

# Rotating online behavior change interventions increases effectiveness but also increases attrition

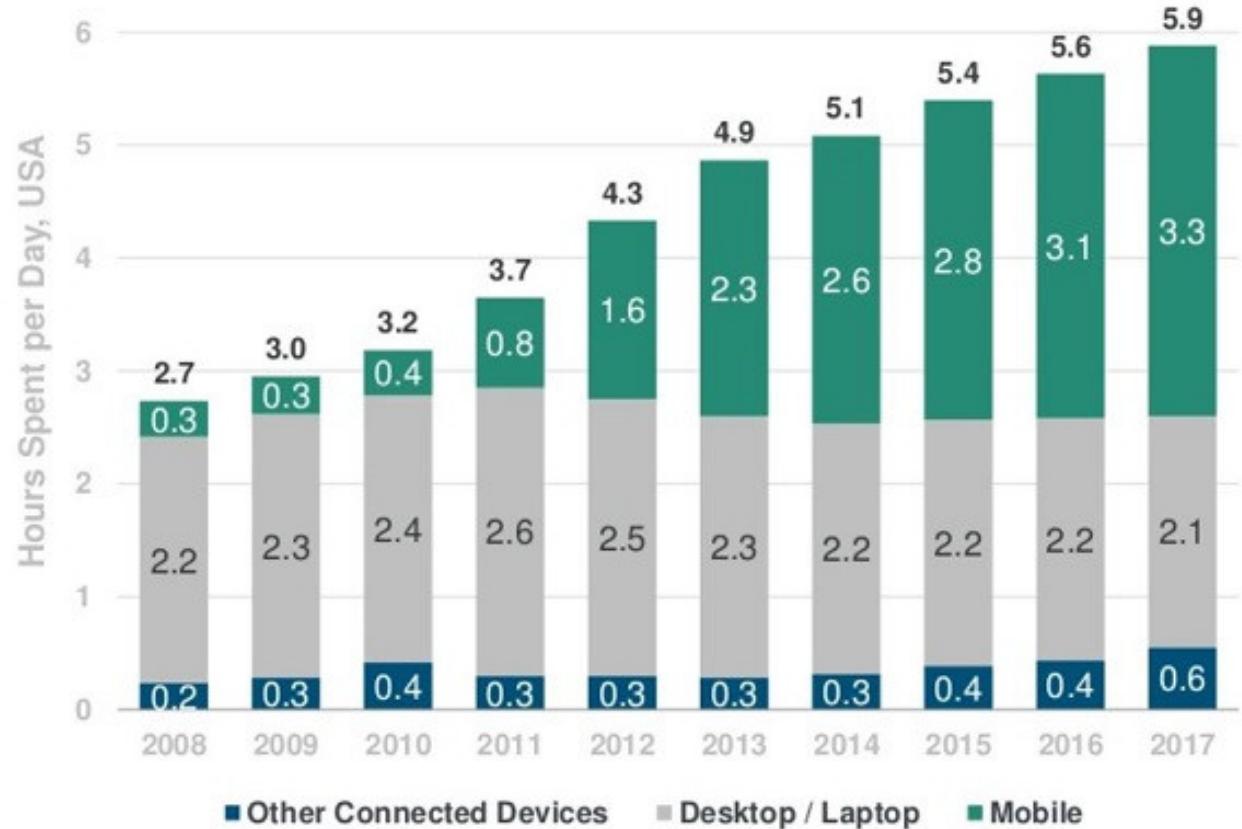
Geza Kovacs  
Zhengxuan Wu  
Michael Bernstein

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

A close-up photograph of a large pile of M&M's candies. The candies are of various colors, including red, blue, green, yellow, orange, and brown. They are scattered across the frame, filling the left side of the image. A thick white diagonal line runs from the bottom-left corner to the top-right corner, separating the candy image from the text area.

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

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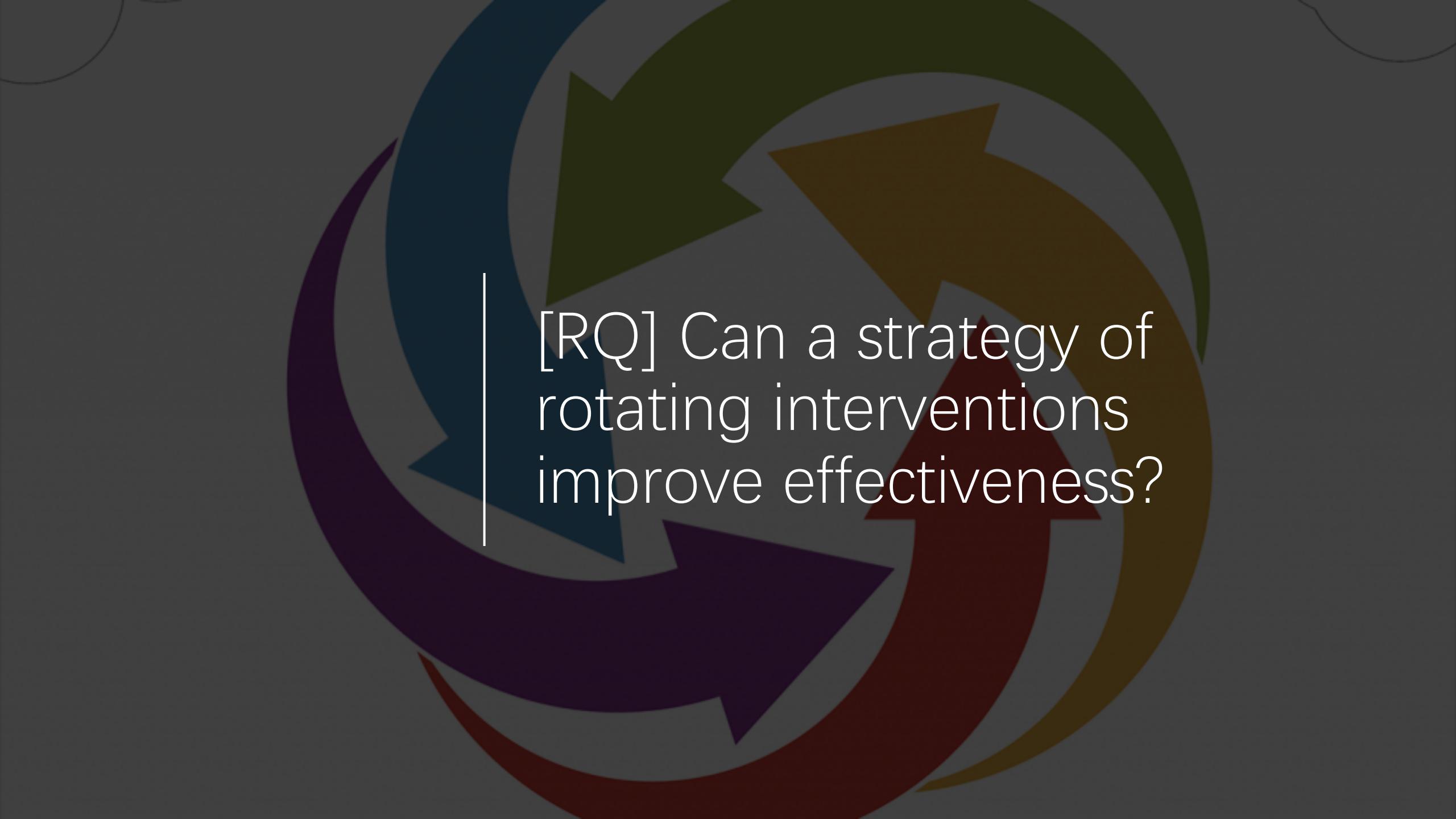
# RescueTime



