

Rotating online behavior
change interventions increases
effectiveness but also increases
attrition

Geza Kovacs

Zhengxuan Wu

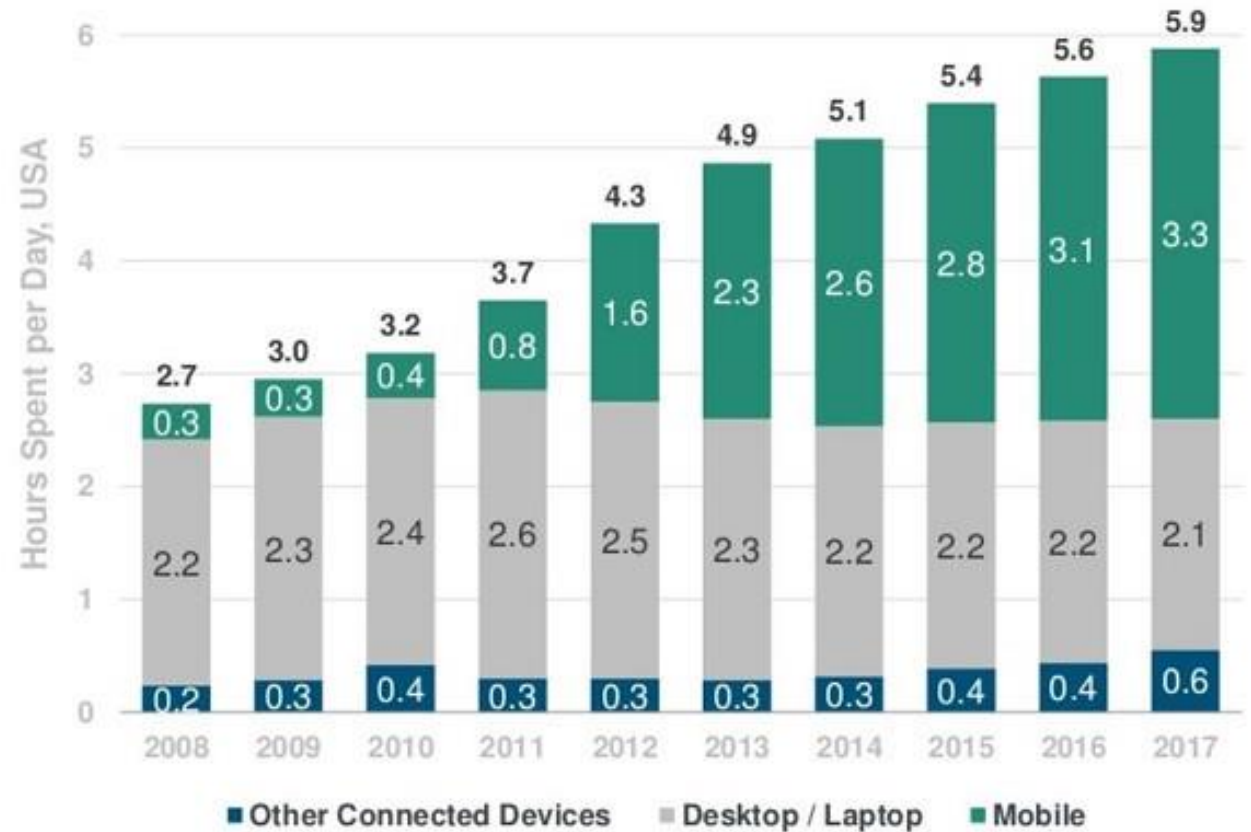
Michael Bernstein

Stanford HCI Group

People spend increasing amounts of time online

Average adult spends 5.9 hours per day with digital media

Daily Hours Spent with Digital Media per Adult User





People struggle to reduce their time online

Kim, Young-Ho, et al. "TimeAware: Leveraging framing effects to enhance personal productivity." *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. ACM, 2016.

Andreassen, Cecilie Schou, et al. "Development of a Facebook addiction scale." *Psychological reports* 110.2 (2012): 501-517.

Behavior change interventions suffer from declined engagement over time

Paul Krebs, James O Prochaska, and Joseph S Rossi. 2010. A meta-analysis of computer-tailored interventions for health behavior change. *Preventive medicine* 51, 3-4 (2010), 214–221





Novelty effects can provide temporary boosts in engagement

Reza Kormi nouri, Lars Goran Nilson, and Nobuo Ohta. [n. d.]. The novelty effect: Support for the Novelty Encoding Hypothesis. *Scandinavian Journal of Psychology*

Existing behavior
change systems
tend to use static
interventions



RescueTime



StayFocusd

Block **time-wasting** websites

Crx4Chrome



[RQ] Can a strategy of rotating interventions improve effectiveness?

A photograph of a dry, cracked desert landscape under a cloudy sky. The ground is parched and broken into irregular, polygonal shapes, resembling a mosaic of dried mud. The sky is filled with soft, grey clouds, and the overall color palette is muted, with earthy browns and greys.

[H1] Static interventions
suffer from decreased
effectiveness over time



[H2] Rotation will
increase intervention
effectiveness

Why study
novelty
effects in
online
behavior
change?

Can measure effectiveness (time spent per visit)

Many interventions possible (can modify sites)

Can frequently alter interventions (can change intervention every visit)

- Motivation
- **The Habitalab Chrome Extension**
- Study 1
- Study 2
- Qualitative feedback
- Study 3

HabitLab

Our browser
behavior
change
platform

8000+ in-the-
wild active
users

The screenshot shows the HabitLab website interface. At the top left is the Stanford University logo, and at the top right is the GitHub logo. The main heading is "HabitLab" with a flask icon, followed by the tagline "Change your online habits". A prominent button in the center says "Add HabitLab to Chrome" with a Chrome extension icon. Below this, a small line of text reads: "Some anonymized data will be sent to Stanford for research purposes. See our privacy policy for details." The bottom section is divided into three blue panels: "Set Goals" (with icons for Facebook, YouTube, Twitter, and Reddit), "Try Interventions" (with a scales of justice icon), and "View Progress" (with a pie chart icon). A language selector at the bottom left shows "English" with a dropdown arrow.

Stanford University

GitHub

HabitLab

Change your online habits

Add HabitLab to Chrome

Some anonymized data will be sent to Stanford for research purposes. See our privacy policy for details.

Set Goals

Try Interventions

View Progress

Pick sites you want to spend less time on

HabitLab tries different interventions each visit

Learn which interventions work best for you

English

Users select sites to reduce time on (goals)

Which sites would you like to spend less time on?

Below are some popular options, along with how much time you spend on them per day (on average).



Add Site
?



Amazon
2.3 mins



Buzzfeed
0 mins



Facebook
9.1 mins



Gmail
19 mins



Iqiyi
0.24 mins



Netflix
0 mins



Reddit
3.6 mins



Twitter
0.37 mins



Youku
0 mins



Youtube
5.8 mins

↓ NEXT

Interventions
help reduce
time on sites

Nudges will help you achieve your goals

One nudge will be selected and shown each time you visit a site.

You can try out and turn off nudges below.



All Sites



Bouncer



1Min
Assassin



GateKeeper



Scroll
Freezer



Supervisor



Stat Whiz



Minute
Watch



Facebook



Time
Injector



Feed Eater



TimeKeeper



No
Comment



Clickbait
Mosaic

↑ PREVIOUS

START USING HABITLAB

Design process for interventions

Existing interventions on the Chrome Store

Ideas proposed by experts and users

Adaptations of techniques from the literature



搜索



Geza Minh Trung Kovacs

首页

创建



Geza Minh Trung ...

动态消息

Messenger

Watch

快速访问

48th Half Moon B...

Corgi Con - Fall E...

Bachata Sentimie...

Stanford Climbing... 2

发现

活动 2

公共主页

小组

好友名单

筹款活动

展开...



记住密码

下次登录这个浏览器时，只要点击头像即可，无需输入密码。

确定

以后再说

发帖 | 照片/视频相册 | 直播视频



Geza Minh Trung Kovacs, 分享你的新鲜事吧

清单

照片/视频

标记好友



CLOSE FACEBOOK

SHOW MY NEWS FEED

TURN OFF

快拍

私人影集 · 设置



发布快拍

分享照片、视频或文字



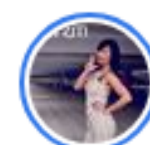
Lilly Shi

3 小时前



Kevin T. Wong

19 小时前



Jane E

约 1 小时前

查看更多

本周有 2 个活动

Stephany Liu 今天过生日

加好友请求

全部



Thai Dao

共同好友: Anh Tran

接受请求

Geza Minh Trung ...

动态消息 ...

Messenger

Watch

快速访问

48th Half Moon B...

Corgi Con - Fall E...

Bachata Sentimie...

Stanford Climbing... 2

发现

活动 2

公共主页

小组

好友名单

筹款活动

展开...

