and $CO_2$ emissions) that were estimated for their tracked trips.

On top of the weekly emails, each participant received tailored information over the course of the study. Additionally, a help-desk service was set up to allow participants to ask questions and communicate any issues that might have occurred during the study. The communication with the help-desk was possible via phone (from 17:00 to 19:00 from Mondays to Friday and from 10:00 to 12:00 Saturdays and Sundays) or at any time via

e-mail.

Prior to the official study, a pretest was run using another in-house GPS tracking app. Due to the unsatisfactory performance of the app at a Swiss-wide level, the project team made the decision to proceed with the Motiontag app for the main study. The choice of using the MotionTag app was made only a couple weeks prior to the official project start, which made running another complete pretest with the app impossible. As a result, some parts of the communication framework needed to be designed or adapted as the main study progressed, which in turn possibly lead to some of the unexpected issues experienced along the way.

### 1.2 Content

The current paper is an overview and analysis of both the emails sent to the participants and the questions and feedback received from the participants over the course of the study. The objective is to inform future studies of common reported issues as well as unexpected cases that need to be considered.

The paper is structured as follows. First, initial descriptive analysis is performed on the data. Then, the efficiency of both the communication framework and help-desk are analyzed and discussed. Finally, the tickets received on the help-desk are classified by language, replied-to email and stage of study to provide insights on the most commonly reported issues during the study. Some anecdotal accounts are also provided.

## 2 Data overview

A total of 5'466 participants registered for the study, with 3'523 going so far as completing the final survey. Table 1 shows the number of study participants who registered and completed the entire study, grouped by language of correspondence.

The study required constant communication with the study participants to ensure they participated as expected over the course of the study. Thus, each participant received tailored emails and reminders at each step of the study in their respective language of

Table 1: Overview of study participants

| Language | Registered | Registered (%) | Completed | Completed/Registered (%) |
|---|---|---|---|---|
| German | 3'561 | 65.1 | 2'339 | 65.7 |
| French | 1'500 | 27.4 | 915 | 61.0 |
| English | 405 | 7.4 | 269 | 66.4 |
| Total | 5'466 | 100.0 | 3'523 | 64.5 |

correspondence. In addition, a help-desk service was set up to allow participants to ask questions and communicate any issues that might have occurred during the study. Each email sent to a participant and each ticket received from a participant on the help-desk were recorded and make up the two datasets. The following section is an overview of this data.

## 2.1 Sent emails

This first dataset comprises a list of all the emails that were sent to the study participants. Each entry contains a unique email identifier, the participant identifier, the date the email was sent, the date it was opened, the email address it was sent to, the subject of the email and a label marking the type of email. Each entry can be further enriched by other participant attributes, for example, the language of correspondence.

Over the course of the entire data collection, spanning from September 1st, 2019 to March 15th, 2020, a total of 103'071 emails were sent to 5'466 registered participants, an average of 18.9 emails per participant. Fig. 1 plots the distribution of the number of emails sent per participant.

A breakdown of the number of emails sent grouped by language of correspondence is shown in Table 2. The share of emails per language group matches the share of participants who registered per language group. However, the average number of emails sent to English speakers is slightly higher than that for German or French speakers, albeit by only one email per person.

The record for each sent email was marked with the date and time it was sent and labelled

Figure 1: Distribution of the number of emails sent per participant.

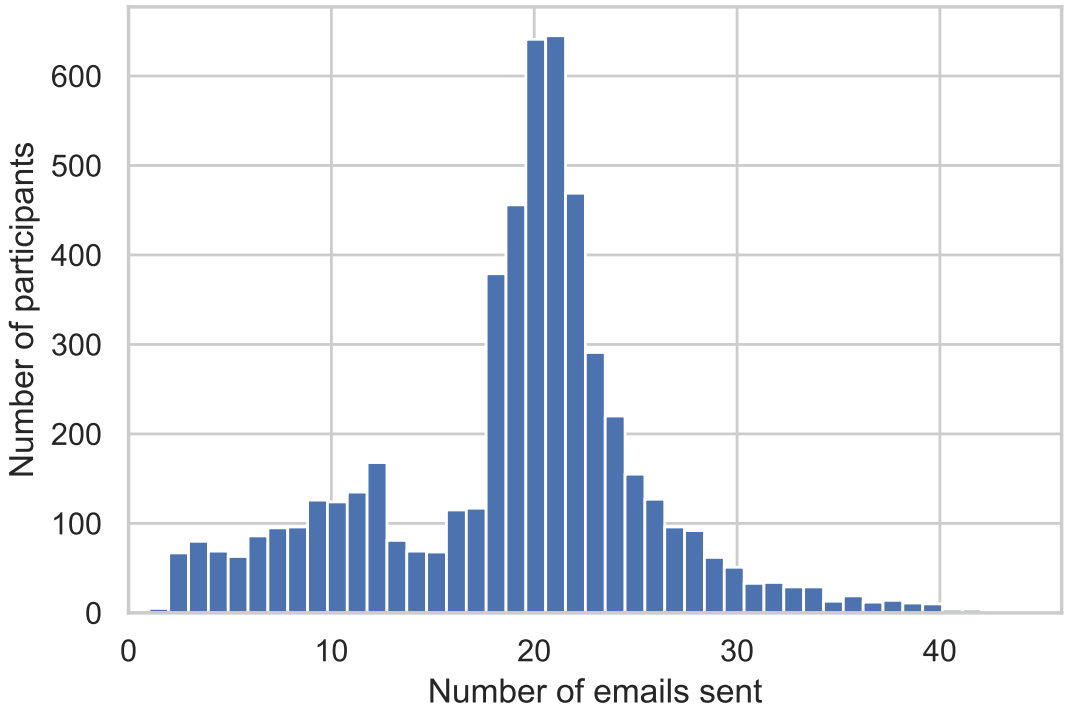



Table 2: Number of emails sent by language of correspondence

| Language | Emails sent | Emails sent (%) | Emails sent per person |
|---|---|---|---|
| German | 66'907 | 64.9 | 18.8 |
| French | 28'184 | 27.3 | 18.8 |
| English | 7'980 | 7.7 | 19.7 |
| Total | 103'071 | 100.0 | 18.9 |

with its subject and type. For example, the email could be a welcome email, a weekly report, an invitation to the final survey, information regarding the payment procedure or reminders to log into the app after registration, activate the tracking, etc. Although the actual contents of an email with a given subject and type might have changed over the course of the study, this gives a general indication of the nature of the email's content.

