

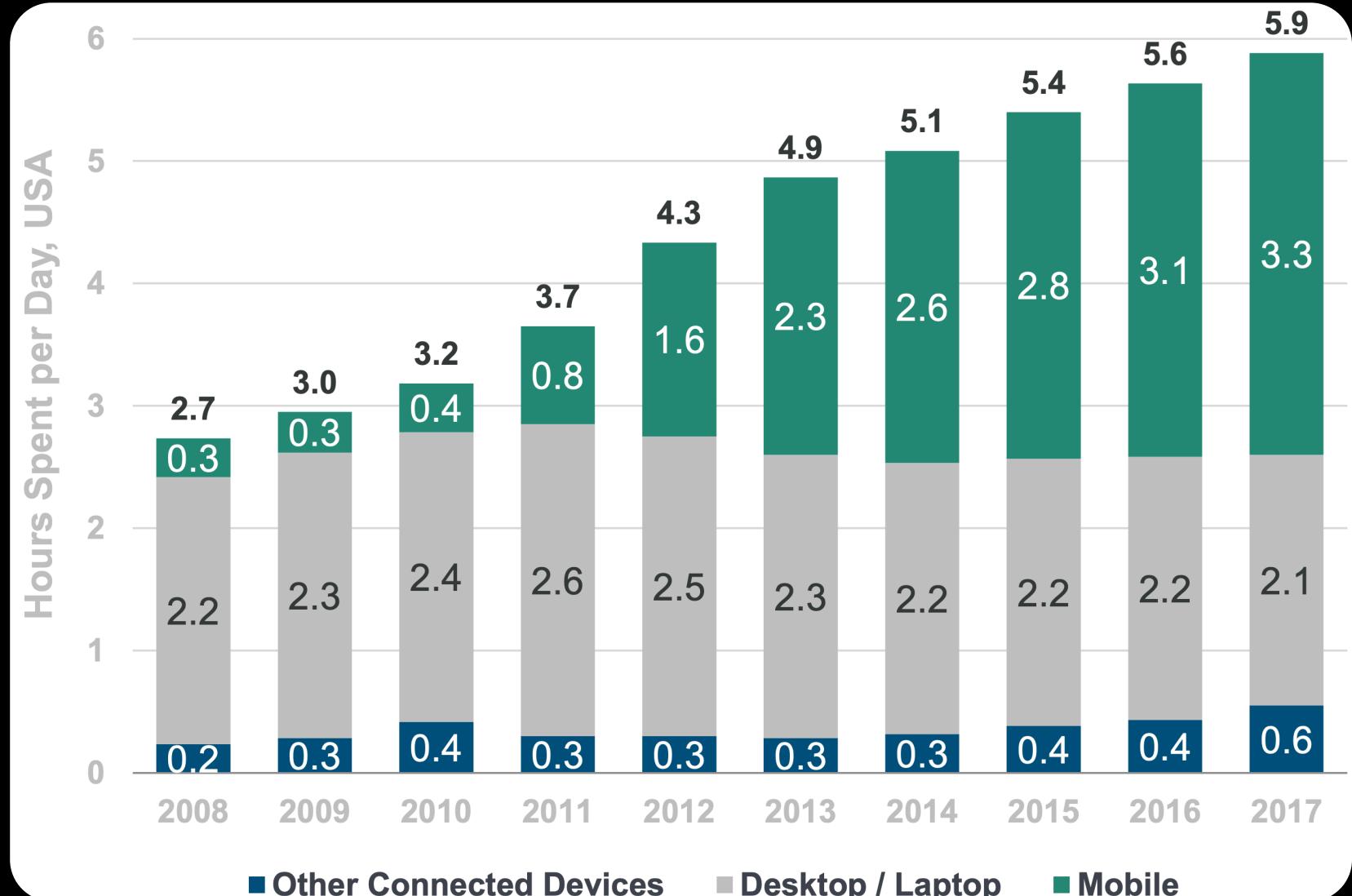
Conservation of Procrastination: Do Productivity Interventions Save Time or Just Redistribute It?

Geza Kovacs, Drew Mylander Gregory, Zilin Ma, Zhengxuan Wu, Golrokh Emami, Jacob Ray, Michael S Bernstein

Stanford HCI Group

People spend increasing amounts of time online

Average US adult spends **5.9 hours** per day with digital media



Source: Kleiner Perkins 2018 Internet Trends



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.

Users use productivity tools to help them reduce time online



Is that time actually saved, or just redirected
to other unproductive activities?

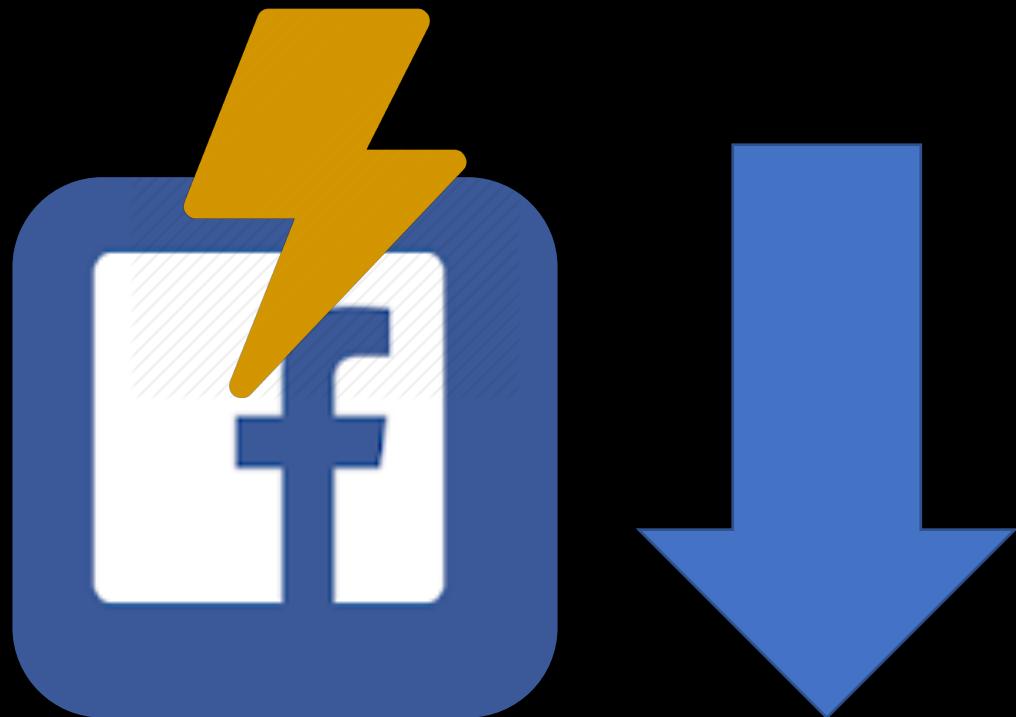
We often assume that intervention effects are isolated



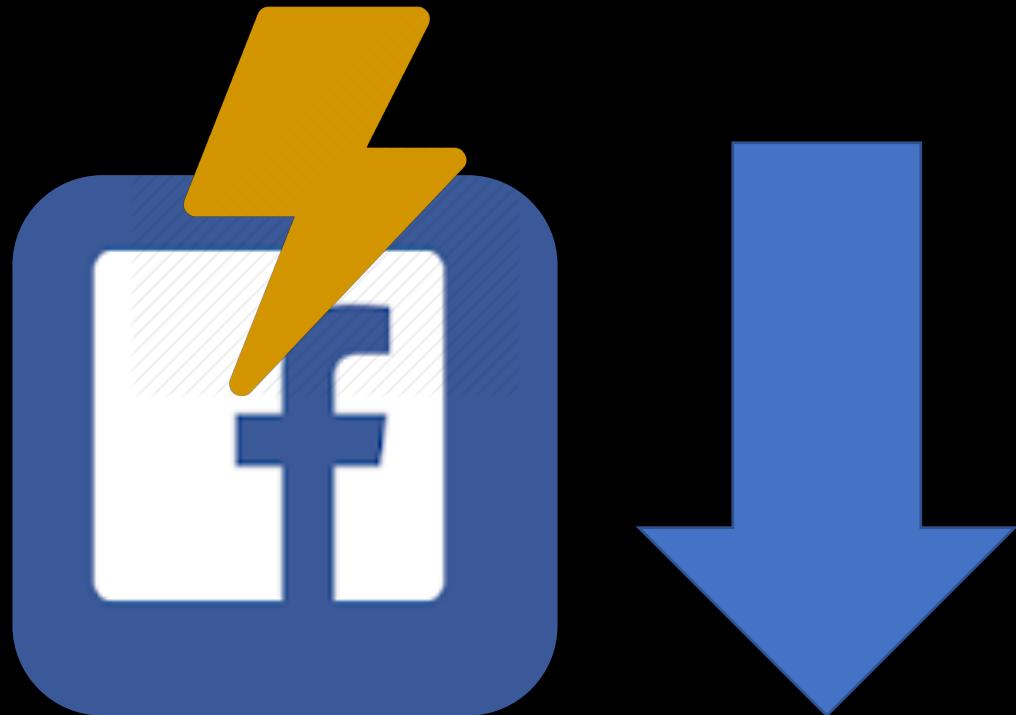
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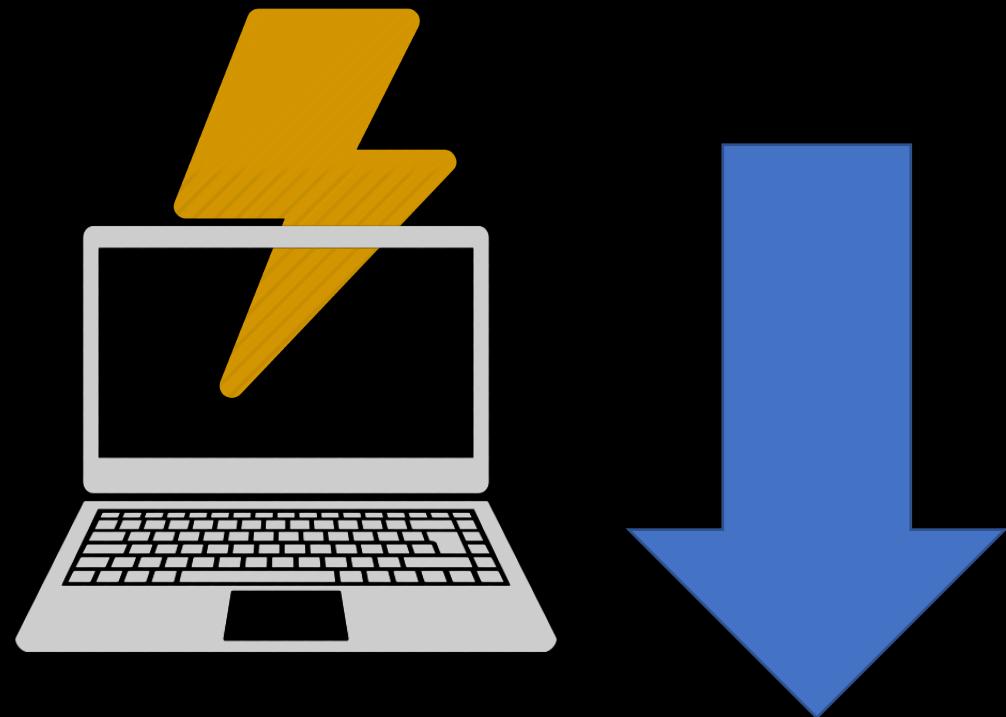
We often assume that intervention effects are isolated



We often assume that intervention effects are isolated



We often assume that intervention effects are isolated



What if the time you saved is just shifted elsewhere?