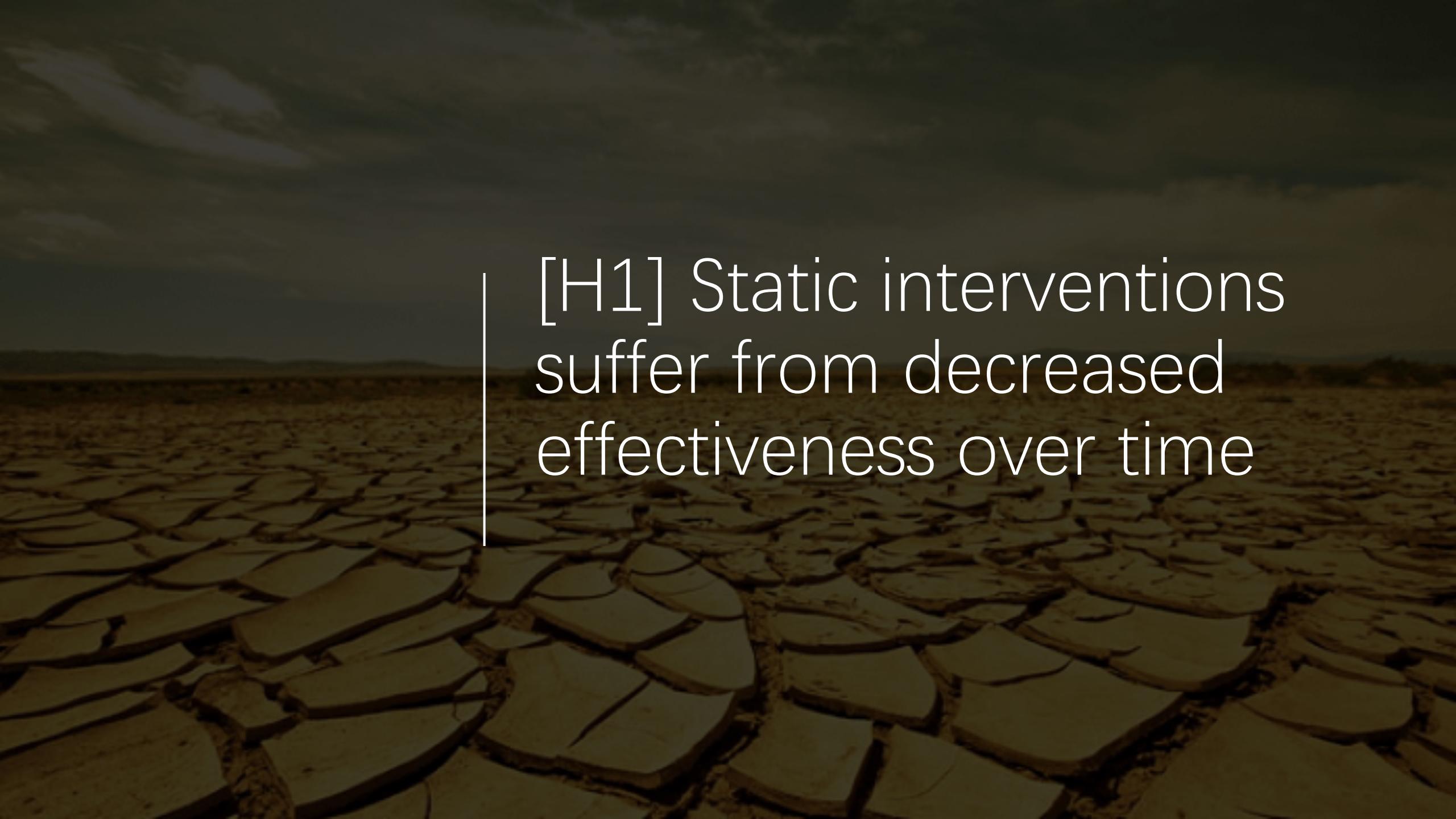
# StayFocusd

Block **time-wasting** websites

Crx4Chrome



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

The background of the slide features a dramatic, dark landscape. In the foreground, the ground is covered in deep, irregular cracks of dry, light-colored earth, characteristic of a desert or arid region after a long drought. Above the horizon, the sky is filled with heavy, dark, grey clouds, suggesting an approaching storm or a very overcast day. The overall mood is somber and suggests themes of environmental degradation or the passage of time.

[H1] Static interventions  
suffer from decreased  
effectiveness over time

A photograph of a lush garden with a variety of colorful flowers, including red, yellow, purple, and white, growing in raised beds made of dark grey stones. The garden is well-maintained and slopes upwards from left to right.

[H2] Rotation will  
increase intervention  
effectiveness

# Why study novelty effects in online behavior change?

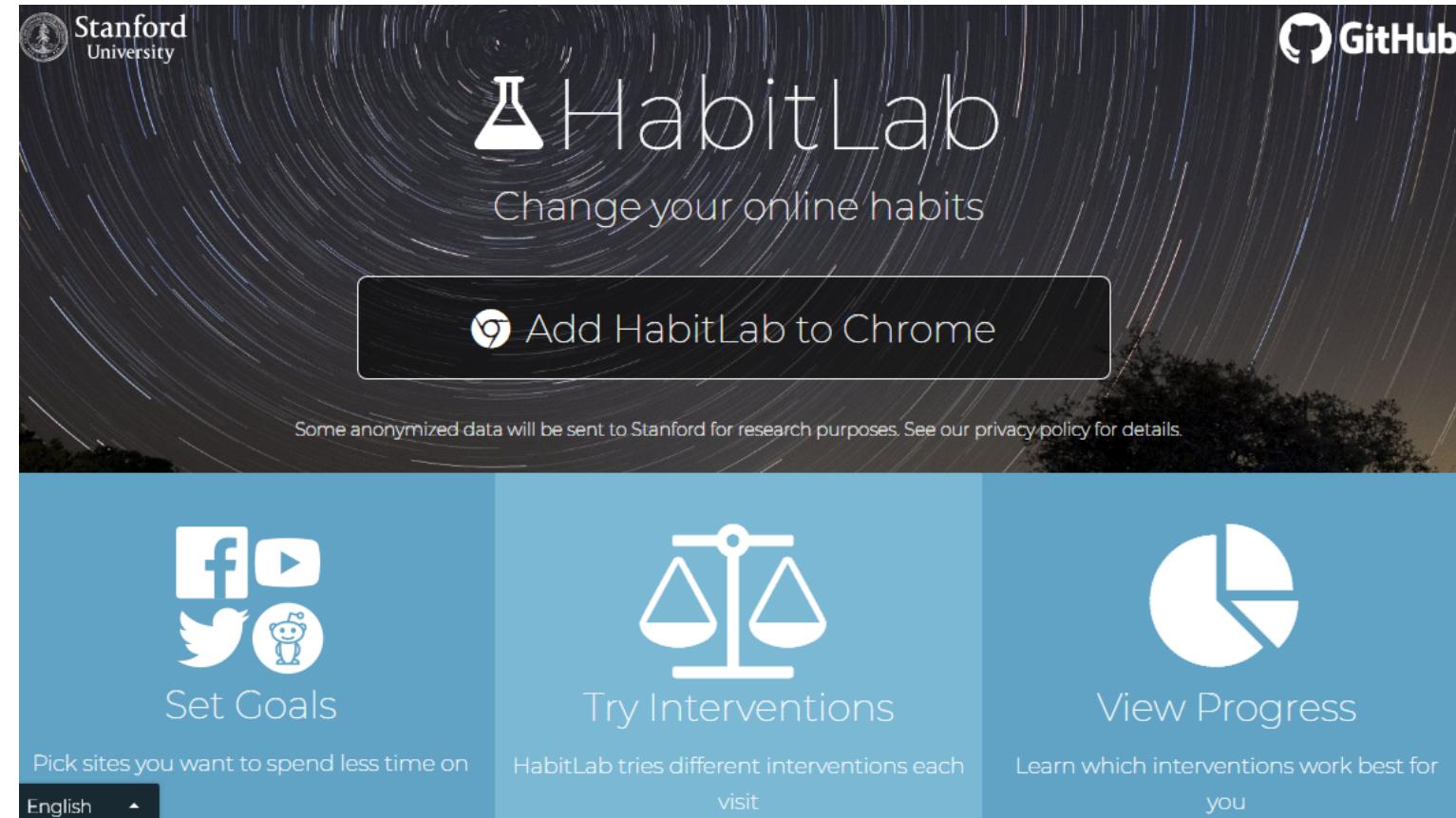
- Can measure effectiveness (time spent per visit)
- Many interventions possible (can modify sites)
- Can frequently alter interventions (can change intervention every visit)

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

# HabitLab

Our browser behavior change platform

8000+ in-the-wild active users



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



1 Min  
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



2



8



Geza Minh Trung ...

动态消息 ...

Messenger

Watch

快速访问

13 48th Half Moon B...

13 Corgi Con - Fall E...

13 Bachata Sentimie...

Stanford Climbing... 2

发现

12 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



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

13 本周有 2 个活动

Stephany Liu 今天过生日

加好友请求



Thai Dao

共同好友: Anh Tran

接受请求

全部

Geza Minh Trung ...

发帖 照片/视频相册 直播视频

快拍

私人影集 · 设置

动态消息

Messenger

Watch

快速访问

48th Half Moon

Corgi Con - Fa

Bachata Senti

Stanford Climb

发现

活动

公共主页

小组

好友名单

筹款活动

展开...



Geza Minh Trung Kovacs, 分享你的新鲜事吧



Blake Villanueva ▶ Fullout Funk Squad

14 小时

...

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



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>)



r/popular

The best posts on Reddit from the most active communities on Reddit. Check here to see the most upvoted, and commented posts on the internet.

CREATE

# Welcome to Reddit!

Come for the cats, stay for the empathy.

BECOME A REDDITOR

CLOSE TAB

Time remaining:

0 **38**  
min sec

ADD  
TIME

Time added:

0  
min

TURN OFF



Posted by u/FuegoFerdinand 3 hours ago

Clerk who refused to sign marriage  
for gay couples, loses to Democrat

s/p... ↗



Share Save ...

Posted by u/throwaway1637482 16 hours ago

Trouble for giving my underage wife alcohol? BOLA Posted

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

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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



TURN OFF

Yiruma, ( 이루마 ) - River Flows in You

70,360,928次观看

95万

1万

分享

...  
三

接下来播放

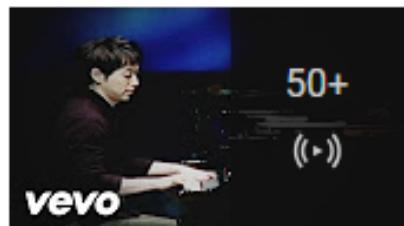
自动播放



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



Toms Mucenieks ✓

30+  
interventions  
available

## Nudges

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



### Time Injector

Injects timer into the Facebook feed

Off

On

Try now



### Feed Eater

Removes the Facebook news feed

Off

On

Try now



### TimeKeeper

Notifies you of time spent in the corner of your desktop

Off

On

Try now



### No Comment

Removes Facebook comments

Off

On

Try now



### Clickbait Mosaic

Removes clickbait

Off

On

Try now



### Minute Watch

Notifies you of time spent every minute

Off

On

Try now



### Supervisor

Shows time spent on site at the top of screen

Off

On

Try now



### Scroll Freezer

Freezes scrolling after a certain amount of scrolls

Off

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

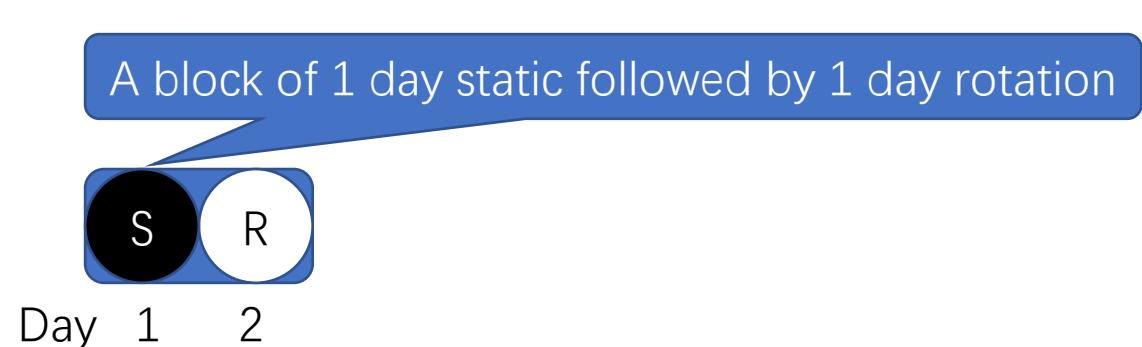
Within-subjects design, 217 participants