Table 3 shows the number of emails sent per type. Weekly reports, reminders and emails regarding the payment of compensation account for over 70% of all emails sent to the participants.

Table 3: Number of emails sent by type

| Type | Emails sent | Emails sent (%) |
|---|---|---|
| weekly_report | 30'990 | 30.1 |
| reminder | 28'057 | 27.2 |
| payment | 13'474 | 13.1 |
| other | 6'826 | 6.6 |
| welcome_email | 5'459 | 5.3 |
| final_survey | 5'383 | 5.2 |
| halfway_email | 3'733 | 3.6 |
| final_report | 3'693 | 3.6 |
| study_end | 3'690 | 3.6 |
| dropout_related | 1'408 | 1.4 |
| bank_info | 358 | 0.3 |

The reminder emails can be further broken down as shown in Table 4.

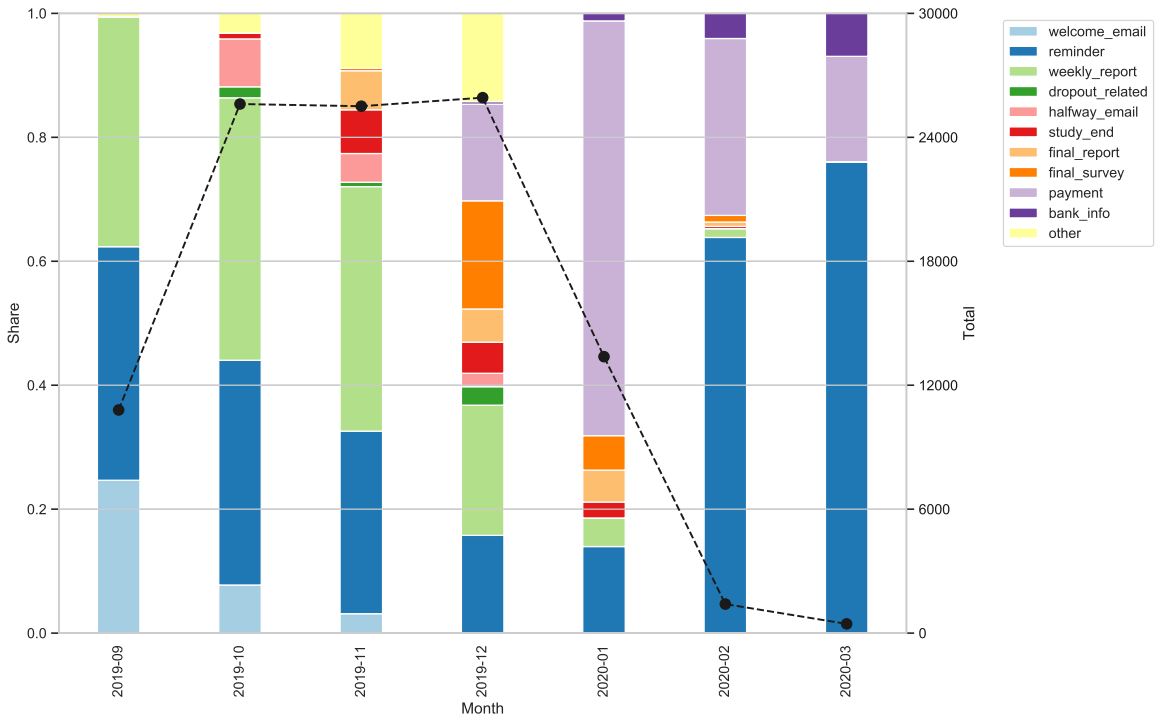
Table 4: Share of reminder sent by type

| Type | Emails sent | Emails sent (%) |
|---|---|---|
| reminder_installation | 8'572 | 30.6 |
| reminder_activation | 6'956 | 24.8 |
| reminder_final_survey | 4'342 | 15.5 |
| reminder_login | 4'337 | 15.5 |
| reminder_deadline | 3'586 | 12.8 |
| reminder_other | 264 | 0.9 |

Reminders related to getting the participants to start using the app (reminder_installation, reminder_login, reminder_deadline) account for nearly 60% of all sent reminders. An additional 25% of reminders (reminder_activation) were sent to participants who were not regularly tracking. These numbers show that a substantial number of the sent emails were related to the use of the tracking app.

Finally, Fig. 2 shows the number of emails sent per study month, grouped by type, giving on good overview of the general communication procedure. During the peak months, nearly 25'000 emails per month (i.e over 800 emails a day on average) were sent to the participants.

