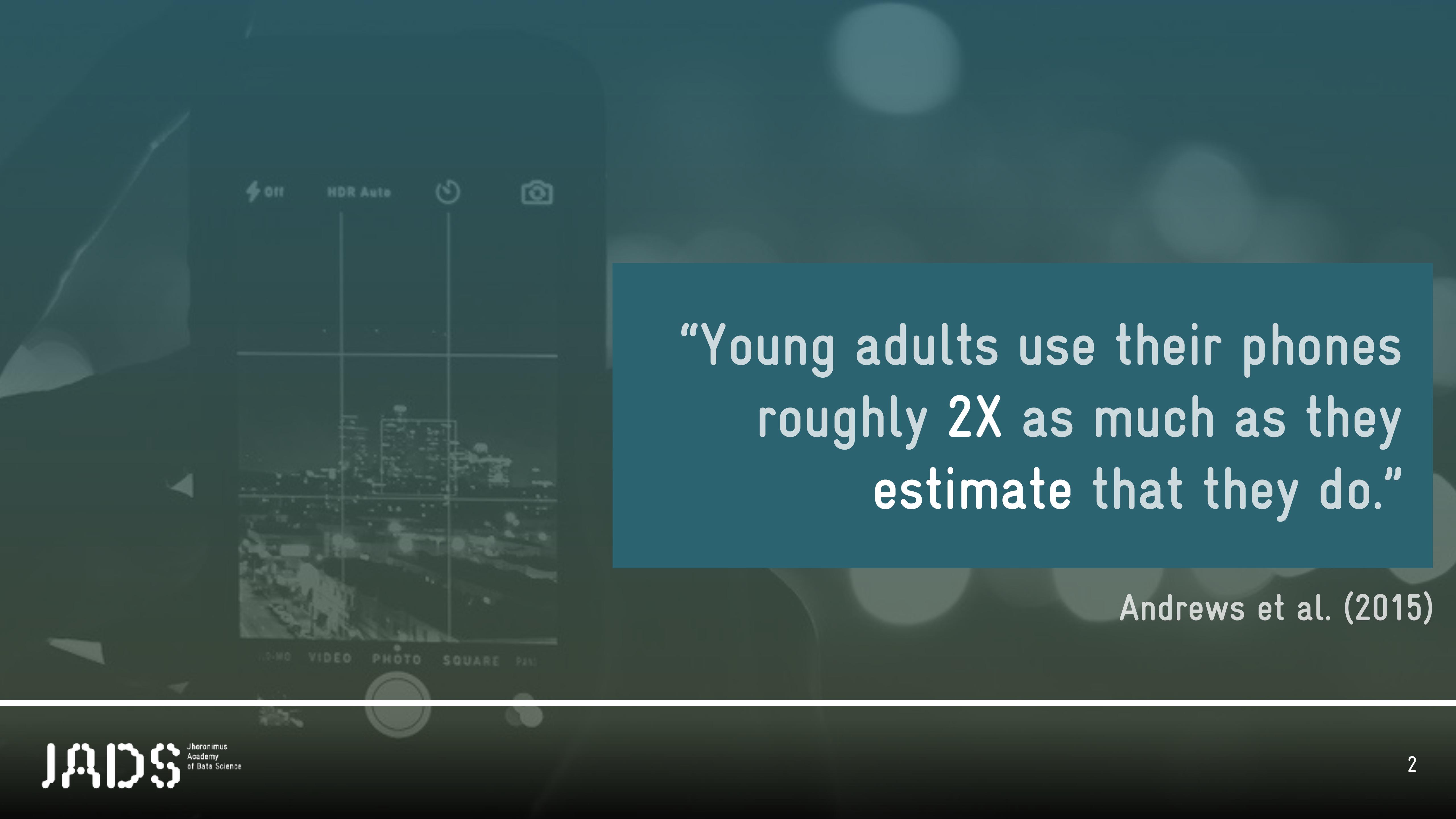


Business Case.

The Application of Smartphones
in Social Sciences Studies

December 21th - 2017
R.J. Klaasse Bos

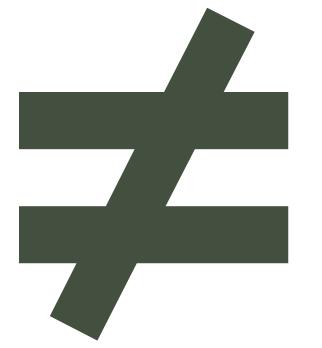


“Young adults use their phones roughly 2X as much as they estimate that they do.”

Andrews et al. (2015)

Problem

Self-report
data



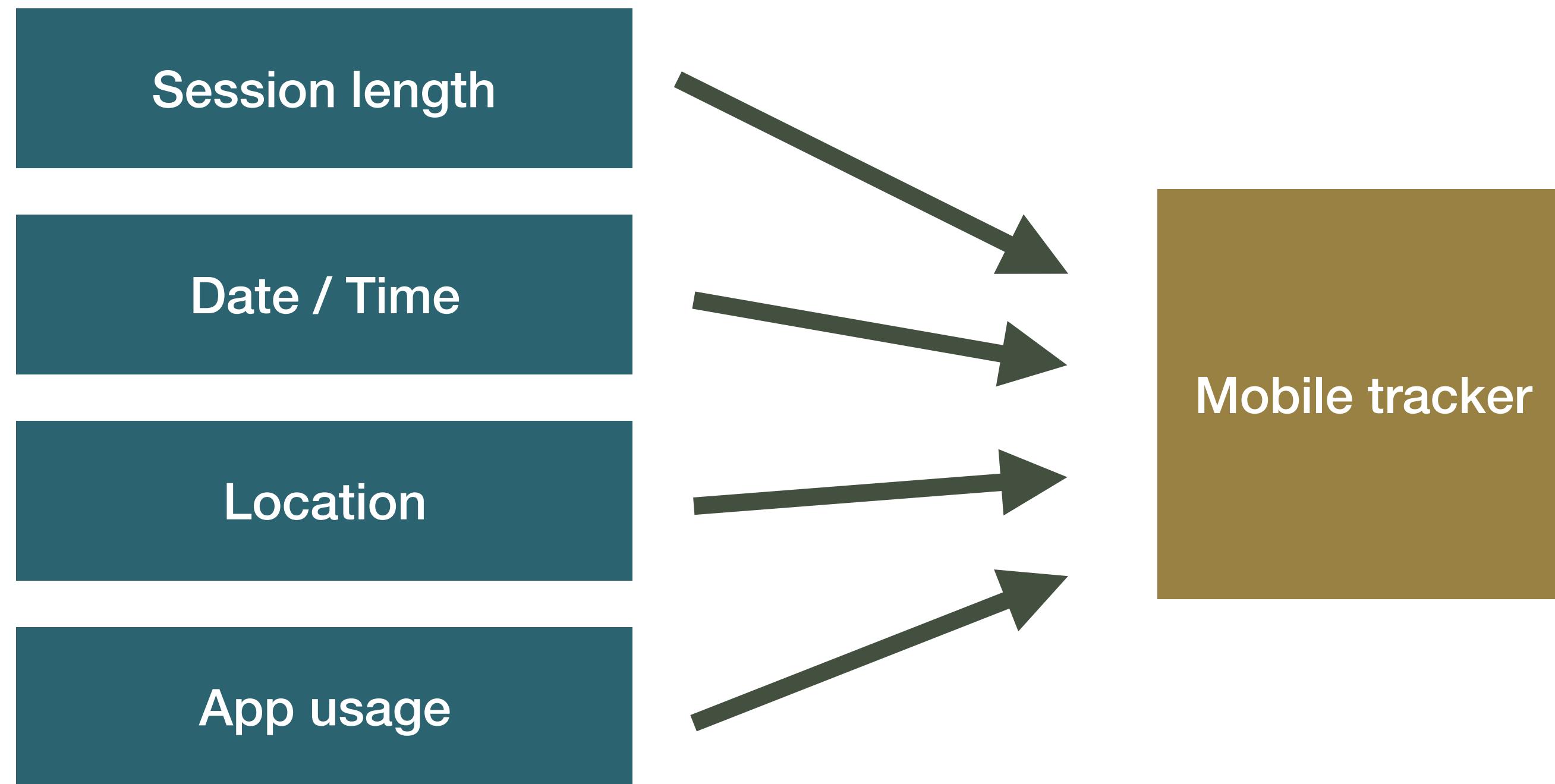
Server log
data

Problem

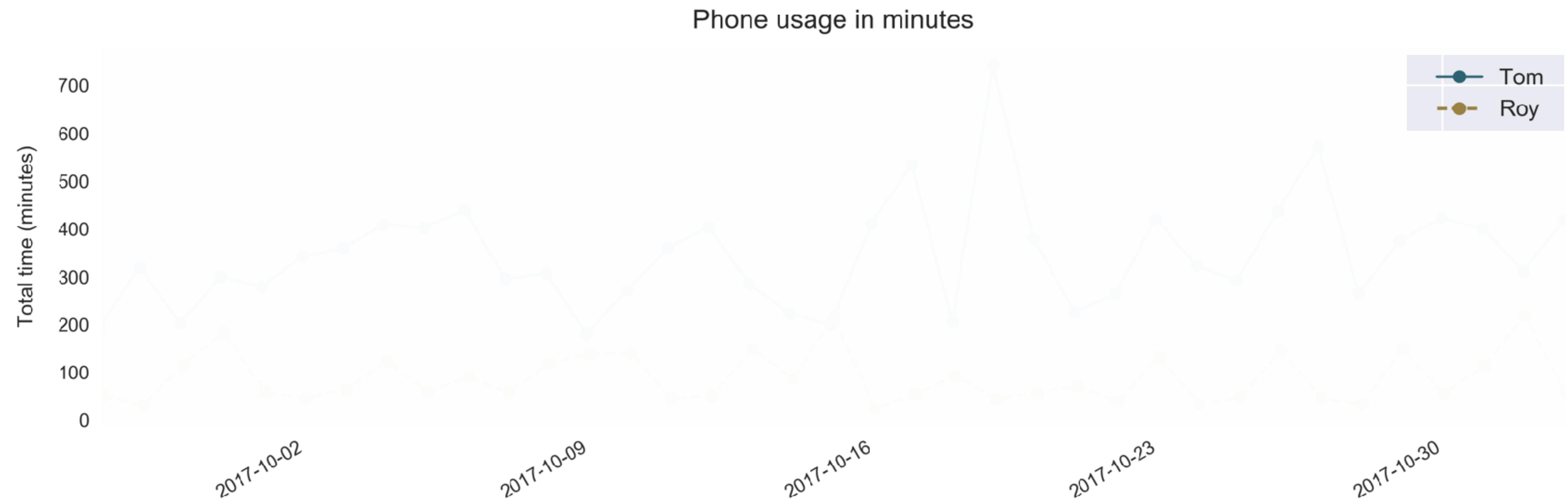
“There is good reason to be **suspicious towards** research that claims to have found significant correlations between **self-report data** and **other variables**.”