发帖 | 照片/视频相册 | 直播视频



Geza Minh Trung Kovacs, 分享你的新鲜事吧

清单

照片/视频

标记好友



Today you have been here for:

2 38
min sec

CLOSE FACEBOOK

TURN OFF



Blake Villanueva ▶ Fullout Funk Squad

14 小时 · 照片

Next practice will be this Sunday from 8-10pm in the ACSR gym mat room! (Same place as last time, different time)

快拍

私人影集 · 设置



发布快拍

分享照片、视频或文字



Lilly Shi

3 小时前



Kevin T. Wong

19 小时前



Jane E

约 1 小时前

查看更多

本周有 2 个活动

Stephany Liu 今天过生日

加好友请求

全部



Thai Dao

共同好友: Anh Tran

接受请求

可能认识

聊天 (离线)

全部



LIVE · 74,128 viewers

r/politics 2018 Midterm Election Coverage [↗](#)

Ongoing coverage of the 2018 midterm election. [Discussion thread here.](https://redd.it/9uvve1)

Welcome to Reddit!

Come for the cats, stay for the empathy.

BECOME A REDDITOR



CLOSE TAB

Time remaining:

0 min 38 sec

Time added:

0 min

ADD TIME



TURN OFF

Posted by u/FuegoFerdinand 3 hours ago

...erk who refused to sign marriage ...gay couples, loses to Democrat

...s/p... [↗](#)



...s [Share](#) [Save](#) ...

Posted by u/throwaway1637482 16 hours ago

...rouble for giving my underage wife alcohol? BOLA Posted

...y short I'm 21 and my wife is 18. Recently my mother-in-law from hell
...ve both drink. She is threatening to call the police on me if I give her



r/popular

The best posts on Reddit from the most active communities on Reddit. Check here to see what's upvoted, and comment on the internet.

CREATE POST

ADVERTISEMENT



Reddit Premium
Ads-free browsing

TRENDING COMMUNITIES



r/planesgonewild
10,826 subscribers



r/PirateKitties
2,763 subscribers



This video is 3 minutes and 30 seconds long.
Are you sure you want to play it?

CLOSE YOUTUBE

WATCH VIDEO

Yiruma, (이루마) - River Flows in You

70,360,928次观看



接下来播放

自动播放



Yiruma, (이루마) - Kiss the Rain

YirumaVEVO

2127万次观看



合辑 - Yiruma, (이루마) - River Flows in You

YouTube



Ludovico Einaudi - Nuvole Bianche [HD]

dureiable

2148万次观看



The Best of Yiruma (이루마) - 2 Hour Relaxing Piano Playlist ~...

YirumaCollection

135万次观看











Chopin - Spring Waltz (Mariage d'Amour) [Please Read...

Toms Muceniaks

30+
interventions
available

Nudges

Nudges turned on will only be shown some of the time [?](#)

| | | | | |
|---------------------------------------------------------------------------------------|------------------|----------------------------------------------------------|---------------------------------------------------------------------|-------------------------|
|  | Time Injector | Injects timer into the Facebook feed | <input type="checkbox"/> Off <input checked="" type="checkbox"/> On | Try now |
|  | Feed Eater | Removes the Facebook news feed | <input type="checkbox"/> Off <input checked="" type="checkbox"/> On | Try now |
|  | TimeKeeper | Notifies you of time spent in the corner of your desktop | <input type="checkbox"/> Off <input checked="" type="checkbox"/> On | Try now |
|  | No Comment | Removes Facebook comments | <input type="checkbox"/> Off <input checked="" type="checkbox"/> On | Try now |
|  | Clickbait Mosaic | Removes clickbait | <input type="checkbox"/> Off <input checked="" type="checkbox"/> On | Try now |
|  | Minute Watch | Notifies you of time spent every minute | <input type="checkbox"/> Off <input checked="" type="checkbox"/> On | Try now |
|  | Supervisor | Shows time spent on site at the top of screen | <input type="checkbox"/> Off <input checked="" type="checkbox"/> On | Try now |
|  | Scroll Freezer | Freezes scrolling after a certain amount of scrolls | <input type="checkbox"/> Off <input checked="" type="checkbox"/> On | Try now |

- Motivation
- The Habitlab Chrome Extension
- **Study 1**
- Study 2
- Qualitative feedback
- Study 3

Compare rotating and static intervention strategies, in terms of:

Effectiveness of interventions over time (daily time on sites)

Attrition rates (time until uninstall)

Within-subjects design, 217 participants

Within-subjects design, 217 participants

Conditions: on some days, users saw the same intervention (**static**), on others, interventions changed each visit (**rotation**)

Within-subjects design, 217 participants

Conditions: on some days, users saw the same intervention (**static**), on others, interventions changed each visit (**rotation**)

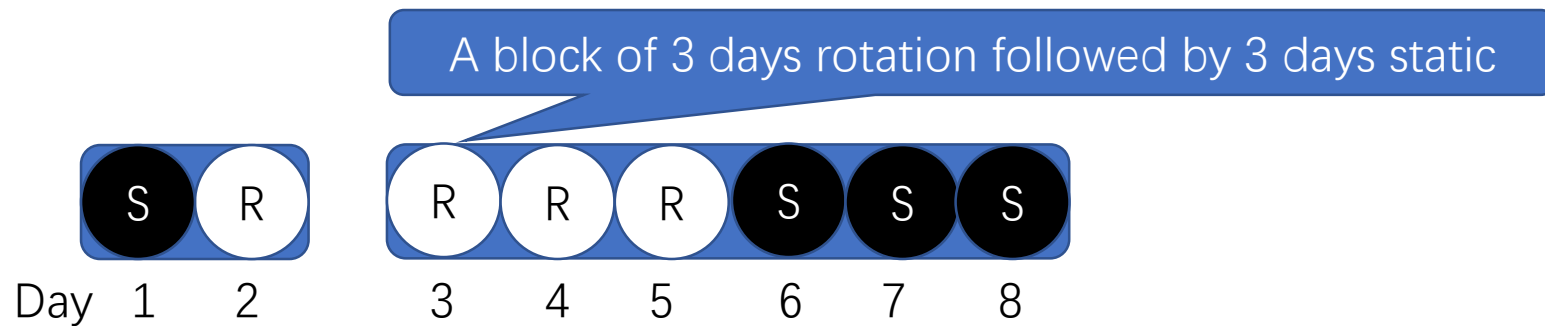
Conditions were organized into blocks of 1, 3, 5, 7 days



Within-subjects design, 217 participants

Conditions: on some days, users saw the same intervention (**static**), on others, interventions changed each visit (**rotation**)

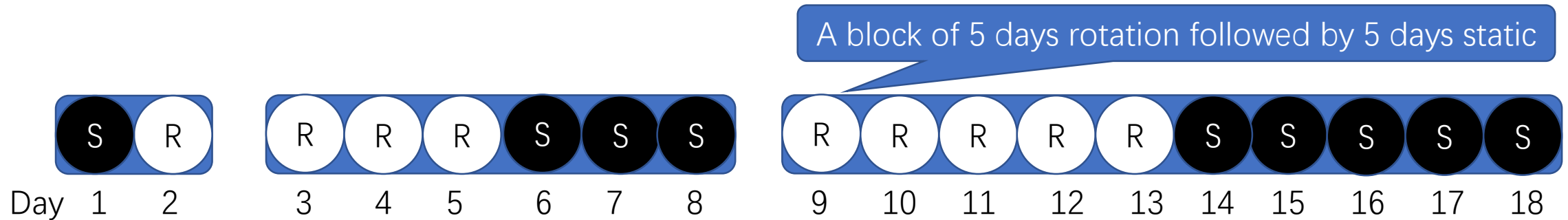
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Within-subjects design, 217 participants

Conditions: on some days, users saw the same intervention (**static**), on others, interventions changed each visit (**rotation**)

Conditions were organized into blocks of 1, 3, 5, 7 days



Do static
interventions
decline in
effectiveness
over time?

Linear Mixed Model

Fixed effects:

#days intervention seen

Random effects:

User ID, Domain

Dependent variable:

Time spent on domain that day (log)

Time spent
on sites
increases over
time with
static
interventions
(decline in
effectiveness)

| | Log time spent per day (dependent variable) |
|------------------------------------|------------------------------------------------|
| # days static intervention seen | 0.225 (p < 0.05) |
| Intercept | 4.759 |
| Observations | 124 |

Interpretation (via exponentiation):

Day 1: 116 seconds per site

Day 2: 146 seconds per site

Day 3: 183 seconds per site

Does rotation
reduce time
spent?

