Appendix

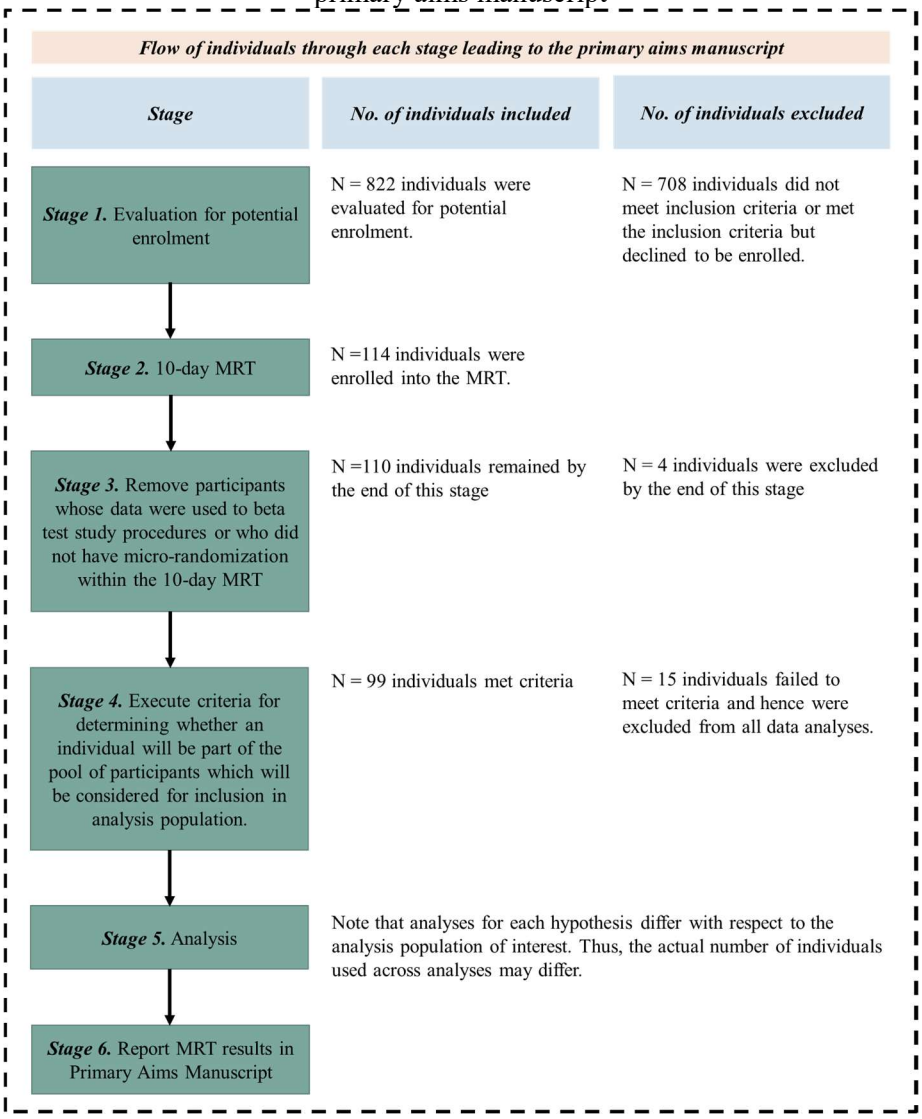
Mobile Assistance for Regulating Smoking Micro-Randomized Trial: Documentation on approach and considerations for deriving analytic datasets

1. Background

1.1 Overview

A total of 822 individuals were evaluated for potential enrolment into the MARS MRT. Of the 822 individuals, 708 individuals (or 86%) did not meet inclusion criteria or met inclusion criteria but declined to be enrolled while 114 individuals (or 14%) met inclusion criteria and were enrolled. Of the 114 individuals, 15 individuals (or 13%) were excluded from all data analyses while 99 individuals (or 87%) met criteria to be considered for analysis population inclusion. We summarize this bird's eye view of the flow of individuals through each stage of the study leading to the primary aims manuscript in Figure 1.

Figure 1: A bird's eye view of the flow of individuals through each stage of the study leading to the primary aims manuscript



Note that criteria used by the study team to evaluate individuals for potential enrolment were described in the main manuscript. Therefore, from here onward, we focus on the 114 individuals who were enrolled into the MRT. We conclude Section 1 by introducing the critical role of person-blocks in operationalizing the study design described in the protocol (Nahum-Shani et al., 2021). In Section 2-3, we describe data exclusion criteria applied to the 114 participants (***Phase 1***), and additional data exclusion criteria subsequently applied to the remaining 110 participants (***Phase 2***). In Section 4, we define the relevant analysis population for each (pre-specified or exploratory) hypothesis reported in the main manuscript (***Phase 3***); the 99 participants that remain after executing all exclusion criteria thus far will be the pool of participants we will use to define the relevant analysis population for each hypothesis. Altogether Sections 2-4 provide an account of our three-phase approach to deriving the analytic datasets. Finally, in Section 5, we report results of checks to diagnose whether the data used in analyses might be characterized by deviations from what we would expect from the protocol.

1.2 Role of person-blocks in operationalizing the study design described in the protocol

The scheduling of assessments and micro-randomizations described in the study's protocol (Nahum-Shani et al., 2021) was enforced by partitioning a day into six contiguous ***person-blocks***, each 140 mins long (≈2 hours). The first person-block began 30 mins after a participant's designated wake time. Person-blocks were used to space-out and place a cap on the frequency of assessments (brief surveys and EMAs) and micro-randomizations to a maximum of 1 of each per person-block; this cap led to a maximum of 6 of each per day. Within person-blocks, further restrictions were placed on the administration of assessments and micro-randomizations; in Algorithm 1 and 2, we display these restrictions. Algorithms 1 and 2 have the effect of restricting the number of feasible sequences to only three, displayed in Table 1. The administration of EMAs and micro-randomizations was orchestrated and carried out solely by the smoking cessation app. Apart from study staff calibrating the smartphones to input the dates (i.e., year-month-day) of each day within the 10-day MRT period and wake times specified by participants, they had no further engagement with the app that impacted the orchestration of the administration of EMAs and micro-randomizations.