Figure 2: Number of emails sent per month, per type



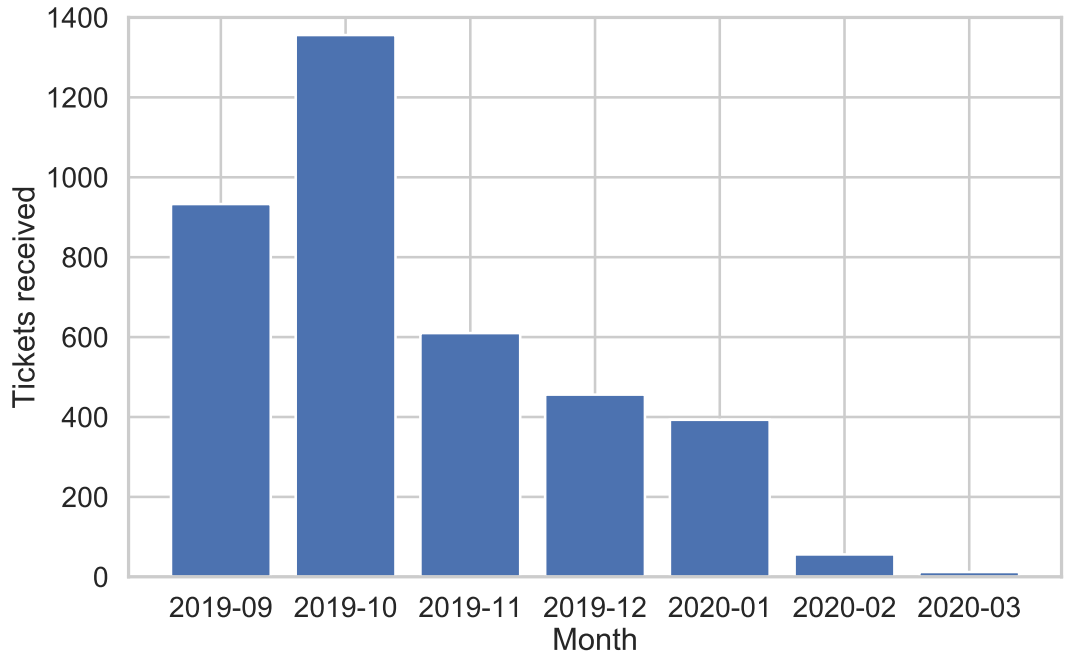

## 2.2 Received tickets

Sending out emails is only one part of the communication process with the participants. Allowing participants to ask questions and raise issues is also an important part of ensuring the study progresses as planned. Thus, a help-desk service was set up for this purpose. This service consisted of both a phone line, which the participants could call during specific hours, and an email address, which the participants could write to at anytime and which was linked to the Freshdesk Customer Support Helpdesk service (Freshdesk, 2019).

Emails sent via this channel were registered as tickets on the Freshdesk platform, thus yielding a second dataset consisting of a list of all the tickets that were created by participants during the study. Each entry contains a unique ticket identifier, the subject and content of the ticket, the date the ticket was created, the date it was resolved, the agent who resolved the ticket, the number of agent interactions, the number of participant interactions, the name and email address of the sender, as well as the participant identifier if the email was sent from the address registered with the participant.

Over the course of the entire data collection from September 1st, 2019 to March 15th,

Figure 3: Number of tickets received per month




2020, a total of 5'218 tickets were received on the help-desk. However, some of these tickets were self-generated or consisted of automatic reply emails or spam. After removing these, a total of 3'816 tickets sent from the participants could be accounted for. Of these, 2'494 were received from email address assigned to a registered participant; the remaining 1'322 tickets came from unassigned email addresses. These can be both invited participants who sent a question but never participated in the study, or participants who sent questions via alternative email addresses.

Fig. 3 shows the number of tickets received per study month. Most of the tickets were received in the first months of the study, with a peak occurring during the month of October 2019. This also corresponds to when most participants started participating in the study and are most likely to have issues with the different parts of the study.

# 3 Planning and resource allocation

One main objective of this paper is to provide insights that could be used for planning and resource allocation purposes related to communicating with study participants in future similar large-scale studies. This optimization can be carried out on two fronts: the sending of emails and the answering of tickets via the help-desk.

## 3.1 Emails

Each participant received tailored emails and reminders to ensure they participated as expected over the course of the study. As this information is crucial to the successful completion of the study, it is important that the emails are read. The emails sent to the participants were therefore monitored to know whether or not they were opened, and if so, when. Hence, the share of opened emails as well as the time needed to be opened can be analyzed as a function of various other factors.

### 3.1.1 Time of day

First, the effect on the time of day when the email was sent is analyzed. Two different time periods are defined: morning, if the email was sent after midnight and before noon, and afternoon, if the email was sent after noon and before midnight. Table 5 shows the number of emails sent by time of day, the share that were opened and, for those that were opened, the median time it took to open them. A larger share of emails sent in the afternoon were eventually opened, but it took longer for them.

Table 5: Share of opened emails and median time to open by time of day

| Time of day | Sent | Sent (%) | Opened (%) | Median time to open (days) |
|---|---|---|---|---|
| Morning | 39'239 | 38.5 | 68.6 | 0.37 |
| Afternoon | 62'750 | 61.5 | 75.7 | 0.64 |

### 3.1.2 Day of week

Next, the effect the day of the week is shown Table 5. The lowest share of opened emails can be seen on both Friday and Saturday, with the longest time required to open them having been on Saturday. Hence, the data suggests that it would be preferable to send out emails during the week.

Table 6: Share of opened emails and median time to open by day of week

| Weekday | Sent | Sent (%) | Opened (%) | Median time to open (days) |
|---|---|---|---|---|
| Monday | 17'797 | 17.4 | 75.8 | 0.43 |
| Tuesday | 14'756 | 14.5 | 71.8 | 0.43 |
| Wednesday | 18'941 | 18.6 | 74.9 | 0.52 |
| Thursday | 17'835 | 17.5 | 74.2 | 0.50 |
| Friday | 12'927 | 12.7 | 69.2 | 0.52 |
| Saturday | 10'137 | 9.9 | 69.4 | 0.90 |
| Sunday | 9'596 | 9.4 | 72.4 | 0.50 |

### 3.1.3 Month of the year

One fear as the study progressed was whether the winter holiday season would have a negative effect on participation. Therefore, the effect of the month was analyzed and is shown Table 7. Interestingly, a higher share of opened emails was recorded during the months of December and January, albeit with a longer median time to open. However, the share of opened emails dramatically reduced thereafter, which coincides for the most part with the official end of the data collection.

### 3.1.4 Language

Additionally, the role of language in the share of opened emails was examined and the results presented in Table 8. The share of opened emails is quite stable throughout the language groups; however, English speakers seem to have opened the emails quicker than

Table 7: Share of opened emails and median time to open by month

| Month | Sent | Sent (%) | Opened (%) | Median time to open (days) |
|---|---|---|---|---|
| 2019-09 | 10'691 | 10.5 | 76.5 | 0.53 |
| 2019-10 | 25'383 | 24.9 | 70.0 | 0.39 |
| 2019-11 | 25'219 | 24.7 | 70.5 | 0.45 |
| 2019-12 | 25'655 | 25.2 | 74.9 | 0.71 |
| 2020-01 | 13'232 | 13.0 | 80.4 | 0.64 |
| 2020-02 | 1'367 | 1.3 | 49.0 | 0.35 |
| 2020-03 | 442 | 0.4 | 38.9 | 0.45 |

both German and French speakers. This observation would still need to be tested for statistical significance.