Linear Mixed Model

Fixed effects:

Condition (static or rotation), Block length

Random effects:

User ID, Domain

Dependent variable:

Time spent on domain that day (log)

Daily time
on sites
reduced in
the rotation
condition

| | Log time spent per day (Dependent variable) |
|------------------------------------|------------------------------------------------|
| Rotation (baseline: static) | -0.417 (p < 0.05) |
| Intercept | 4.981 |
| Observations | 370 |

Interpretation (via exponentiation):

Static: 146 seconds per site daily

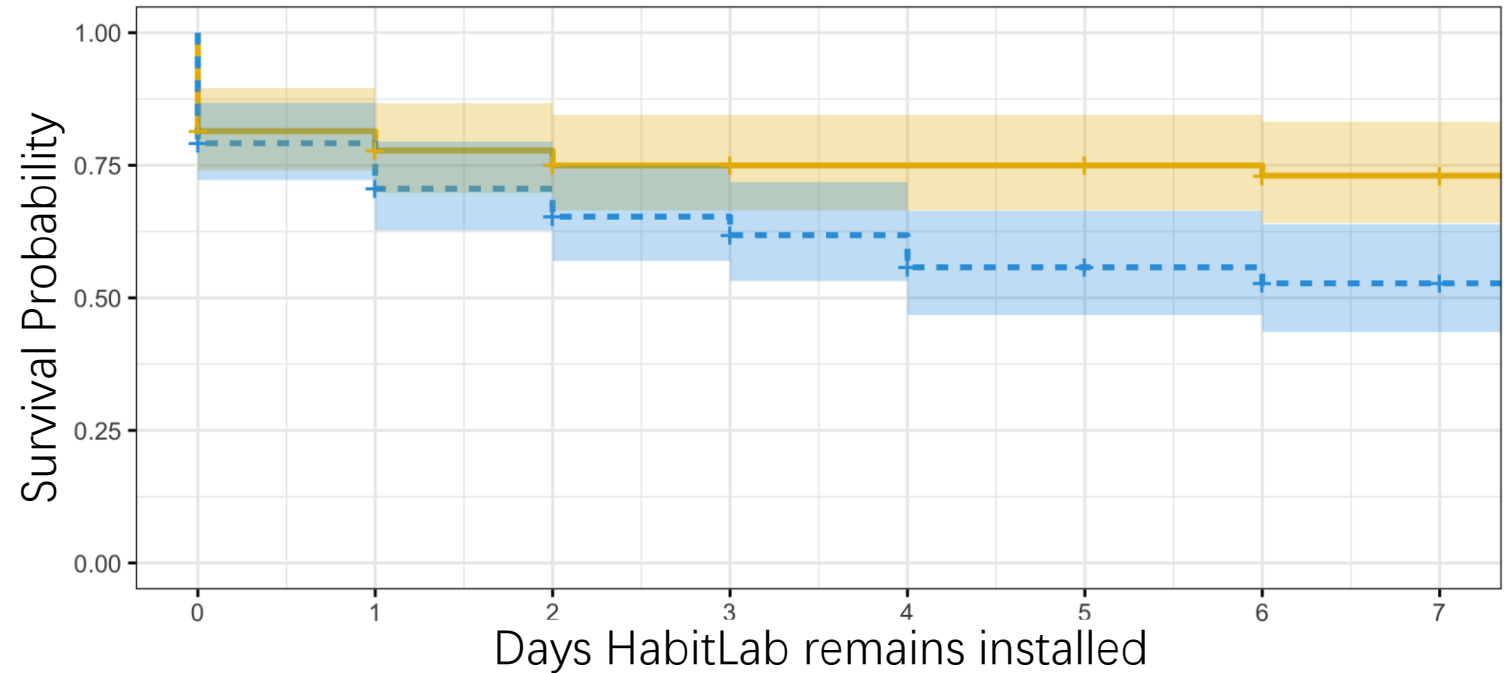
Rotation: 96 seconds per site daily

Does rotation
increase
attrition?

Cox hazard regression

Predicting survival probability as a function of condition (static or rotation), within the first block

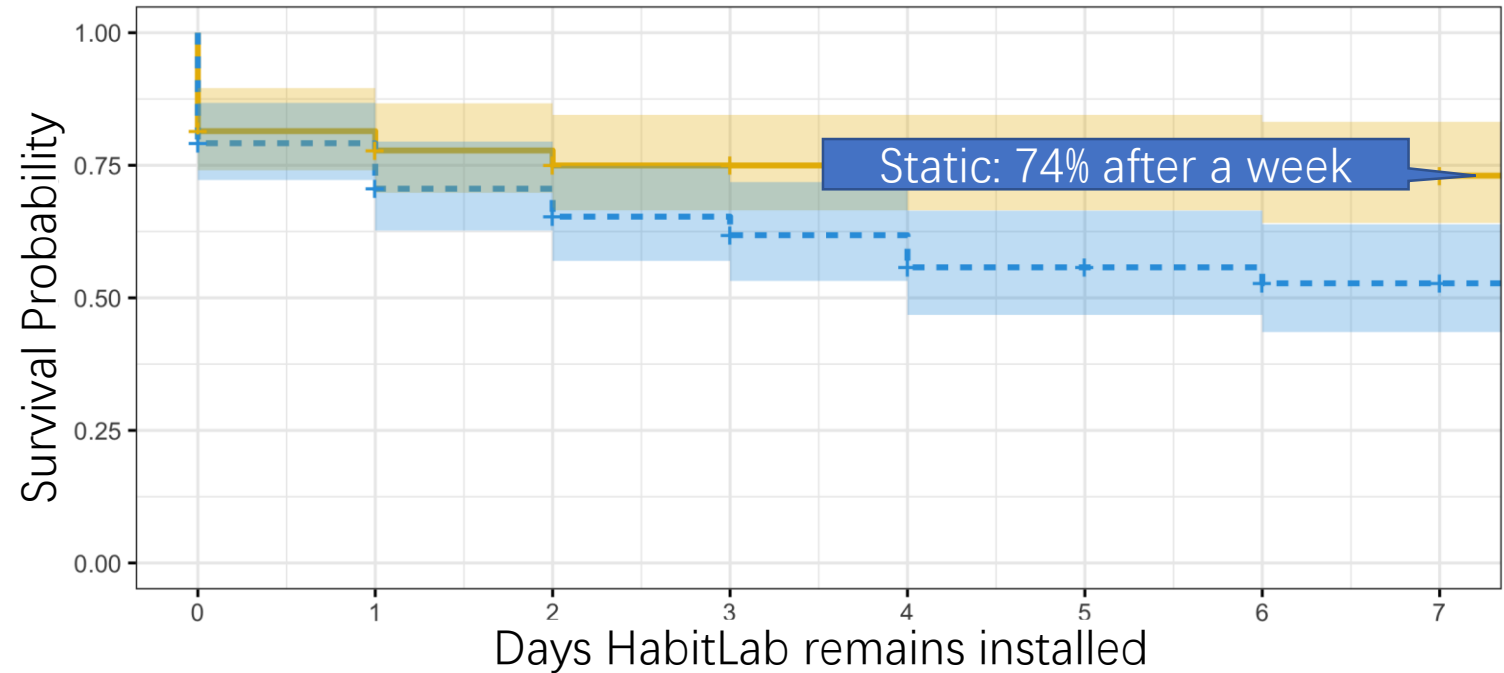
Rotating
interventions
increases
attrition



- Static interventions
- Rotating interventions

Log hazard ratio for rotation
condition: 0.544 ($p < 0.05$)

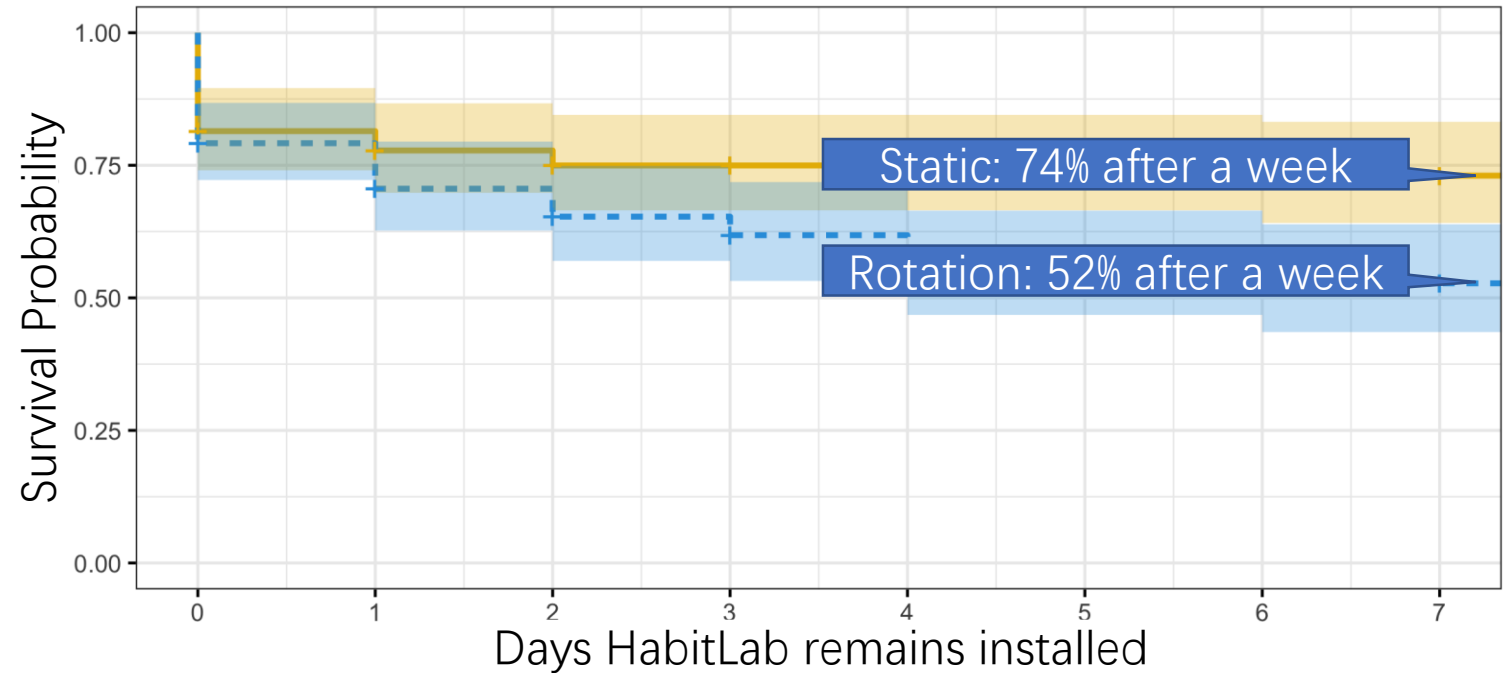
Rotating interventions increases attrition