We have a
limited supply
of willpower

We need breaks
and downtime

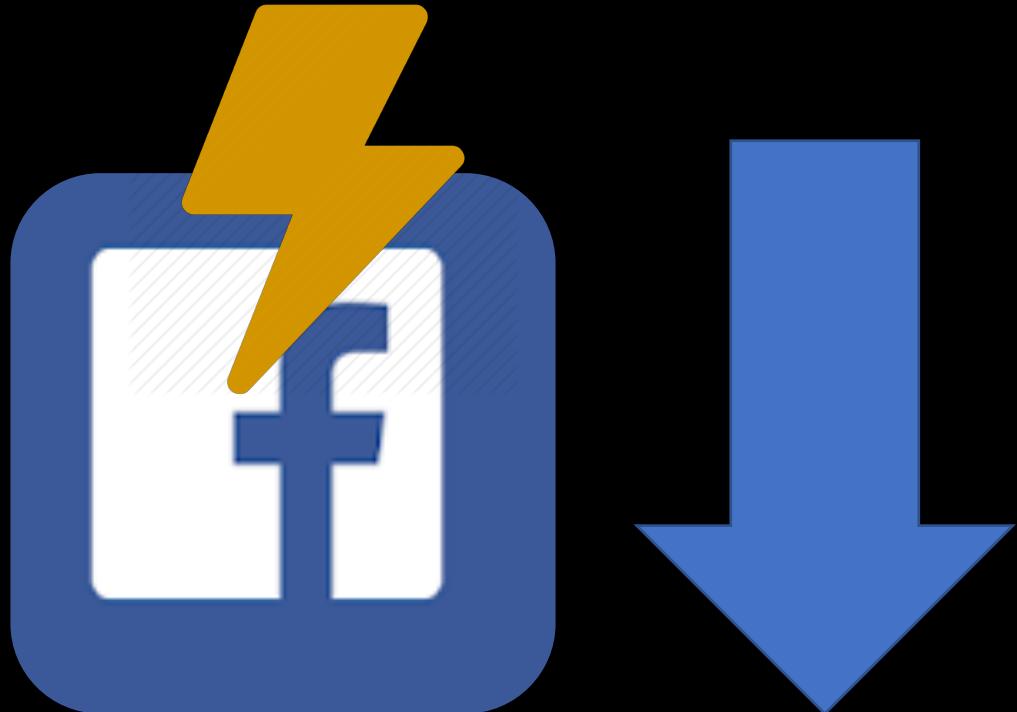


Laura Dabbish, Gloria Mark, and Víctor M González. 2011. Why do I keep interrupting myself?: Environment, Habit and Self-interruption. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. ACM, 3127–3130.

Roy E Baumeister, Ellen Bratslavsky, Mark Muraven, and Dianne M Tice. 1998. Ego Depletion: Is the Active Self a Limited Resource? *Journal of Personality and Social Psychology* 74, 5 (1998), 1252–1265.

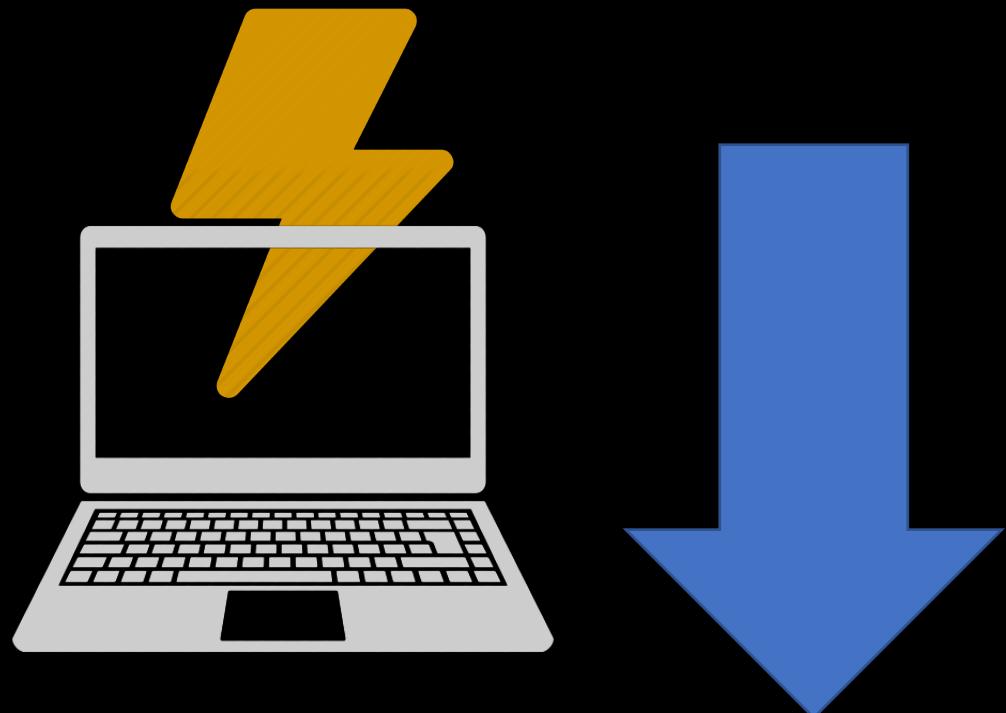
Is there a conservation-of-procrastination effect?

Does reducing time on one site or app **increase** time on others?



Is there a conservation-of-procrastination effect?

Does reducing time on one device **increase** time on others?



Do interventions have benefits outside the apps they were targeting?

The Hook

Apps are designed to be habit-building

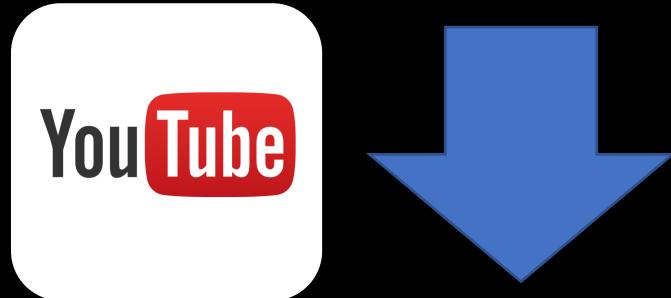
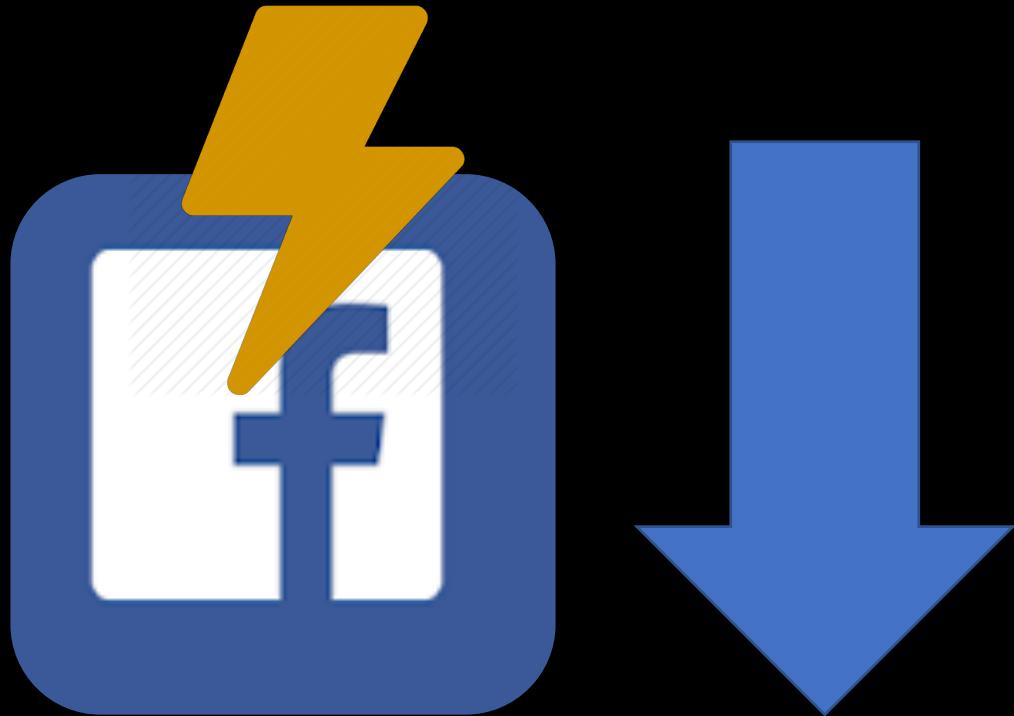
Results in habit loop of constantly visiting sites or checking phones



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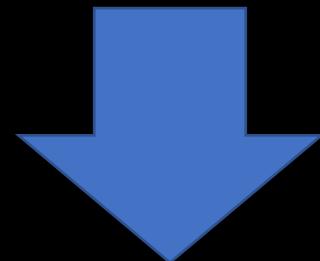
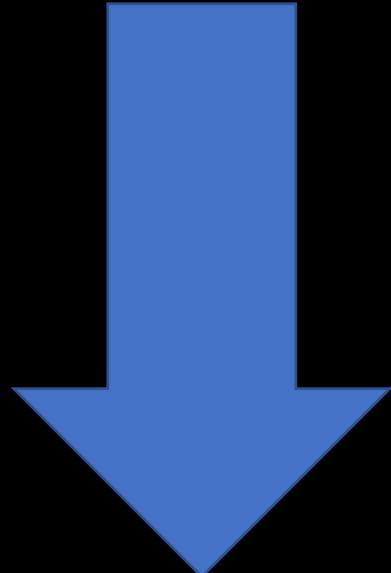
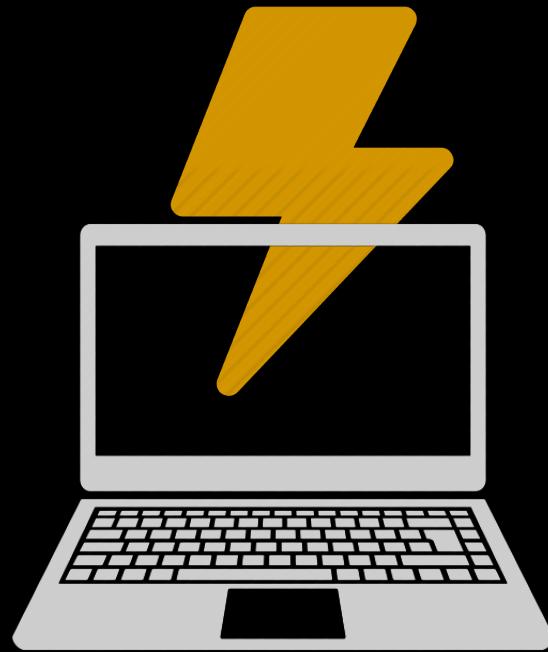
Does breaking habit loops result in further decreases in time spent elsewhere?

Does reducing time on one app or site **decrease** time on others?



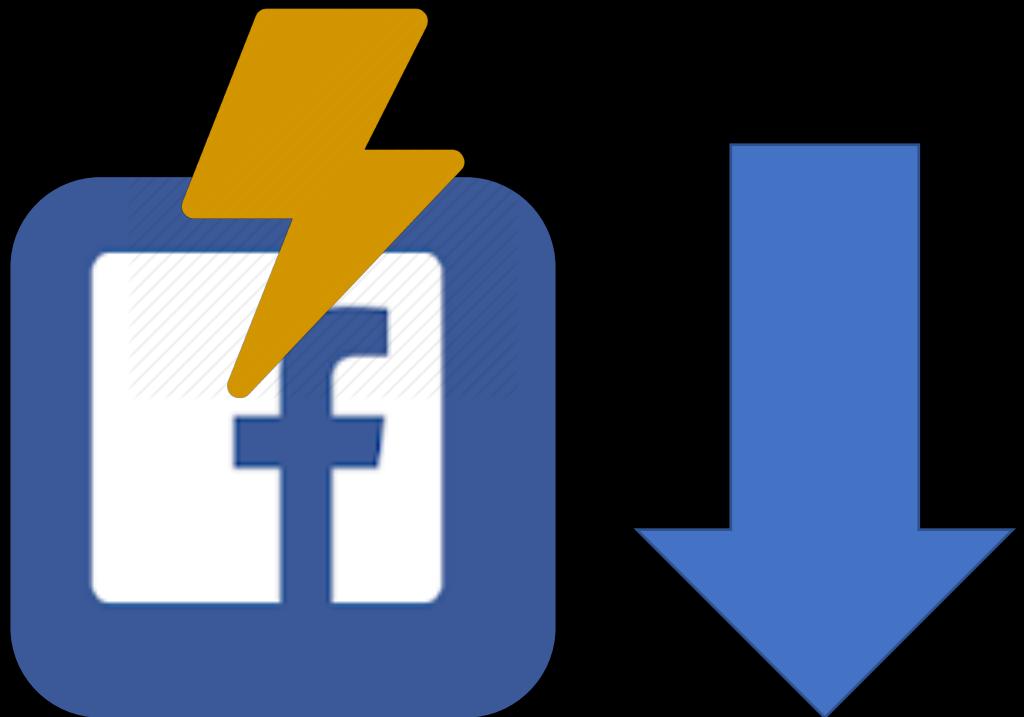
Does breaking habit loops result in further decreases in time spent elsewhere?