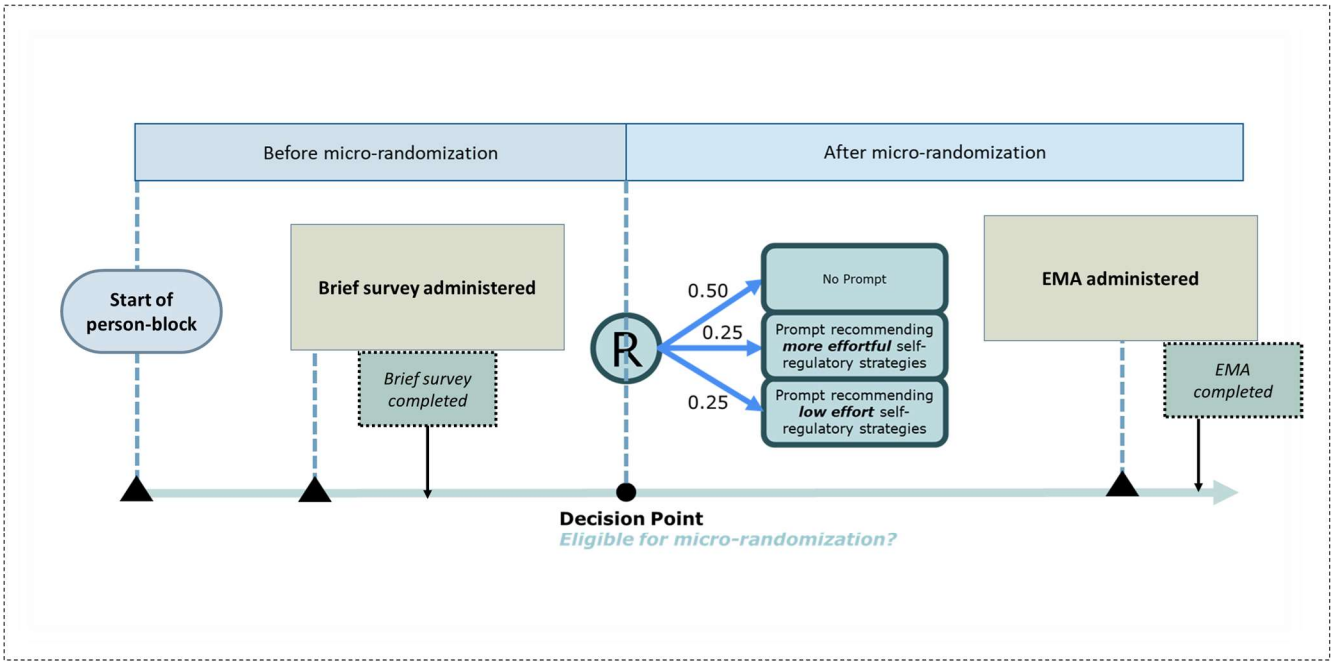
Table 1: Feasible sequences in person-blocks

#	**Sequence**
S1	Short survey administered (just once), no micro-randomization, no EMA administered
S2	Short survey administered (just once), micro-randomization (just once), no EMA administered
S3	Short survey administered (just once), micro-randomization (just once), EMA administered (just once)

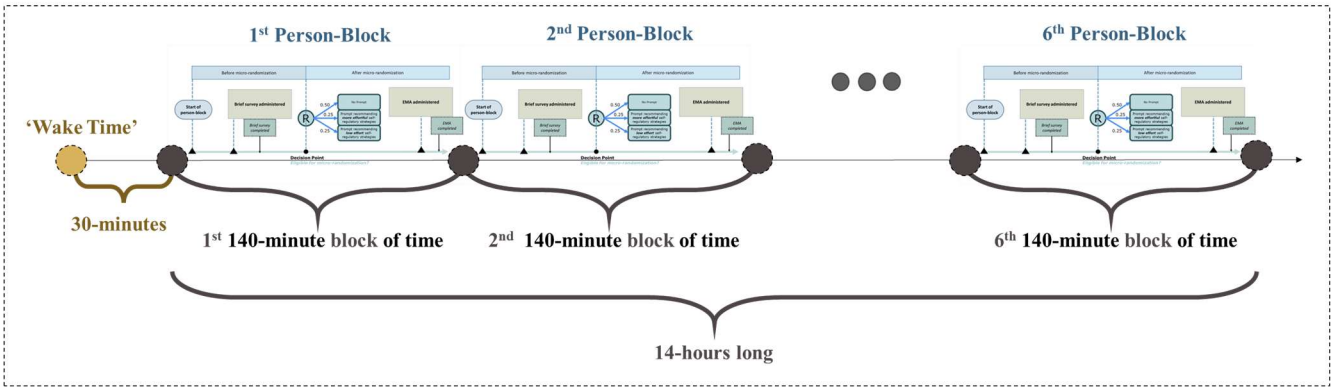
Figure 2 illustrates a typical person-block (a), and the typical person-block structure in a typical person-day (b).

Figure 2: An illustration of typical person-block structure in the MARS MRT

(a) Zoomed in to capture data collected in a typical person-block



(b) Zoomed out to capture person-block structure in a typical participant-day



Algorithm 1: Overarching rule on administration of assessments and micro-randomizations followed within person-blocks

IF no brief survey has been administered yet
- **IF** passed restrictions (&)
  - Administer brief survey
  - **IF** a brief survey has been administered but no micro-randomization yet
    - **IF** passed restrictions (&)
      - Micro-randomize
      - **IF** a brief survey has already been administered & micro-randomized, but no EMA administered yet
        - **IF** pass restrictions (&)
          - Administer EMA
        - **ELSE** (**IF** did not pass restrictions)
          - Do not administer EMA
      - **ELSE** (**IF** brief survey has already been administered, micro-randomized, & EMA has already been administered)
        - Do not administer EMA
    - **ELSE** (**IF** did not pass restrictions)
      - Do not micro-randomize
  - **ELSE** (**IF** a brief survey has been administered and micro-randomized)
    - Do not micro-randomize
- **ELSE** (**IF** did not pass restrictions)
  - Do not administer brief survey

ELSE (**IF** a brief survey has already been administered)
- Do not administer brief survey

Note: Restrictions that are checked in Algorithm 1 (&) are described in Algorithm 2. See also note in Algorithm 2.