- Static interventions
- Rotating interventions

Log hazard ratio for rotation condition: 0.544 ($p < 0.05$)

Rotating interventions increases attrition



- Static interventions
- Rotating interventions

Log hazard ratio for rotation condition: 0.544 ($p < 0.05$)

Rotating
interventions
improves
effectiveness
but increases
attrition

- Motivation
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- Study 1
- **Study 2**
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Does rotating between **more interventions** increase attrition?

Does rotating between **more interventions** increase attrition?

Between-subjects design, 409 participants, 5 weeks

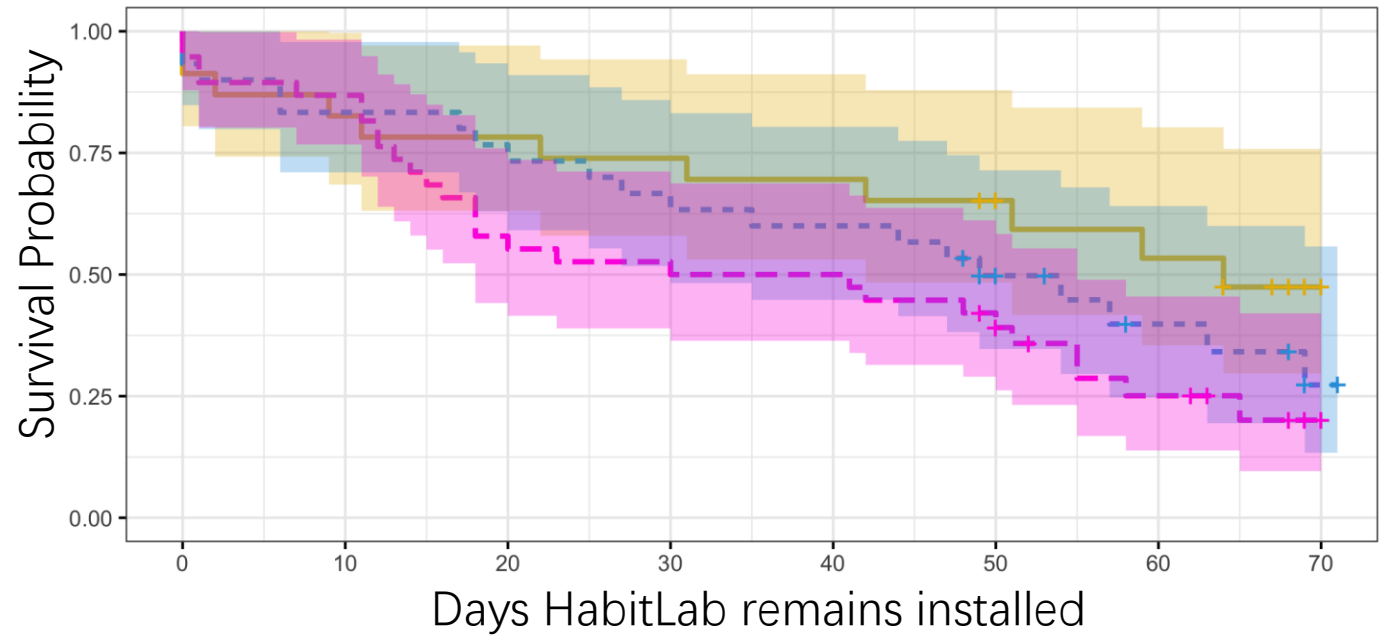
Does rotating between **more interventions** increase attrition?

Between-subjects design, 409 participants, 5 weeks

Conditions differ in number of interventions being rotated:

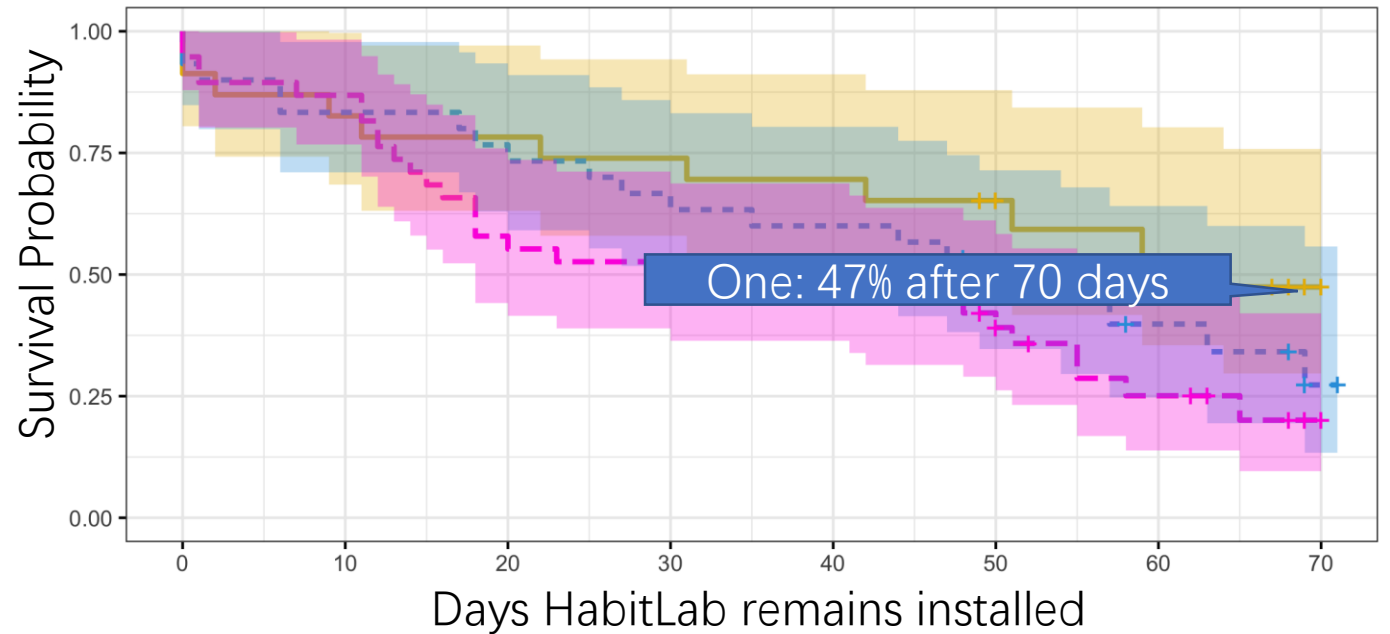
- **One** intervention per site
- **Half** of all available interventions per site (ie, 4 on Facebook)
- **All** available interventions per site (ie, 8 on Facebook)