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

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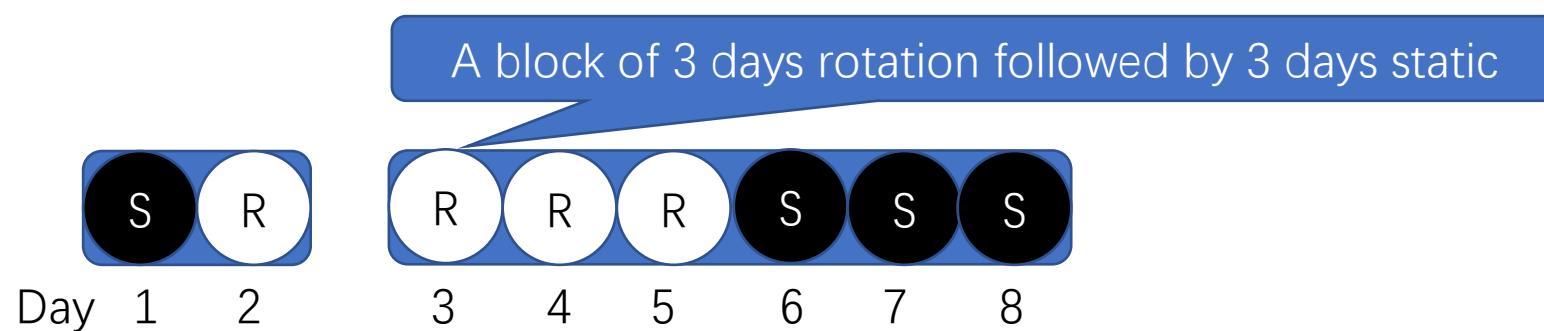
Conditions were organized into blocks of 1, 3, 5, 7 days



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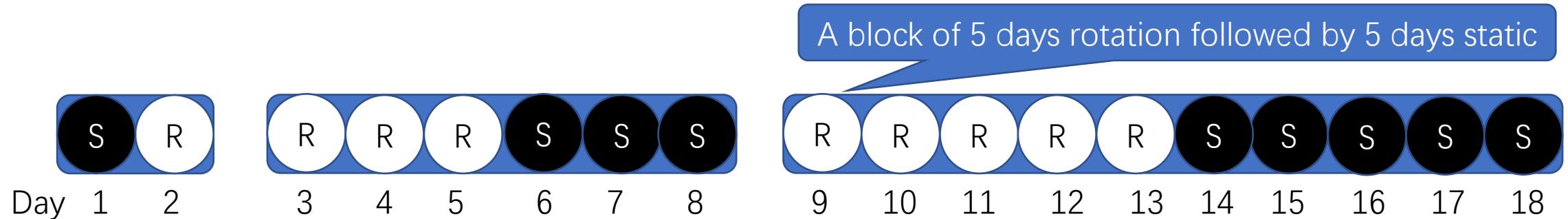
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Within-subjects design, 217 participants

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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)
<b>Rotation (baseline: static)</b>	-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

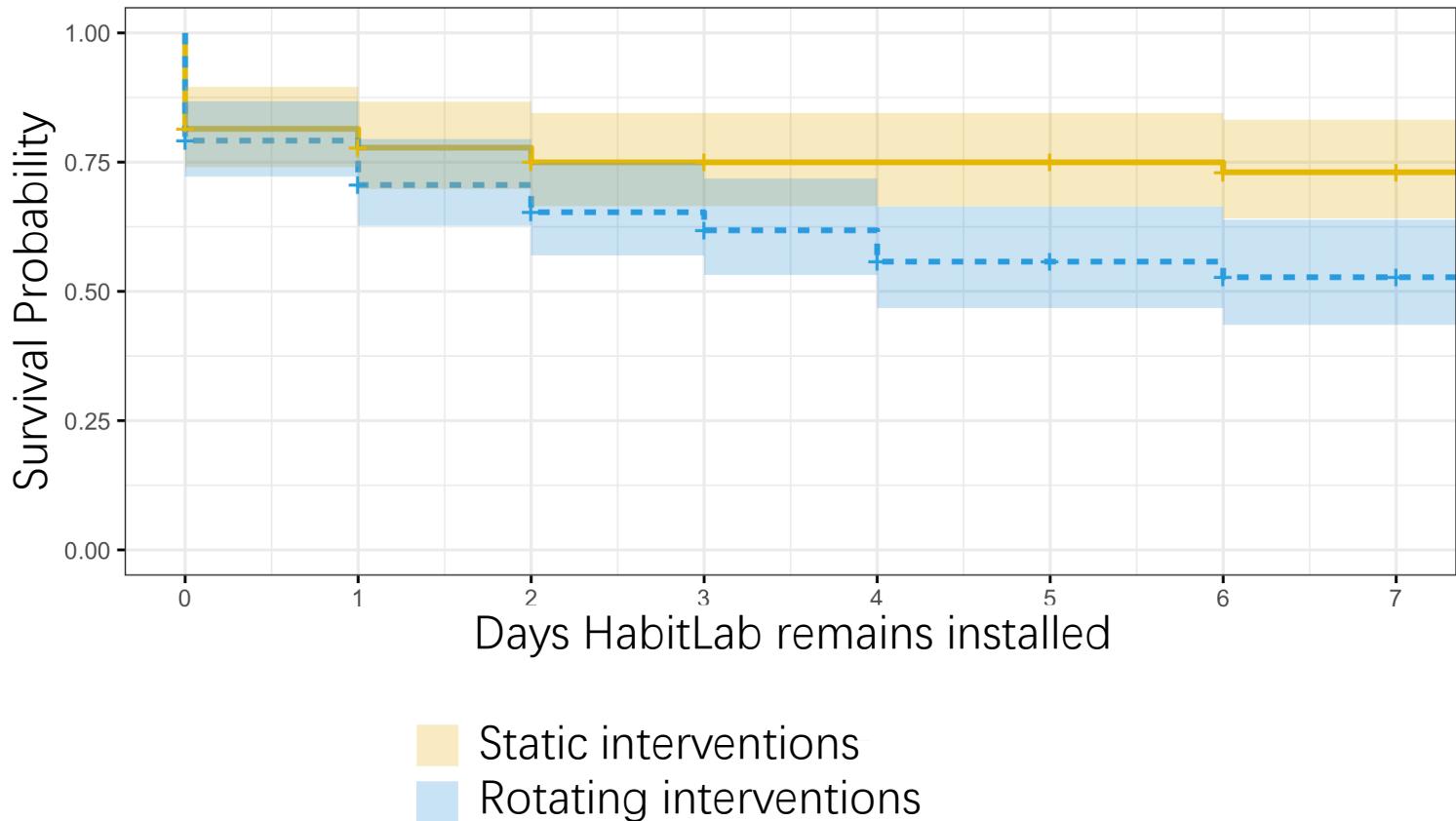
# Does rotation increase attrition?

Cox hazard regression

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

# Rotating interventions increases attrition

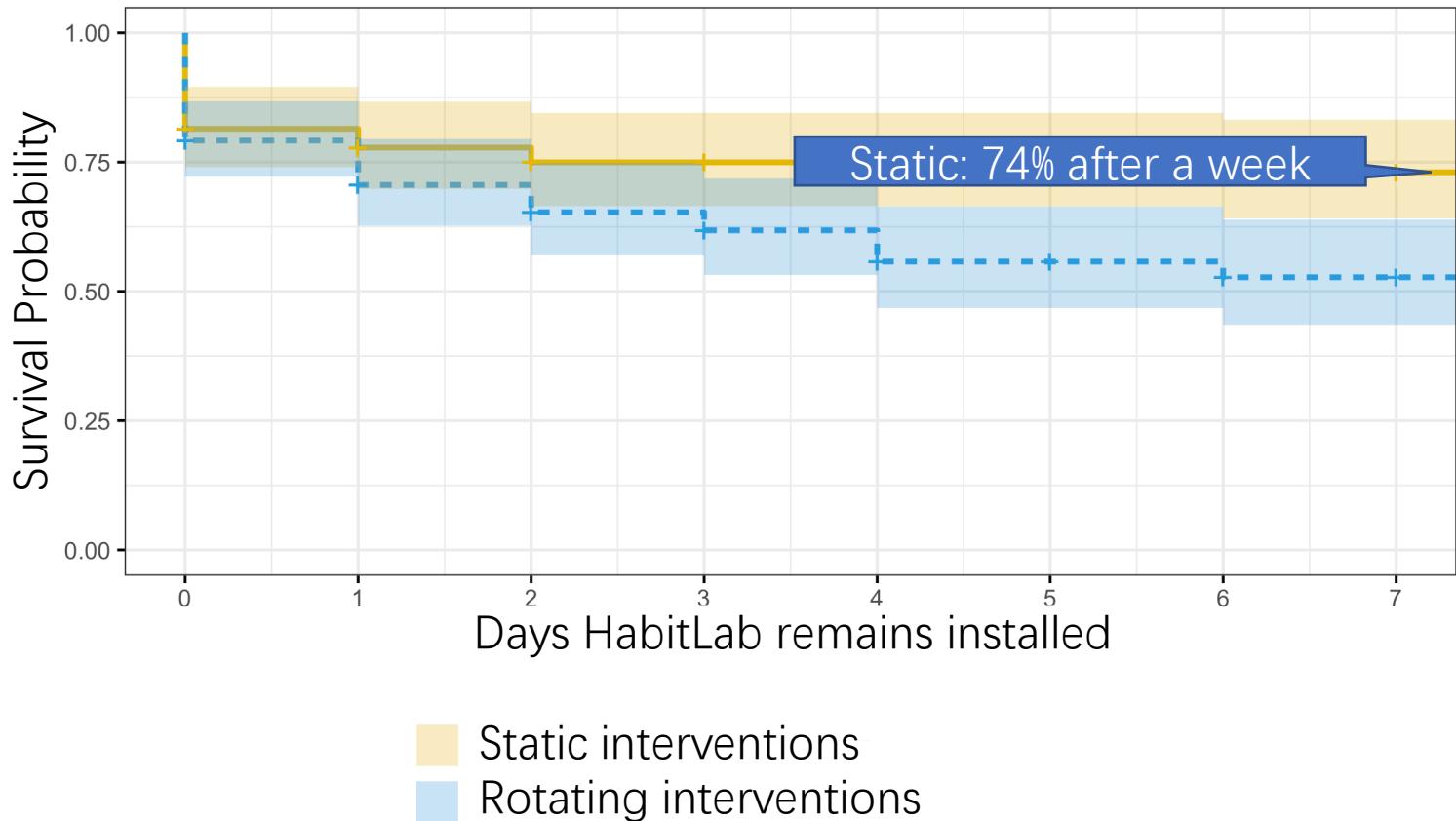
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Log hazard ratio for rotation condition: 0.544 ( $p < 0.05$ )