Andrews et al. (2015); Boase and Ling (2013)

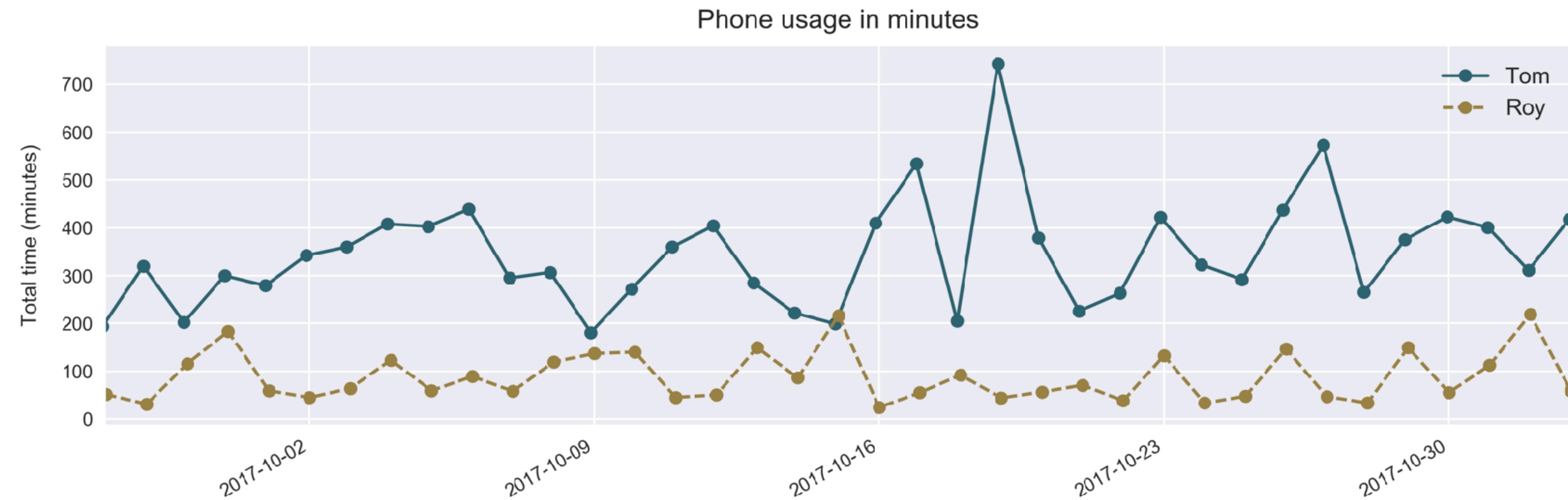
Suggested Solution



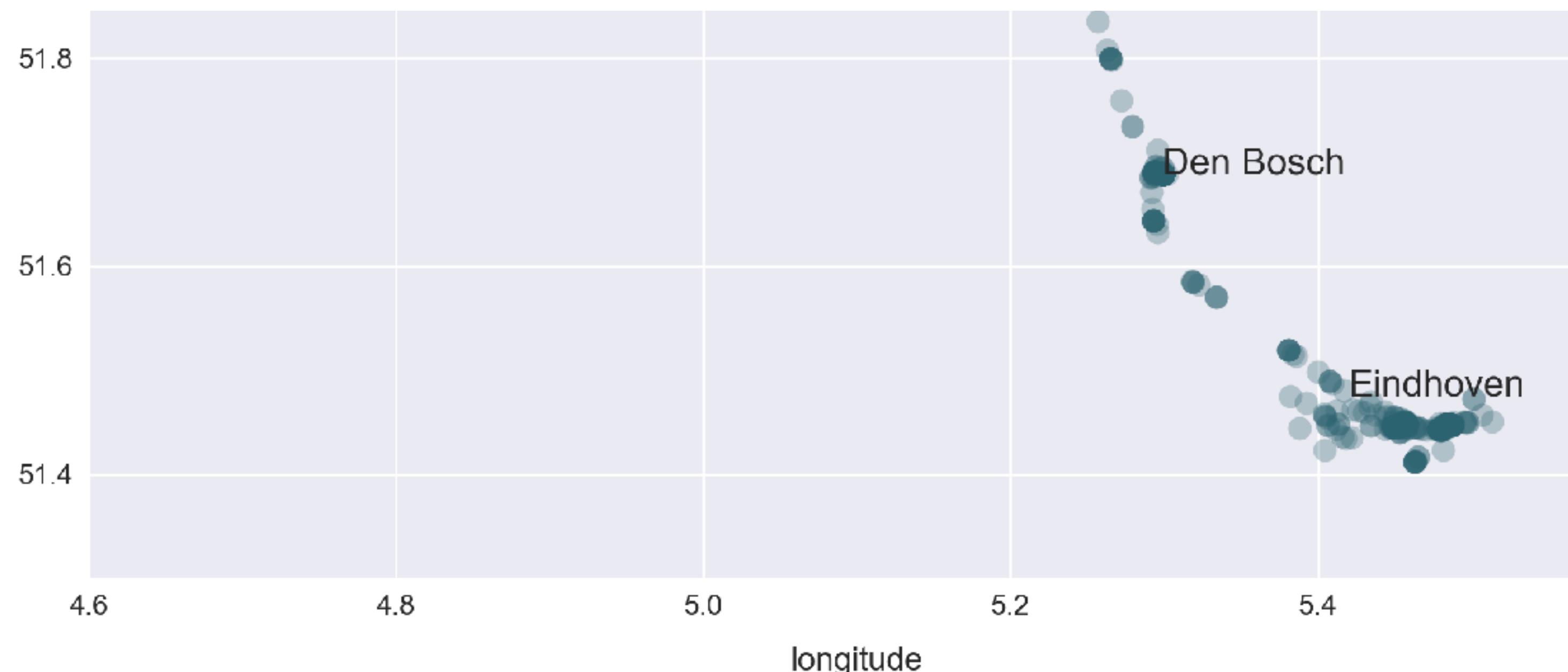
Example: Phone Usage



Example: Phone Usage

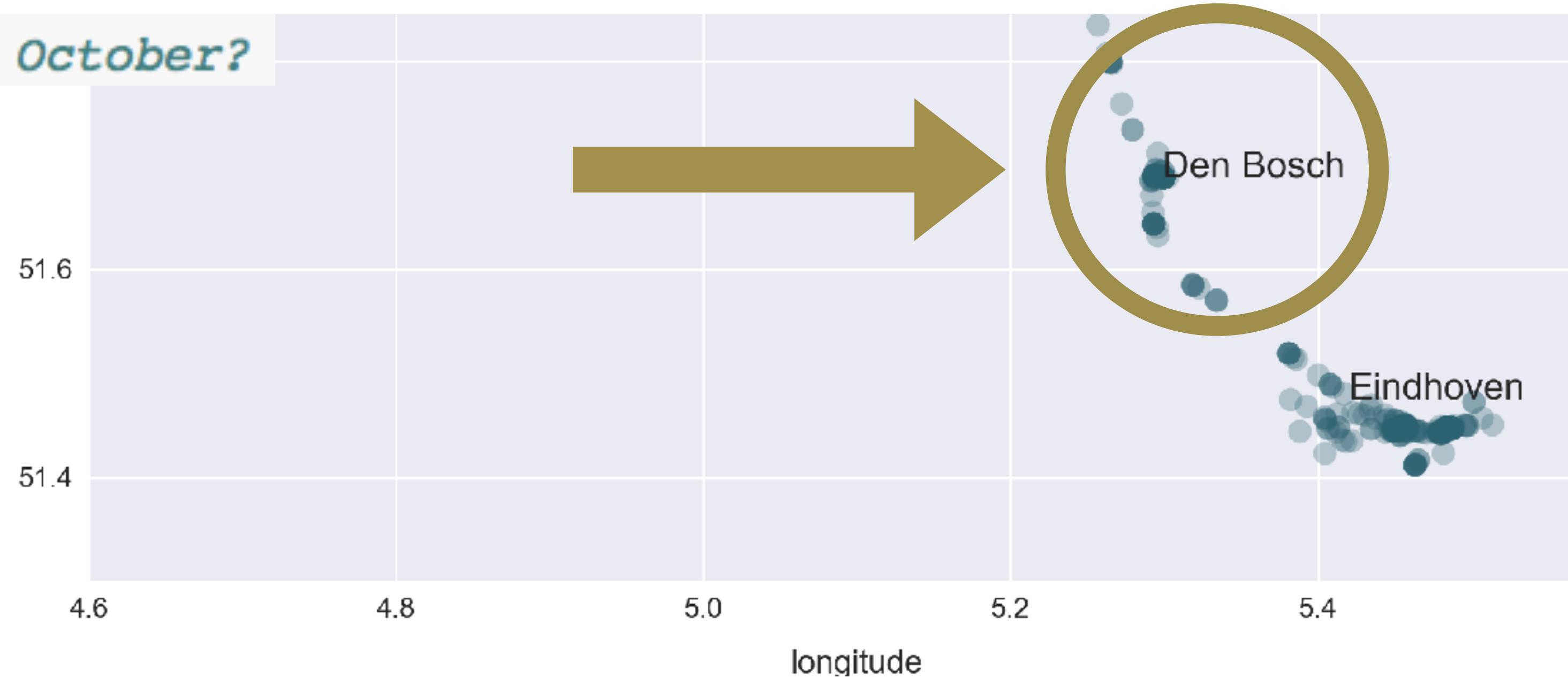


Example: Location



Example: Location

1 # How often did I go to JADS in October?



Example: Location

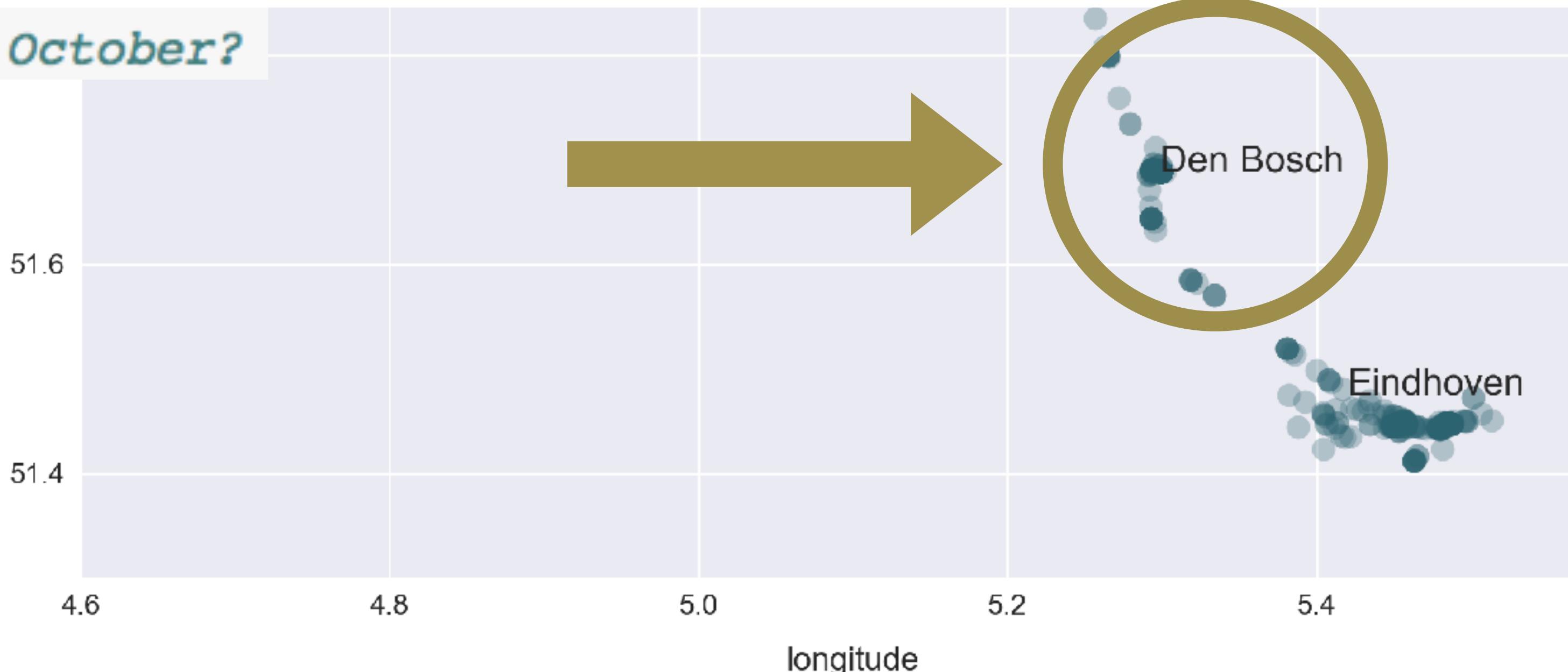
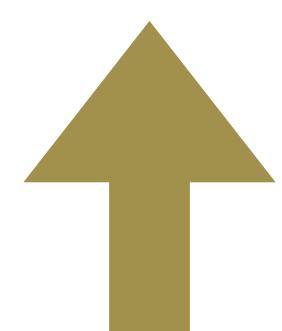
```
1 # How often did I go to JADS in October?
```

```
TIME BY: date
```

```
2017-10-05 01:34:31
2017-10-10 03:40:06
2017-10-11 02:00:27
2017-10-13 01:30:12
2017-10-19 00:52:02
2017-10-20 04:22:01
```

```
Name: time, dtype: timedelta64[ns]
```

```
TOTAL TIME: 0 days 13:59:19
```