Does reducing time on one device **decrease** time on the other?

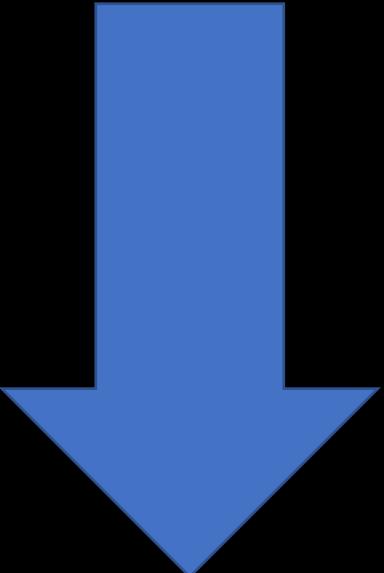


RQ1: Do interventions on one site or app influence time spent on other sites and apps?

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RQ1: Do interventions on one site or app influence time spent on other sites and apps?



Isolation



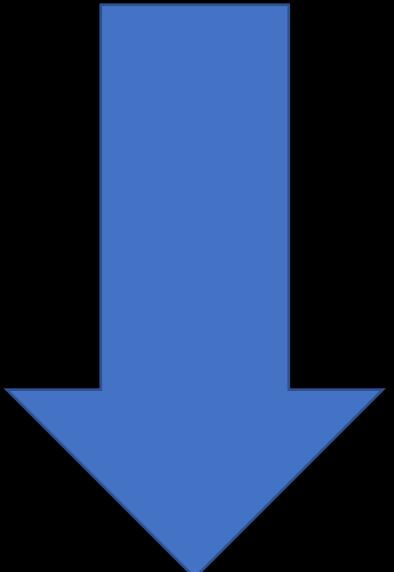
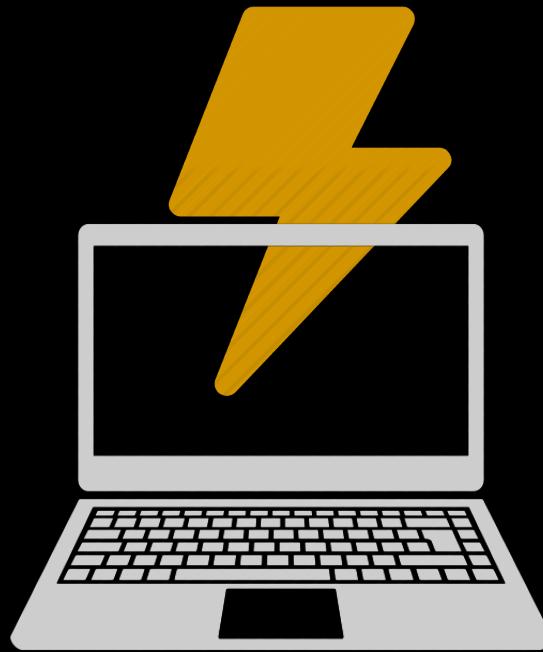
Redistribution



Reduction



RQ2: Do interventions on one device influence time spent on other devices?



Isolation



Redistribution



Reduction



Outline

- Our behavior change system (**HabitLab**)
- Are interventions effective at reducing time on the focal goal?
- RQ1: Is time redistributed to other sites on the same platform?
- RQ2: Is time redistributed across devices?

HabitLab

Our behavior
change platform

12,000+ in-the-
wild active users
(Browser+Android)



The image displays the HabitLab platform. At the top left is the Stanford University logo. On the right is the GitHub logo. The main heading "HabitLab" is in large white font with a flask icon, followed by "Change your online habits". Below this is a button with "Add HabitLab to Chrome". A small note states: "Some anonymized data will be sent to Stanford for research purposes. See our privacy policy for details." The bottom section shows three cards: "Set Goals" with social media icons (Facebook, YouTube, Twitter, Reddit), "Try Interventions" with a scale icon, and "View Progress" with a pie chart icon.

Stanford University

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

Pick sites you want to spend less time on

English ▾

Try Interventions

HabitLab tries different interventions each visit

View Progress

Learn which interventions work best for you

GitHub

HabitLab

Our behavior change platform

12,000+ in-the-wild active users
(Browser+Android)

The image shows the HabitLab app page on a mobile store. The top section displays the app's logo (a flask icon), developer information ("HabitLab (Stanford HCI Group) 商务办公"), a 5-star rating (22 reviews), and a green "已安装" (Installed) button. Below this are four screenshots illustrating the app's features:

- Customize:** Choose the apps you want to track. The screen shows a list of apps including Facebook, Instagram, Messenger, Snapchat, YouTube, Alipay, Amazon Shopping, Baidu, and Browser, with a "Done" button at the bottom.
- Track:** See daily stats for your selected apps. It features a circular progress chart with a total of 102 minutes and three bar charts below for Snapchat, YouTube, and Alipay.
- Improve:** Monitor your progress over time. This screen shows stacked bar charts for "Mins on Watchlist This Week" and "Total" for various apps, along with specific stats for Snapchat and YouTube.
- Intro:** Fun, interactive content, partially visible on the right.

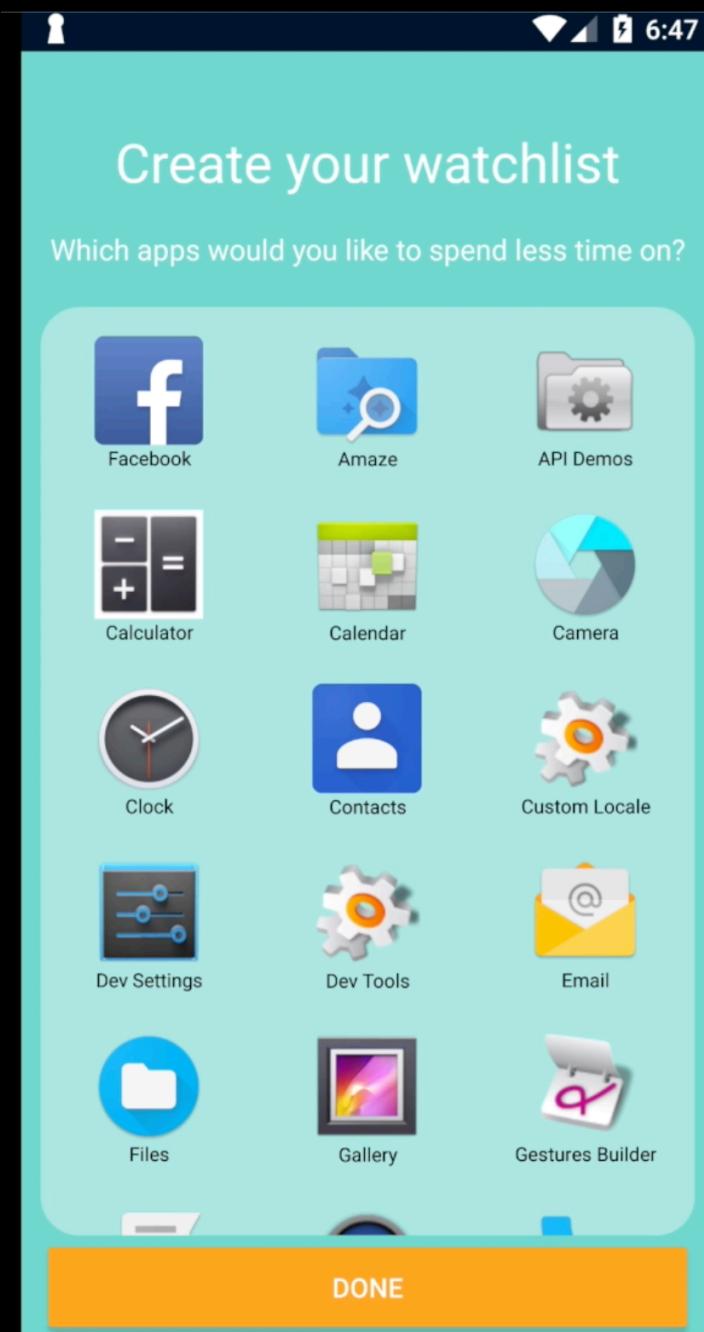
Users select
sites or apps
to reduce
time on
(goals)

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).

Site/App	Average Time Spent (mins)
Add Site	0 mins
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

Users select
sites or apps
to reduce
time on
(goals)



Interventions help reduce time on goal sites and apps

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.

The nudges are:

- All Sites (star icon)
- Bouncer (ball icon)
- 1Min Assassin (target icon)
- GateKeeper (gate icon)
- Scroll Freezer (laptop with snowflake icon)
- Supervisor (eye icon)
- Stat Whiz (bell icon)
- Minute Watch (watch icon)
- Facebook (Facebook logo icon)
- Time Injector (syringe icon)
- Feed Eater (pacman icon)
- TimeKeeper (hourglass icon)
- No Comment (stacked document icon)
- Clickbait Mosaic (explosion icon)

NAVIGATION

UP PREVIOUS

START USING HABITLAB

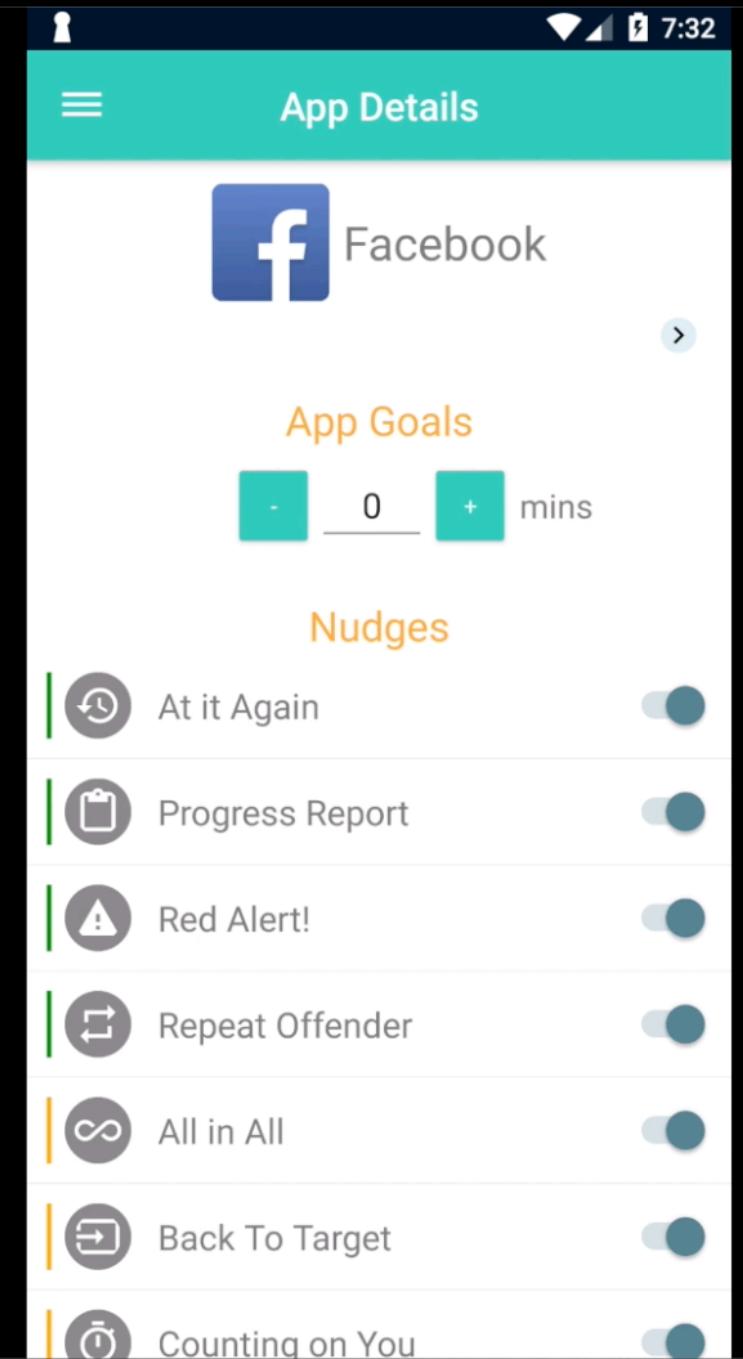
30+
interventions
available

Nudges

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

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

30+
interventions
available



CLOSE FACEBOOK

SHOW MY NEWS FEED



TURN OFF

Today you have been here for:

2 38
min sec

CLOSE FACEBOOK



TURN OFF

•  **clownheights** From the community 2 hours ago
A wet floor sign tells your brain to turn on traction control

• 108 comments • Give Award • More • Save • ...