Algorithm 2: Restrictions applied within Algorithm 1

IF data for driving does not exist within 5 mins prior to *t** and data for sleep mode activation does not exist at *t**
- *PASS = TRUE*

ELSE IF data for driving does not exist within 5 mins prior to *t** but data for sleep mode activation exists at *t**
- **IF** sleep mode was activated at *t**
  - *PASS = FALSE*
- **ELSE** (**IF** sleep mode was not activated at *t**)
  - *PASS = TRUE*

ELSE IF data for driving exists within 5 mins prior to *t** and data for sleep mode activation does not exist at *t**
- **IF** driving within 5 mins prior to *t**
  - *PASS = FALSE*
- **ELSE** (**IF** not driving within 5 mins prior to *t**)
  - *PASS = TRUE*

ELSE (**IF** data for driving exists within 5 mins prior to *t** and data for sleep mode activation exists at *t**)
- **IF** driving within 5 mins prior to *t** or sleep mode was activated at *t**
  - *PASS = FALSE*
- **ELSE** (**IF** not driving within 5 mins prior to *t** and sleep mode was not activated at *t**)
  - *PASS = TRUE*

Note: 1. *t** denotes the specific moment Algorithm 2 was checked. 2. In some cases, when wake times might be after 10am (in the participant's local time), person-blocks on the current day cross over to the next day. In these cases, Algorithm 1 and 2 were not checked; moreover, administration of brief surveys & EMAs and micro-randomizations will automatically be forfeited during the person-block that overlaps into the following day. 3. Administration of brief surveys & EMAs and micro-randomizations cannot occur while the smartphone remains uncharged. Thus, Algorithm 1 and 2 were not checked in a person-block was when participants neglected to keep their smartphones charged for the duration of the person-block.

2. Data exclusion criteria applied to the N = 114 participants (Phase 1)

2.1 Rationale for the development of a matching procedure

The raw data was structured such that there was no ***primary key*** (Chen, P.P.S, 1976) that could be used to uniquely link responses to brief surveys, treatment assignments, responses to EMAs, and timestamps corresponding to when micro-randomizations happened (which would be used to derive time-of-day and time-in-study variables) to the particular person-block they were intended to occur. Conceptually, a primary key can be thought of as a variable (column) in a typical rectangular dataset which can be used to uniquely link rows in one dataset with rows in another dataset (i.e., ascertain a one-to-one match between separate datasets). Although the raw data in the MARS study was not structured in the typical format of a rectangular dataset, this conceptual analogy provides a rough description of the issue.

To overcome this issue, we developed a ***matching*** *procedure*, also known as a ***record linkage*** *method* (Fellegi & Sunter, 1969, Newcombe et al., 1959). Matching or record linkage refers to "bringing together of information from two records that are believed to relate to the same entity – for example, the same individual, the same family, or the same business" (Herzog, Scheuren & Winkler, 2007); records are brought together using "quasi-identifiers" which "do not uniquely identify [the person, business, etc.] by themselves but may, in combination, uniquely identify an entity [the person, business, etc.]" (Winkler, 2014). In brief, our matching procedure is composed of a few deterministic decision rules which mimicked the logic obeyed by the smoking cessation app within each person-block in order to uniquely link responses to brief surveys, treatment assignments, responses to EMAs, and timestamps corresponding to when micro-randomizations happened to the particular person-block they were intended to occur (our entity of interest). Therefore, in effect, our matching procedure recovers the person-block structure. We discuss the result of the matching procedure in Section 2.2 and checks diagnosing the adequacy of the matching procedure in Section 5.

2.2 Result of applying the matching procedure

The matching procedure yielded a dataset where a sequence of events is matched to the particular person-block they were intended to occur. More specifically, after applying the matching procedure to each of the 114 participants who entered the MRT, we found that 5380 person-blocks contained any one of 10 possible sequences described in Table 2. Of the 5380 sequences, the vast majority were consistent with study protocol (99.76%; S1-S3 in Table 2), with a few exceptions (0.24%; A1-A7 in Table 2).

Data excluded: Apart from data we deemed to represent duplicates, no data on brief survey responses, treatment assignments, or EMA responses were removed by the matching procedure.

Note: It is possible for person-blocks to not contain any sequence. This scenario happens if a person-block had *(i)* no brief survey administered and *(ii)* no micro-randomization and *(iii)* no EMA administered. These person-blocks were not within the scope of our matching procedure but were accounted for when ascertaining the order (i.e., 1, 2, 3, …, 60) at which a person-block occurred (described in Section 4.1).

2.3 Handling sequences which were not consistent with study protocol

As we already observed in Table 2, there were rare cases of person-blocks containing sequences which were not consistent with study protocol. The inconsistency with study protocol was due to short surveys having been administered twice in succession immediately before micro-randomization (A3, A4, A5 in Table 2), EMAs having been administered twice in succession immediately after micro-randomization (A1 in Table 2), micro-randomization having occurred twice in succession between the administration of

short survey and EMA (A2 in Table 2), among other possibilities (A6, A7 in Table 2) within a person-block.

Decision: We dropped the first occurrence if short survey administration, micro-randomization, or EMA administration occurred twice within a person-block. In effect, applying this rule resulted in conforming sequences into what we would expect to see based on study protocol. The specific rules applied to cases A1-A7 in Table 2 are described in Table 4.

Data excluded: 6 micro-randomizations were excluded from all subsequent analyses (4 from A2, 1 from A6, and 1 from A7 in Table 3). Table 3 describes the number of person-blocks remaining after applying the decisions in Table 4 to the 13 sequences not consistent with study protocol.

Table 2: Sequences of events resulting from applying the matching procedure to the raw data

	#	Sequence	Total person-blocks	
Consistent with study protocol	S1	Short survey administered (just once), no micro-randomization, no EMA administered	**5367**	58
	S2	Short survey administered (just once), micro-randomization (just once), no EMA administered		628
	S3	Short survey administered (just once), micro-randomization (just once), EMA administered (just once)		4681
Not consistent with study protocol	A1	Short survey administered (just once), micro-randomized (just once), EMA administered (1st time), EMA administered (2nd time)	**13**	1
	A2	Short survey administered (just once), micro-randomized (1st time), micro-randomized (2nd time), EMA administered (just once)		4
	A3	Short survey administered (1st time), short survey administered (2nd time), micro-randomized (just once), EMA administered (just once)		2
	A4	Short survey administered (1st time), short survey administered (2nd time), no micro-randomization, no EMA administered		2
	A5	Short survey administered (1st time), short survey administered (2nd time), micro-randomized (just once), no EMA administered		2
	A6	Short survey administered (1st time), micro-randomized (1st time), short survey administered (2nd time), micro-randomized (2nd time), EMA administered (just once)		1
	A7	Short survey administered (1st time), micro-randomized (1st time), short survey administered (2nd time), micro-randomized (2nd time), no EMA administered		1
		Grand total person-blocks (across all 114 participants)	**5380**	

Table 3: Specific decisions for sequences of events inconsistent with study protocol