# Rotating interventions increases attrition

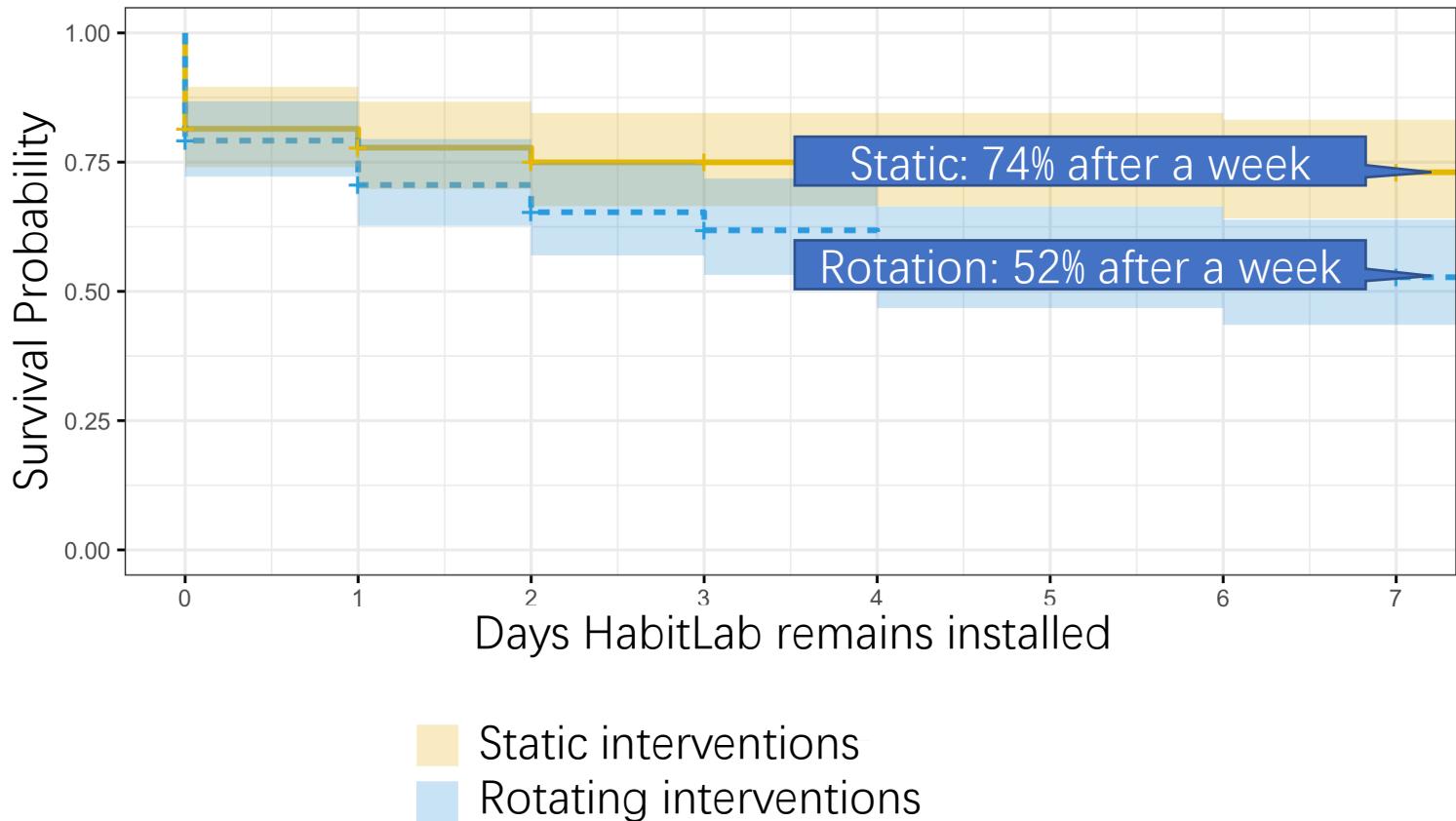
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Log hazard ratio for rotation condition: 0.544 ( $p < 0.05$ )

# Rotating interventions increases attrition

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

Rotating  
interventions  
improves  
effectiveness  
but increases  
attrition

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- Qualitative feedback
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Does rotating between **more interventions** increase attrition?

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Between-subjects design, 409 participants, 5 weeks

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

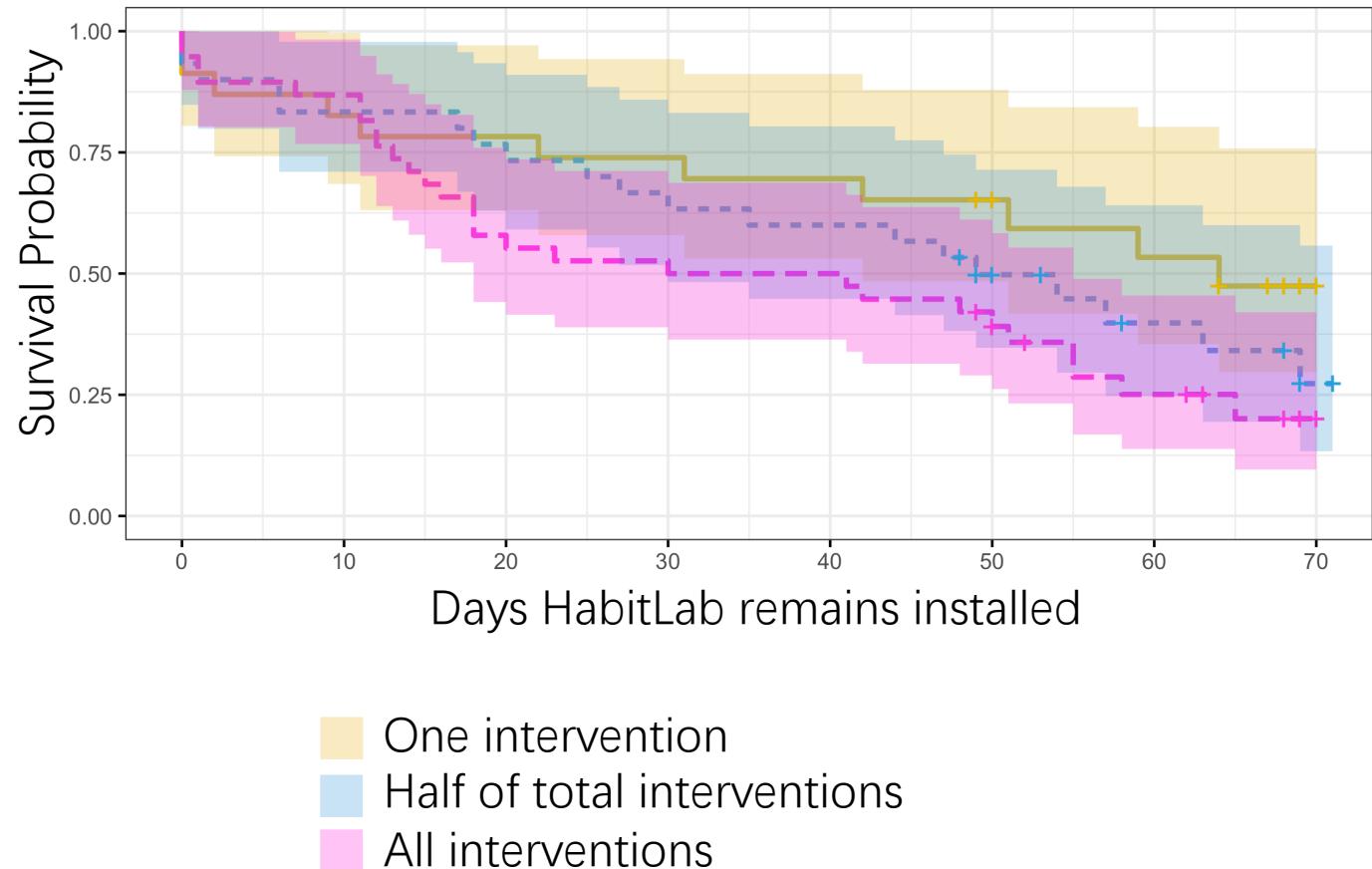
Between-subjects design, 409 participants, 5 weeks

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)