Smartphone as data-collection instrument

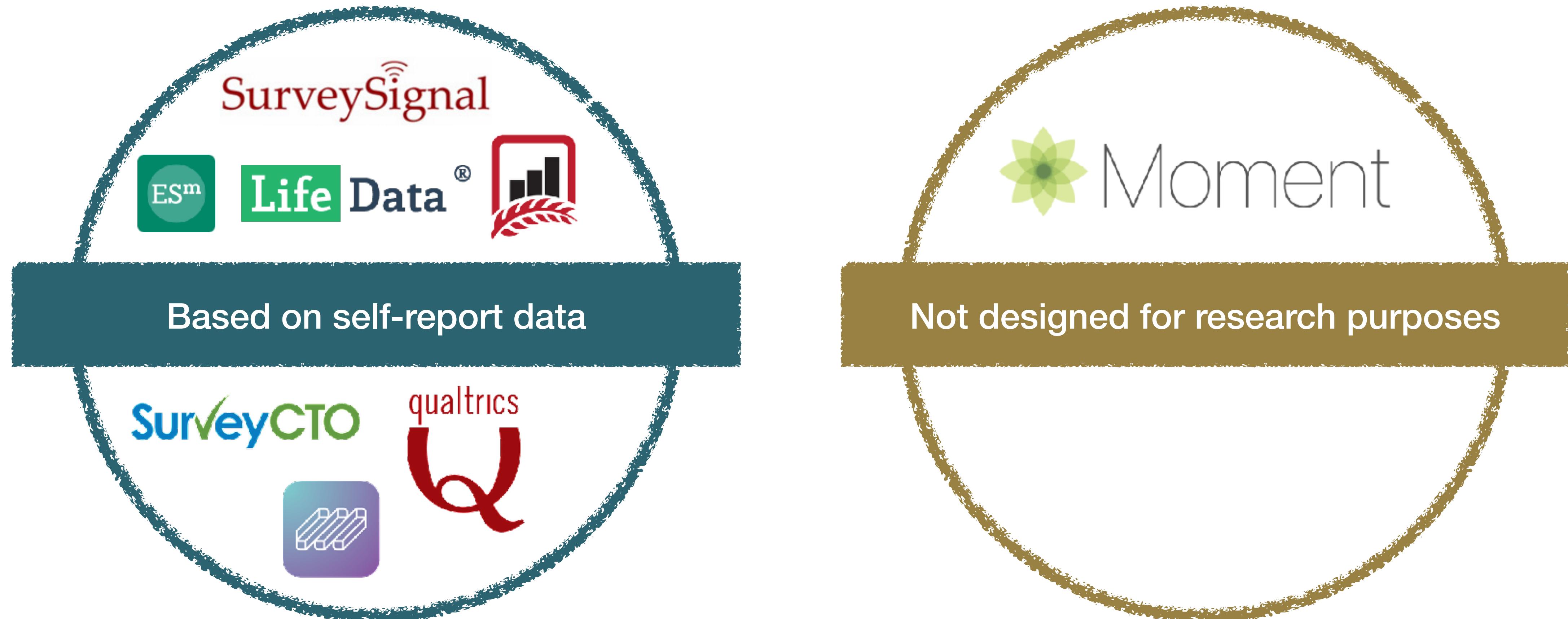
1. High adoption rate

2. Willingness to participate

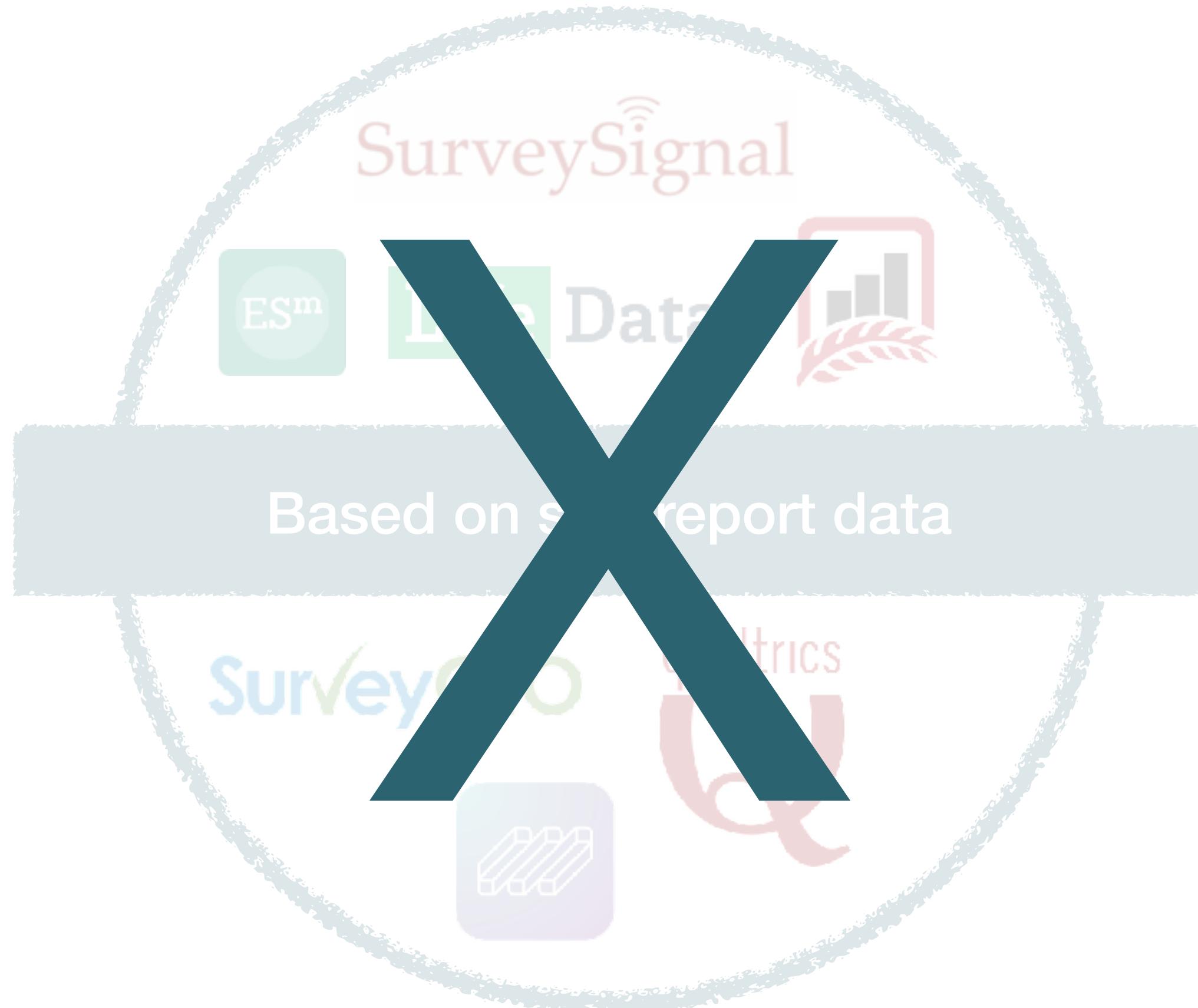
3. Cost-efficiency

Raento et al. (2009); Sonck & Fernee (2013)

Current Suboptimal Solutions



Current Suboptimal Solutions



Our Solution



iOS & Android app

Customer segments

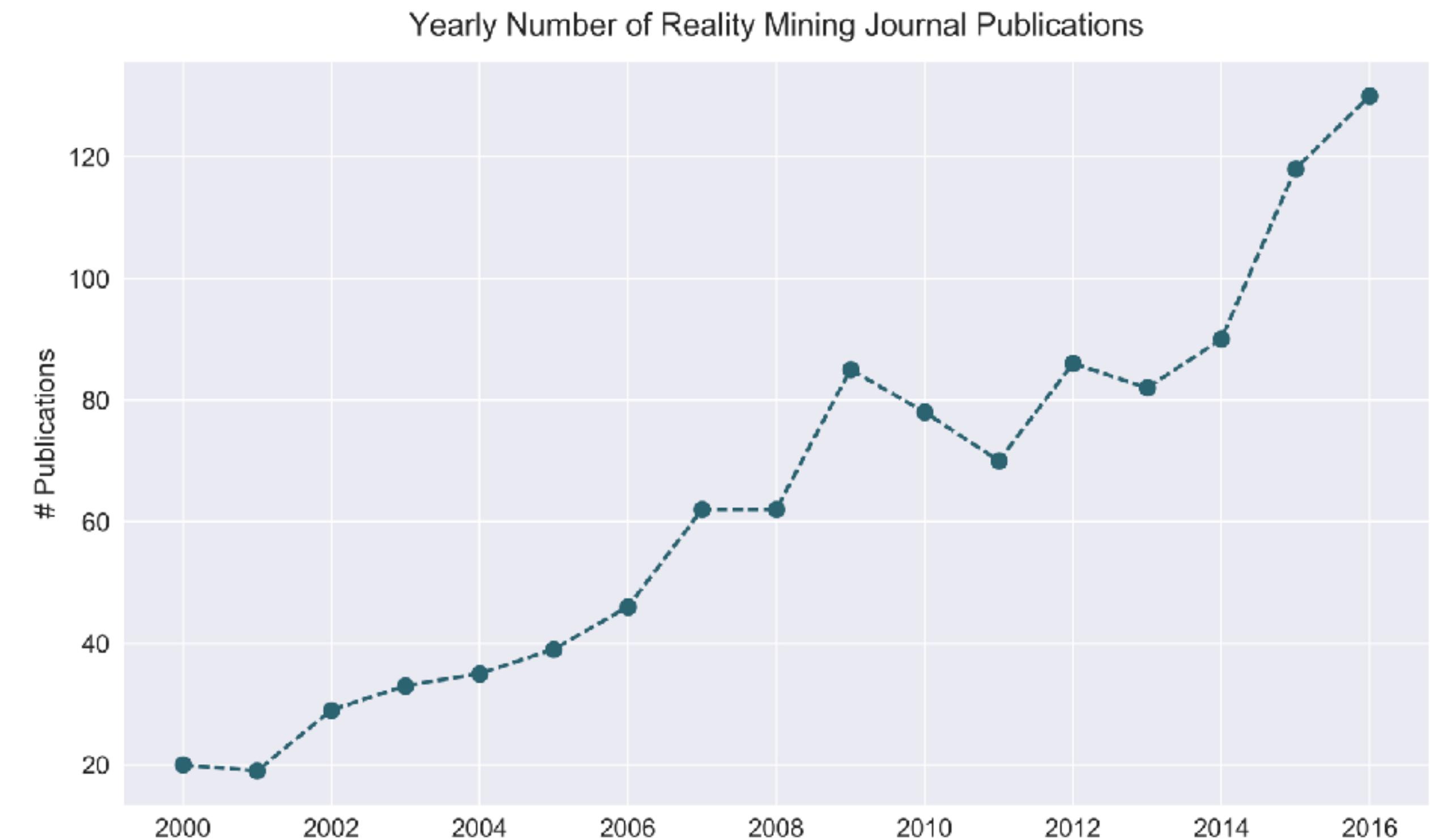
1. Sociologists

2. Economists

3. Psychologists

Financial Feasibility

- Increasing number of reality mining published journals
- SaaS subscription model
- Profitable from year 2 onwards



MEASURING = KNOWING

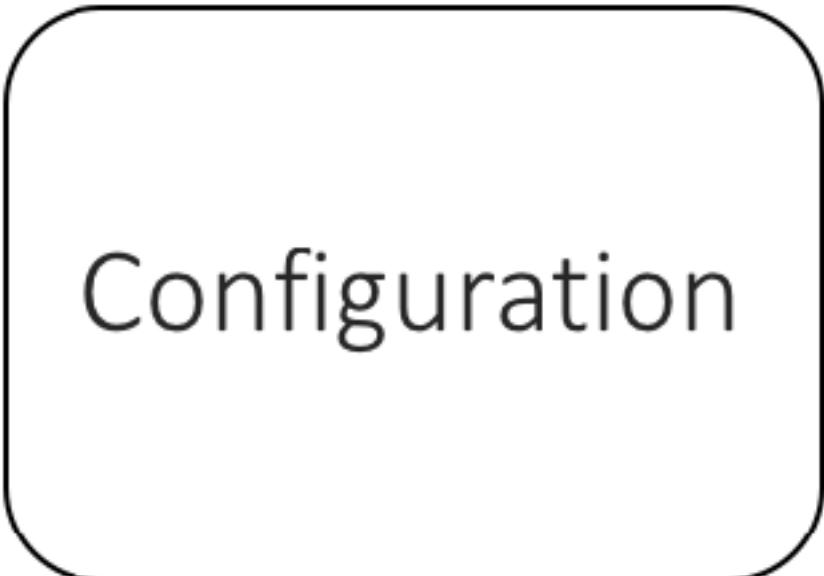
MEASURING = KNOWING

BUT... GARBAGE IN,
GARBAGE OUT

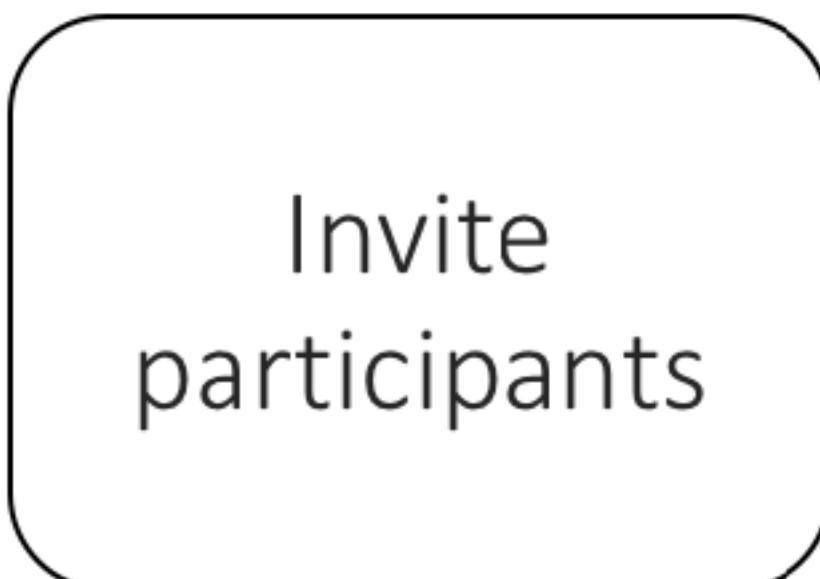
Back-up slides

In case of tricky questions...