•  **youngbliss** From the community 2 hours ago
Maine becomes the first state to ban Styrofoam

• 40 comments • Give Award • More • Save • ...

•  **clownheights** From the community 2 hours ago
Henry VIII and his choices in marriage 
Obviously there has been a lot of discussion on the marriages of Henry VIII.
I have a question about them:
"Why were only 2 of his six wives foreign princesses?"
Catherine of Aragon was a traditional choice of wife.
Anne of Cleves sort of was, even though she was just the daughter of a duke.
The other wives were all English (quite modest to be fair).
So why didn't he use his money for alliance purposes? As seen the note
• 108 comments • Give Award • More • Save • ...

•  **clownheights** From the community 2 hours ago
In Classic Children's Books, a Window to Childhood in Past Centuries: Rare children's books, made available online through the Library of Congress, show both the constants and the evolution in children's literature


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Help
The Reddit User
Reddit Content
Reddit Premium
Reddit API

Cookie Policy | Privacy Policy
User Agreement | Mod Policy
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CLOSE TAB

Time remaining:

0 min 42 sec

Time added:

ADD TIME

0 min



TURN OFF

BACK TO TOP

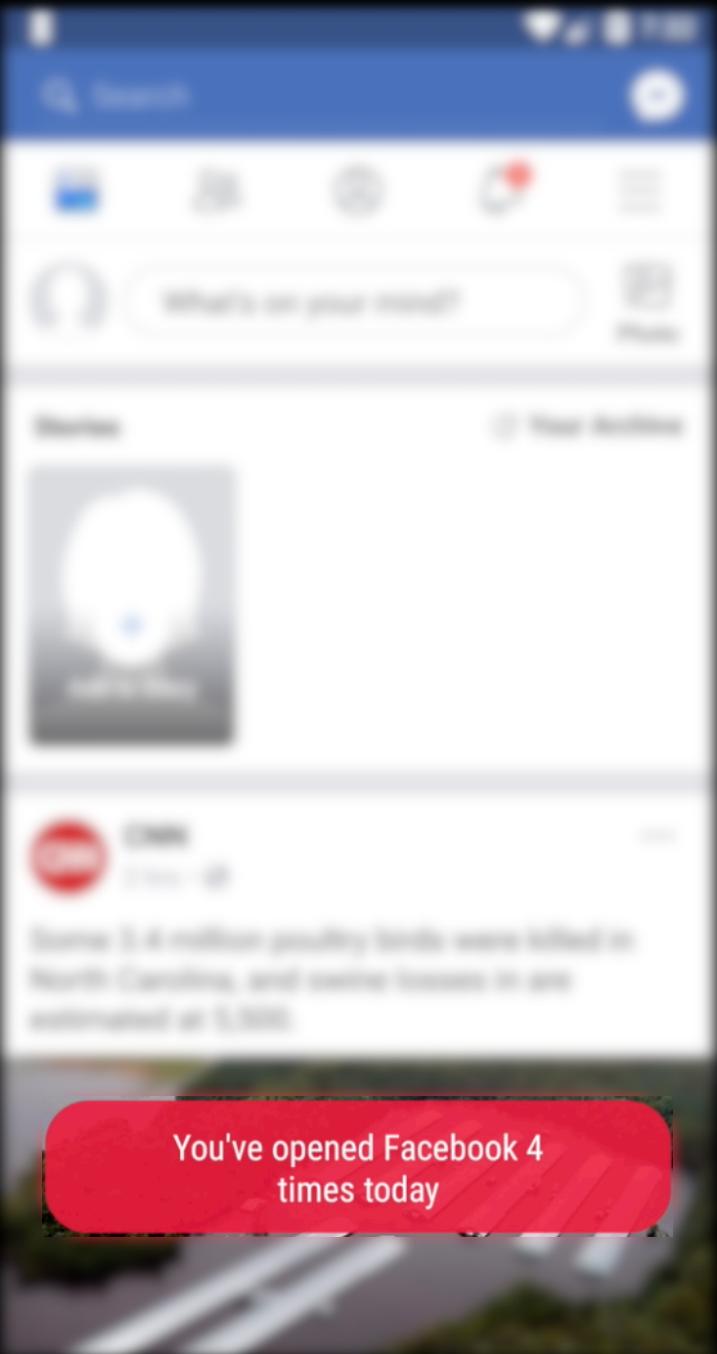


TURN OFF

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

CLOSE YOUTUBE

WATCH VIDEO



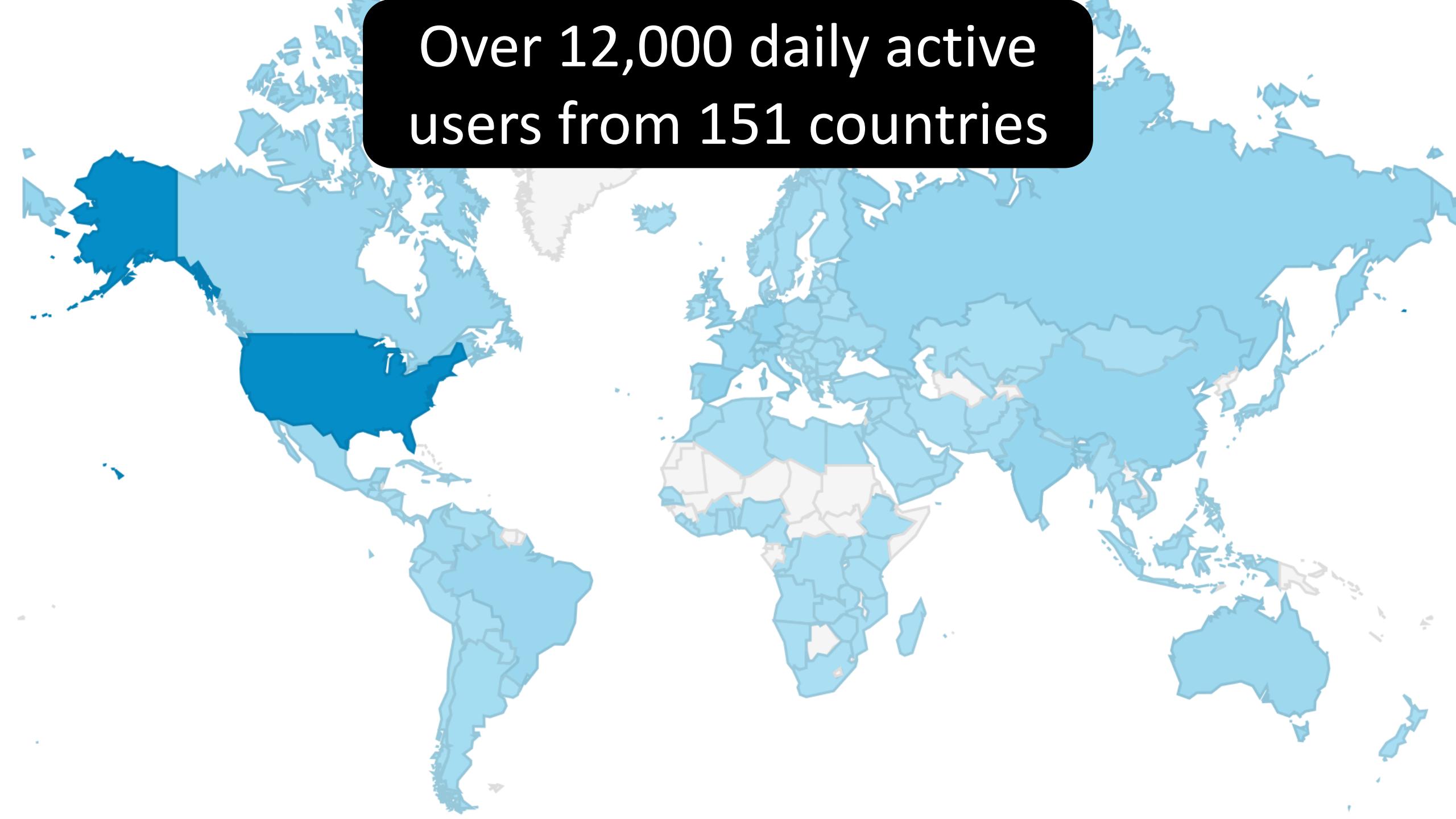


Continue to Facebook?

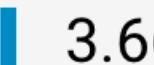
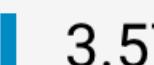
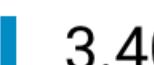
You've been here 39 times
today. Want to take a break?

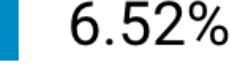
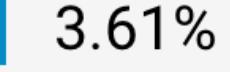
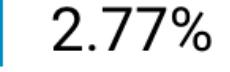
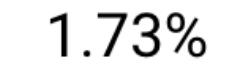
[GET ME OUT OF HERE!](#)