Table 8: Share of opened emails and median time to open by language

| Language | Sent | Sent (%) | Opened (%) | Median time to open (days) |
|---|---|---|---|---|
| German | 66'170 | 64.9 | 72.5 | 0.53 |
| French | 27'892 | 27.3 | 74.0 | 0.55 |
| English | 7'927 | 7.8 | 73.7 | 0.37 |

#### 3.1.5 Type of email

Finally, the effect of email type is presented in Table 9. For nearly all types of emails, over 80% of the sent emails were indeed opened. The most notable exception to this were the reminder emails, which were opened at a rate of barely over 50%. On the other hand, the most opened email type were those related to the payment of the compensation, followed by emails that were sent toward the end of the data collection (study_end, final_report, final_survey). This could be possibly due to the fact that the participants who made it to this stage were actually interested in the study and thus more used to opening the emails.

Table 9: Share of opened emails and median time to open by type

| Type | Sent | Sent (%) | Opened (%) | Median time to open (days) |
|---|---|---|---|---|
| payment | 13'350 | 13.1 | 86.8 | 0.43 |
| final_survey | 5'342 | 5.2 | 84.6 | 1.01 |
| study_end | 3'654 | 3.6 | 84.4 | 0.85 |
| final_report | 3'656 | 3.6 | 83.9 | 1.11 |
| welcome_email | 5'398 | 5.3 | 82.5 | 0.55 |
| bank_info | 355 | 0.3 | 80.3 | 2.90 |
| halfway_email | 3'699 | 3.6 | 80.3 | 0.28 |
| weekly_report | 30'710 | 30.1 | 80.1 | 0.34 |
| other | 6'727 | 6.6 | 75.4 | 0.59 |
| reminder | 27727 | 27.2 | 51.2 | 0.62 |
| dropout_related | 1371 | 1.3 | 45.4 | 0.22 |

## 3.2 Help-desk

The help-desk was set up to answer participants' questions and troubleshoot any issues related to the tracking app. It consisted of three main groups:

- Student assistants (Hiwi) : 8 students hired to man the help-desk
- MOBIS : 8 members of the MOBIS project team
- MotionTag : a representative from the app developers to assist with troubleshooting

To assess its efficiency, the following performance metrics are considered:

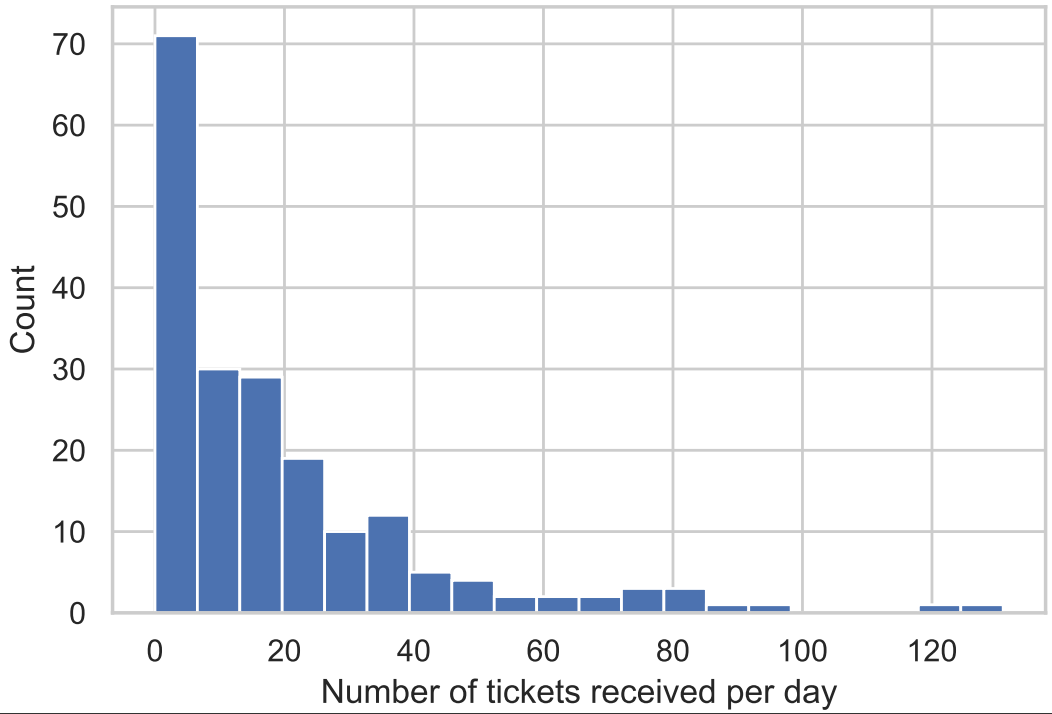
- number of tickets closed
- number of interactions between the participants and the agents
- time elapsed between the creation and closing of a ticket

The following sections will analyze how well the help-desk performed according to these metrics.

### 3.2.1 Tickets received

Fig. 4 plots the distribution of the number of tickets received per day, corresponding roughly to an average of 584 tickets per month, 136 tickets per week or 19.5 tickets per

Figure 4: Distribution of the number of tickets received per day




day, with a maximum single day value of 131. Assuming that a ticket takes an average of 5 minutes to close (which would be an underestimation, as tickets require agents to look up different information on the participants, several interactions, etc.), this means that, on average, 1 hour and 37 minutes would need to be allocated daily to resolving tickets. In the peak case, just under 11 hours would be needed for this task. These estimates demonstrate clearly the need of having an able help-desk team to tackle this workload.

### 3.2.2 Tickets closed

To aid the student assistants in resolving the tickets, a series of ready-made responses were written by the MOBIS project team and saved on the help-desk platform. The goal was to speed up the closing of similar tickets and relieve the burden on the project team.

Table 10 shows the number of tickets closed by each agent group. The "No Agent" group refers to tickets that were closed directly, without being assigned to a specific agent or

having been responded to. From this chart, it can be clearly seen that the MOBIS team carried the bulk of the load, responding to over 60% of the tickets, twice as much as the student assistants hired specifically for the help-desk. Of the 2'421 tickets closed by the MOBIS project team, 87% were resolved by only two members. Three student assistants resolved over 80% of the 1'085 tickets closed by their respective group.

Table 10: Number of tickets closed by agent group

| Agent group | Tickets closed | Tickets closed (%) |
|---|---|---|
| MOBIS | 2'421 | 63.5 |
| Hiwi | 1'085 | 28.4 |
| No Agent | 264 | 6.9 |
| MotionTag | 45 | 1.2 |

This one-side trend in ticket closing is further exposed in Fig. 5. It can be clearly seen that the MOBIS project team resolved the majority of the tickets for every month except the first, and the student assitant contribution decreased as the study progressed. Of course, this might be due to the pressure of the on-going semester, but such things need to be considered when allocating resources to such a project.