Rotating between
interventions
increases attrition



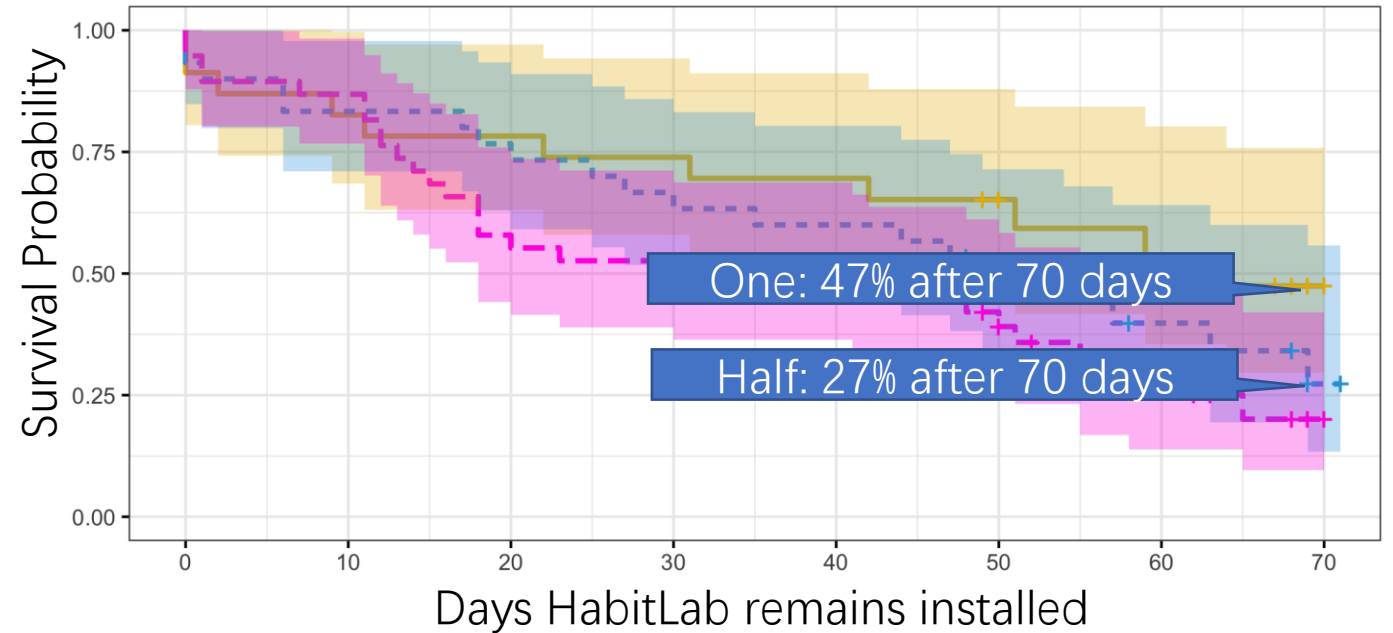
- One intervention
- Half of total interventions
- All interventions

Rotating between interventions increases attrition



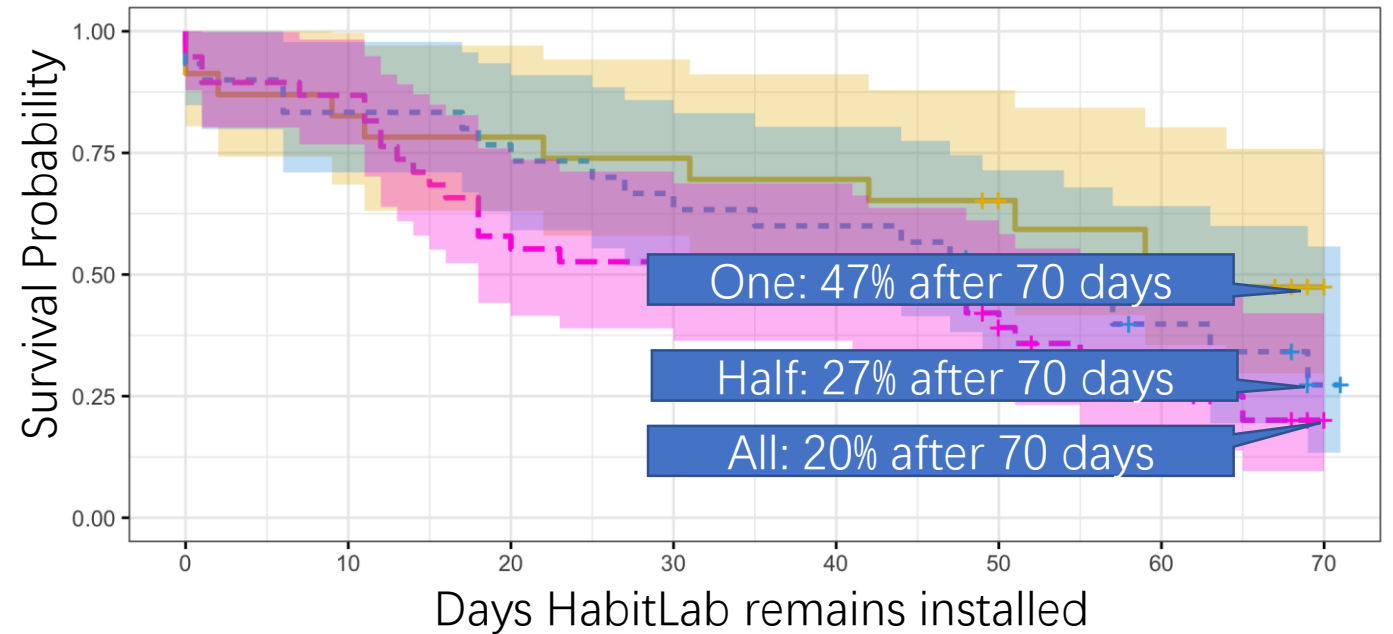
- One intervention
- Half of total interventions
- All interventions

Rotating between interventions increases attrition



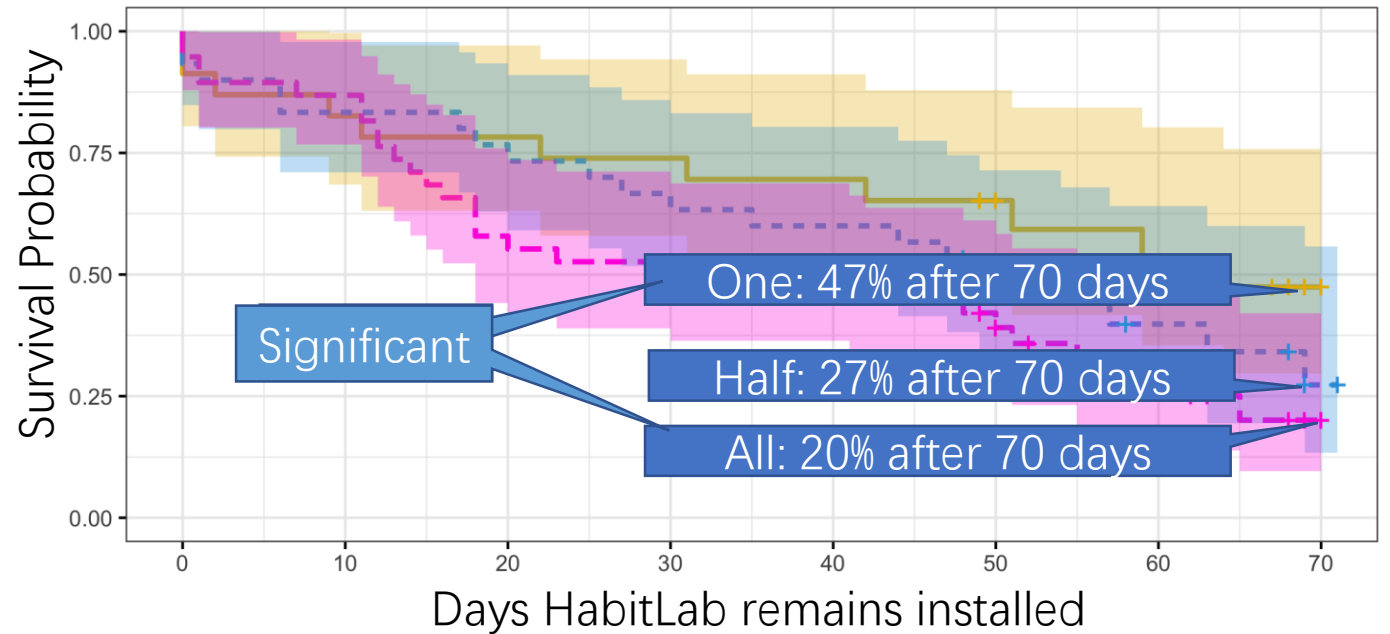
- One intervention
- Half of total interventions
- All interventions

Rotating between
interventions
increases attrition



- One intervention
- Half of total interventions
- All interventions

Rotating between interventions increases attrition



- One intervention
- Half of total interventions
- All interventions

Rotating interventions itself causes attrition

- Motivation
- The Habitlab Chrome Extension
- Study 1
- Study 2
- **Qualitative feedback**
- Study 3

Collected
uninstall
feedback to
understand
reasons for
attrition

Sorry to see you go! HabitLab has been uninstalled

Thanks for trying HabitLab! We'd appreciate your feedback so we can make it better! Why are you uninstalling?

- Interventions were annoying
- Was causing lag
- Did not feel effective
- Privacy concerns
- Other reason

We would appreciate your feedback here

Submit

Collected
uninstall
feedback to
understand
reasons for
attrition

Incorrect mental models

Didn't seem what I was expected. Installed two minutes ago and removed it

Dissatisfaction with particular interventions

Mostly it was the bar covering up facebook message indicators

Why did
rotating
interventions
increase
attrition?