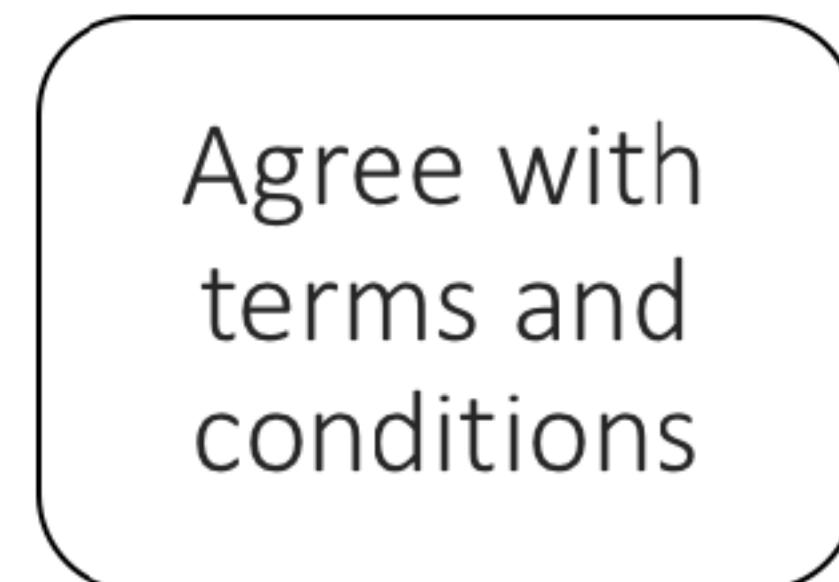




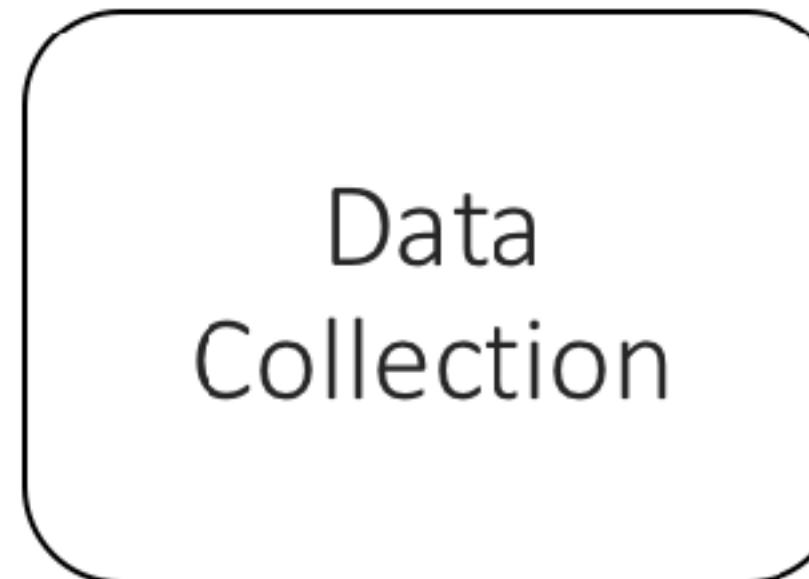
- Researcher decides which attributes have to be collected and how frequently



- Participants receive SMS message with activation code and download link



- Participants are informed about the data being collected, research purpose and other practicalities (e.g. compensation, duration)



- After activation the app starts tracking data as configured in the first step by the researcher

| Attribute | In scope | Out of scope |
|--|----------|--------------|
| Number of calls | | x |
| Length of calls | x | |
| Recording of calls | | x |
| Recording of background noise | | x |
| Number of SMS messages sent | | x |
| Number of SMS messages received | | x |
| Time on phone | x | |
| Number of phone pickups | x | |
| Location | x | |
| User interaction (e.g. pop-up to fill out a survey) | | x |
| Intelligent context dependent triggers (incl. reminders) | | x |
| Other devices in physical proximity | | x |
| Search history on internet | | x |
| Calendar events | | x |
| Object detection with the phone's camera | | x |
| Battery level | x | |
| Network coverage | | x |
| Alarm status | | x |
| Usage of apps | x | |

Estimated Costs for Product Development

| Description | Type of Cost | Cost (estimate) | Source |
|--|--------------|--|---------------------------|
| App development and testing (iOS) | Fixed | € 51,700 | (Crew, n.d.) [3] |
| App development and testing (Android) | Fixed | € 51,700 | (Crew, n.d.) [3] |
| Web app development (for configuration by researchers) | Fixed | € 10,000 | (Hagen, L. n.d.) [6] |
| 2-3 minute instruction film | Fixed | € 8,500 | (Fix, J., 2010) [5] |
| Loan phones (incl. prepaid cards) | Fixed | € 200/phone + € 10/month (cellular data) | (Raento et al., 2009) [9] |
| Server bandwidth and cloud storage | Variable | € 84.70/month | (Rackspace, n.d.) [8] |

Revenue Model

- **5 papers / year** based on mobile phone empirical research (Boase & Ling, 2013)

Example case Sonck & Fernee (2013):

- **150 participants per**
- Study lasted for **1 year**

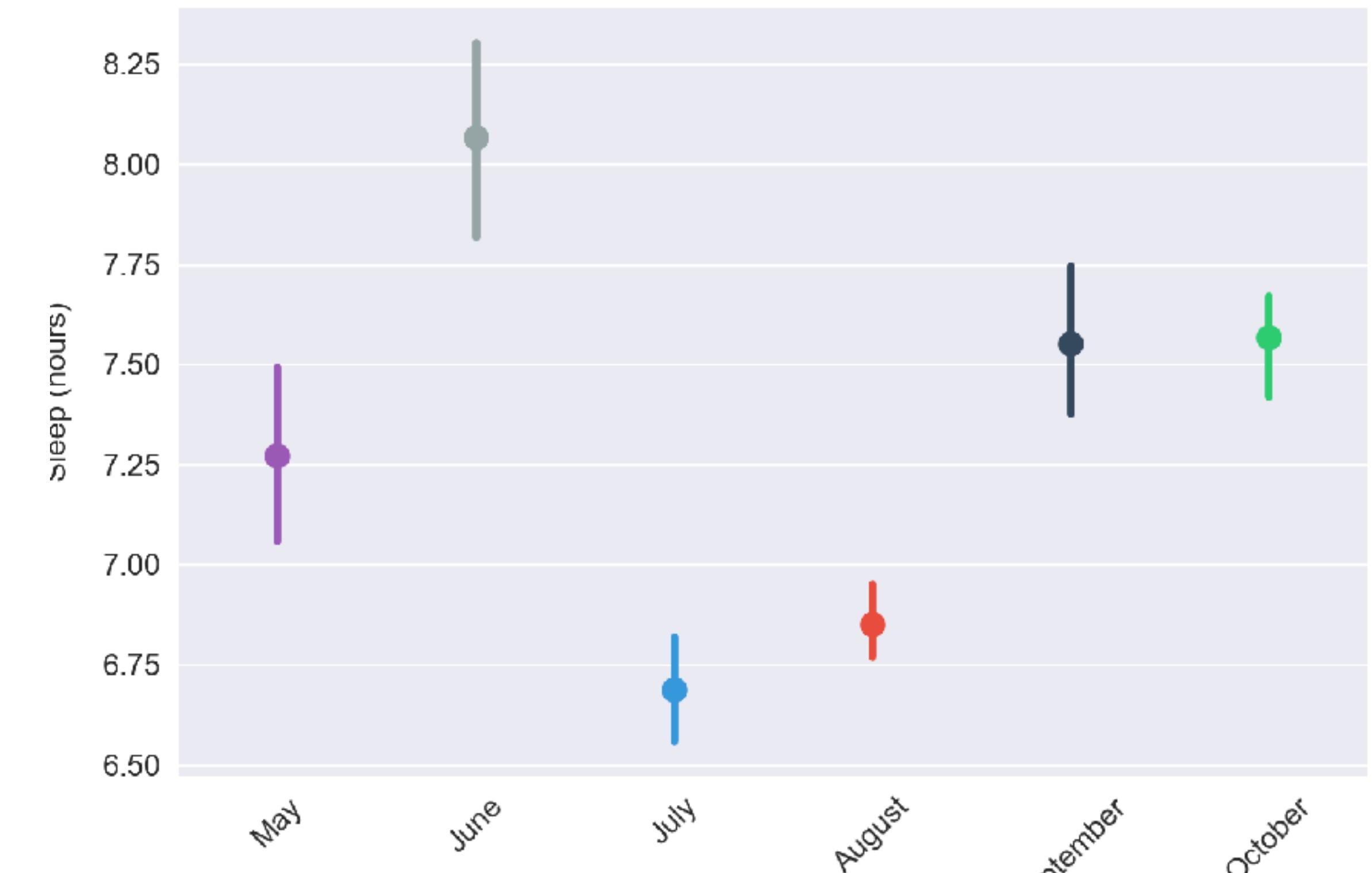
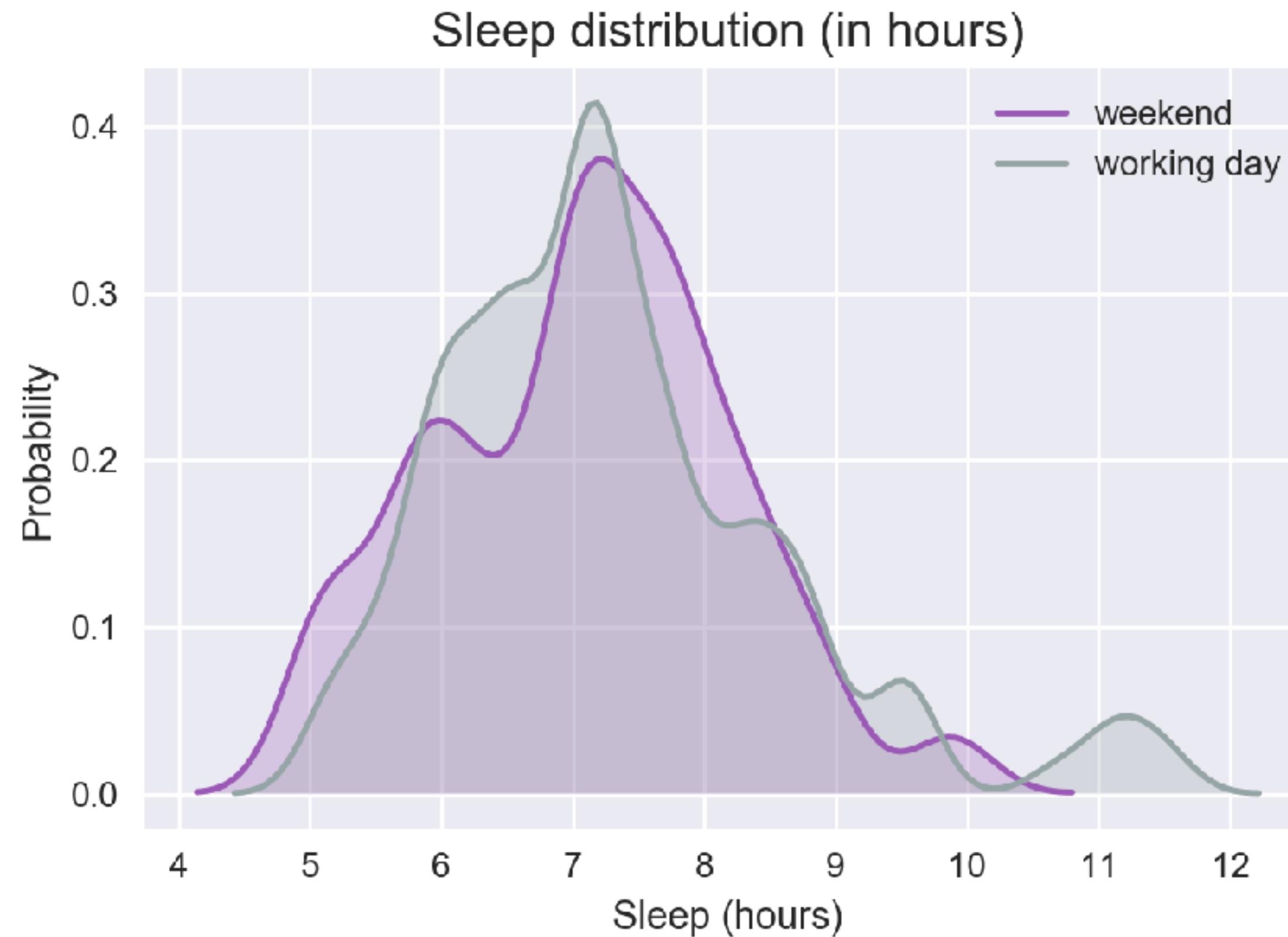
Pricing example SurveySignal: €0.42 / day