### 3.2.3 Interactions with the participants

The number of interactions, that is the number of times a participant writes to the help-desk and the number of times an agent responds to a ticket, are recorded for each ticket in the dataset. Fig. 6 shows the distribution of the number of interactions per ticket. The median value is 2 interactions, meaning the agent only needed to respond once to resolve the ticket and did not receive any further reply. This of course excludes cases where the participants respond by creating a completely new ticket. The maximum number of interactions for a single ticket was 20.

Figure 5: Share of tickets closed per agent group by month

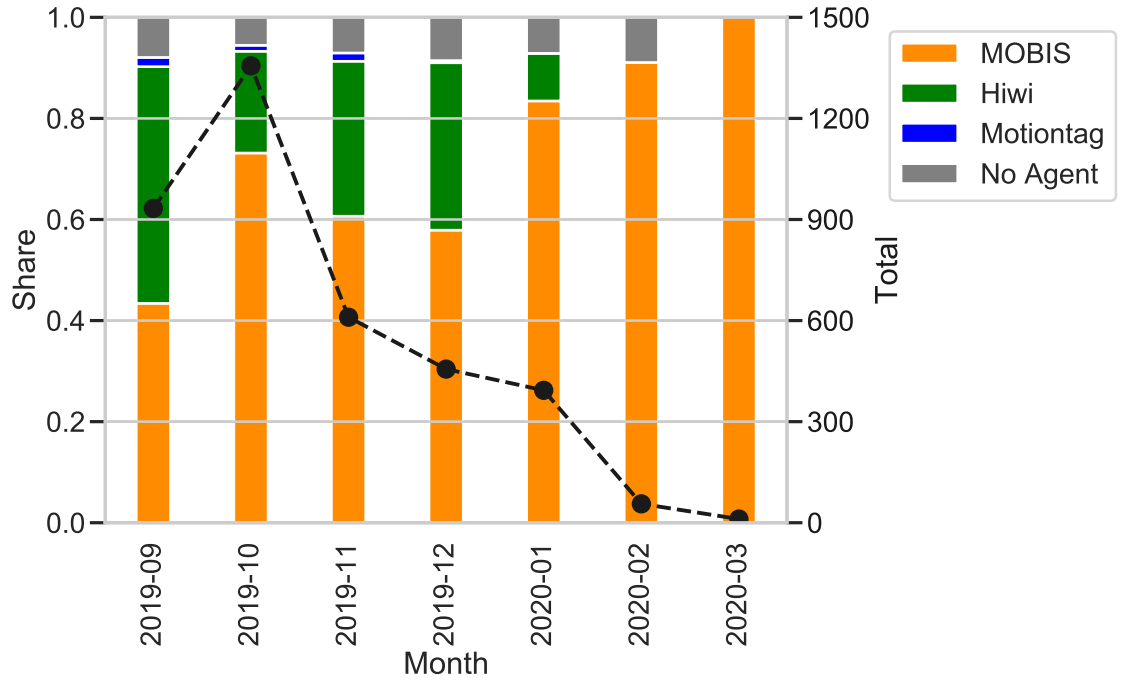



Figure 6: Distribution of the number of interactions per ticket

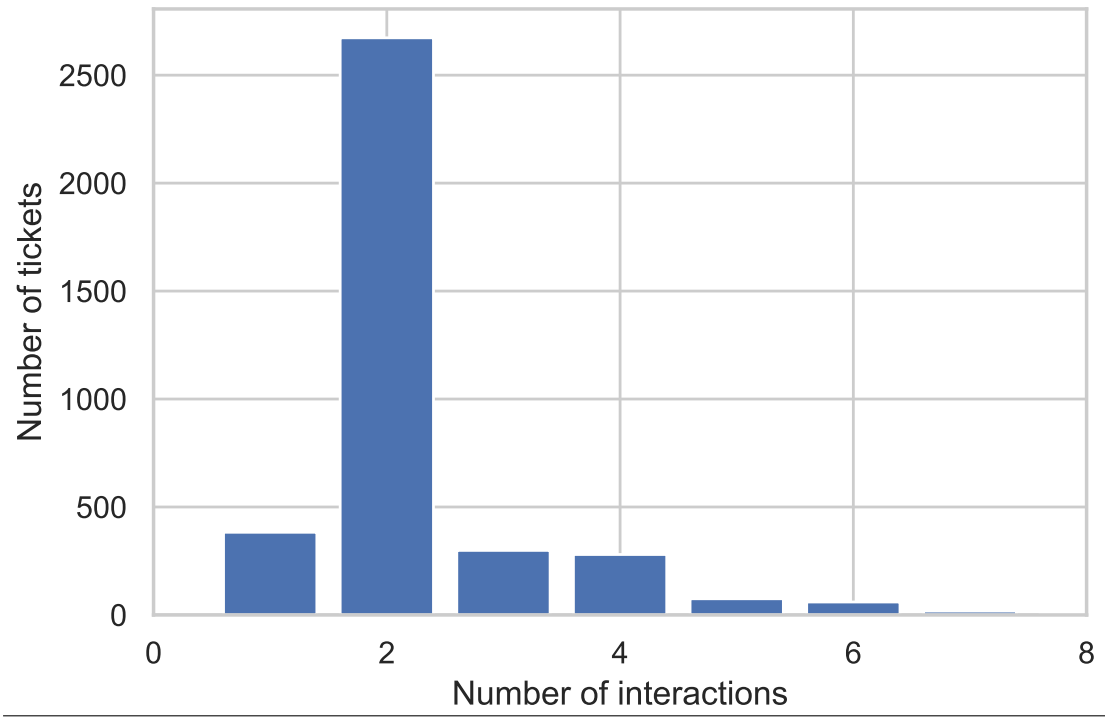
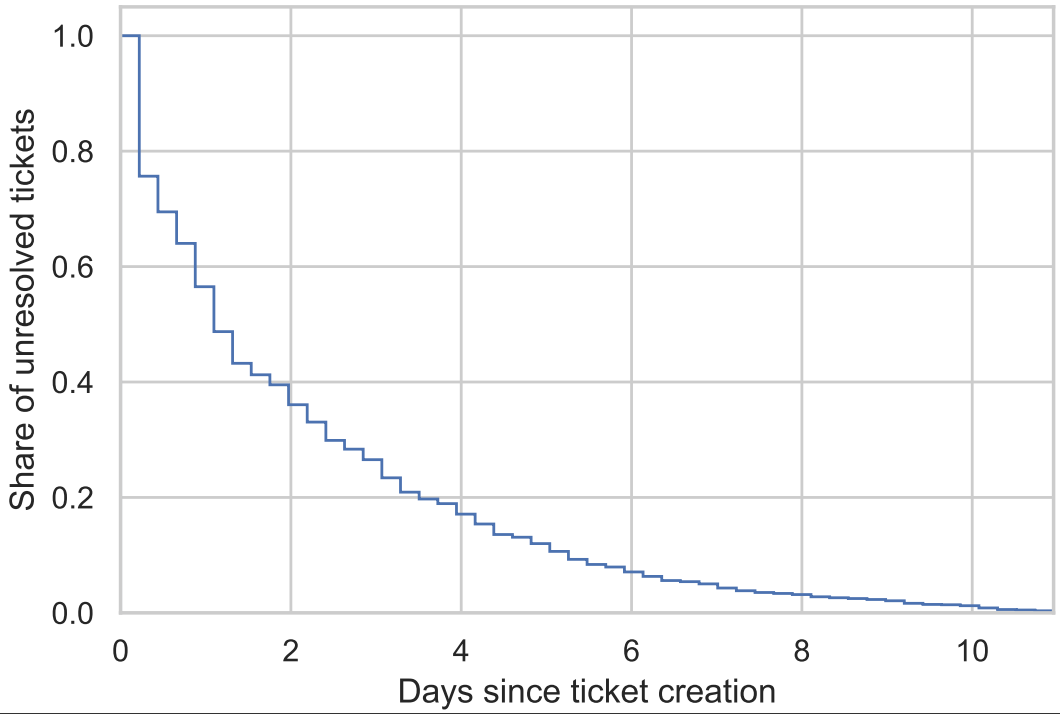