Violation of mental models
Users lack sense of control

Rotating
interventions
improves
effectiveness
but increases
attrition

- Motivation
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- **Study 3**

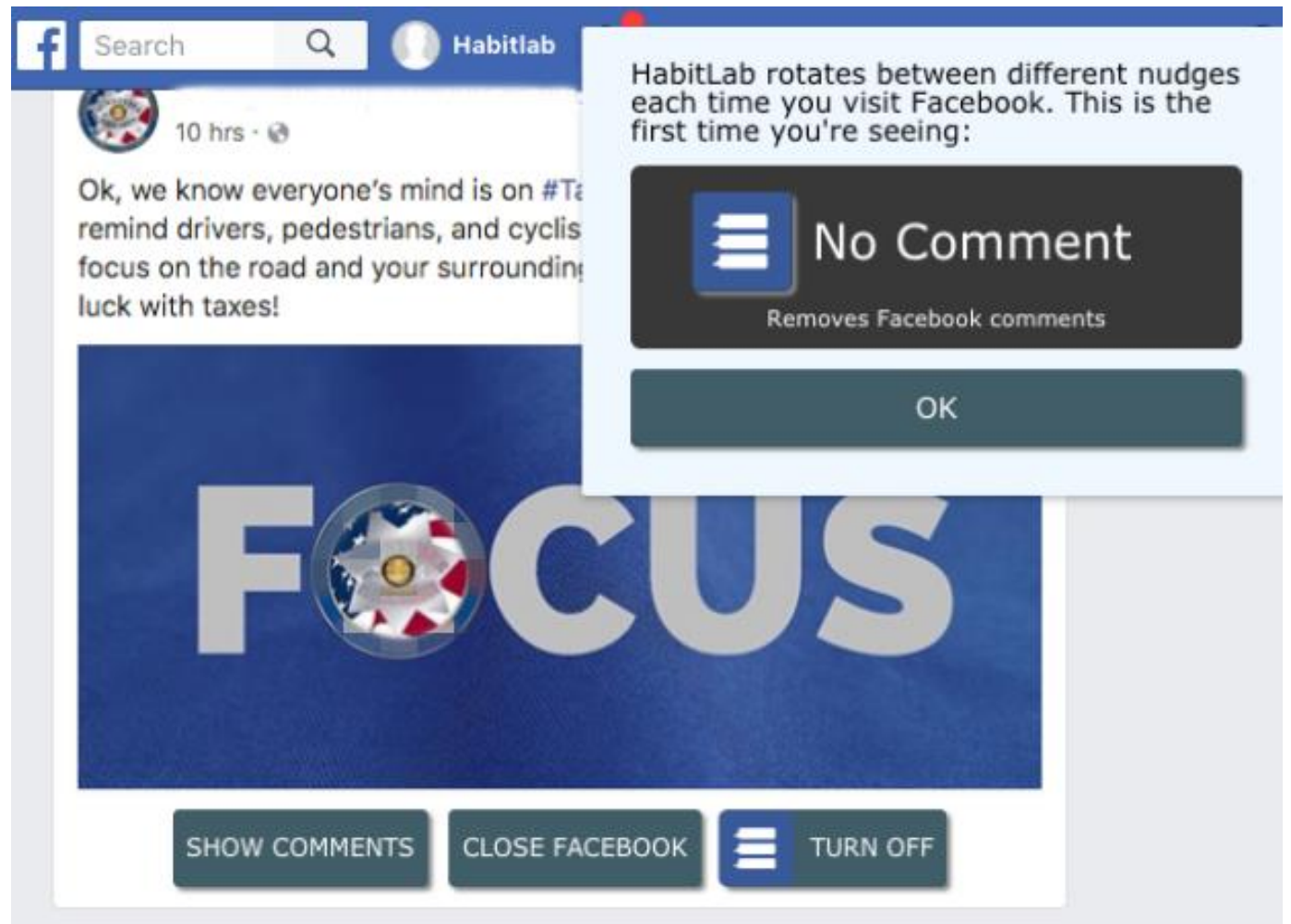
Can we
reduce
attrition when
intervention
rotation
happens?