Total revenue for a single 1-year study: $150 * 365 * 0.42 = €22,995$

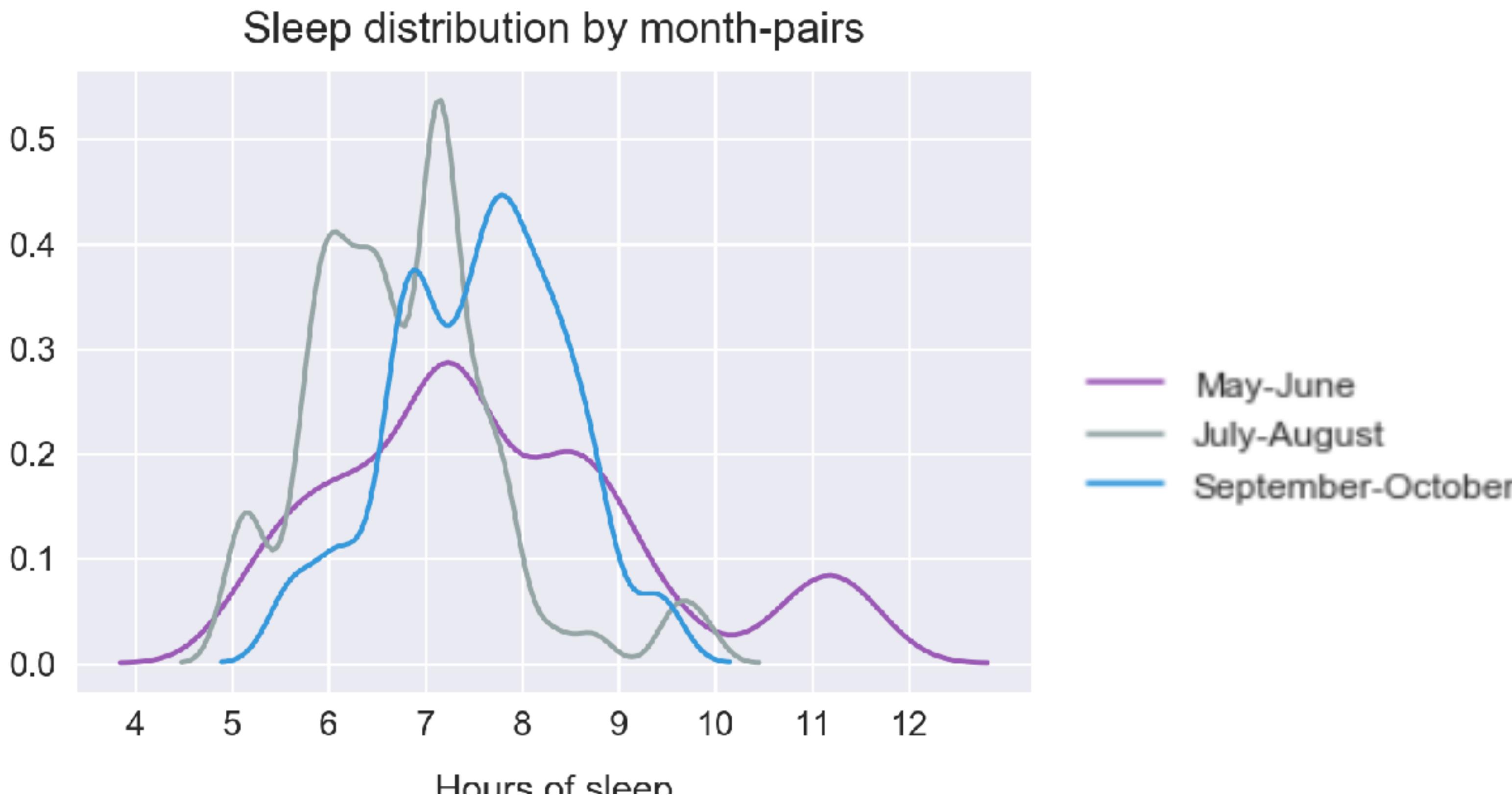
Features Collected

| Feature | Definition |
|-----------------------|--|
| longitude | Horizontal coordinate according to the geographic coordinate system the moment the phone is picked up. |
| latitude | Vertical coordinate according to the geographic coordinate system the moment the phone is picked up. |
| location_accuracy | An indication of the accuracy of the longitude and latitude coordinates the moment the phone is picked up. |
| date | The current date on the day of the phone session displayed in the following format: DD/MM/YYYY |
| time | The current time at the moment of the phone pick-up displayed in the following format: hh/mm/ss |
| length_in_seconds | The duration of the phone session (i.e. the time between unlocking and locking). |
| starting_batterylevel | The battery level of the phone at the moment of phone pick-up expressed as a decimal number between 0 and 1. |
| ending_batterylevel | The battery level of the phone at the end of the session expressed as a decimal number between 0 and 1. |

1. How many hours of sleep do I get on a typical night?



1. How many hours of sleep do I get on a typical night?



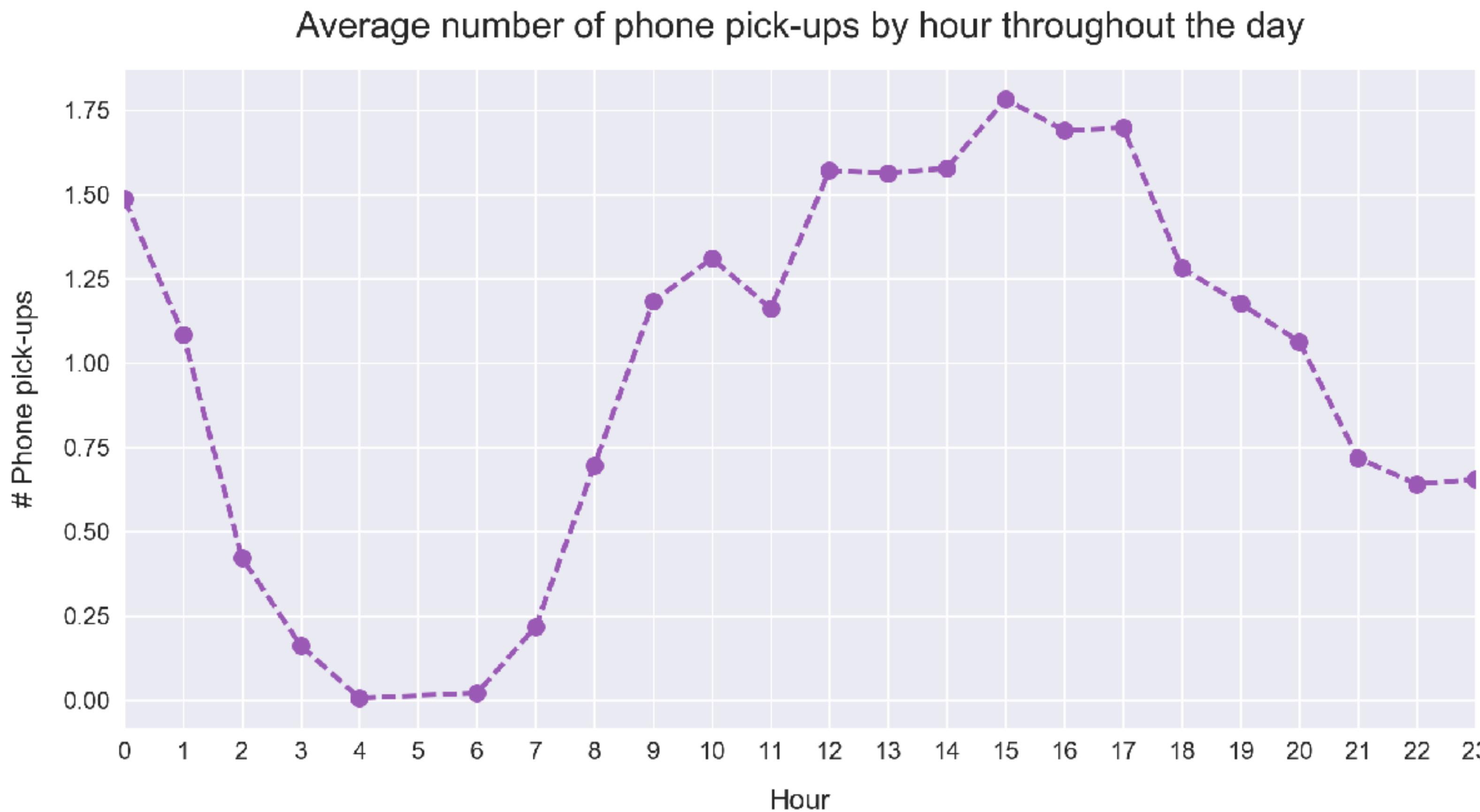
2. Is there a relationship between wake up time and total hours of sleep?