#	Original Sequence	Total Person-Blocks	Decision	Sequence after Applying Decision	
A1	Short survey administered (just once), micro-randomized (just once), EMA administered (1st time), EMA administered (2nd time)	1	Exclude EMA administered the 1st time within a person-block	Short survey administered (just once), micro-randomized (just once), EMA administered (just once)	S3
A2	Short survey administered (just once), micro-randomized (1st time), micro-randomized (2nd time), EMA administered (just once)	4	Exclude micro-randomizations which occurred the 1st time within a person-block	Short survey administered (just once), micro-randomized (just once), EMA administered (just once)	S3
A3	Short survey administered (1st time), short survey administered (2nd time), micro-randomized (just once), EMA administered (just once)	2	Exclude short survey administered the 1st time within a person-block	Short survey administered (just once), micro-randomized (just once), EMA administered (just once)	S3
A4	Short survey administered (1st time), short survey administered (2nd time), no micro-randomization, no EMA administered	2	Exclude short survey administered the 1st time within a person-block	Short survey administered (just once), no micro-randomization, no EMA administered	S1
A5	Short survey administered (1st time), short survey administered (2nd time), micro-randomized (just once), no EMA administered	2	Exclude short survey administered the 1st time within a person-block	Short survey administered (just once), micro-randomized (just once), no EMA administered	S2
A6	Short survey administered (1st time), micro-randomized (1st time), short survey administered (2nd time), micro-randomized (2nd time), EMA administered (just once)	1	Exclude short survey administered and micro-randomization which occurred the 1st time within a person-block	Short survey administered (just once), micro-randomized (just once), EMA administered (just once)	S3
A7	Short survey administered (1st time), micro-randomized (1st time), short survey administered (2nd time), micro-randomized (2nd time), no EMA administered	1	Exclude short survey administered and micro-randomization which occurred the 1st time within a person-block	Short survey administered (just once), micro-randomized (just once), no EMA administered	S2

Table 4: Remaining number of person-blocks after applying decisions in Table 3 to the 13 sequences not consistent with study protocol (as seen in Table 2)

		Number of person-blocks		
#	Sequence	Number of person-blocks after applying matching procedure to raw data (C1)	Additional person-blocks after applying decisions in Table 3 (C1)	Total person-blocks (C1+C2)
S1	Short survey administered (just once), no micro-randomization, no EMA administered	58	2	60
S2	Short survey administered (just once), micro-randomization (just once), no EMA administered	628	3	631
S3	Short survey administered (just once), micro-randomization (just once), EMA administered (just once)	4681	8	4689
	Grand total person-blocks (across all 114 participants)	**5367**	**13**	**5380**

2.4 Handling sequences which occurred outside the 10-day MRT period

A number of sequences in Table 3 occurred in person-blocks that began either before or after participants' designated 10-day MRT period. Sequences contained in person-blocks that fall outside of the 10-day MRT period do not represent participant data.

Staff programmed study software to specify the 10-day MRT period. This helped anchor the participant, staff, and data managers and analysts to the dates on which the participant was enrolled in the MRT. However, the software did not restrict data collection to just those 10 days and thus, micro-randomization could occur both before and after the 10 days that the participant was in the MRT. For example, for remote participants, the phone was programmed by staff and then mailed to the participant. When the 10-day MRT was complete, the participant mailed the phone back to staff. Micro-randomization could have occurred between the time that staff first programmed the dates into the phone and the time that a remote participant received the phone in the mail. Similarly, micro-randomization could have occurred between the time that the participant finished their last day of the MRT and the time that staff received the phone back from the participant through the mail.

In sum, because study staff could not pause data collection performed by the smartphone remotely, micro-randomization occurred outside of the 10 days, such as in the example provided above.

Decision: Exclude sequences which fall outside participants' designated 10-day MRT period from all analyses.

Data excluded: We used participants and sequences that remain at the end of Phase 1 as a starting point for quantifying data excluded. After executing the decision described in Section 2.4, 478 sequences

(which had 450 micro-randomizations, i.e., not all sequences excluded had a micro-randomization) were excluded from all analyses.

2.5 Handling participants who were part of the pilot run of the study

Decision: Participants who were part of the study's pilot run were excluded from all analyses.

Data excluded: We used participants and sequences that remain at the end of Section 2.4 as a starting point for quantifying data excluded. After executing the decision described in Section 2.5, 148 sequences (which had 147 micro-randomizations) were excluded from all analyses.

3. Data exclusion criteria applied to the N = 110 participants (Phase 2)

3.1 Handling participants who did not meet threshold for EMA completion

Decision: Participants who did not complete at least 3 EMA between the second day and ninth day, inclusive, of their designated 10-day MRT period are to be excluded from all analyses.

Data excluded: We used participants and sequences that remain at the end of Section 2.5 as a starting point for quantifying data excluded. After executing the decision described in Section 3.1, 172 sequences (which had172 micro-randomizations, i.e., all sequences excluded had a micro-randomization) were excluded from all analyses.