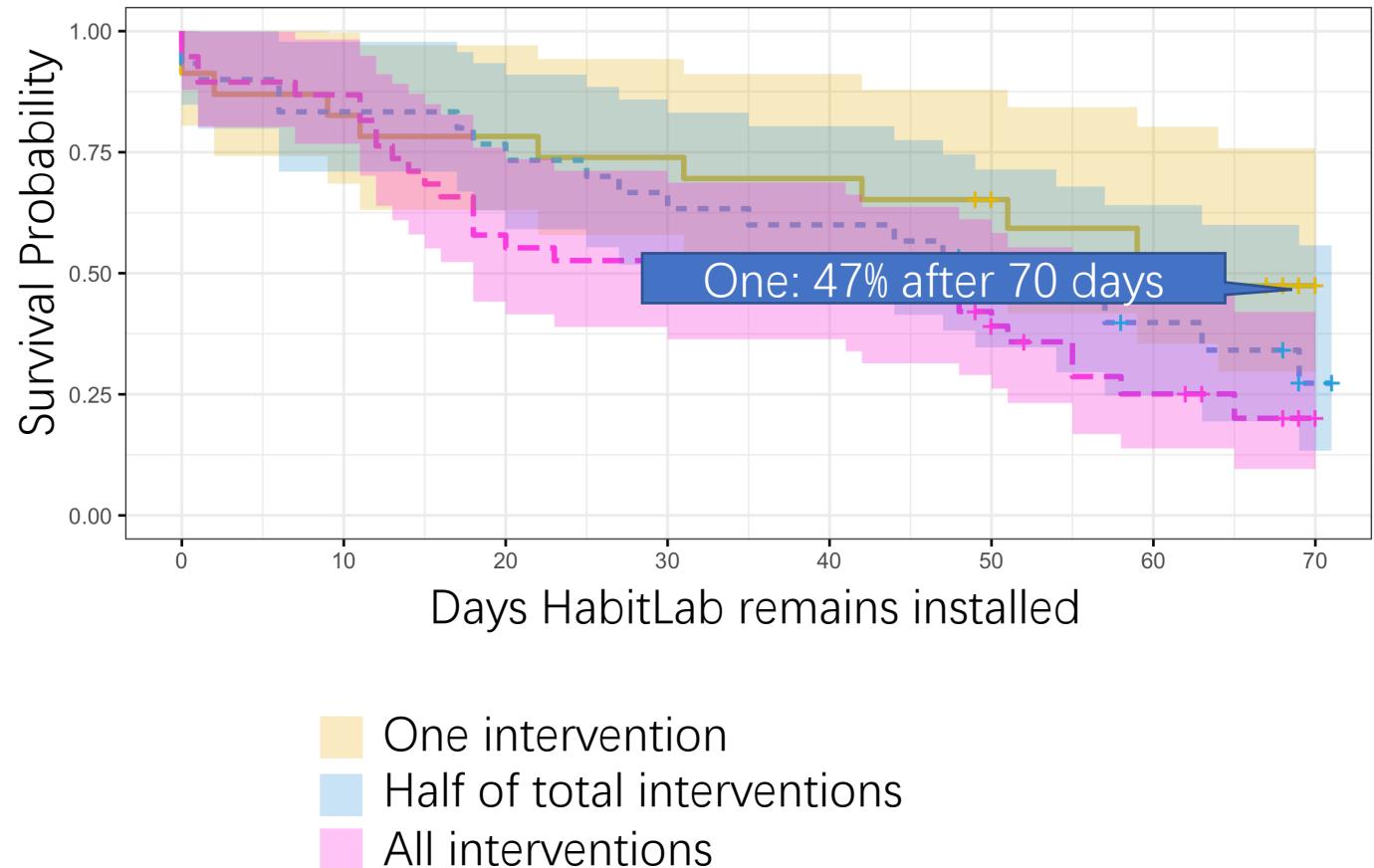
Rotating between  
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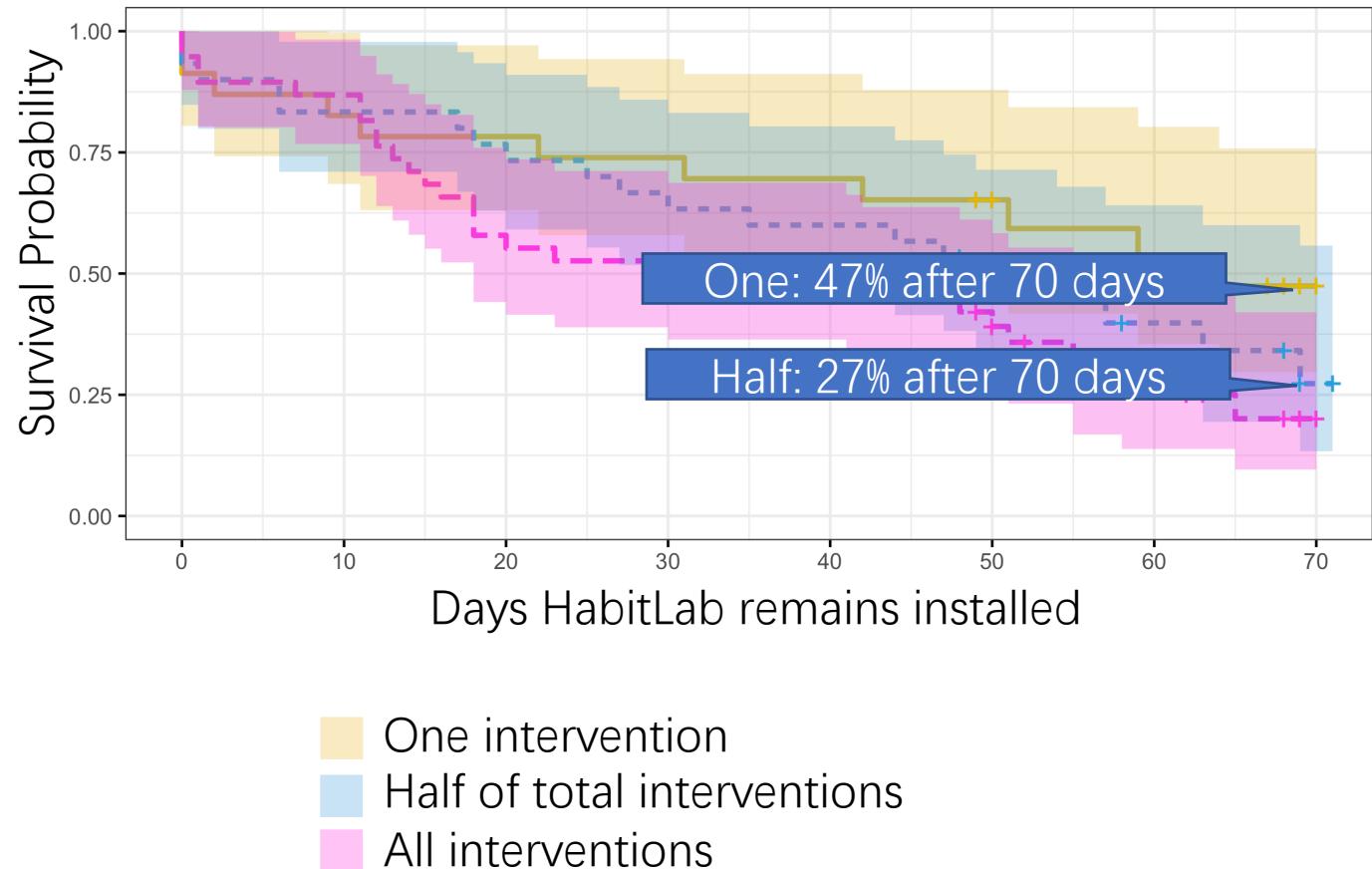
# Rotating between interventions increases attrition

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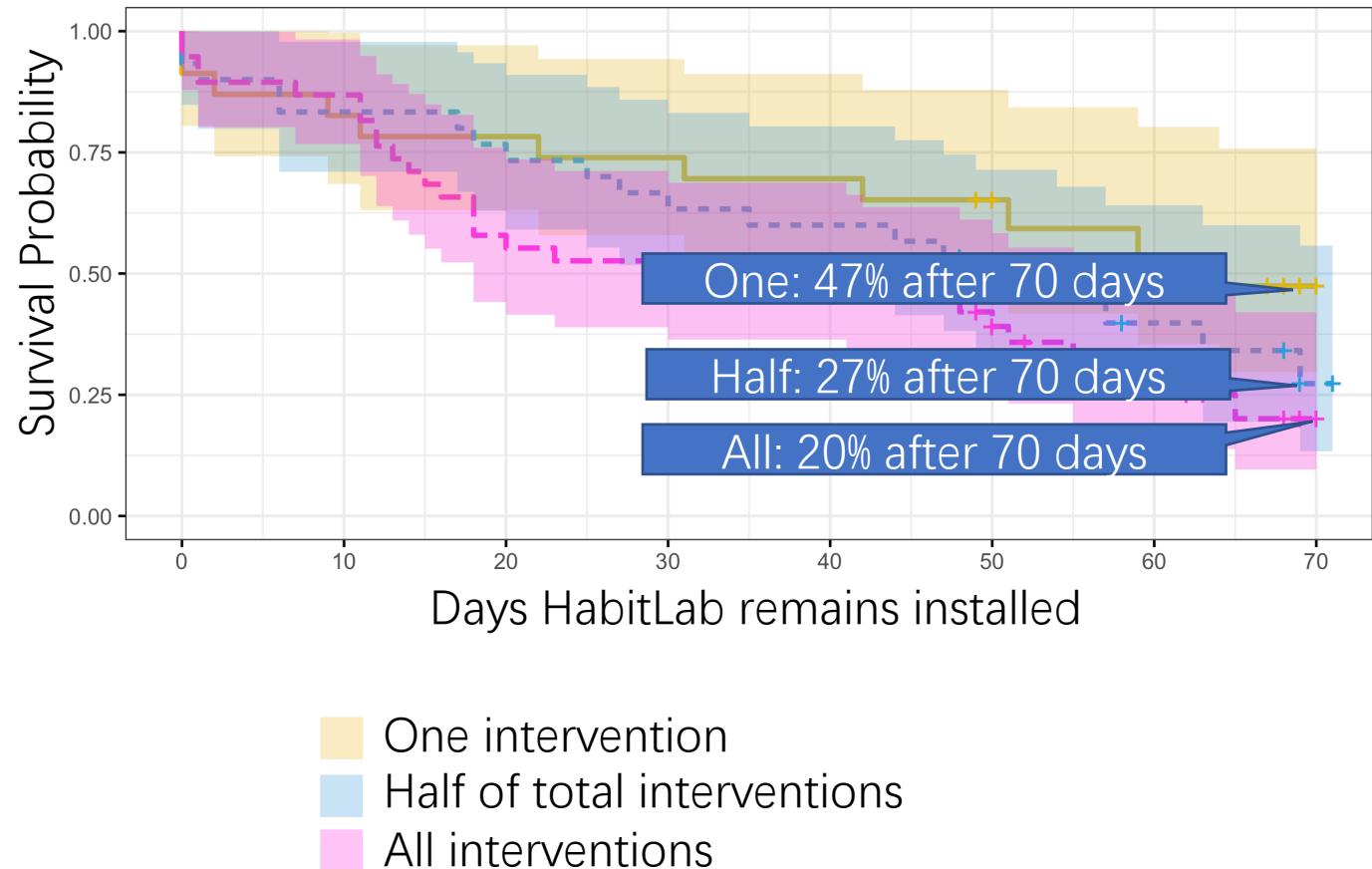
# Rotating between interventions increases attrition