Figure 7: Share of unresolved tickets since ticket was created




### 3.2.4 Time required to close a ticket

The longer it takes to resolve a ticket, the longer the issue the participant is experiencing is likely to persist, thus compromising the quality of the study results. Depending on the nature of the issue, a delayed response can lead to the participant losing interest and dropping out from the study. Therefore, it is important that tickets be resolved as quickly as possible.

Fig. 7 shows the share of unresolved tickets as a function of the elapsed time since the ticket was created. Since most tickets only required 2 interactions, resolving a ticket can essentially be considered the same as simply answering it. Only about 60% of tickets were resolved within 2 days, whereas it took up to 7 days to resolve 90% of the tickets.

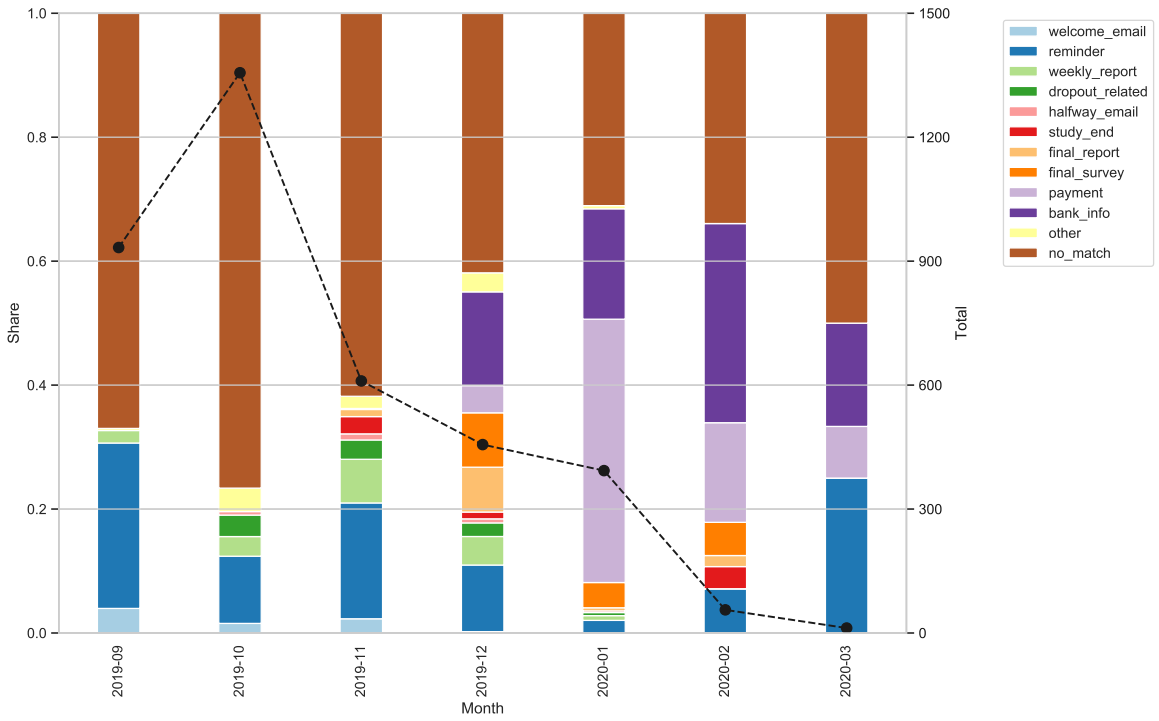
# 4 Common reported issues

The following sections attempts to classify the received tickets and shed some light on the most commonly reported issues during the MOBIS study.

## 4.1 Direct email replies

Some tickets are direct replies to the emails sent by the MOBIS study team. Since the subject of each email sent to the participant is known, each direct reply can be matched to an sent email type by searching for the known subject string in either the ticket content or subject. 1'437 tickets can be matched in this way (38%), leaving 2'379 tickets unmatched. Fig. 8 shows the number of tickets received per study month, grouped by matched type.

Figure 8: Share of tickets received per month, per type




It can be seen that earlier in the study, a larger share of direct replies were targeted to reminder emails, whereas later in the study, most direct replies were to emails concerning the payment of the compensation and the participants' banking information. The share of unmatched tickets was larger in the earlier months, possibly due to tickets created by

participants after being invited who ultimately did not take part in the study.