3.2 Handling sequences on the First Day and Last Day

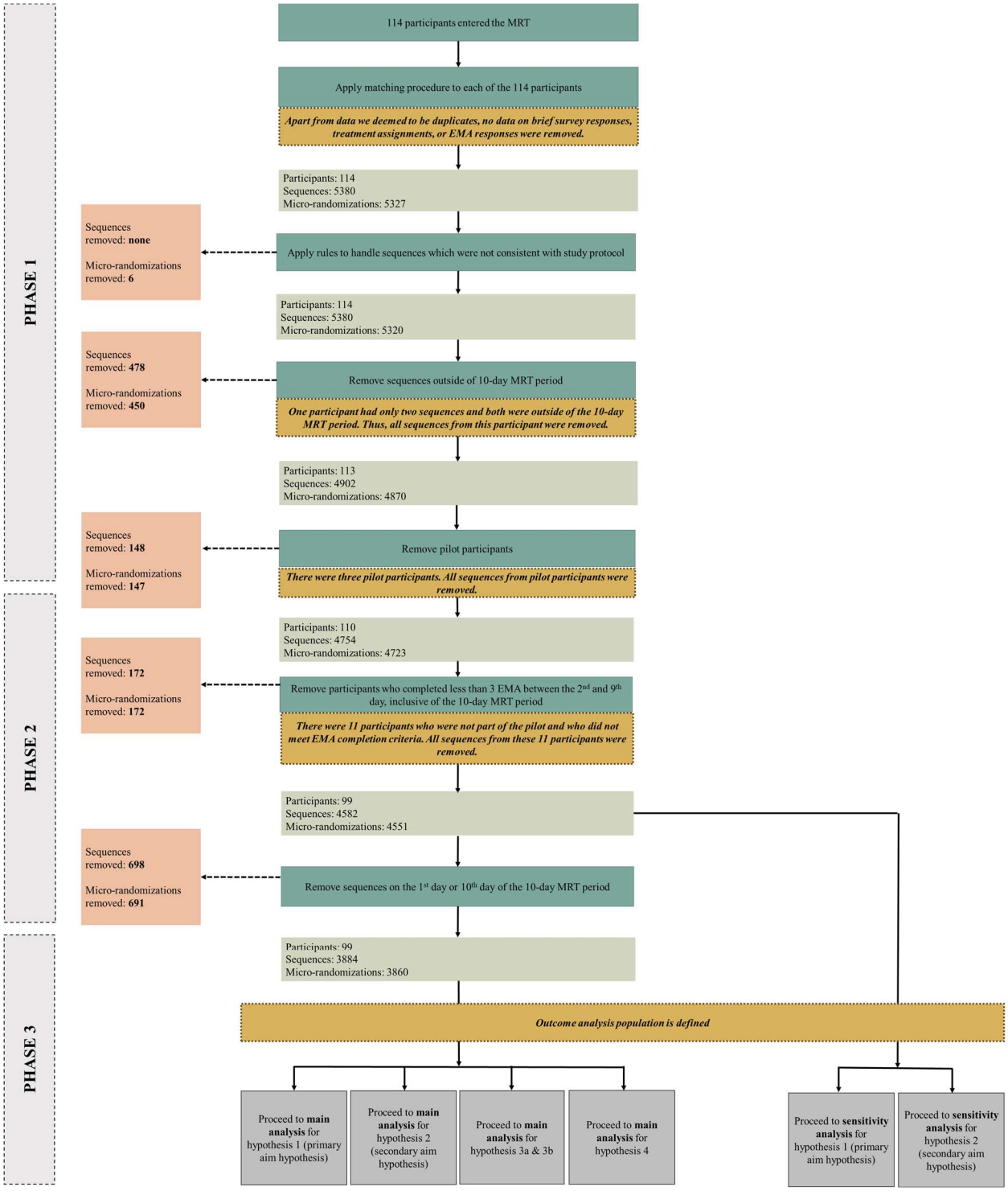
Decision: For each participant, a sequence was removed if it was contained in a person-block that began either on the First Day or Last Day of the participant's designated 10-day MRT period. This decision was operationalized by removing a sequence if it was contained within the 1st through 6th or 55th through 60th person-blocks in the 10-day MRT period.

Data excluded: We used participants and sequences that remain at the end of Section 3.1 as a starting point for quantifying data excluded. After executing the decision described in Section 3.2, 698 sequences (which had 691 micro-randomizations, i.e., not all sequences excluded had a micro-randomization) were excluded from all analyses.

Sensitivity analysis: We will perform a sensitivity analysis for Hypothesis 1 (Primary Aim Hypothesis) and Hypothesis 2 (Secondary Aim Hypothesis) where hypotheses will be tested using all sequences contained in person-blocks that began at any time in a participant's designated 10-day MRT period, including the First Day and the Last Day (i.e., if a sequence was contained within the 1st through 6th or 55th through 60th person-blocks, it was not excluded).

Figure 3 summarizes Sections 2-3 by depicting data excluded at critical junctures of Phase 1 and Phase 2 and serves as a bridge to Section 4 by depicting participants and sequences used as a starting point for defining the analysis population corresponding to each hypothesis.

Figure 3: Participants, sequences, micro-randomizations excluded from analyses in Phase 1 and Phase 2.



4. Defining the analysis population using the N = 99 participants (Phase 3)

4.1 Ascertaining order of person-blocks within participants' designated 10-day MRT period

We developed a procedure to deduce the order of person-blocks within each participant's designated 10-day MRT period (or ***study-level block order***, for brevity), i.e., whether a particular person-block was the 1st, 2nd, 3rd, …, 59th, 60th person-block within the 10-day MRT period. Our procedure overcomes a limitation of the raw data in that if a person-block did not contain any sequence, then timestamps corresponding to when that person-block begun and ended was not necessarily[1] recorded in the raw data but these timestamps were recorded in the raw data if a person-block did in fact contain a sequence. In effect, our procedure is able to assign a study-level block order to person-blocks, even for those that did not contain a sequence. We note that person-blocks that contained a sequence also had their ***day-level block order*** recorded in the raw data (again, this was not necessarily the case for person-blocks which did not contain any sequence)

Procedure:

- **Step 1:** Using only those person-blocks which had a sequence as our starting point, we used Equation 1 to deduce study-level block order.
- **Step 2:** We simply fill in the gaps to deduce study-level block order for the remaining person-blocks (<u>none</u> of which contained a sequence) in the 10-day MRT period.

<u>Notation:</u>

- t denotes study-level block order, which ranges between 1 to 60
- δ_t denotes number of days elapsed between midnight of the date of 1st visit and date-time[2] corresponding to the start of the t^{th} person-block
- $\lfloor \delta_t \rfloor$ denotes rounding down the value of δ_t to the nearest integer
- b denotes day-level block order coded as 0, 1, 2, 3, 4, 5

<u>Equation 1:</u> $t = 6\lfloor \delta_t \rfloor + (b + 1)$

Having the complete sequence on hand would now allow us to correctly align person-block data between participants and carry out analyses that require this information. In particular,

- when creating the multiply imputed datasets
- when carrying out analyses that utilize moderators operationalized in terms of responses in person-blocks just prior to the current person-block (Hypothesis 3a & 3b)
- when carrying out analyses that utilize a proximal outcome operationalized in terms of responses in person-blocks right after the current person-block (Hypothesis 4a & 4b)

<u>Data excluded:</u> None at this step; however, this step allows us to appropriately define the outcome analysis population for each analysis (see Section 4.2-4.4).

For the rest of this section (Section 4.2 – 4.4), we use the following notation:

- t denotes study-level block order, which ranges between 1 to 60

[1] If it happened that the smartphone was not charged for the whole day, then this information will not be recorded in the raw data for that day. If it happened that the smartphone was only charged before a participant's designated wake time (but not charged for the rest of the day), then this information might be recorded.

[2] Recall that a date-time is a date plus a time that uniquely identifies an instant of time to the nearest second, including time zones. All calculations in Equation 1 were carried out in the participant's local time.

- I_t denotes whether the t^{th} person-block was eligible for micro-randomization whose value is 1 if eligible and 0 if not eligible
- n_t denotes the number of person-blocks prior to t (not including t) in the past 24 hours which were eligible for micro-randomization

We used the 99 participants and 3884 sequences (which had 3860 micro-randomizations, i.e., not all sequences had a micro-randomization) that remain at the end of Phase 2 as a starting point for defining the outcome analysis population in Phase 3. Since the actual data excluded can vary depending on the variables included in the data analysis model, we report numbers analyzed when reporting the results for each data analysis model (e.g., in tables reporting data analysis results in the main manuscript).