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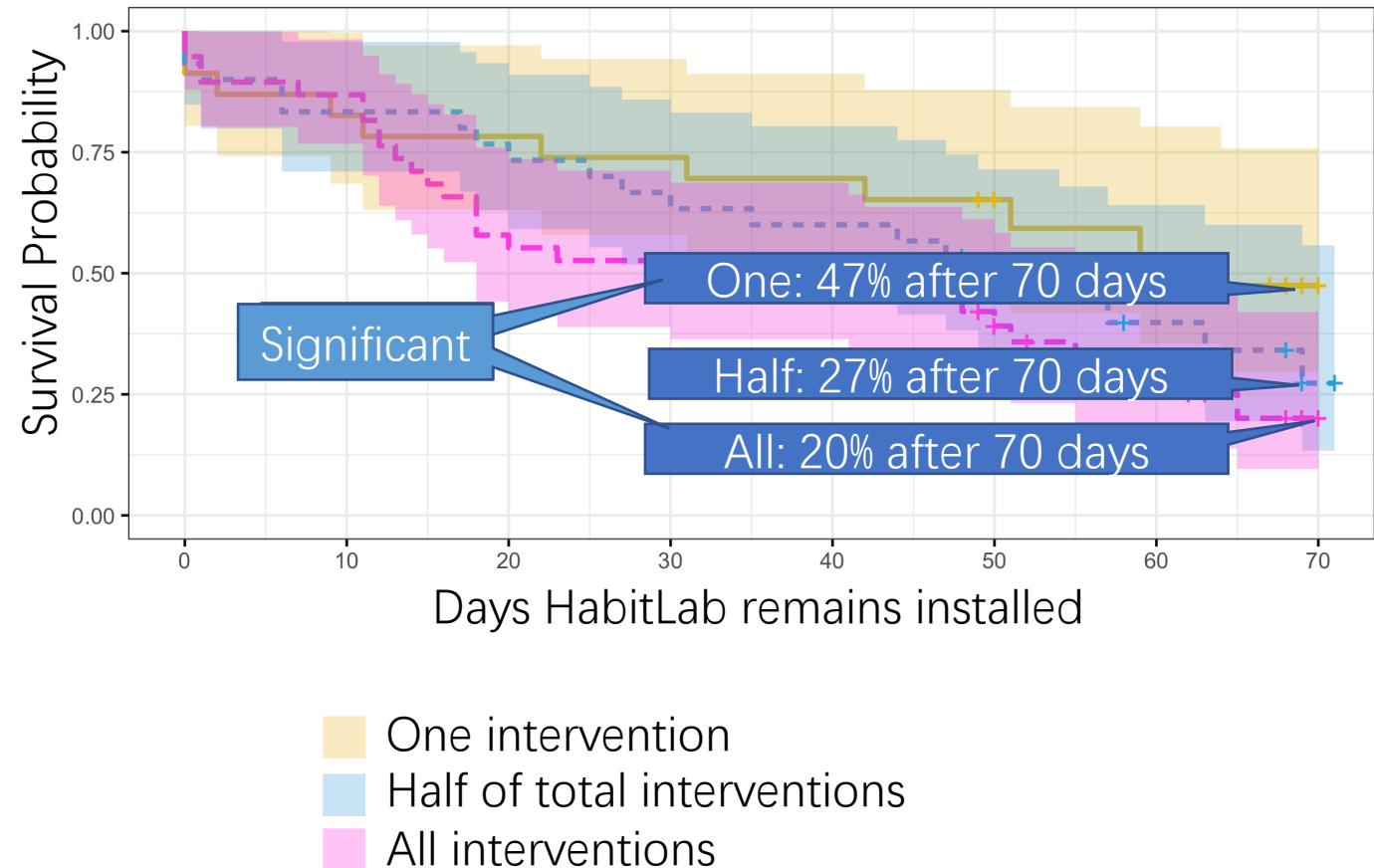
# Rotating between interventions increases attrition

---



# Rotating between interventions increases attrition

---



# 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**

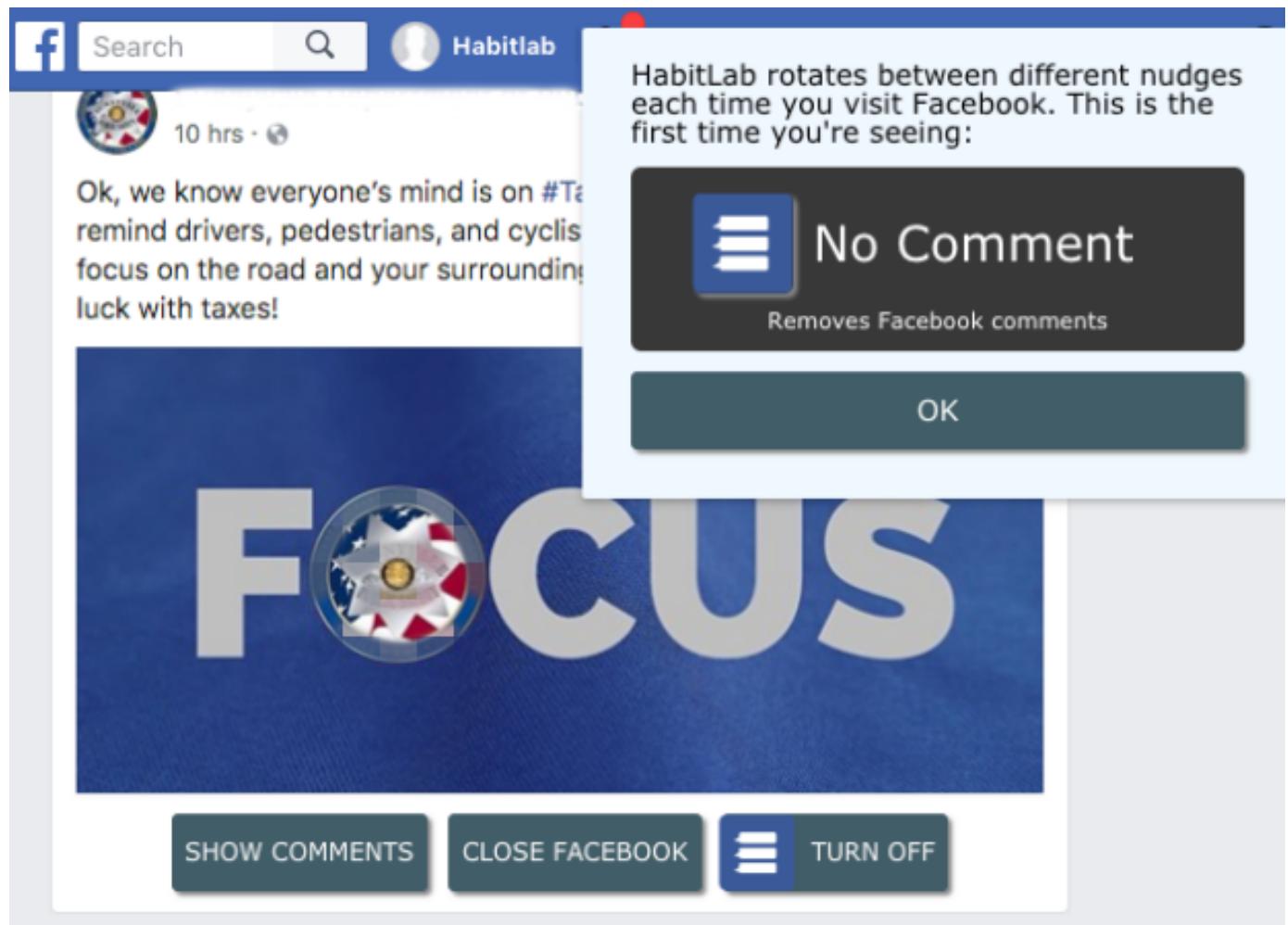
# Can we reduce attrition when intervention rotation happens?