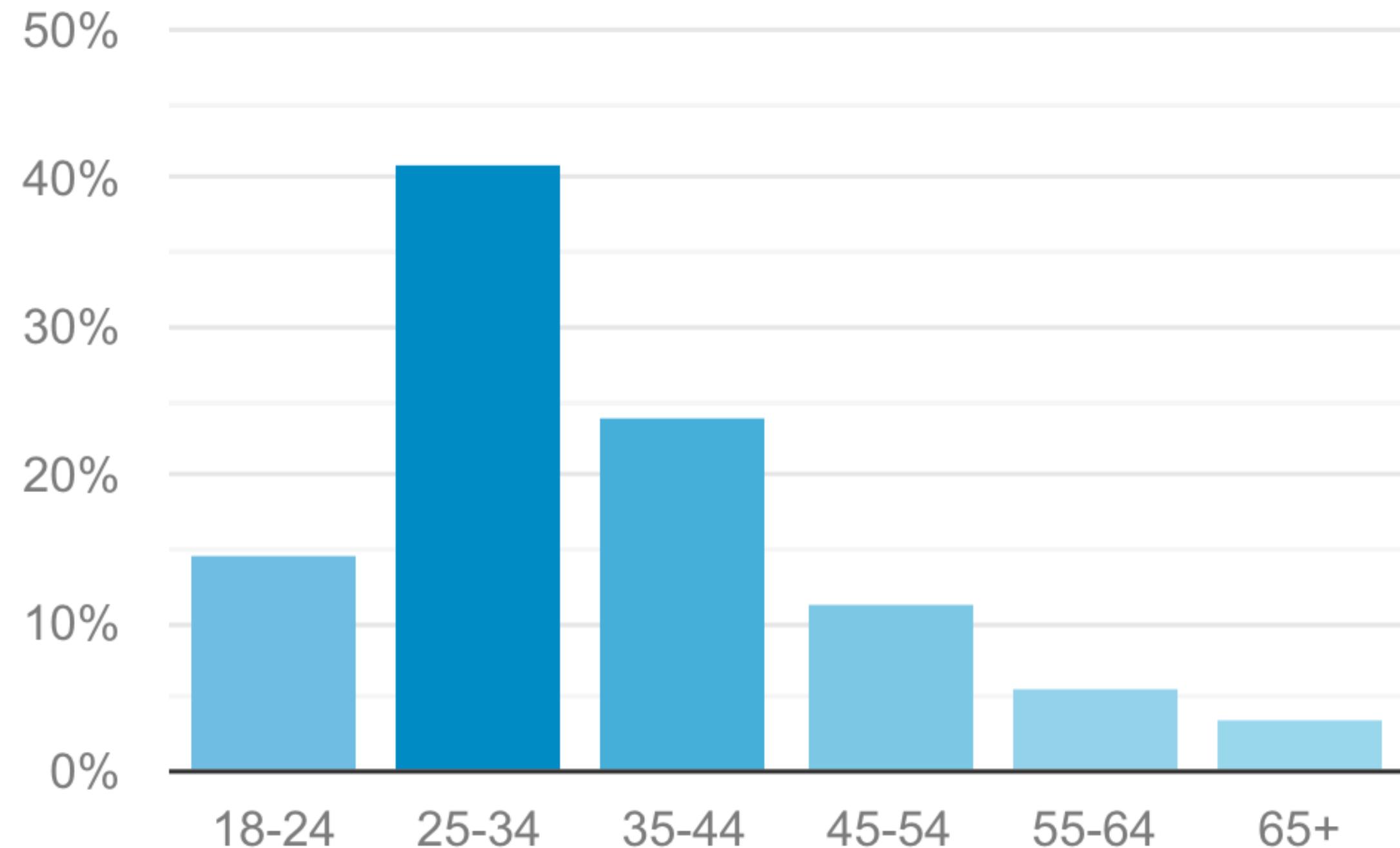
[Continue to Facebook](#)



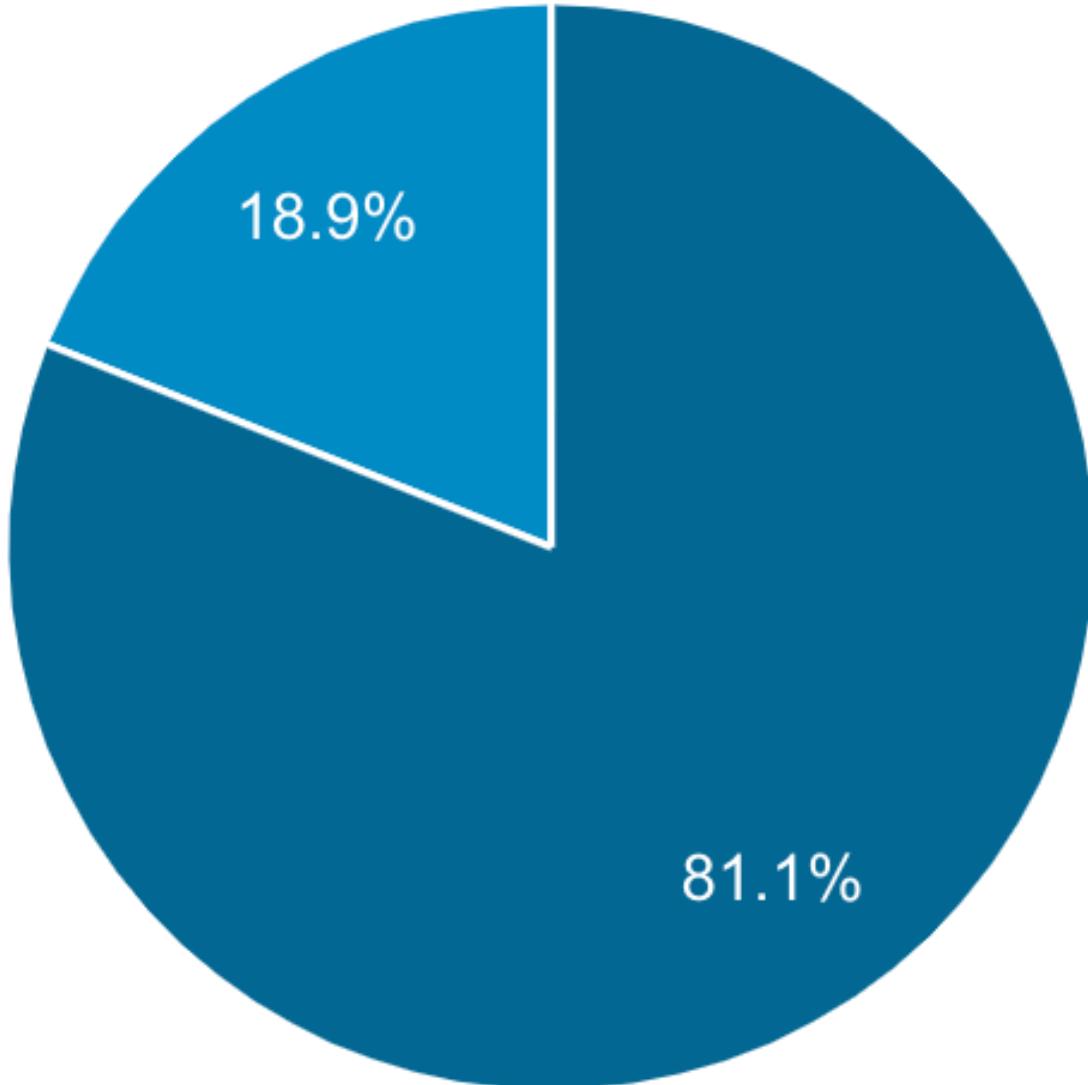
Over 12,000 daily active
users from 151 countries

1.		United States	3,710		30.16%
2.		Spain	605		4.92%
3.		Germany	540		4.39%
4.		Russia	461		3.75%
5.		China	450		3.66%
6.		India	448		3.64%
7.		United Kingdom	439		3.57%
8.		France	418		3.40%
9.		Italy	402		3.27%
10.		Canada	368		2.99%

1. English (US)	6,143		50.00%
2. Spanish	801		6.52%
3. English (UK)	725		5.90%
4. Chinese (Simplified)	462		3.76%
5. Russian	443		3.61%
6. Italian	340		2.77%
7. Portuguese (Brazil)	293		2.38%
8. French	289		2.35%
9. German (Germany)	260		2.12%
10. German	212		1.73%



■ male ■ female



Outline

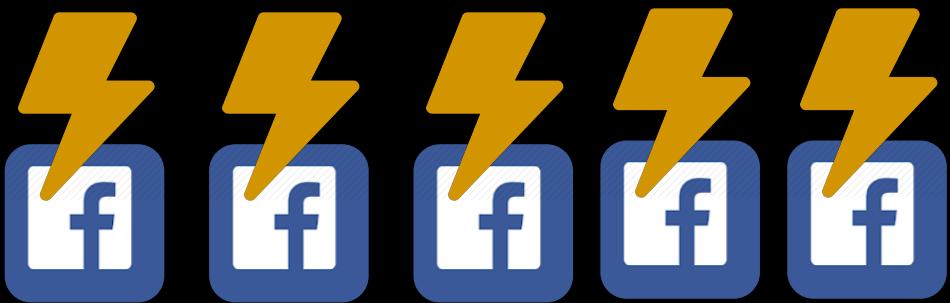
- Our behavior change system (HabitLab)
- **Are interventions effective at reducing time on the focal goal?**
- RQ1: Is time redistributed to other sites on the same platform?
- RQ2: Is time redistributed across devices?

Are interventions effective? (Method)

For each goal, we randomly assign it to one of 2 conditions each week:

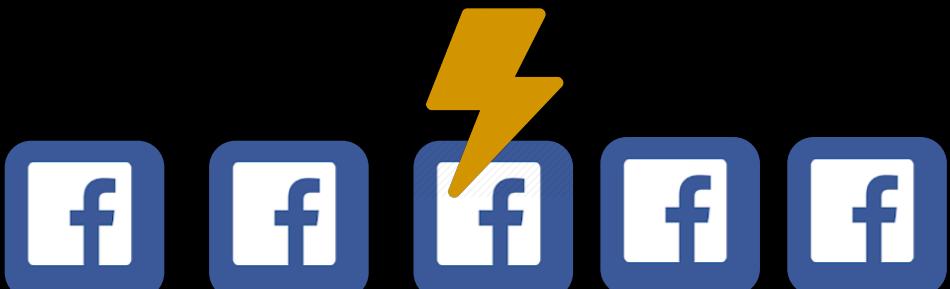
Frequent

An intervention is shown every visit
(each site visit for browser, each app visit on android)



Infrequent

An intervention is shown on 20% of visits



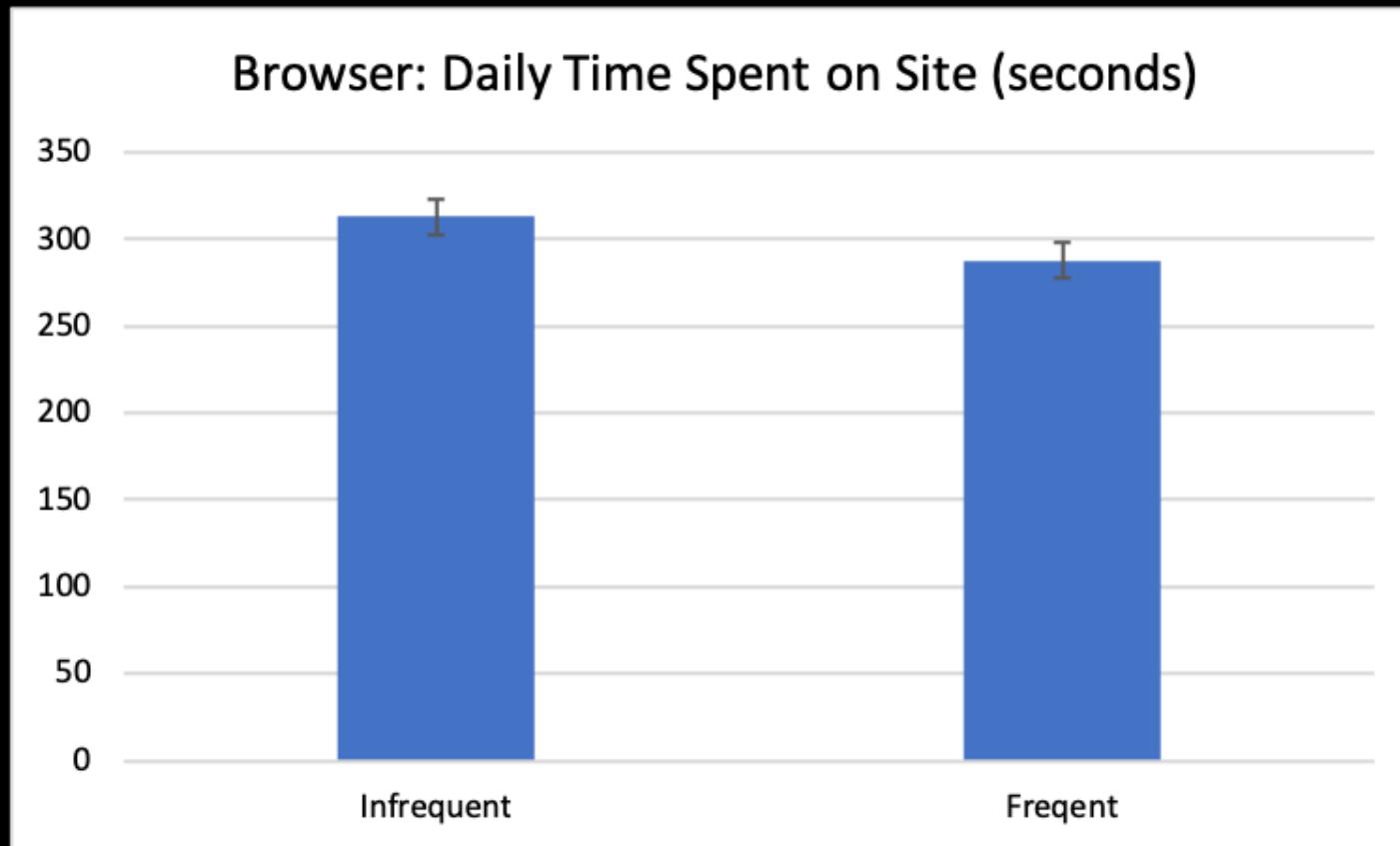
Are interventions effective? (Method)