4.2 Defining the analysis population for H1 (primary aim hypothesis) and H2 (secondary aim hypothesis)

- Main Analysis: the analysis population consist of person-blocks $t = 7,8,\ldots,54$ where $I_t = 1$; **if performing a complete case analysis, we additionally require that all variables included in our data analysis model have an observed value whenever** $I_t = 1$ (i.e., we only require variables to have an observed value when $I_t = 1$).
- Sensitivity Analysis: the analysis population consist of person-blocks $t = 1,2,\ldots,60$ where $I_t = 1$; **if performing a complete case analysis, we additionally require that all variables included in our data analysis model have an observed value whenever** $I_t = 1$.

4.3 Defining the analysis population for H3a and H3b

We note that three types of main analysis were performed for H3, requiring a different analysis population for each one.

- Main Analysis 1: We use a time-varying moderator operationalized in terms of the person-block just prior to the current person-block.
  - the analysis population consist of person-blocks $t = 7,8,\ldots,54$ where $I_t = 1$ and $I_{t-1} = 1$ (i.e., <u>both</u> restrictions are satisfied); **if performing a complete case analysis, we additionally require that all variables included in our data analysis model have an observed value whenever** $I_t = 1$ and $I_{t-1} = 1$ (i.e., we only require variables to have an observed value when both restrictions are satisfied).
- Main Analysis 2: We use a time-varying moderator operationalized in terms of the past 24 hours from the current person-block.
  - the analysis population consist of person-blocks $t = 7,8,\ldots,54$ where $I_t = 1$ and $\sum_{j=1}^{n_t} I_{t-j} \geq 1$ (i.e., <u>both</u> restrictions are satisfied); **if performing a complete case analysis, we additionally require that all variables included in our data analysis model have an observed value whenever** $I_t = 1$ and $\sum_{j=1}^{n_t} I_{t-j} \geq 1$ (i.e., we only require variables to have an observed value when both restrictions are satisfied).
- Main Analysis 3: We use a baseline moderator.
  - the analysis population consist of person-blocks $t = 7,8,\ldots,54$ where $I_t = 1$; **if performing a complete case analysis, we additionally require that all variables included in our data analysis model have an observed value whenever** $I_t = 1$.

5. Range checks

We used the 99 participants and 3884 sequences (which had 3860 micro-randomizations) at the end of Phase 2 to conduct the checks described in this section.

5.1 Range checks on number of minutes elapsed between events within a person-block

We compared the distribution of the number of minutes elapsed between events (Q1-Q4 listed below) in a person-block to their expected distribution based on protocol. These checks diagnosed whether there were a significant number of person-blocks that violated these expected characteristics for the values of Q1-Q4; a large number of offending person-blocks may be symptomatic of an inadequate matching procedure.

Q1. the number of minutes elapsed between the time at which a brief survey was administered and when brief survey was completed
Q2. The number of minutes elapsed between the time at which a brief survey was administered and micro-randomization
Q3. The number of minutes elapsed between the time at which a brief survey was administered and the time at which EMA was administered
Q4. The number of minutes elapsed between the time at which EMA was administered and the time at which EMA was completed

Drawing from the study's protocol, we would expect that the value of Q1 ranges between ≈0-5 mins and in most cases be a few seconds, Q2 ranges between ≈0-5 mins and in most cases be a few seconds, Q3 ranges between ≈60-120 mins and in most cases be between ≈60-65 mins, Q4 ranges between ≈0-60 mins and in most cases be between ≈0-5 mins.

The quantities above, also illustrated in Figure 4 (a), were calculated based on brief surveys, micro-randomizations, and EMAs which were matched to the same person-block by our matching procedure. For Q1 and Q4, only brief surveys and EMAs which were completed were used in the calculation (i.e., if they were partially complete or had no response to any item, they were not used in the calculation)

Result of checks: We display the result of these checks in see Figure 4 (b). Person-blocks in Table 4 were consistent with the characteristics of the distribution of Q1, Q2, Q3, Q4 that we would expect from study protocol.

Data excluded: No data was excluded as a result of these checks.

5.2 More range checks on the number of minutes elapsed between events within a person-block

We compared the distribution of the number of minutes elapsed between events (R1-R2 listed below) in a person-block to their expected distribution based on protocol. These checks diagnosed whether there were a significant number of person-blocks that violated these expected characteristics for the values of R1-R2. In contrast to Section 5.1 where checks were developed to diagnose whether our matching procedure might be inadequate, in Section 5.2, checks diagnosed whether there were a significant number of person-blocks that had values for either R1 or R2 that fell on the upper end of this range which would indicate the need to discard brief survey or EMA responses, respectively (i.e., regard as responses missing).

R1. The number of minutes elapsed between the time at which a participant completed the brief survey and micro-randomization
R2. The number of minutes elapsed between micro-randomization and the time at which a participant began responding to an administered EMA

Drawing from the study's protocol, we would expect that the value of R1 ranges between ≈0-120 mins and in most cases be almost instantaneous and that R2 ranges between ≈60-120 mins and in most cases be between ≈60-65 mins.

The quantities above, also illustrated in Figure 4 (a), were calculated based on brief surveys, micro-randomizations, and EMAs which were matched to the same person-block by our matching procedure.

Result of checks: We display the result of these checks in Figure 4 (b). Regarding R1, at first sight, it may appear as though a notable number of sequences manifest a violation of what we would expect to see from protocol given the wide range of values. However, calculation of the upper percentiles show that in 92% of sequences included in the calculation, the number of minutes elapsed between the time at which a participant completed brief survey and micro-randomization is less than one minute; furthermore, in 99% of sequences included in the calculation, the number of minutes elapsed between the time at which a participant completed a brief survey and micro-randomization is less than 18 minutes (see Table 5). Regarding R2, we noted rare exceptions represented by points above the solid red line in the plot for R2 in Figure 4 (b). Overall, person-blocks were generally consistent with the characteristics of the distribution of R1 and R2 that we would expect from study protocol.

Table 5: Upper 90^{th} – 99^{th} percentiles of the distribution of the number of minutes elapsed between the time at which a participant completed the brief survey and micro-randomization (i.e., R1)

90^{th}	91^{st}	92^{nd}	93^{rd}	94^{th}	95^{th}	96^{th}	97^{th}	98^{th}	99^{th}	Max
0.32	0.41	0.69	4.49	4.88	5.00	5.07	5.18	7.94	17.996	50.64

Data excluded: No data was excluded as a result of these checks.

5.3 Range checks on the micro-randomizations

We calculated the empirical probability (and its 95% confidence interval) of being assigned to one of three possible treatment options among person-blocks where micro-randomization was feasible. This range check diagnosed whether there was any evidence that the randomization probabilities employed during the conduct of the study deviated from what we would expect from study protocol.