3. When am I most active on my phone?

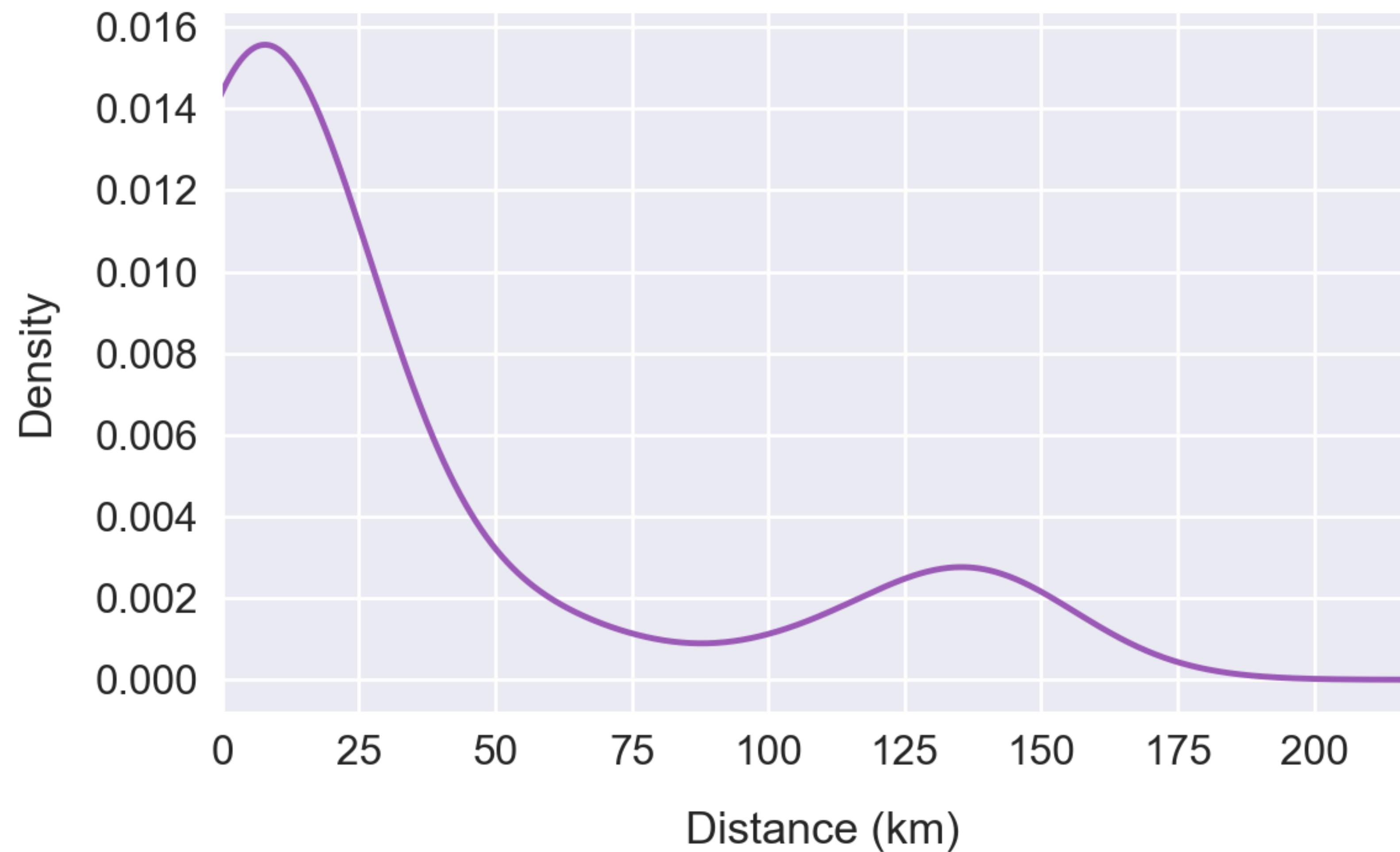


3. When am I most active on my phone?

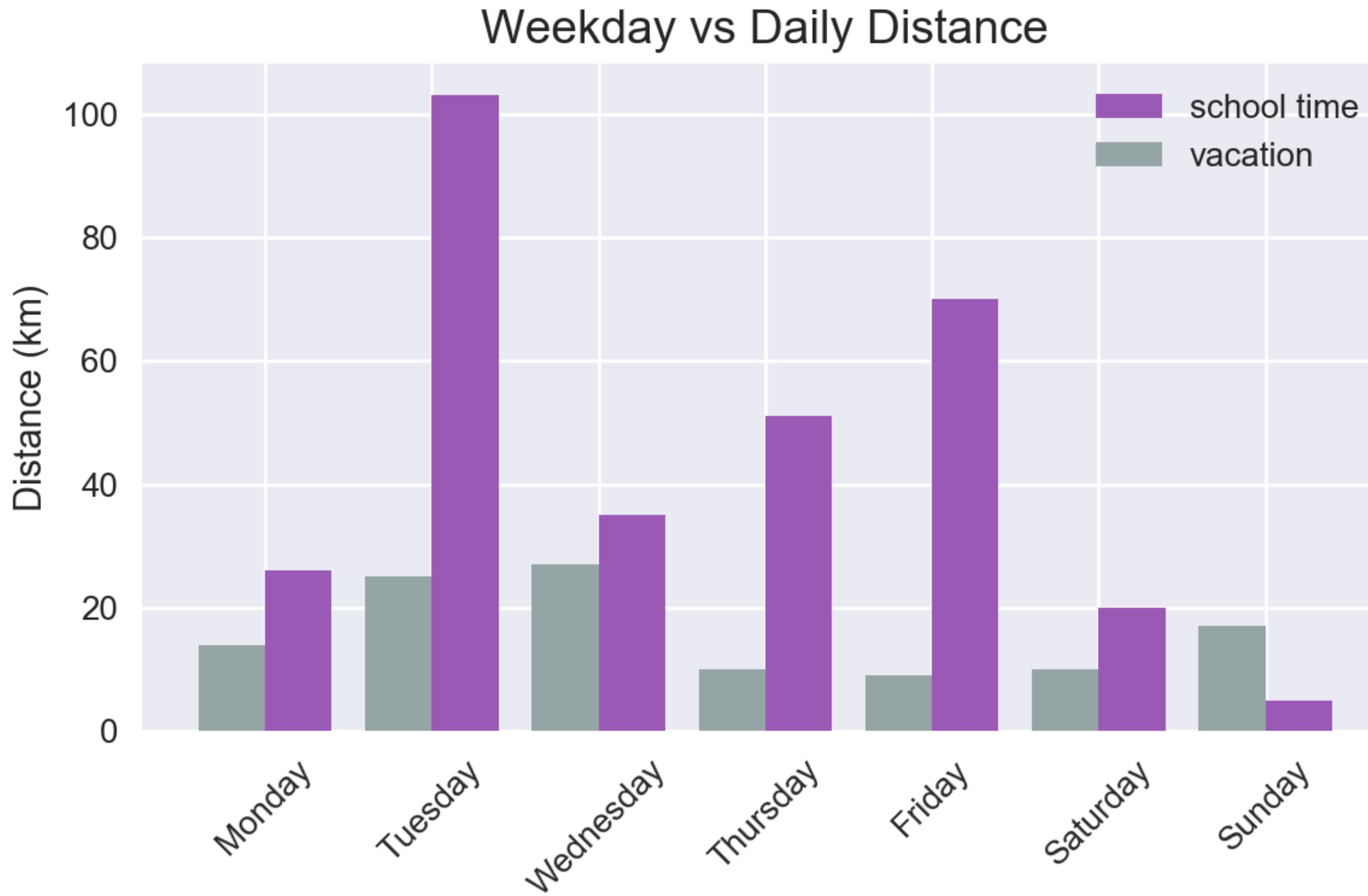


4. How much do I move on a given day?

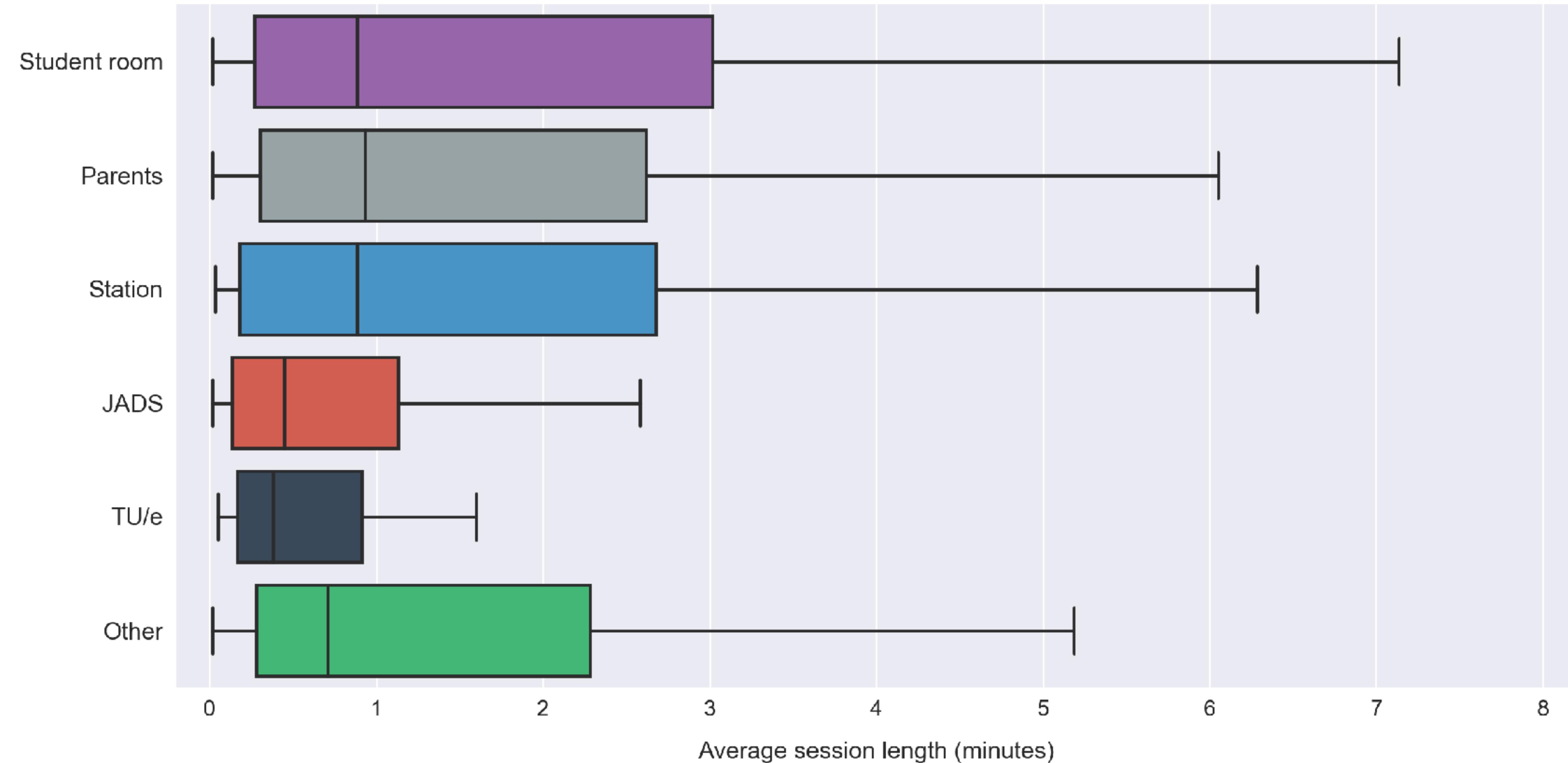
Distance travelled by day (distribution)



4. How much do I move on a given day?



5. Where do I spend most time on my phone?



6. How often and for how long did I go to JADS?

TIME BY: date

2017-10-05 01:34:31

2017-10-10 03:40:06

2017-10-11 02:00:27

2017-10-13 01:30:12

2017-10-19 00:52:02

2017-10-20 04:22:01

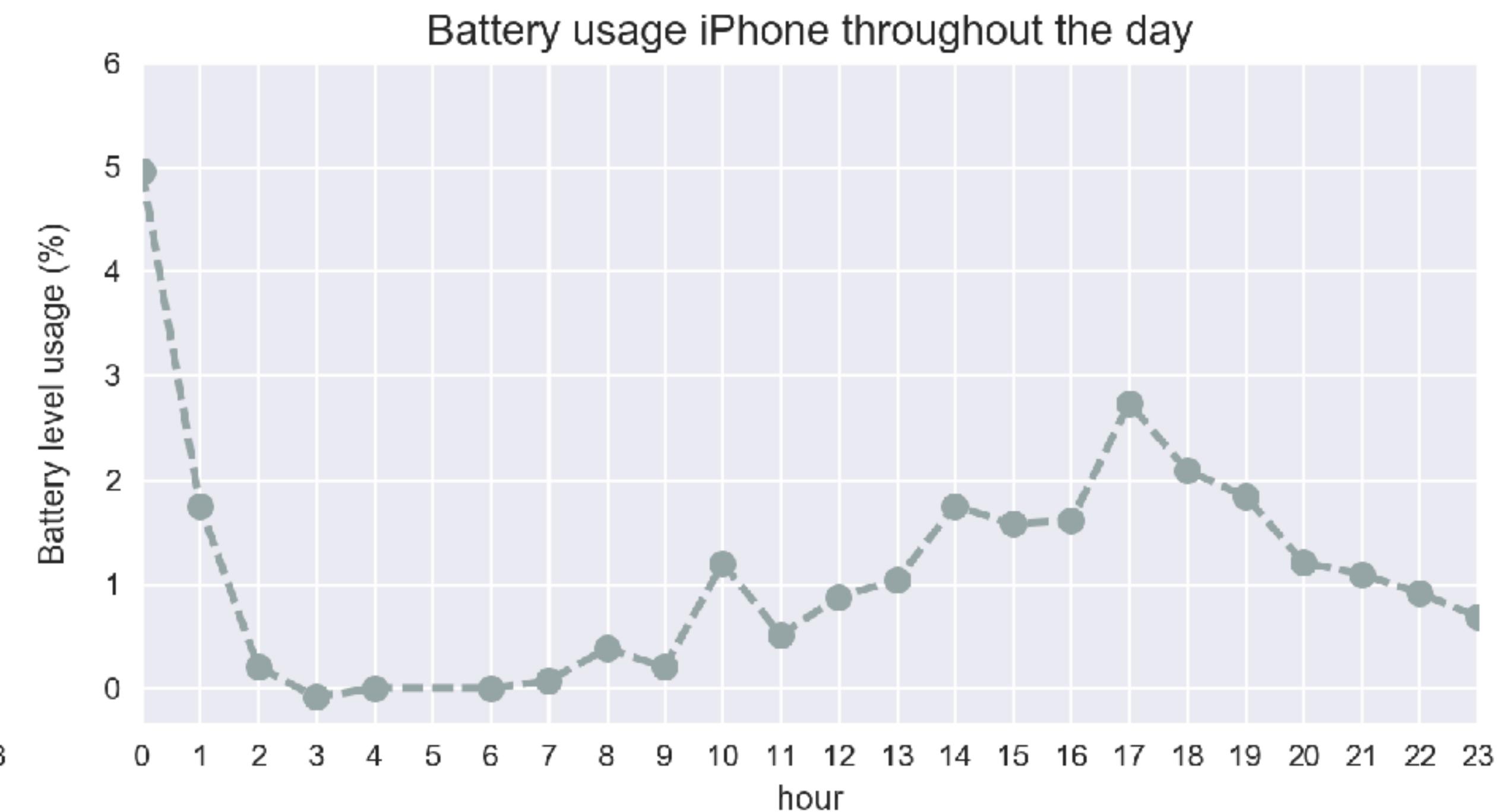
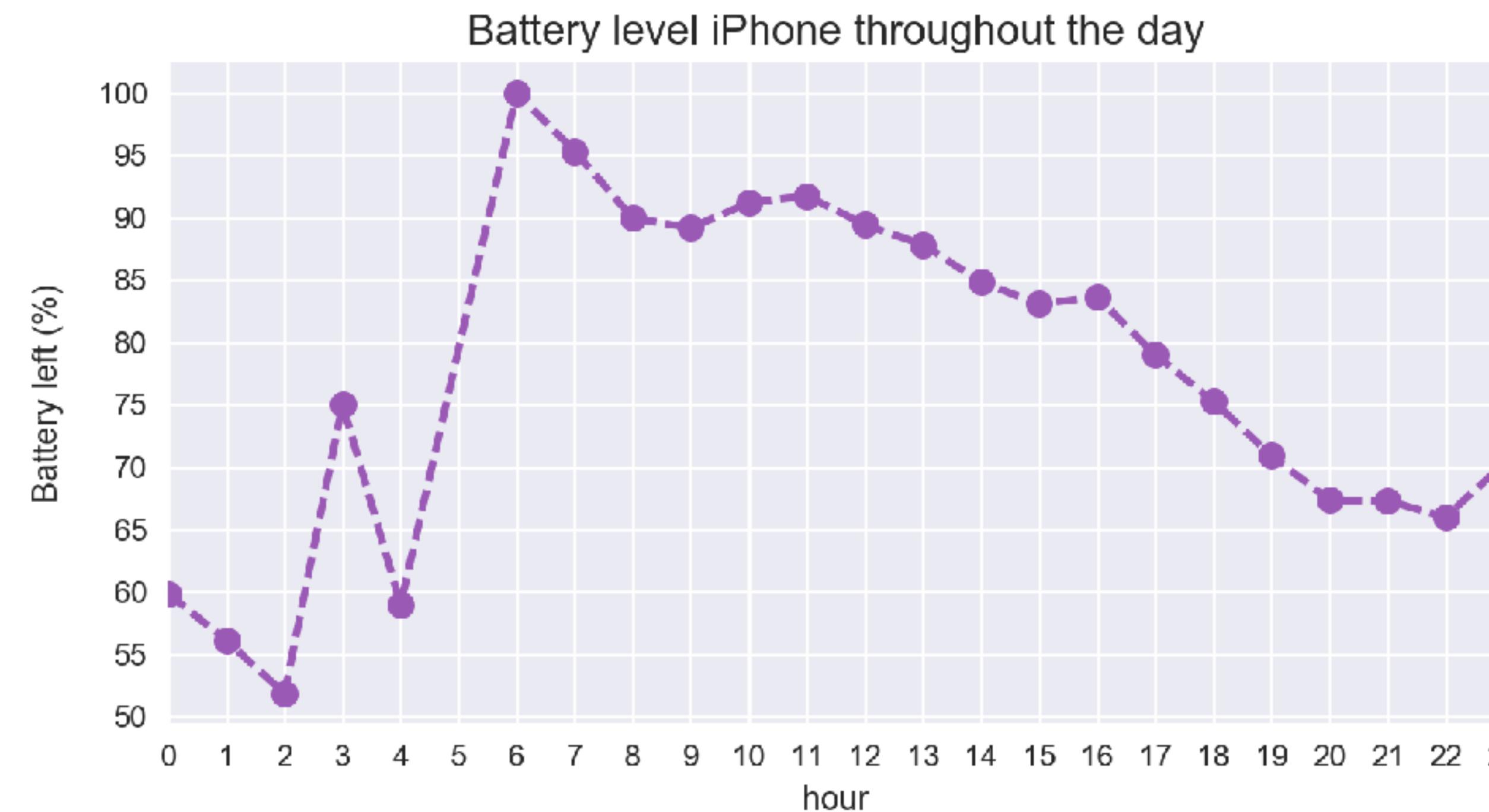
Name: time, dtype: timedelta64[ns]