- Compare daily time spent on days in the frequent vs infrequent conditions, for each goal

Are interventions effective? (Method)

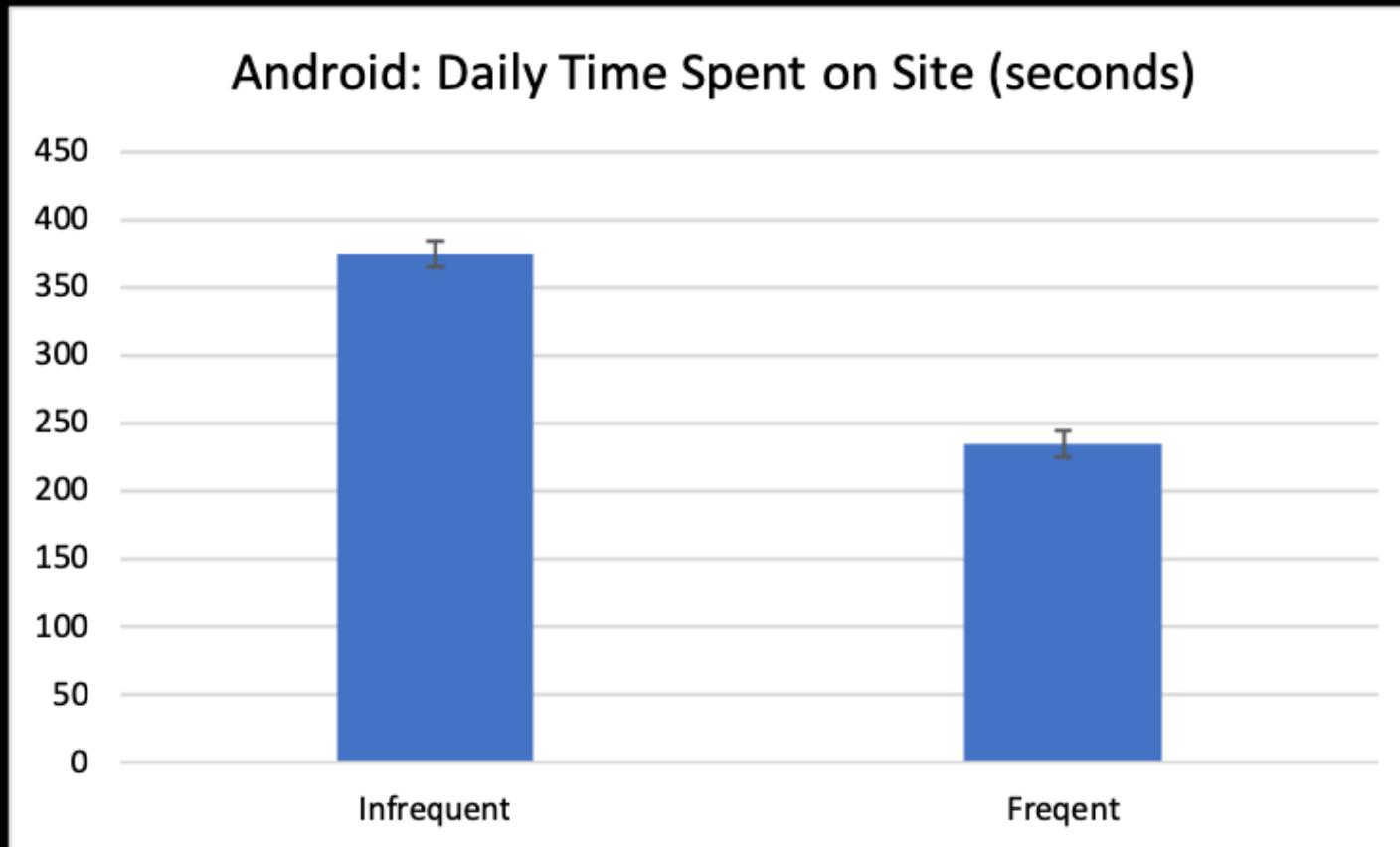
- Compare daily time spent on days in the frequent vs infrequent conditions, for each goal
- 5.8 weeks with 1034 users on browser ($n=22,462$ days), and 876 users on mobile ($n=26,273$ days)

Interventions are effective on both platforms



7.3% reduction in daily time spent on browser version, on frequent weeks. Statistically significant ($p < 0.001$)

Interventions are effective on both platforms



37.2% reduction in daily time spent on android version, on frequent weeks. Statistically significant ($p < 0.001$)

Outline

- Our behavior change system (HabitLab)
- Are interventions effective at reducing time on the focal goal?
 - **Effective on both browser and mobile**
- RQ1: Is time redistributed to other sites on the same platform?
- RQ2: Is time redistributed across devices?

Outline

- Our behavior change system (HabitLab)
- Are interventions effective at reducing time on the focal goal?
 - Effective on both Browser and Android
- **RQ1: Is time redistributed to other sites on the same platform?**
- RQ2: Is time redistributed across devices?

Is time redistributed within platform? (Method)

We developed a metric of how intense interventions are this day (**intensity**)

- Percentage of sessions on a goal that triggered an intervention

Is time redistributed within platform? (Method)

We developed a metric of how intense interventions are this day (**intensity**)

- Percentage of sessions on a goal that triggered an intervention.
- E.g. if visited Facebook 10x, and saw 0 interventions, then intensity=0

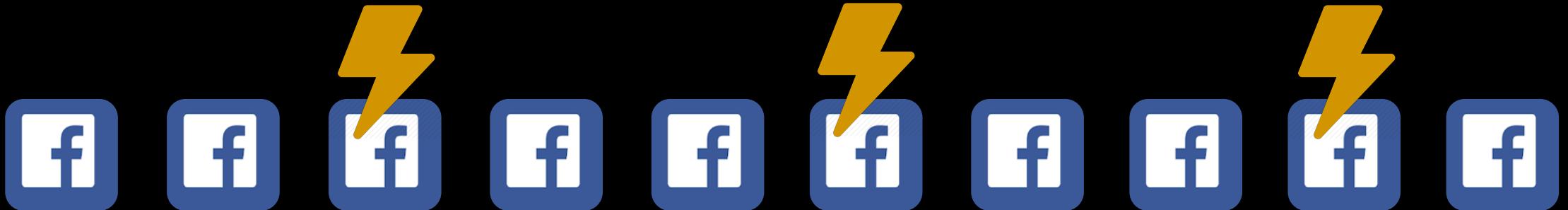


Intensity=0

Is time redistributed within platform? (Method)

We developed a metric of how intense interventions are this day (**intensity**)

- Percentage of sessions on a goal that triggered an intervention.
- E.g. if visited Facebook 10x, and saw 3 interventions, then intensity=0.3

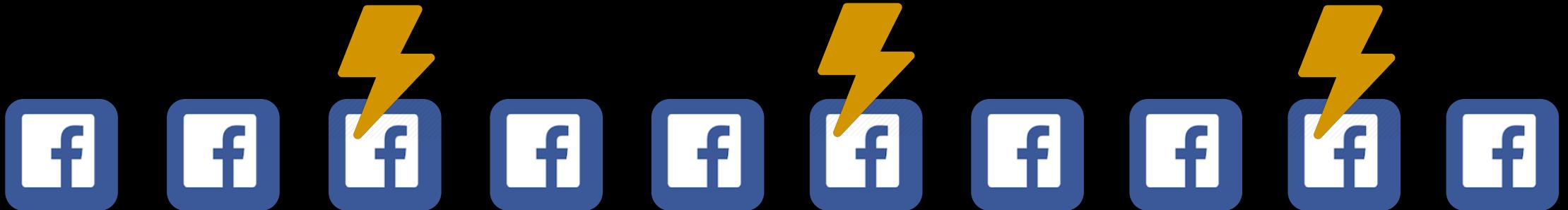


Intensity=0.3

Is time redistributed within platform? (Method)

We developed a metric of how intense interventions are this day (**intensity**)

- Percentage of sessions on a goal that triggered an intervention.
- Verified that on days where intensity is higher, overall total time on goal sites is significantly lower on both platforms



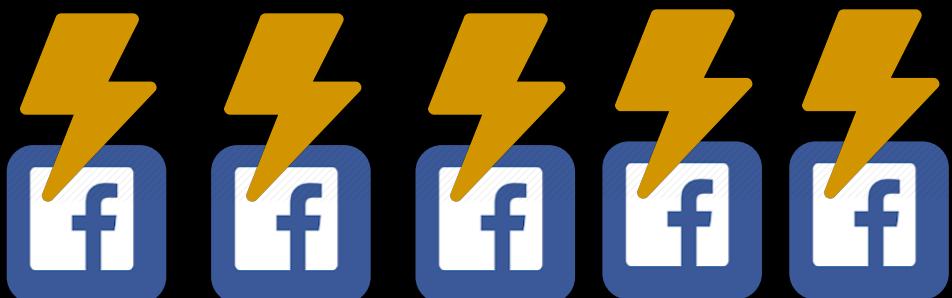
Intensity=0.3

Is time redistributed within platform? (Method)

To manipulate intensity, we randomly assign each goal to have either frequent or infrequent interventions each week, resulting in a continuous intensity value from 0 to 1

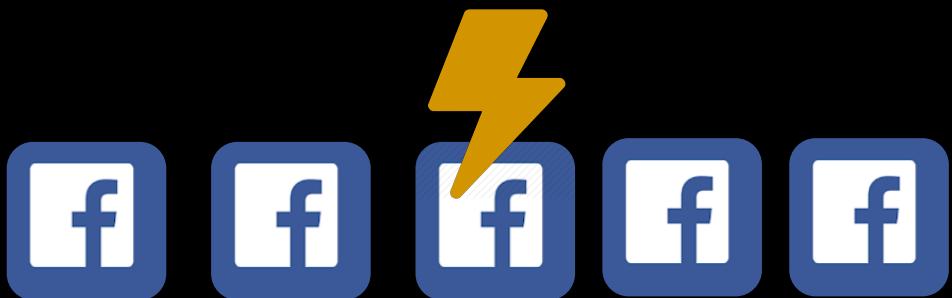
Frequent

An intervention is shown every visit
(each site visit for browser, each app visit on android)