Study protocol: When it was feasible to micro-randomize within a person-block, the participant was micro-randomized (2:1:1) to:

- no prompt; or
- prompt recommending more effortful self-regulatory strategies; or
- prompt recommending low effort self-regulatory strategies

Therefore, if it were feasible to micro-randomize in all six person-blocks each day, participants would receive, on average, three prompts each day with equal representation of the two types of prompts.

Result of checks: We display the result of these checks in Figure 5. In all, these checks show that the empirical probability of being assigned to one of three possible treatment options is consistent with what we would expect from study protocol.

Data excluded: No data was excluded as a result of these checks.

Figure 4: An illustration of the correspondence between quantities checked and the person-block structure (*figure continued on next page*)

(a) Visualizing quantities we performed range checks on with respect to person-block structure

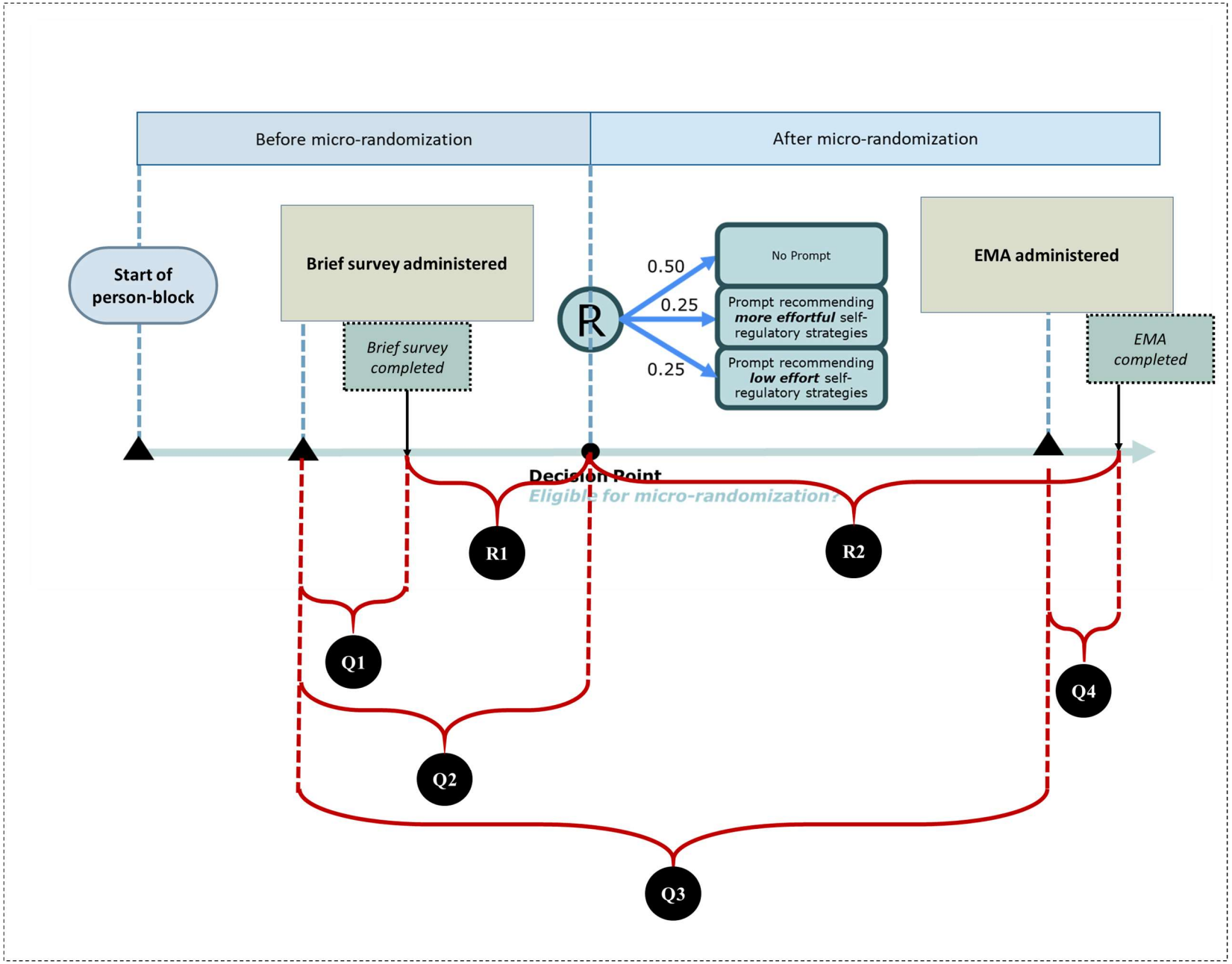


Figure 4: An illustration of the correspondence between quantities checked and the person-block structure (*figure continued from previous page*)

(b) Box plots display minimum, 25th percentile, 50th percentile, 75th percentile, maximum value of the quantities in each panel. Violin plots display the probability density of the quantities in each pane.