Table 11 shows the rate at which each email sent was directly replied to, sorted by decreasing reply rate. Interestingly, participants massively replied directly to emails asking them to clarify their bank information, which was necessary for the payment of compensation.

Table 11: Reply rate by sent email type

| type | Emails sent | Direct replies | Reply rate (%) |
|---|---|---|---|
| bank_info | 358 | 159 | 44.4 |
| dropout_related | 1'408 | 78 | 5.5 |
| reminder | 28'057 | 574 | 2.0 |
| payment | 13'474 | 197 | 1.5 |
| welcome_email | 5'459 | 73 | 1.3 |
| other | 6'826 | 82 | 1.2 |
| final_report | 3'693 | 43 | 1.2 |
| final_survey | 5'383 | 60 | 1.1 |
| study_end | 3'690 | 25 | 0.7 |
| halfway_email | 3'733 | 17 | 0.5 |
| weekly_report | 30'990 | 129 | 0.4 |

## 4.2 Emails received per stage

Every time a new participant registered for the MOBIS study, their contact information (name, email address and participant ID) was uploaded to the helpdesk, allowing us to directly associate each future received email to a participant. In the case an email was received from an address not on file, an attempt was made to determine which participant sent the email and update the helpdesk list accordingly. This was possible in the majority of cases.

It is therefore possible to match each ticket to a participant. Since, for each participant, the time at which they registered, activated the tracking app, recorded their first GPS track, reached the halfway point, completed the study and filled out the final survey was recorded, it is possible to assign each ticket received to a study stage. All unmatched tickets are then assumed to have been sent by people who ultimately did not participate in the study and are therefore assigned to the invitation stage. Table 12 shows the number

of tickets received per study stage.

Table 12: Tickets received per study stage

| Stage | Tickets received | (%) |
|---|---|---|
| invited | 1359 | 35.61 |
| registered | 322 | 8.44 |
| activated | 196 | 5.14 |
| tracking_phase1 | 690 | 18.08 |
| tracking_phase2 | 381 | 9.98 |
| final_survey | 294 | 7.70 |
| payment | 548 | 14.36 |
| dropped_out | 26 | 0.68 |

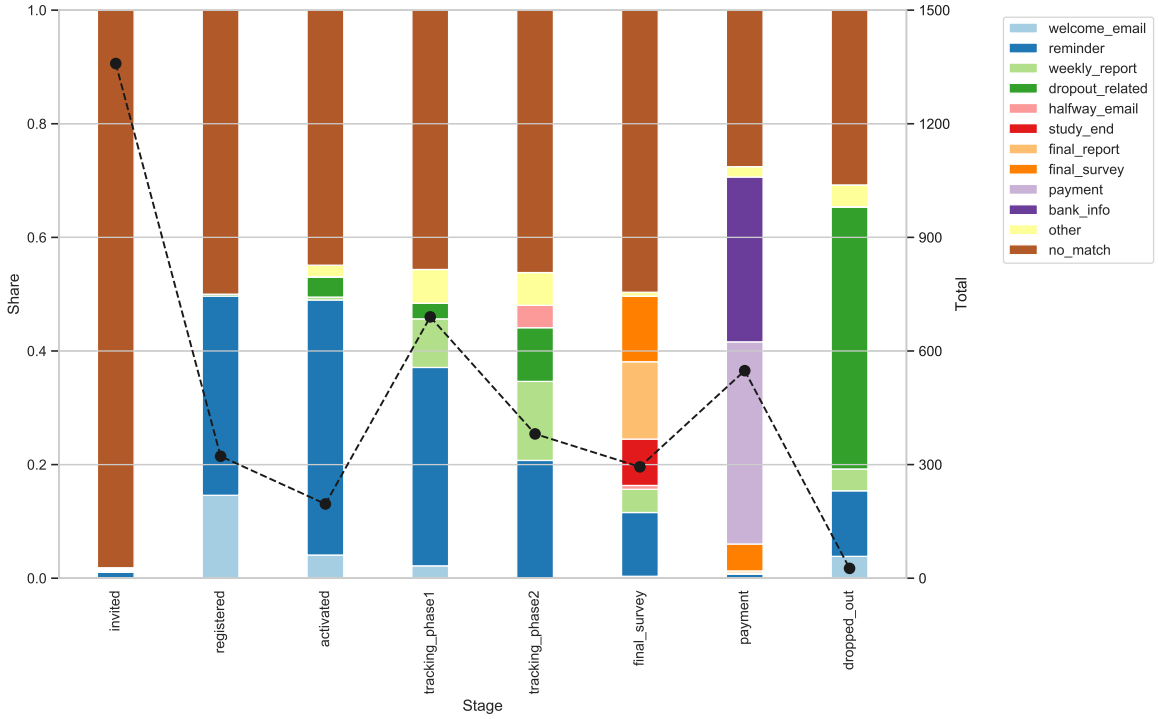
The stages can be described as follows :

- invited : the period before the participant registered for the study
- registered : from when the participant registered until they downloaded and activated the tracking app
- activated : from when the participant activated the tracking app until they recorded their first GPS track
- tracking_phase1 : the first 4 tracking weeks after the first GPS track
- tracking_phase2 : the final 4 tracking weeks (the study lasted a total of 8 weeks)
- final_survey : from when the participant finished the 8 tracking weeks until they completed the final survey
- payment : the period after the participant completed the final survey
- dropped_out : any ticket received after the participant dropped out

Table 12 shows that 35% of tickets were received during the invitation stage. Upon direct examination of the content of the tickets, these were often people expressing their desire not to participate in the study. The entire onboarding period as a whole ("invited", "registered" and "activated") resulted in almost 50% of all received tickets, a possible indication of issues with the onboarding process. Next, the tracking period ("tracking_phase1" and "tracking_phase1") yielded 28% of all received tickets, with phase 1 having resulted in nearly twice as many tickets as phase 2. This could be an indication of issues with the tracking in the app as well as the validation of the GPS tracks at the beginning of the tracking period which subsequently were resolved as the study progressed. Finally, the "final_survey" and "payment" stages resulted in 7.7% and 14.4% of received tickets respectively.

Matching the tickets received in each stage to the sent email types can give further insights on the contents of the tickets. Fig. 9 shows the share of tickets received per stage and per type after having further matched the tickets in each stage to the sent emails.