Infrequent

An intervention is shown on 20% of visits

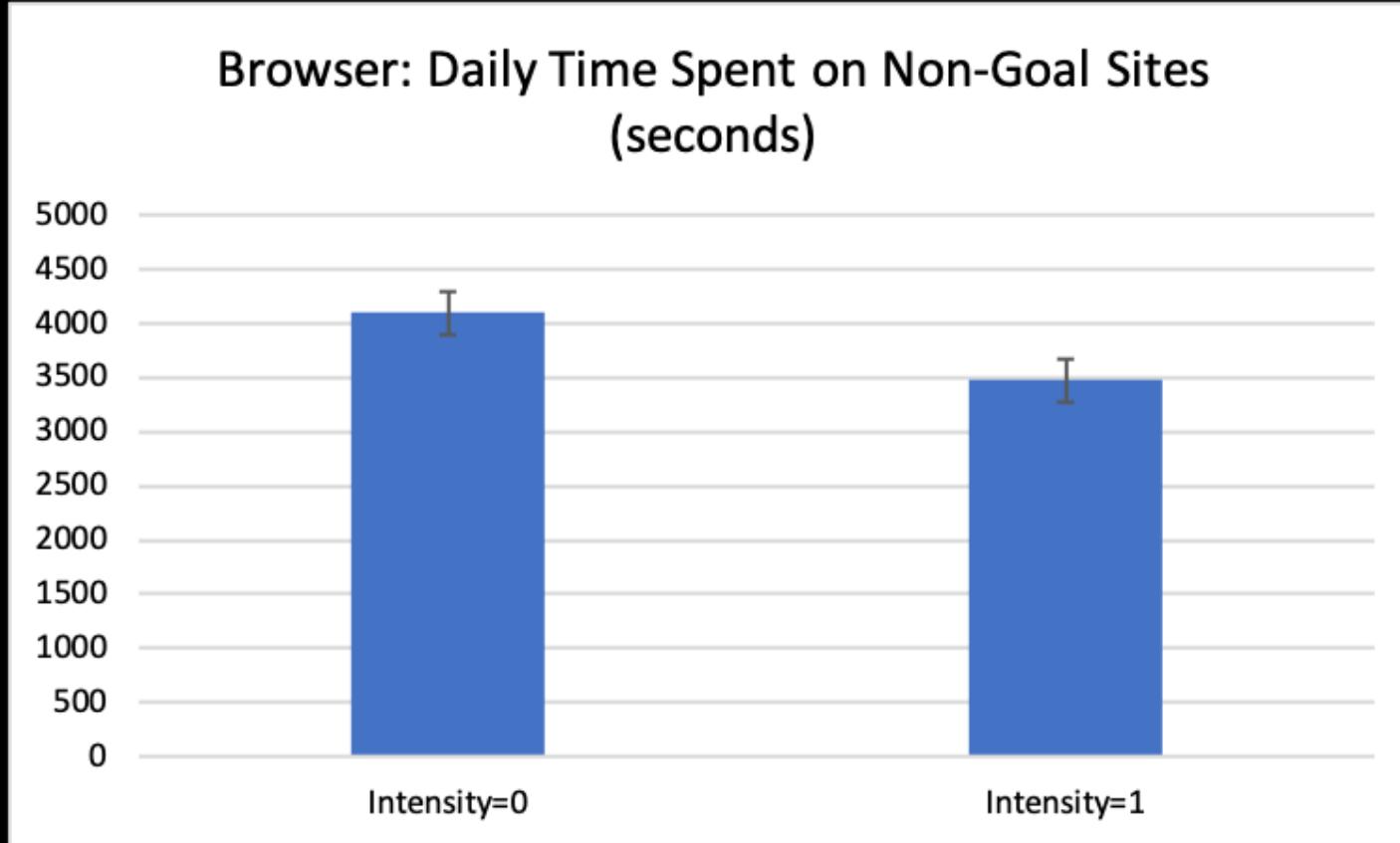


Is time redistributed within platform? (Method)

On days when intensity is higher, what is the effect on the time spent on non-goal apps and sites?

LMM (Linear Mixed Model) structure	
Dependent variable	Total time on non-goal sites (log)
Fixed effects	Intensity
Random effects	User

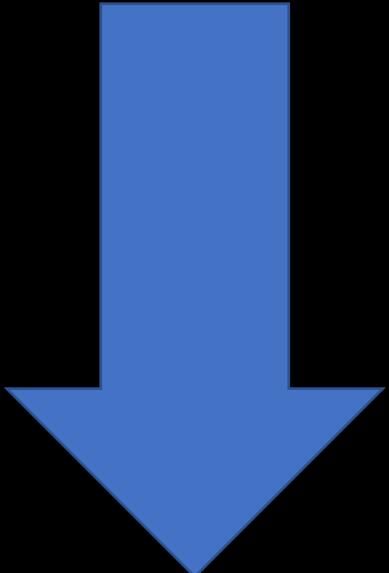
Browser: reduction of time spent on other sites when intensity is higher



15% reduction in time spent when intensity increases from 0→1 ($p < 0.0001$)

Mobile: No significant effect of time on one app on other apps

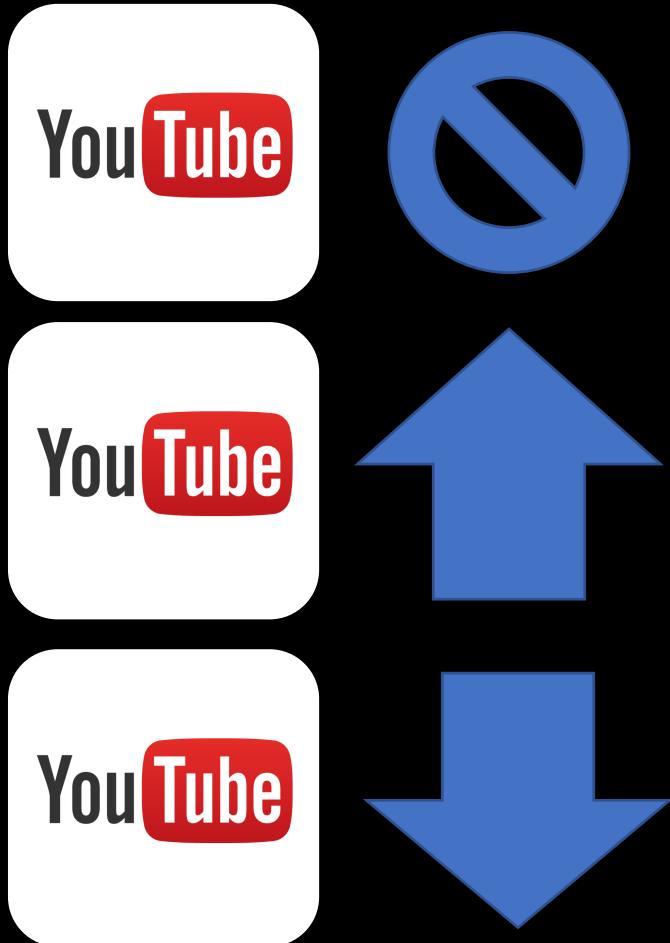
RQ1: Do interventions on one site/app influence time spent on other sites/apps?



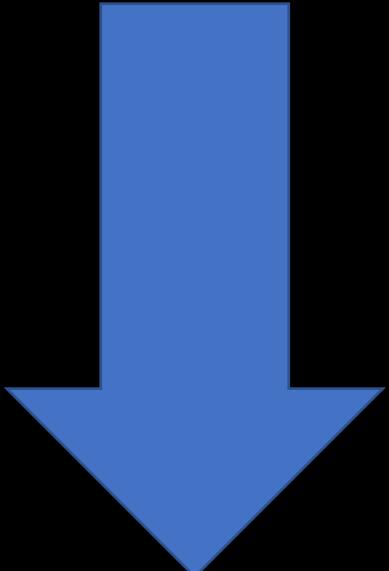
Isolation

Conservation

Reduction



RQ1: Do interventions on one site/app influence time spent on other sites/apps?

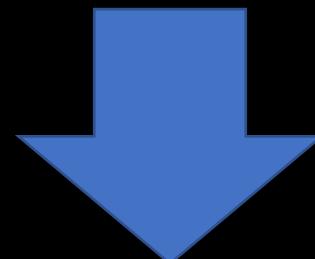
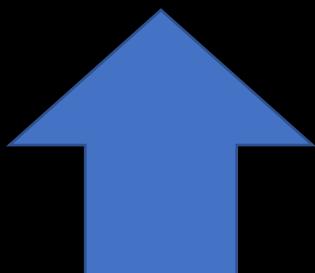