Developed 2 dialogs shown when an
intervention is first seen

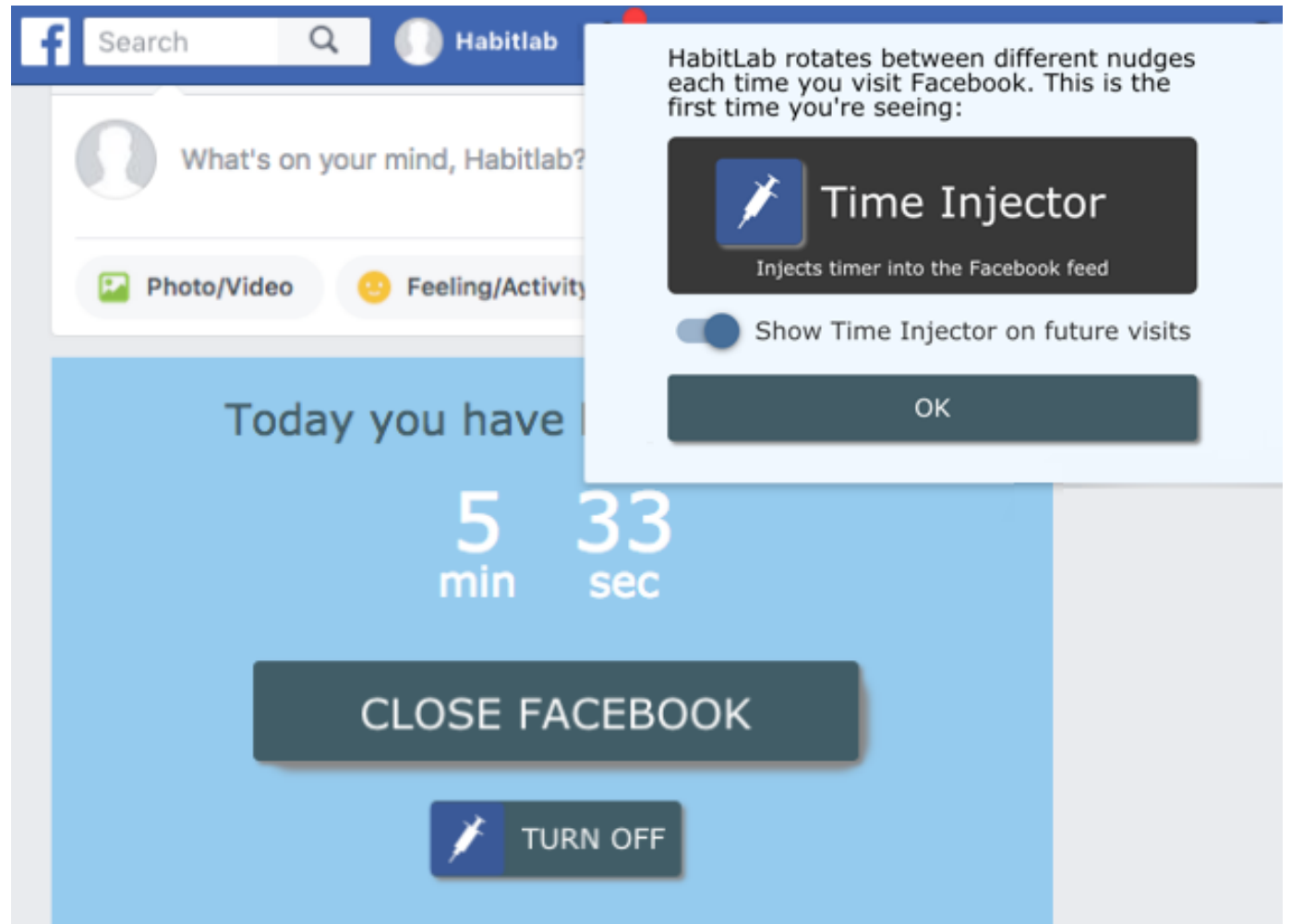
Mental model design

User control design

Mental model design



User control design



Between subjects design, 282 participants, 10 days

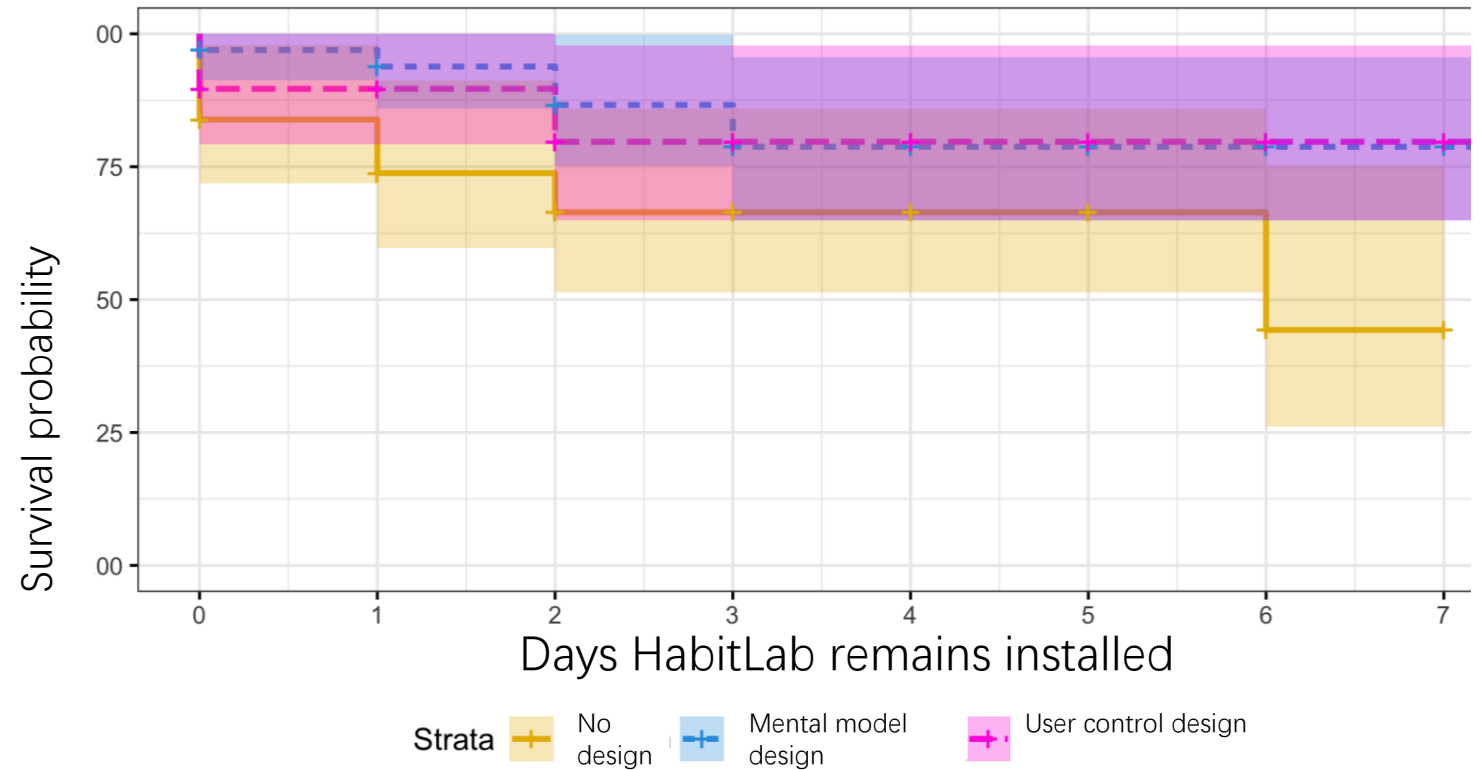
Conditions differ according to which design is shown when an intervention is seen for the first time:

None: No design shown

Mental model design

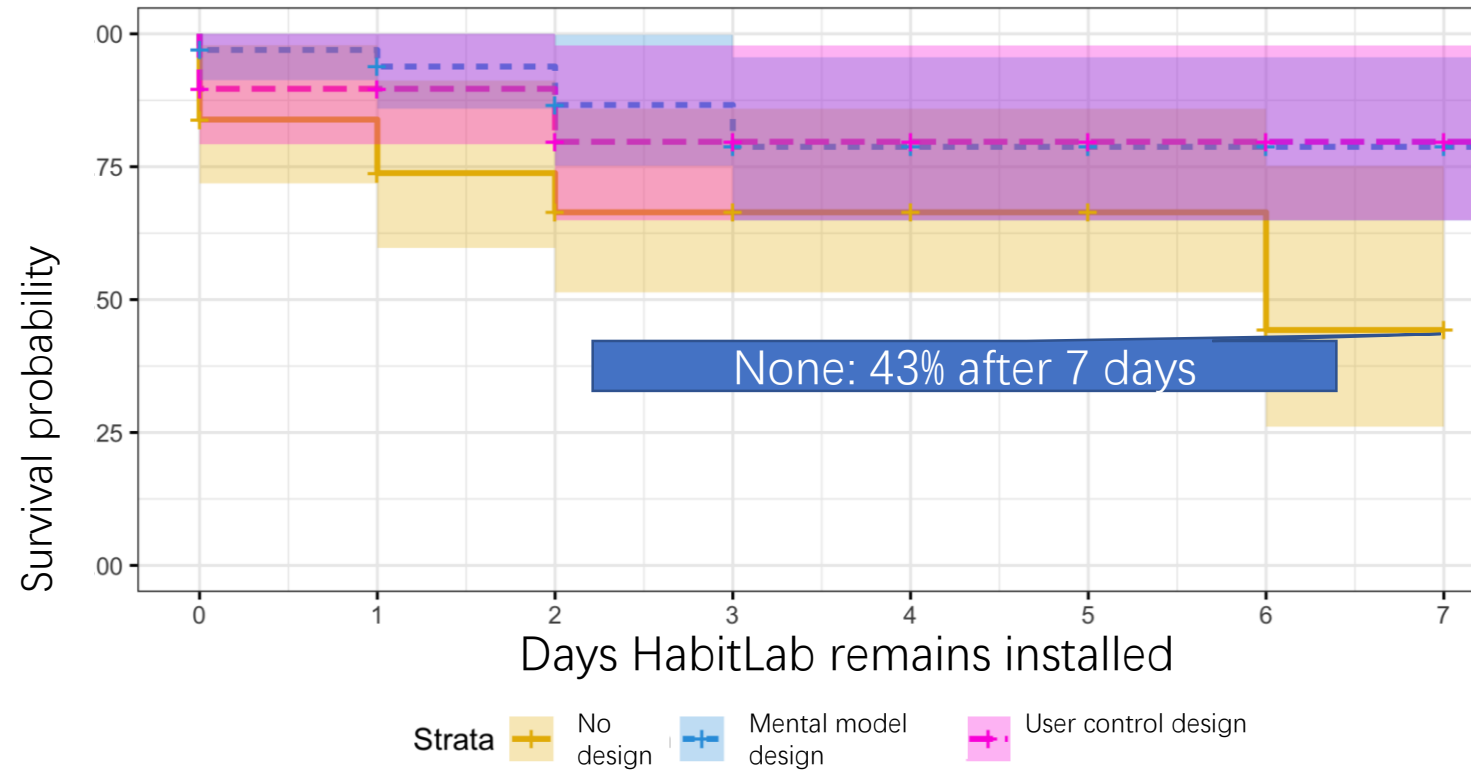
User control design

Mental model design reduces attrition by half



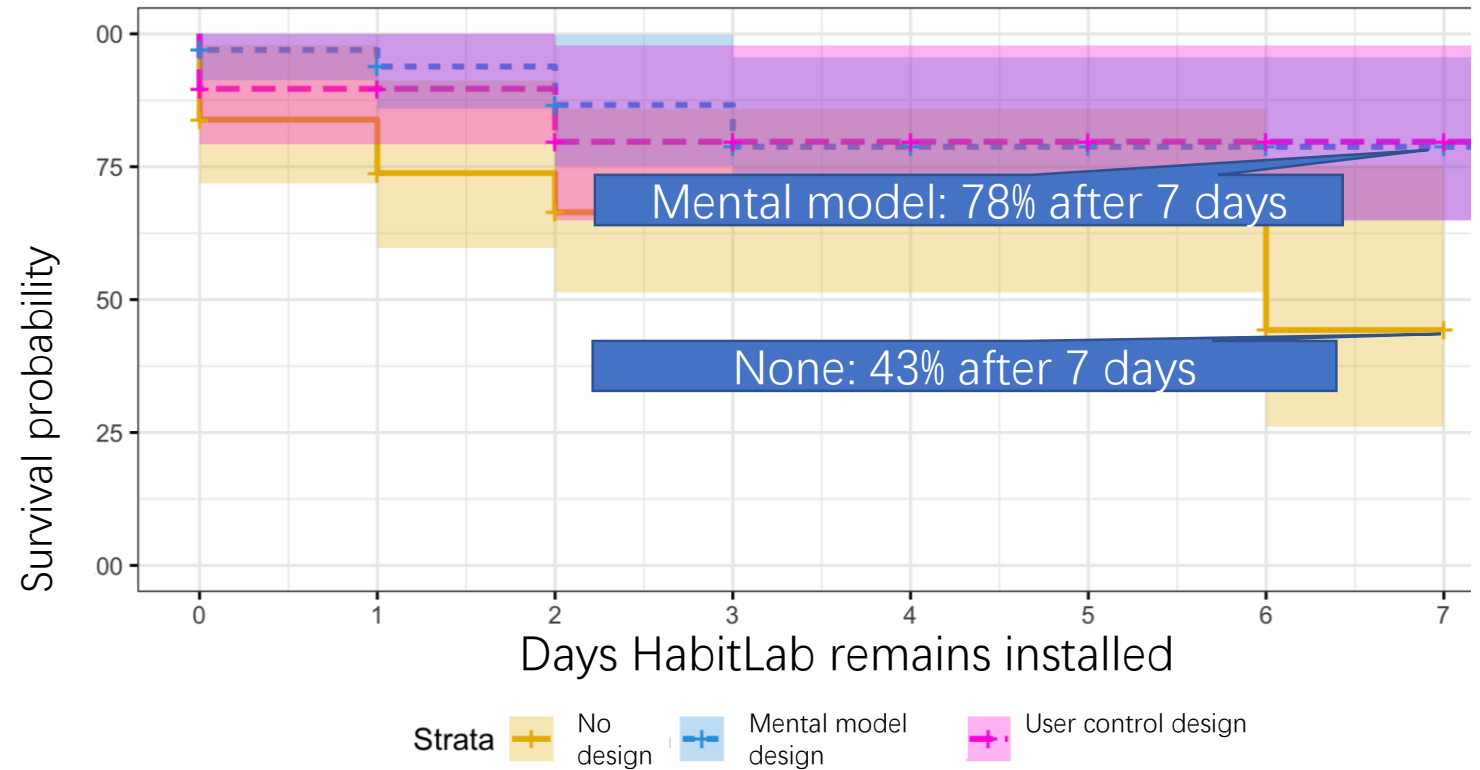
| Design | Log hazard ratio |
|--------------|-------------------|
| Mental model | -1.015 (p < 0.05) |
| User control | -0.869 |