Figure 9: Share of tickets received per stage, per type




As expected, 98% of all tickets received during the invitation stage were not matched to a sent email and 97% were not matched to a participant, further supporting that these tickets were sent by people who ultimately chose not to participate in the study. The few tickets that were matched to emails in this stage are likely due the helpdesk list not having been updated in those cases.

For every other stage, more than 50% of the received tickets were matched as the reply to a corresponding sent email. During the "registered", "activated" and "tracking_phase_1" stages, the largest share of matched tickets were to reminder emails.

For both tracking stages, a substantial share of the match emails are related to the weekly reports, with this share increasing in phase 2.

As expected, during the "final_survey" stage, most matched tickets were replies to emails related to the end of the study and the final survey, whereas during the "payment" stage,

the majority of matched tickets were related to payment and banking information.

## 4.3 Notable cases

The following section provides an anecdotal overview of some of the notable cases having arisen during the MOBIS study.

**Problems with onboarding process** Several problems occurred during the onboarding process. In order to register in the Catch-My-Day app, participants were provided with a 5-character participant ID they needed to provide as a login code, in addition to an email address and password. Many participants reported this login code to be invalid. In most cases, this was due to a misunderstanding on the participant's part (confusing code and password) and the project team was able to manually register the participant. However, there were a few cases were participants had been assigned a previously assigned participant ID, rendering the ID invalid. Once the participants registered in the app, they were sent an activation code to the email address they had provided. In some cases, the participants had misspelled their email addresses, meaning they had never received the activation email. A script needed to be written to check for such misspellings by comparing to the email address on file and activate the app. Finally, once the app was activated, the participants could log into the app. Some participants confused logging in with registering, others confused their password with the login code, and other simply could not remember which email address and password they had provided and were not able to request a new password through the app interface.

**Participants living abroad** Although the study selection criteria clearly stated that only people living in the French- and German-speaking areas of Switzerland were allowed to participate, there were still a few participants who were tracking from abroad, without intending to return to Switzerland during the study period. After noticing this, participants who started tracking abroad were asked if they intended on returning to Switzerland during the 2-month study period and those who did not were kindly requested to unsubscribe from the study.

**Participants not tracking** One big issue that occurred during the study was participants not recording any GPS tracks for several days. If no tracks were detected for 3 consecutive days, an automatic emails was sent out to the participant, informing them to inspect both their app and phone settings. It was crucial that this issue be solved as soon as possible, as issues with the tracking directly results in a loss of data. However, the presence of several different mobile operating system within the study sample complicated the troubleshooting procedure. An entire web page (MOBIS, 2019a) specifically targeted on correctly using the app was therefore created and regularly updated as new app-related issues were discovered and solved.

**OS updates** During the study, updates to the iOS and Android mobile operating system caused changes in how location permissions were handled, causing the app to no longer have access to the participants location. This information as well as the appropriate solutions for each operating system needed to be quickly shared with the participants to ensure that the tracking could continue to function as expected.

**Participants tracking only 30 days** At the beginning of the study, the participants were intentionally unaware that the study was composed of two distinct tracking phases. At first, to be eligible for compensation, the participants were only required to track at least half the time for a two-month period to ensure that enough data would be collected in both phase 1 and 2. Some participants took this requirement literally, tracking for the entirety of phase 1 and then stopping completely in phase 2. This behaviour had not been expected and therefore, the requirements for compensation had to be modified during the course of the study. Participants were henceforth required to track at least 15 days per study month. Participants who failed to track sufficient in phase 1 were automatically unsubscribed from the study, whereas participants who did not track sufficiently in phase 2 were only offered half the promised compensation.

**Issues with bank account details** A form was provided at the end of the final survey in which the participants could enter their bank account details. The following fields were required: IBAN, name of account holder, address of account holder, city and postal code. Since paying all 3'523 participants manually would have been very time consuming, the bank account information was then compiled and sent to the ETH finance department, who could process the payment requests in bulk. However, miscommunication with the finance department with regards to the exact format of the banking details (no foreign

IBAN, names and address must be less than a certain number of characters) as well as a lack of checks in the online form (IBAN and postcode validation) resulted in multiple issues with the collected banking data. A banking information validation script needed to be written for the provided banking data and the project team was then required to request corrections from the participants, further prolonging the time required to carry out the payments.

**Prepaid card as IBAN** One particular issue with the banking information that was encountered was participants providing a prepaid card (ex. Revolut) as their IBAN. This took some time to solve, as this IBAN is valid and was originally not detected by the validation scripts.

**Payment not received** Some participants contacted the project team regarding having not received their payments after the study and requesting confirmation from the ETH finance department. In all cases, the participant simply failed to see the payment on their online bank transcripts, but still required the project team contacting the finance department to request confirmation that the payment had indeed been sent.

# 5 Conclusion

This paper has provided an overview of both the emails sent to the participants and the questions and feedback received from the participants over the course of the MOBIS study. The objective is to inform future studies of best practices as well as issues that need to be considered.

A study of this nature with so many participants requires constant communication with them to ensure that the process goes as smoothly as possible. For future studies, we therefore recommend, as was done in this study, to set up database to gather the data on the participants, an automatic emailing system which can send out emails based on that data and an online helpdesk where the participants can ask questions.

The amount of time needed by the student assistants to answer the phone was underestimated, resulting in them being less available to respond to tickets received on the helpdesk and leaving this task to the MOBIS project team. Therefore, we recommend

adequately staffing both the phone and online helpdesks and training that staff to relieve the pressure on the project team.

A high number of helpdesk tickets were created during the onboarding process. The choice of using the MotionTag app was made only a couple weeks prior to the official project start, which made running another complete pretest with the app impossible. This in turn made the project team unaware of a certain number of technical issues that could have been planned for and thus avoided. Therefore, we recommend running a proper pretest with the app to be used before the official study, even if this means delaying the official start of the study. This will allow for more time to prepare for potential technical questions and set up resources and instructions to help the participants and well as give feedback to the app developers so they can fix the app before the study.

Finally, we recommend that one clarifies the requirements for processing payment requests in full before requesting banking information from the participants so that these requirements can be coded directly into the survey used to collect them. This would reduce the amount of time needed later to correct the information.

# 6 References

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