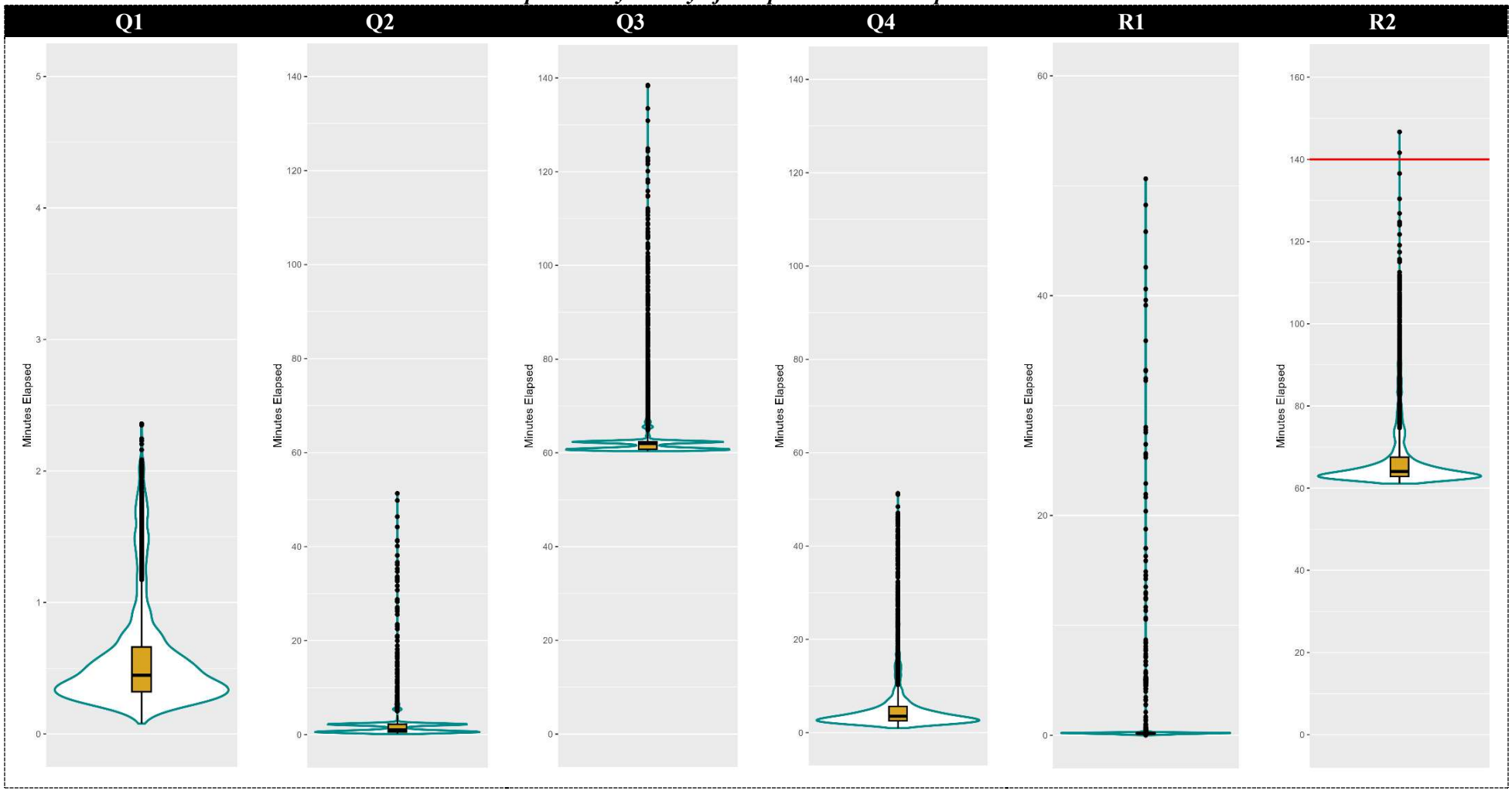
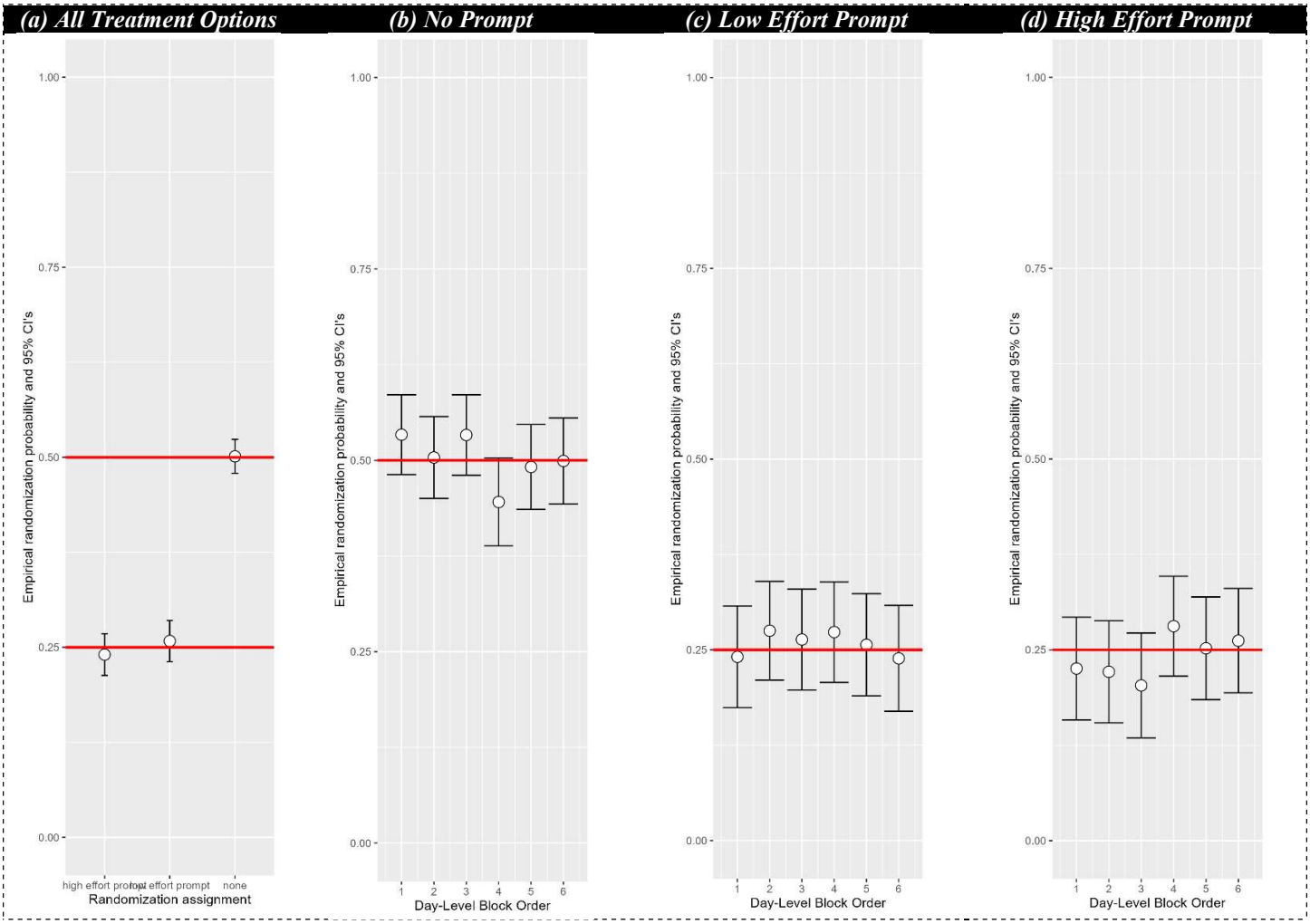


Figure 5: Among person-blocks where micro-randomization was feasible, the empirical probability of being assigned to no prompt, prompt recommending more effortful self-regulatory strategies, or prompt recommending low effort self-regulatory strategies. In panel (a), the calculation was performed marginally over time; on the other hand, in panels (b), (c), and (d), the calculation was performed conditionally over time by operationalizing time as the order of the person-block within a person-day and restricting the calculation to only the 1st, 2nd, …, 6th block of the person-day.



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