Developed 2 dialogs shown when an intervention is first seen

Mental model design  
User control design

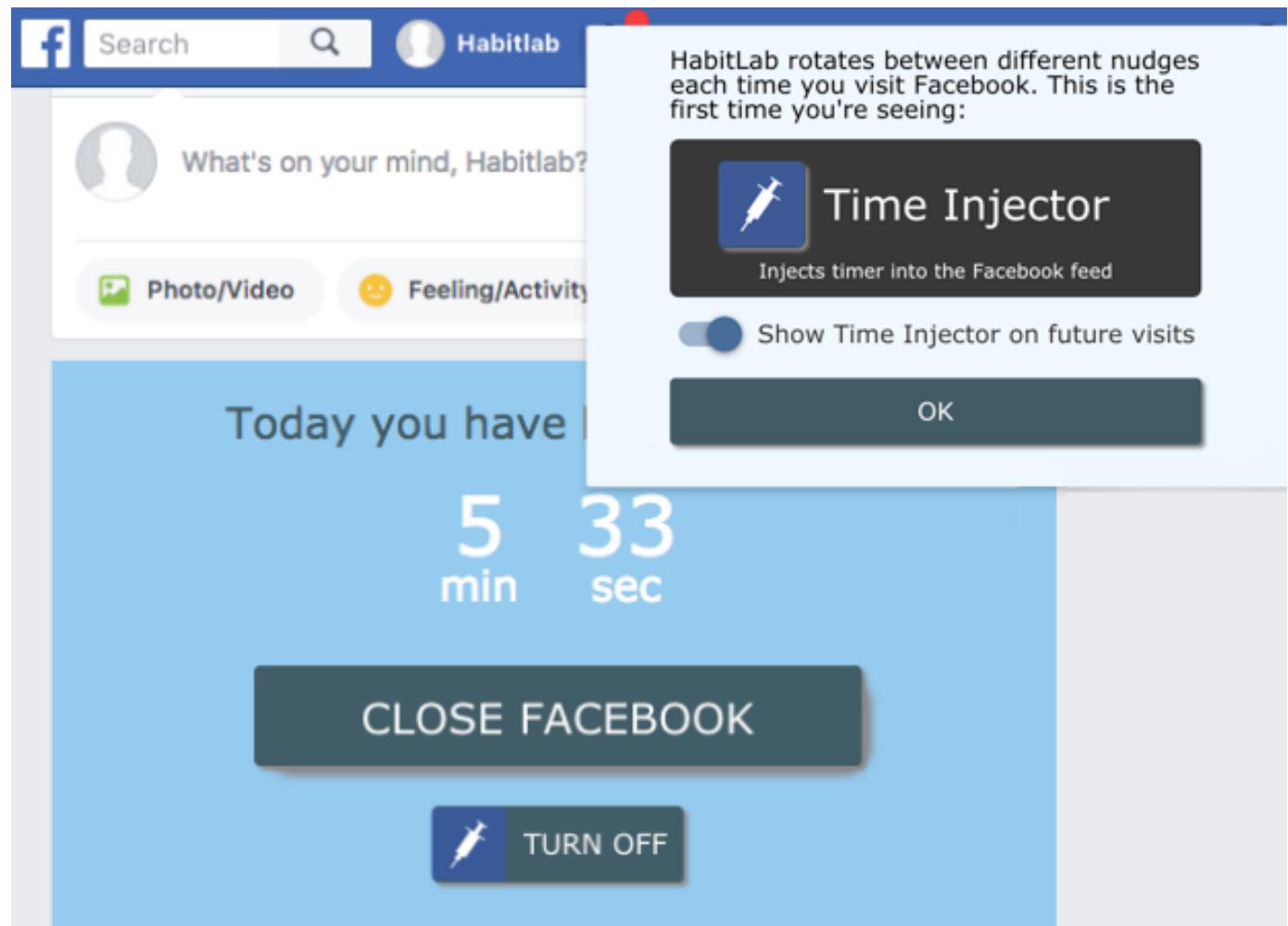
# Mental model design

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# User control design

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Between subjects design, 282 participants, 10 days

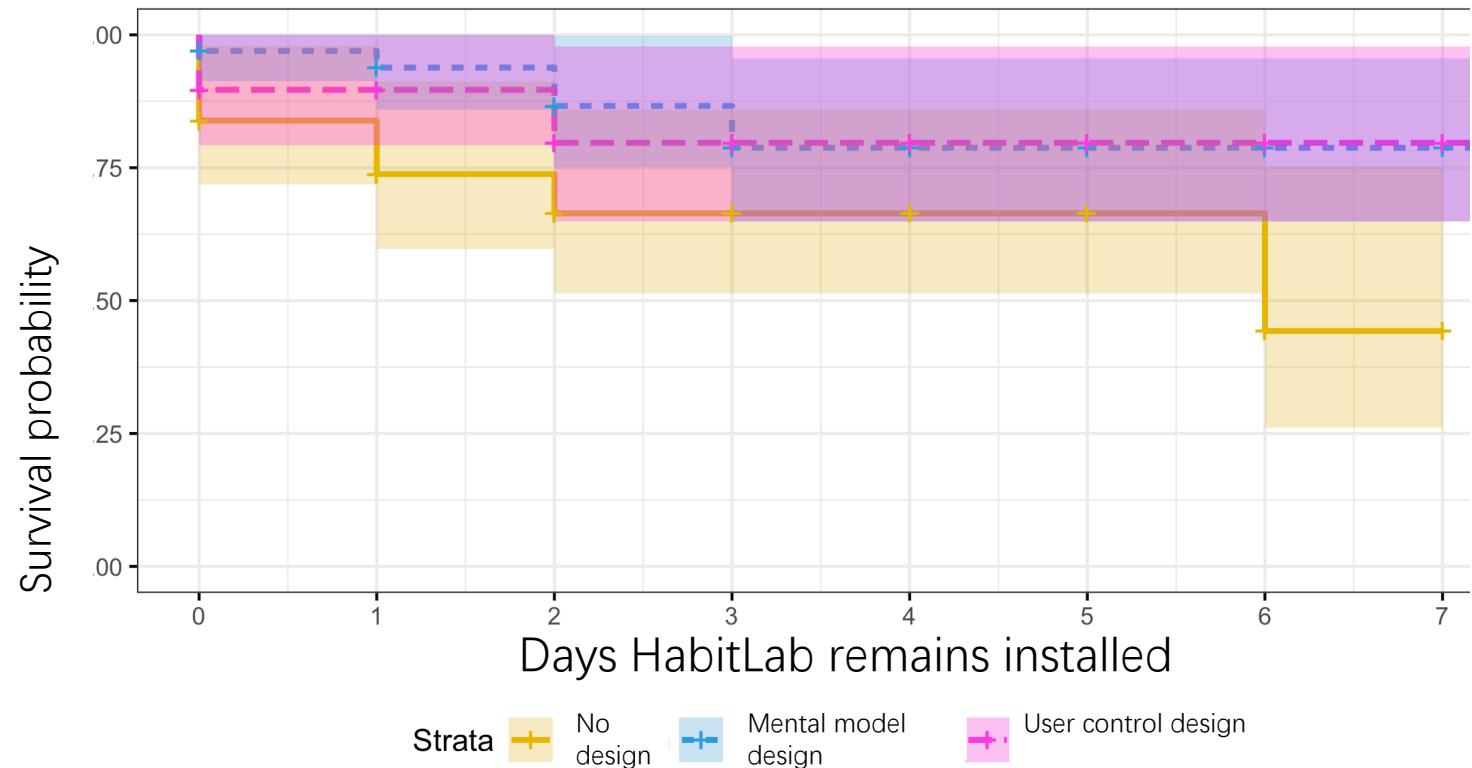
Conditions differ according to which design is shown when an intervention is seen for the first time:

**None**: No design shown

**Mental model** design

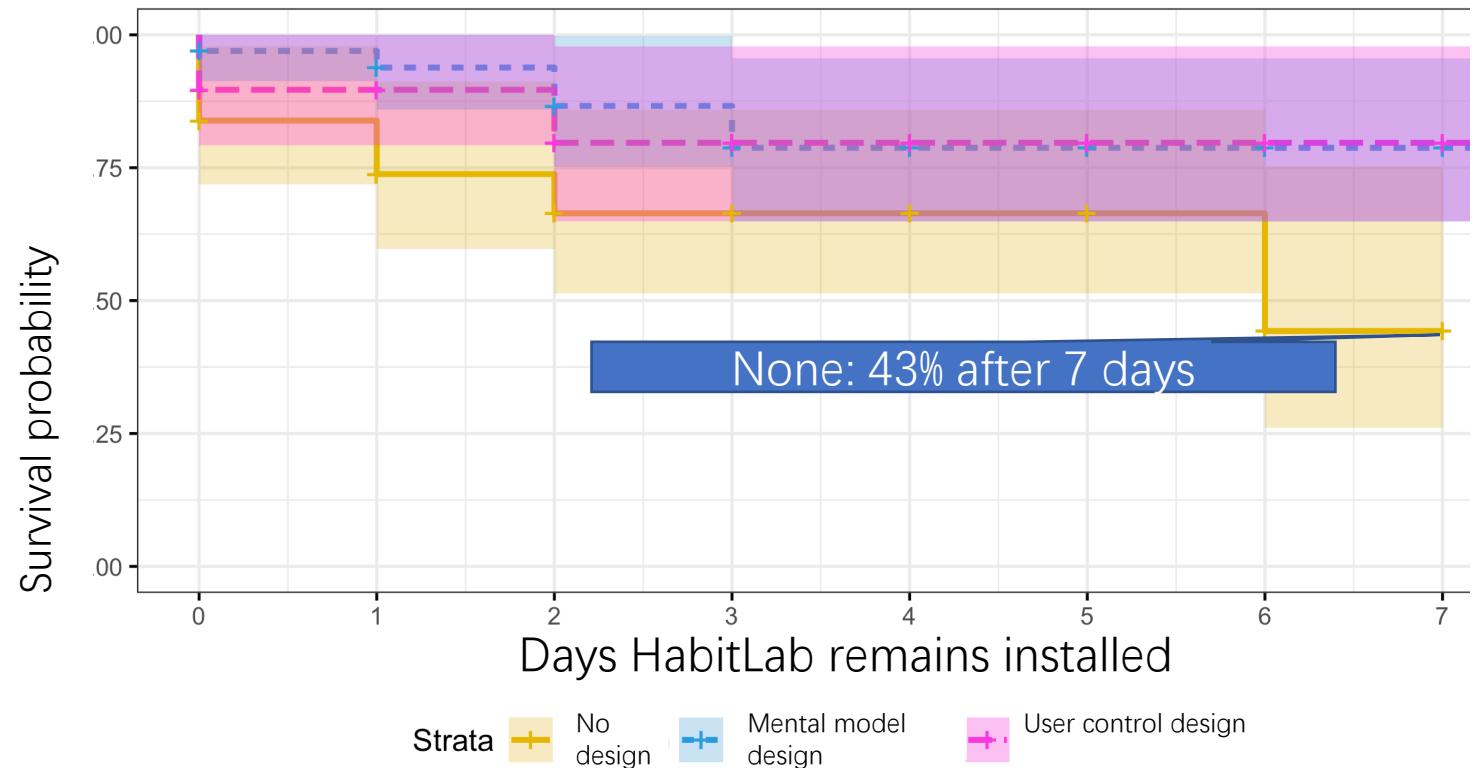
**User control** design

# Mental model design reduces attrition by half



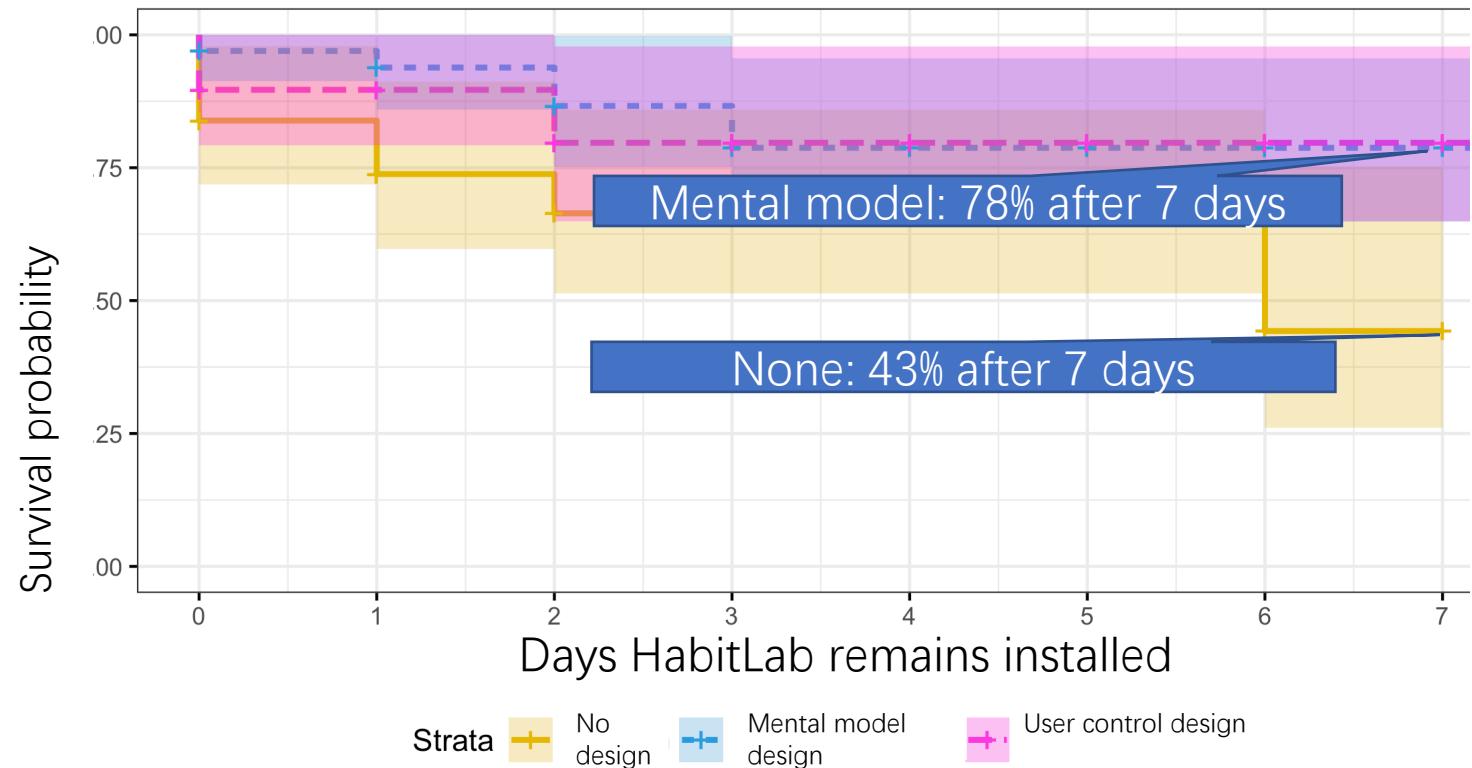
Design	Log hazard ratio
Mental model	-1.015 ( $p < 0.05$ )
User control	-0.869

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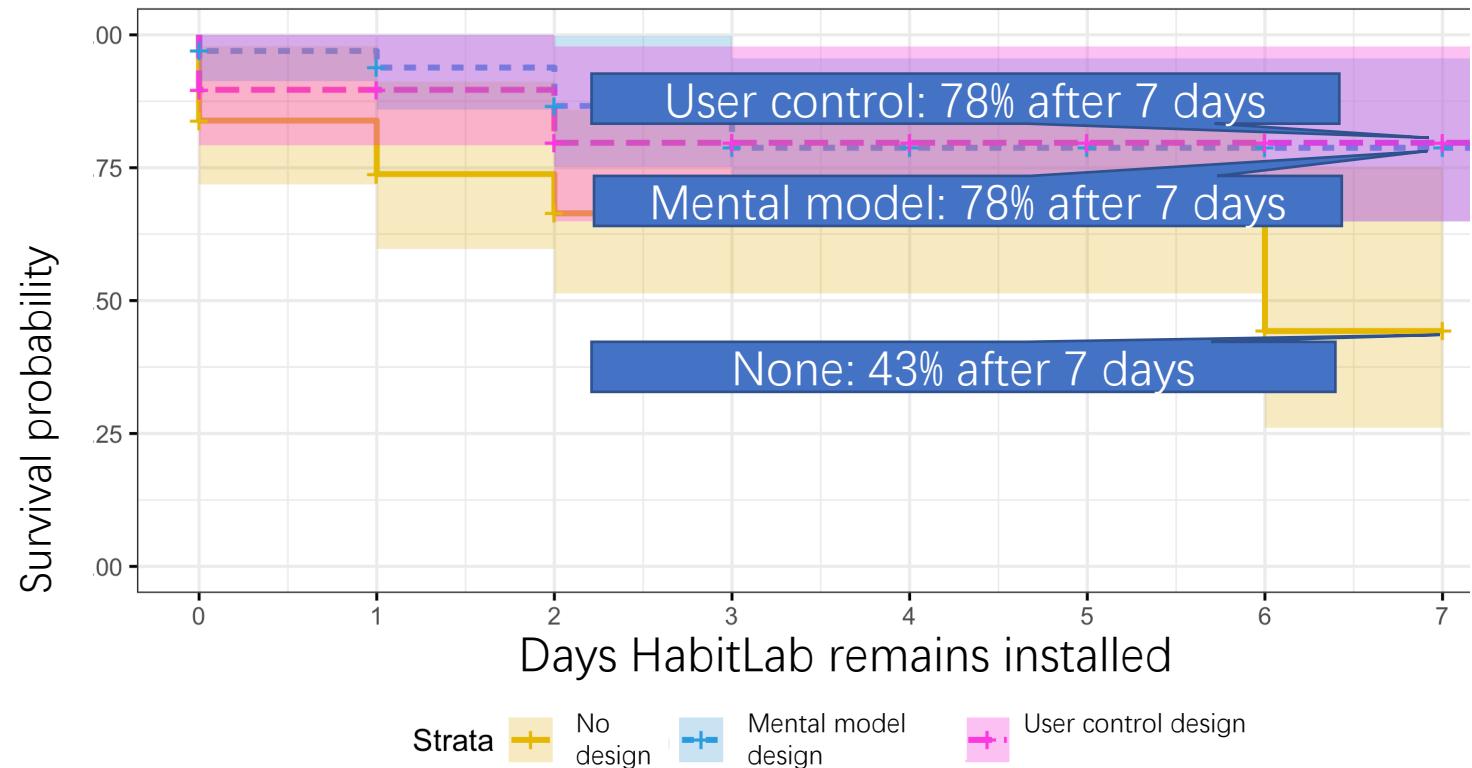
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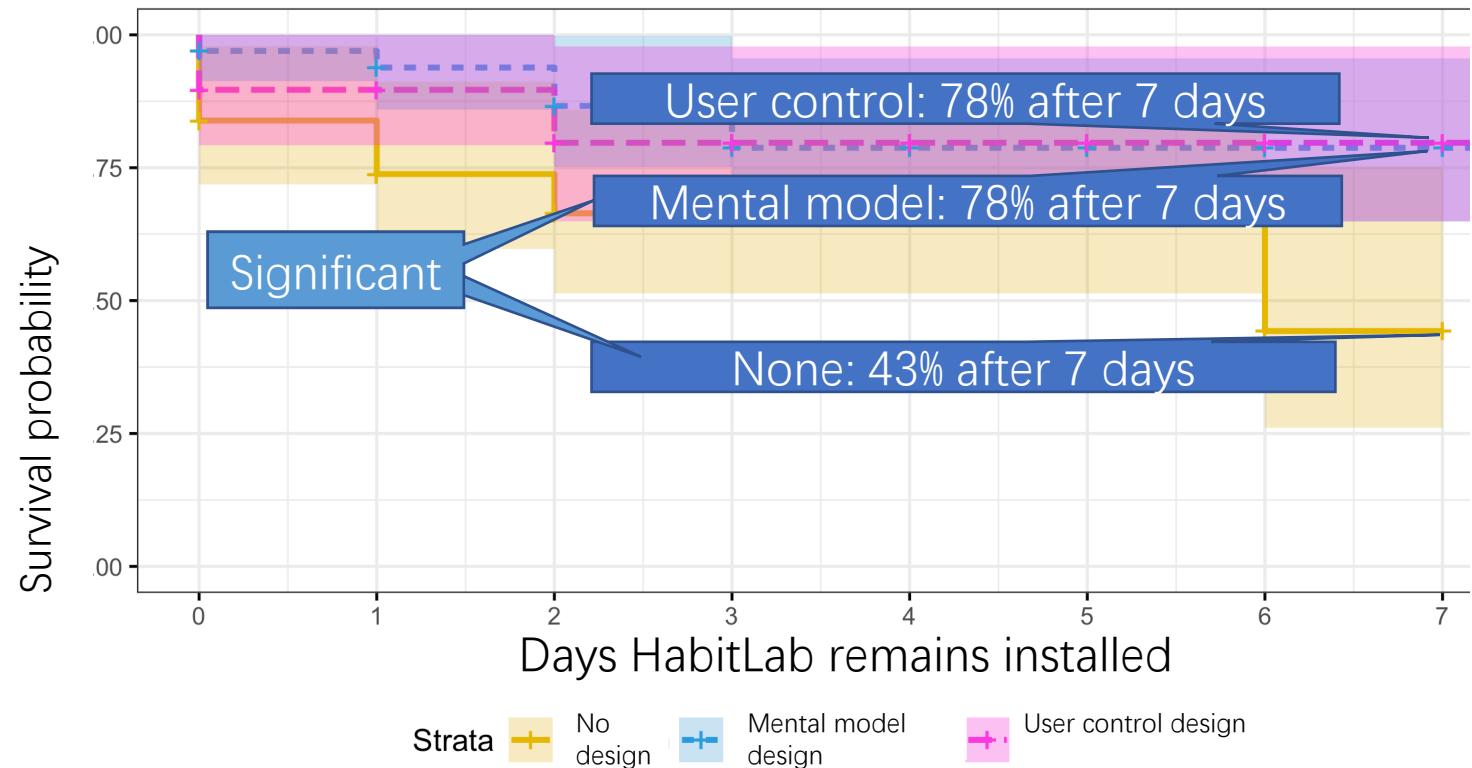
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# Conclusions

- 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  
Geza Kovacs geza@cs.stanford.edu