TOTAL TIME: 0 days 13:59:19

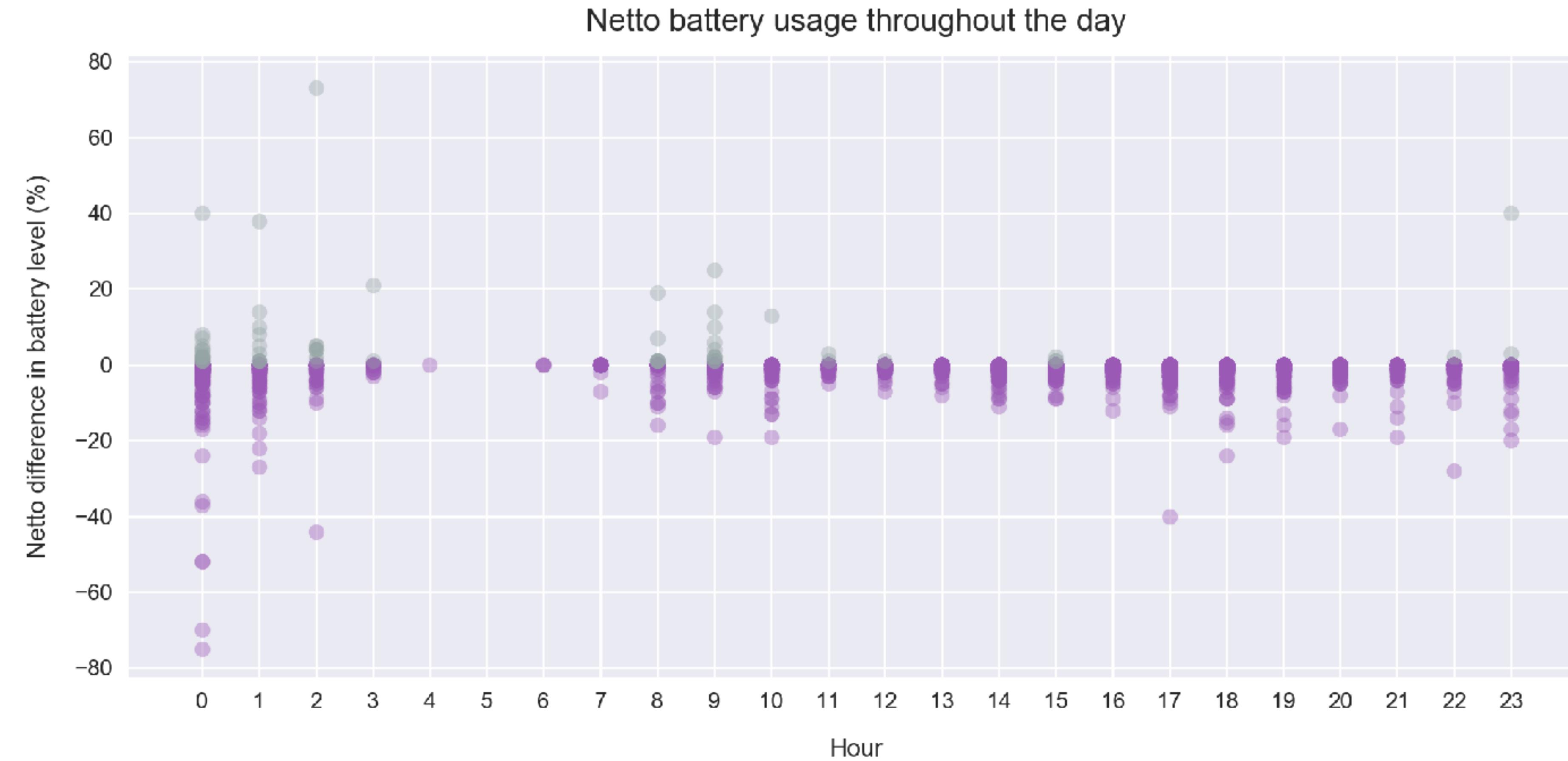
7. How often did I fall asleep with my phone turned on?

| | date | time | length_in_seconds |
|-------------|-------------|---------------------|--------------------------|
| 2 | 2017-05-09 | 2017-12-20 01:10:50 | 30645.0 |
| 219 | 2017-05-22 | 2017-12-20 00:15:37 | 20749.0 |
| 289 | 2017-05-27 | 2017-12-20 00:24:32 | 12278.0 |
| 414 | 2017-06-04 | 2017-12-20 00:27:52 | 17047.0 |
| 972 | 2017-07-01 | 2017-12-20 00:12:34 | 14529.0 |
| 2267 | 2017-08-23 | 2017-12-20 02:13:38 | 12938.0 |
| 2277 | 2017-08-24 | 2017-12-20 00:41:50 | 15443.0 |

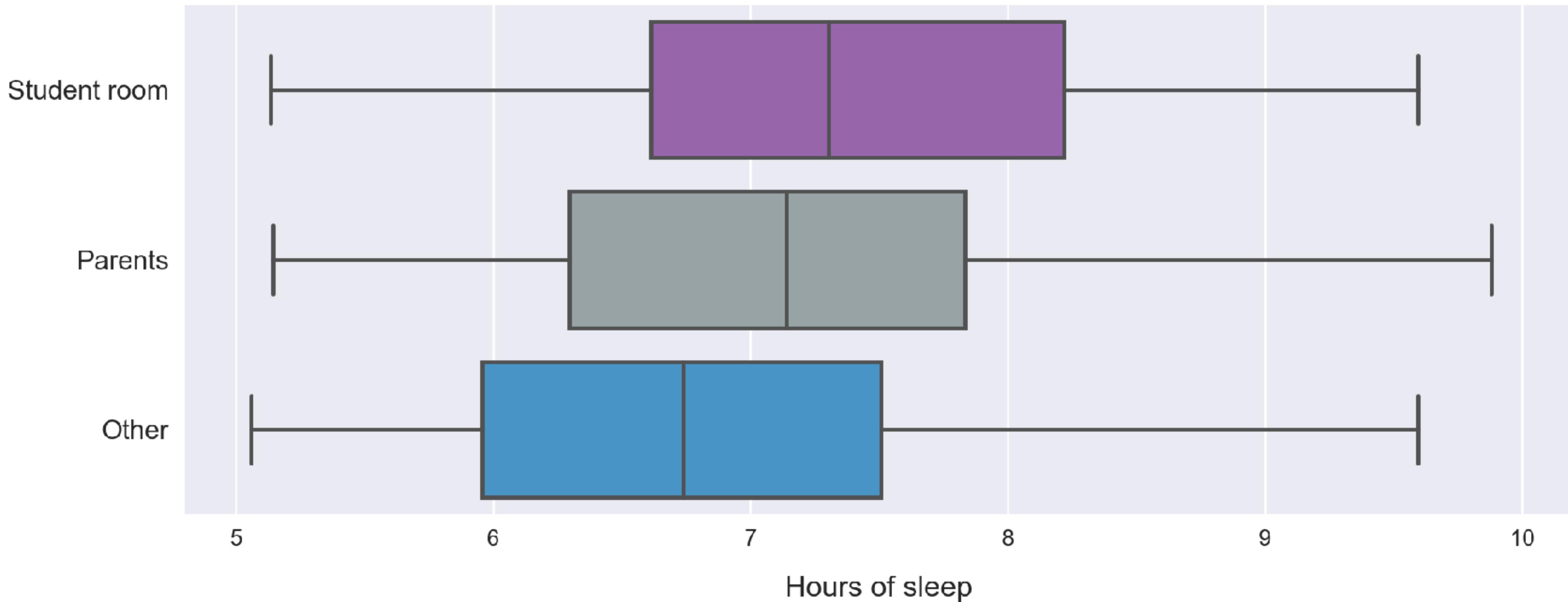
8. What time do I charge my phone normally?