Mental model design reduces attrition by half



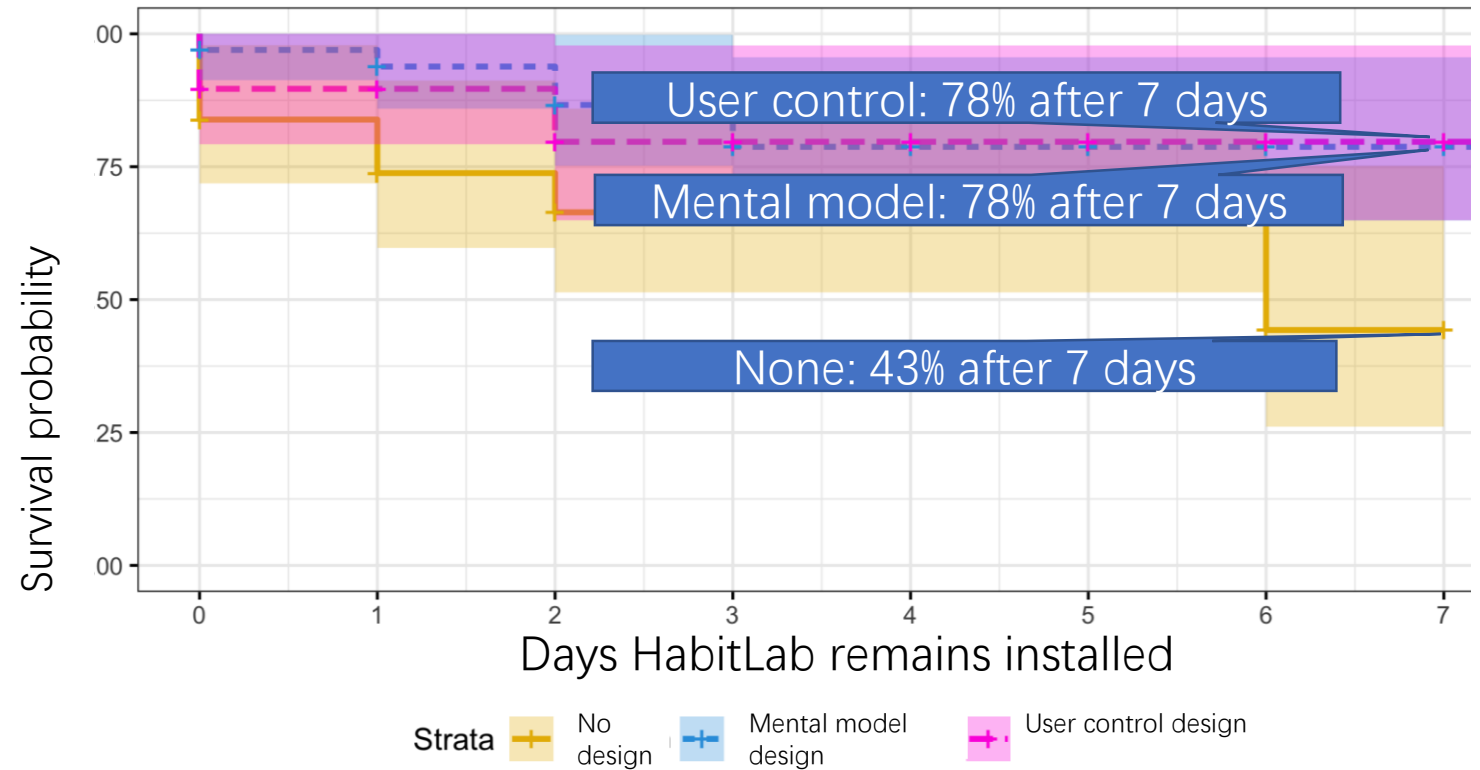
| Design | Log hazard ratio |
|--------------|-------------------|
| Mental model | -1.015 (p < 0.05) |
| User control | -0.869 |

Mental model design reduces attrition by half



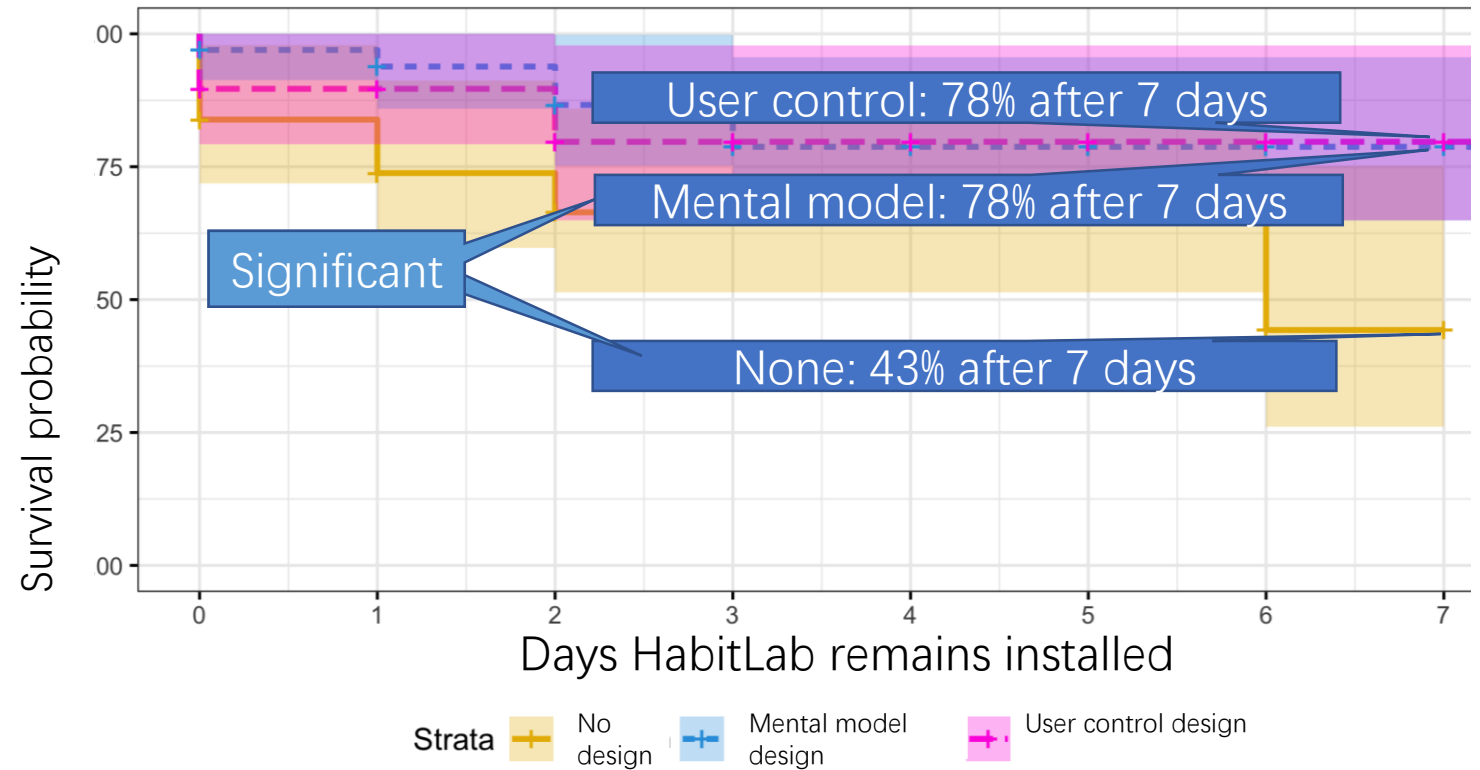
| Design | Log hazard ratio |
|--------------|-------------------|
| Mental model | -1.015 (p < 0.05) |
| User control | -0.869 |

Mental model design reduces attrition by half



| Design | Log hazard ratio |
|--------------|-------------------|
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Mental model design reduces attrition by half



| Design | Log hazard ratio |
|--------------|-------------------|
| Mental model | -1.015 (p < 0.05) |
| User control | -0.869 |

Conclusions

- Static interventions **decline in effectiveness** over time
- Rotating interventions **improves effectiveness** but **increases attrition**
- Attrition may be due to **incorrect mental models** and lack of control
- We can reduce attrition with a simple design that improves users' mental models

Rotating online behavior change interventions increases effectiveness but also increases attrition

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