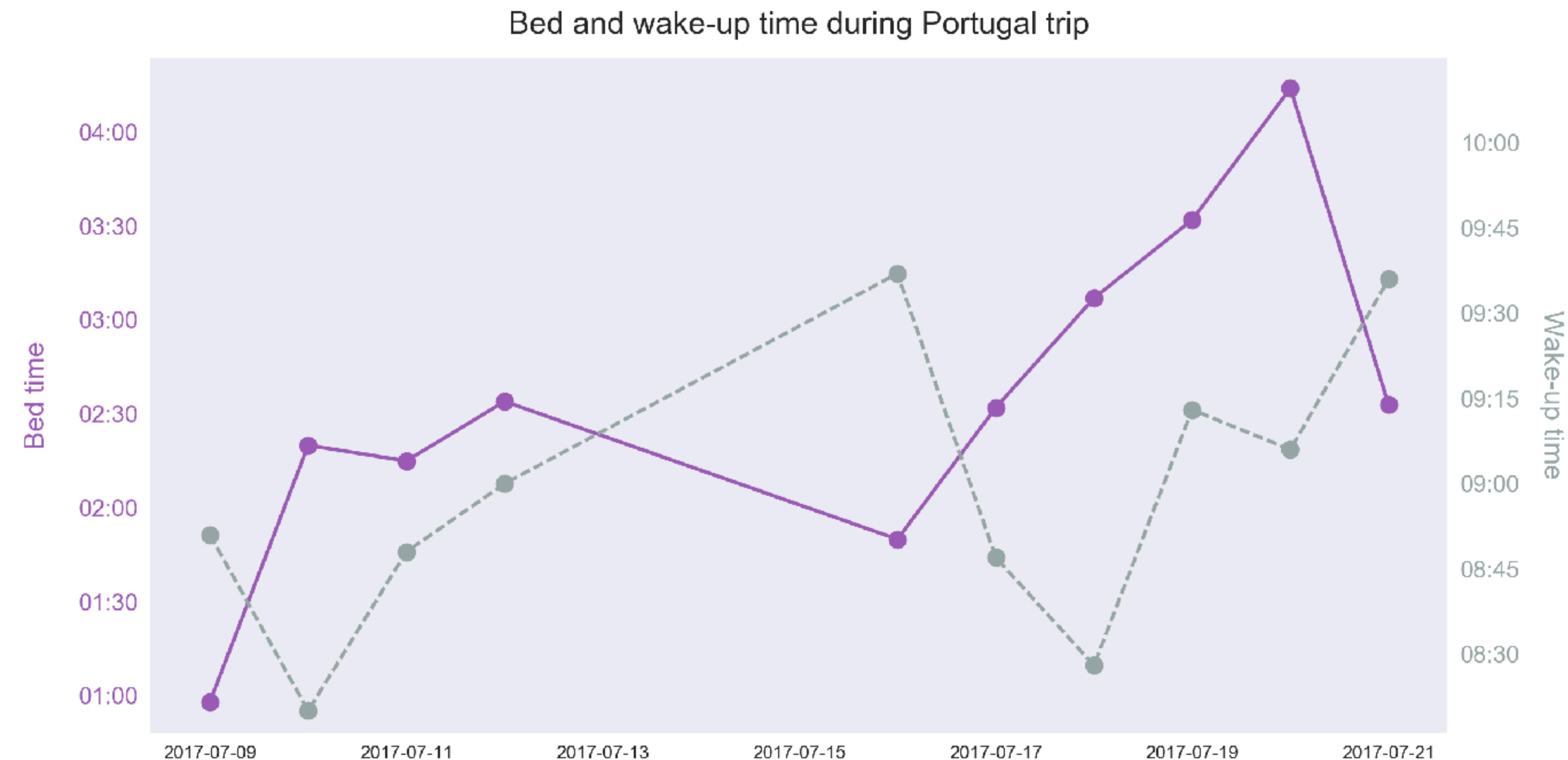
8. What time do I charge my phone normally?



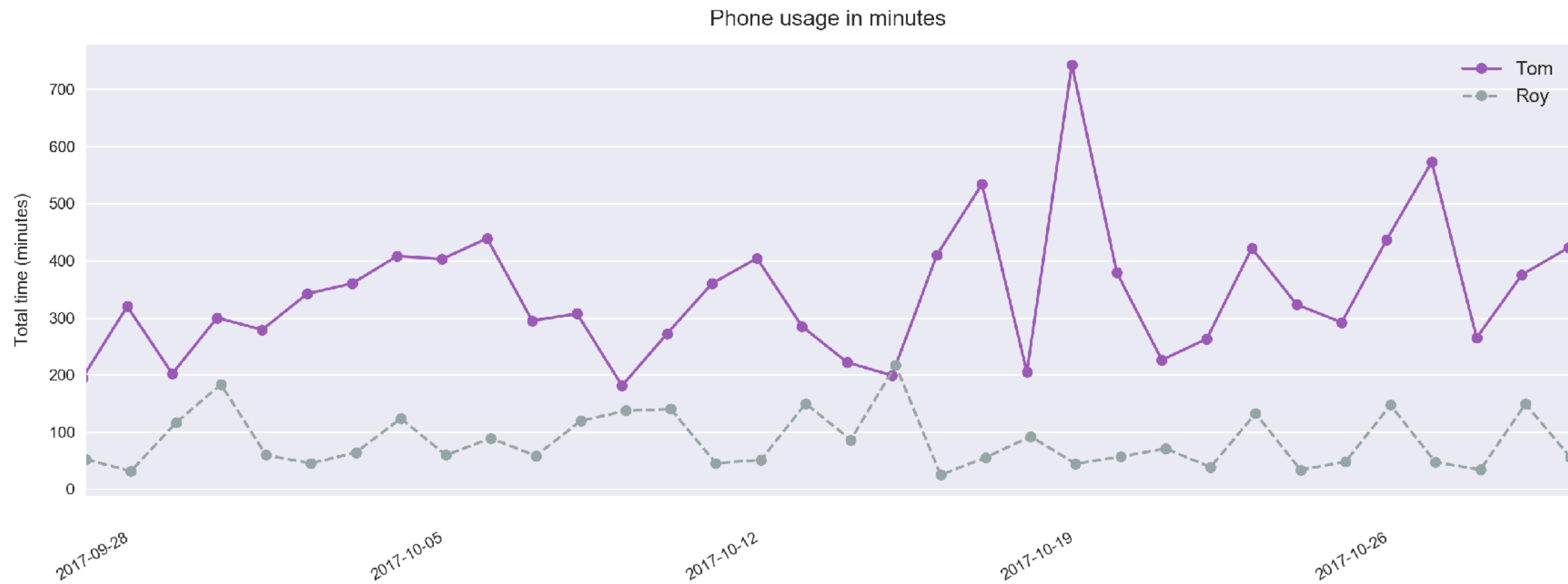
9. Does my sleeping length depend on the location?



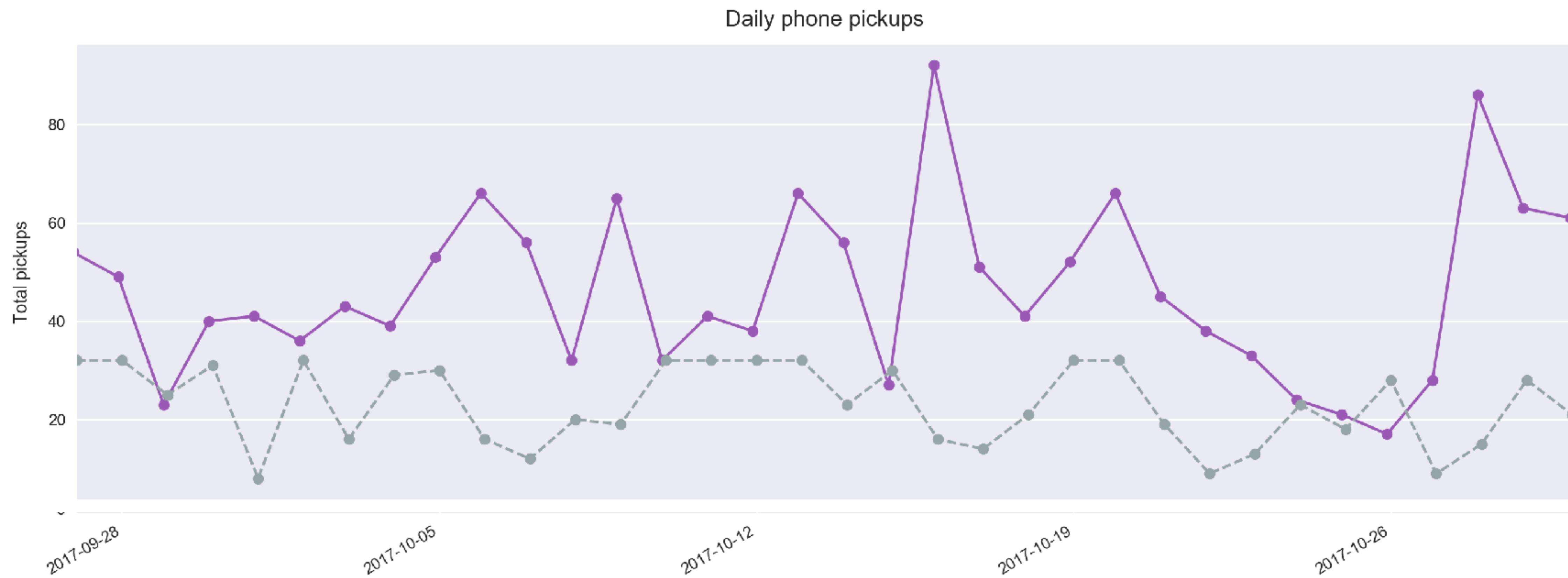
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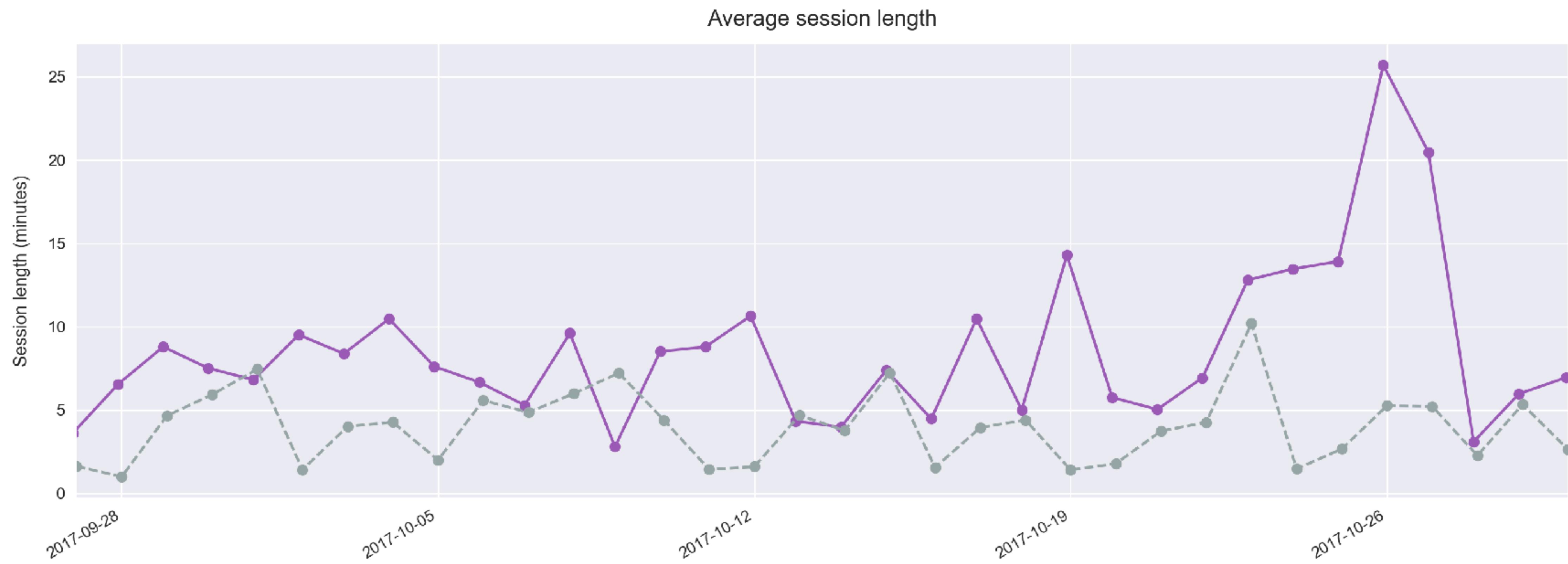
10. How does my daily phone usage compare to my brother?



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| Location | Classification | Relative frequency |
|--------------|----------------|--------------------|
| Parents | 1 | 55.2% |
| Student room | 2 | 37.2% |
| Other | 3 | 7.6% |

RANDOM FOREST

```
accuracy : 0.8118811881188119
{'max_depth': 8, 'min_samples_split': 6, 'n_estimators': 19}
```

DECISION TREE

```
accuracy : 0.7326732673267327
{'max_depth': 4, 'min_samples_split': 6}
```

65% incorrect
class-2 predictions

```
array([[ 11.8,    4.2,    0. ],
       [  2.3,    2.7,    0. ],
       [  0.3,    0.9,   3.8]])
```

References

- [1] Andrews, S., Ellis, D. A., Shaw, H., & Piwek, L. (2015). *Beyond self-report: Tools to compare estimated and real-world smartphone use*. PLoS ONE, 10(10), 19. <https://doi.org/10.1371/journal.pone.0139004>
- [2] Boase, J., & Ling, R. (2013). Measuring Mobile Phone Use: Self-Report Versus Log Data. *Journal of Computer-Mediated Communication*, 18(4), 508519. <https://doi.org/10.1111/jcc4.12021>
- [3] Crew (n.d.). How Much To Make An App. Retrieved from <http://howmuchtomakeanapp.com/>
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- [5] Fix, J. (2010). What does a corporate web video cost? 25 Factors (with prices) that affect corporate video production costs. Retrieved from: <https://onemarketmedia.com/2010/03/03/what-does-a-web-video-cost-25-factors-with-prices-that-affect-video-production-costs/>
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- [7] Hofmann, W., & Patel, P. V. (2015). SurveySignal. *Social Science Computer Review*, 33(2), 235253. <https://doi.org/10.1177/0894439314525117>
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- [10] Sonck, N.; Fernee, H. (2013). Using smartphones in survey research. The Hague: The Netherlands Institute for Social Research. Retrieved from