Isolation

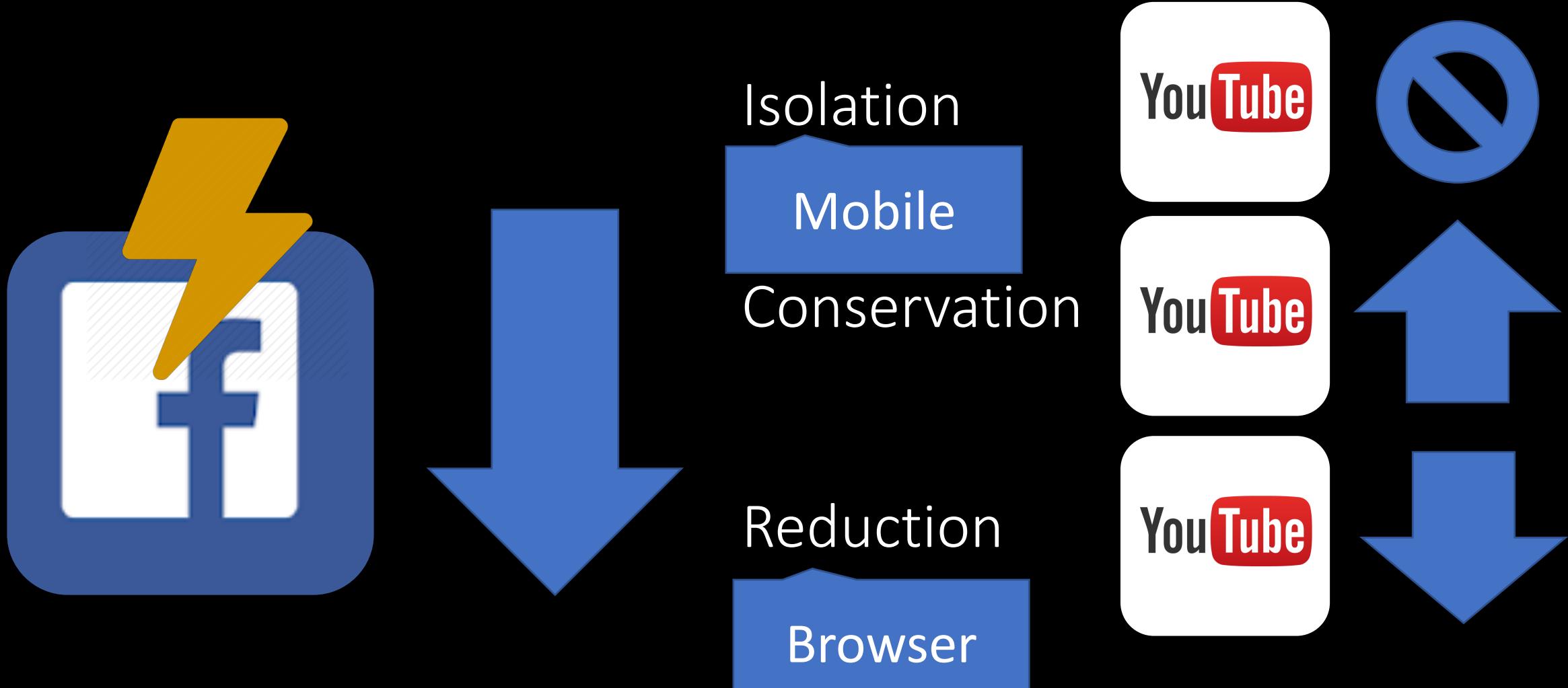
Conservation

Reduction

Browser



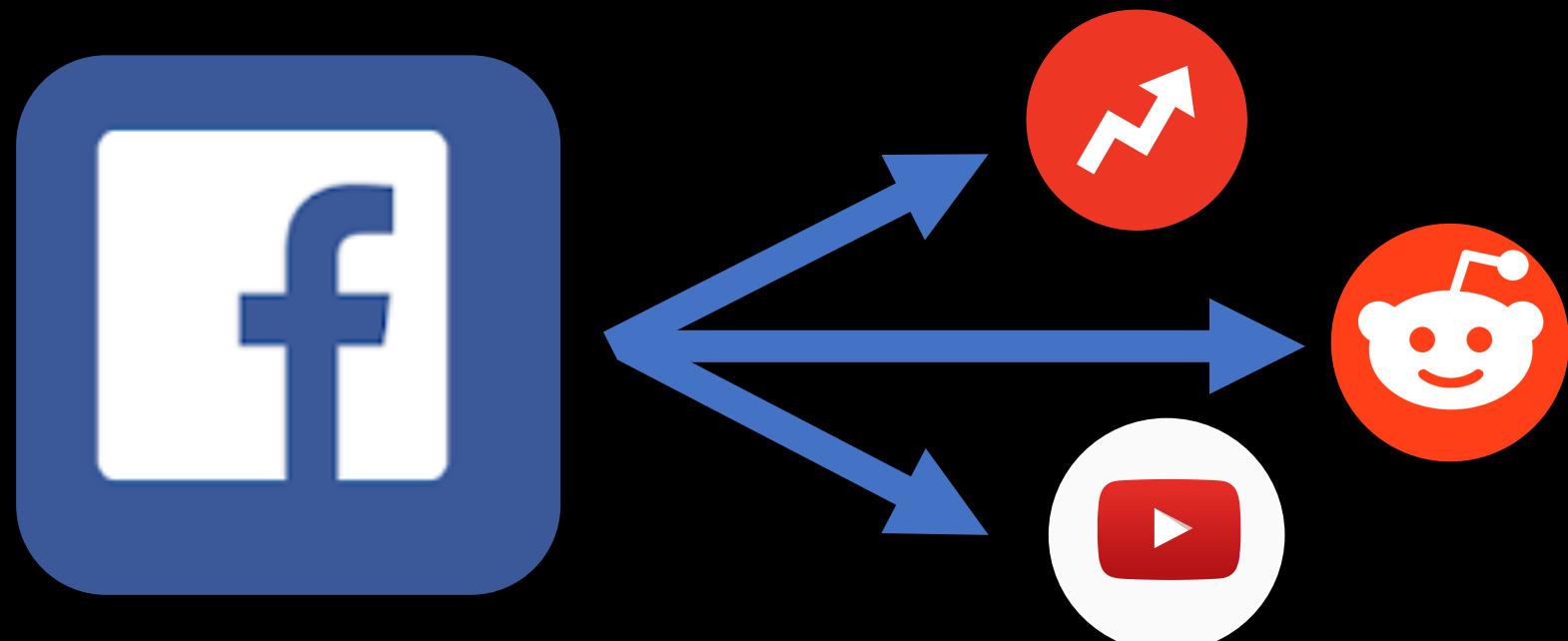
RQ1: Do interventions on one site/app influence time spent on other sites/apps?



Why was there a reduction effect on browser?

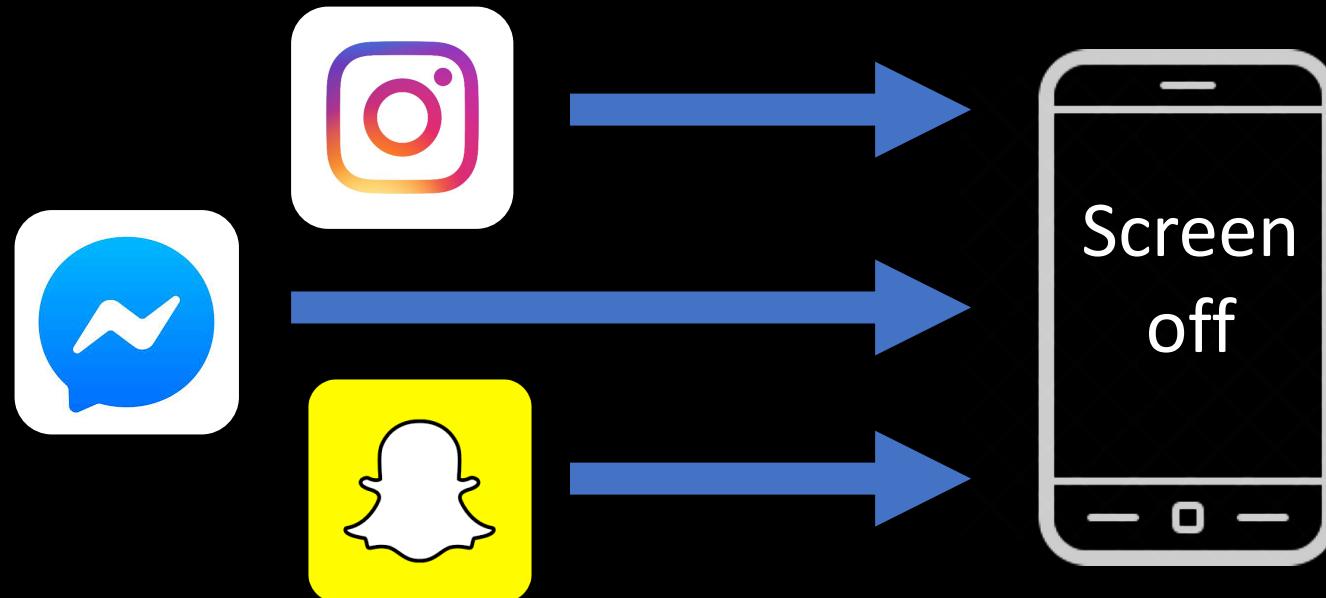
Aggregator sites such as Facebook often link to other domains

By reducing visits and time on Facebook, we reduce time on other domains



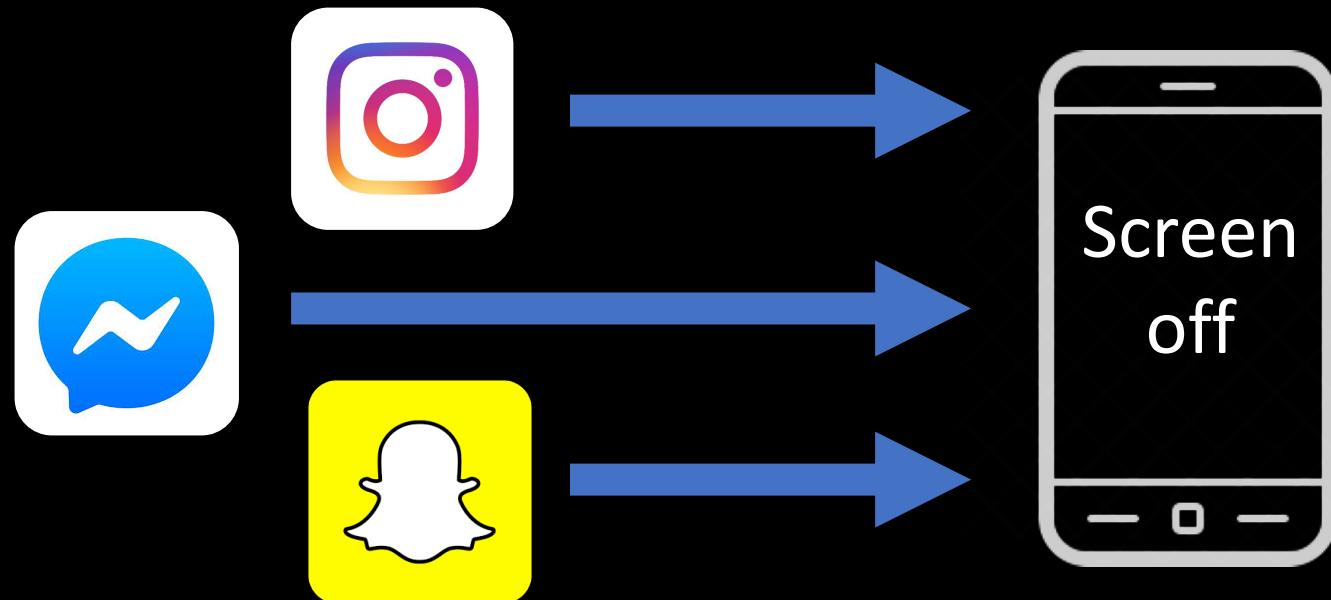
Why was there no effect on mobile?

Mobile goal apps were mostly messaging-oriented, not aggregators
Sessions were short and followed by turning off the screen



Why was there no effect on mobile?

Many mobile apps such as Facebook embed an in-app browser, so visiting external links remains within the same app



Outline

- Our behavior change system (HabitLab)
- Are interventions effective at reducing time on the focal goal?
 - Effective on both browser and mobile
- RQ1: Is time redistributed to other sites on the same platform?
 - **Reducing time on one site reduces time elsewhere on browser (reduction hypothesis), but not mobile (isolation hypothesis)**
- RQ2: Is time redistributed across devices?

Outline

- Our behavior change system (HabitLab)
- Are interventions effective at reducing time on the focal goal?
 - Effective on both browser and mobile
- RQ1: Is time redistributed to other sites on the same platform?
 - Reducing time on one site reduces time elsewhere on browser (reduction hypothesis), but not mobile (isolation hypothesis)
- **RQ2: Is time redistributed across devices?**

Is time redistributed across devices? (Method)

- On days when intensity is higher on one device, what is the effect on total time spent on goal sites on the other device?

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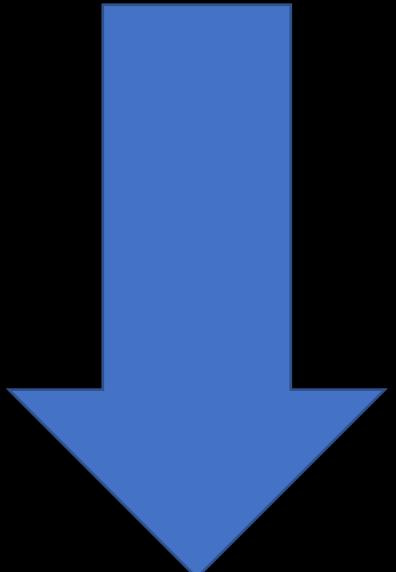
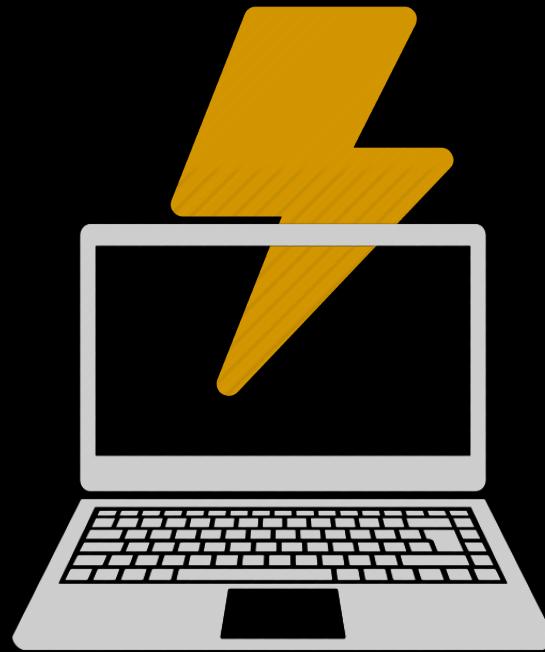
- On days when intensity is higher on one device, what is the effect on total time spent on goal sites on the other device?
- Limited to participants using HabitLab on both platforms (60 participants, n=429 days)

LMM (Linear Mixed Model) structure	
Dependent variable	Total time on other device (log)
Fixed effects	Intensity on this device
Random effects	User

Time is not redistributed across devices

- Effects of browser intensity on mobile: No significant effect ($p>.5$)
- Effects of mobile intensity on browser: No significant effect ($p>.5$)

RQ2: Do interventions on one device influence time spent on other devices?



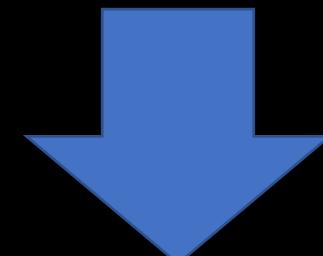
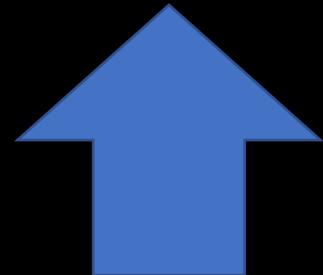
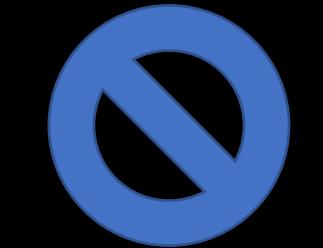
Isolation



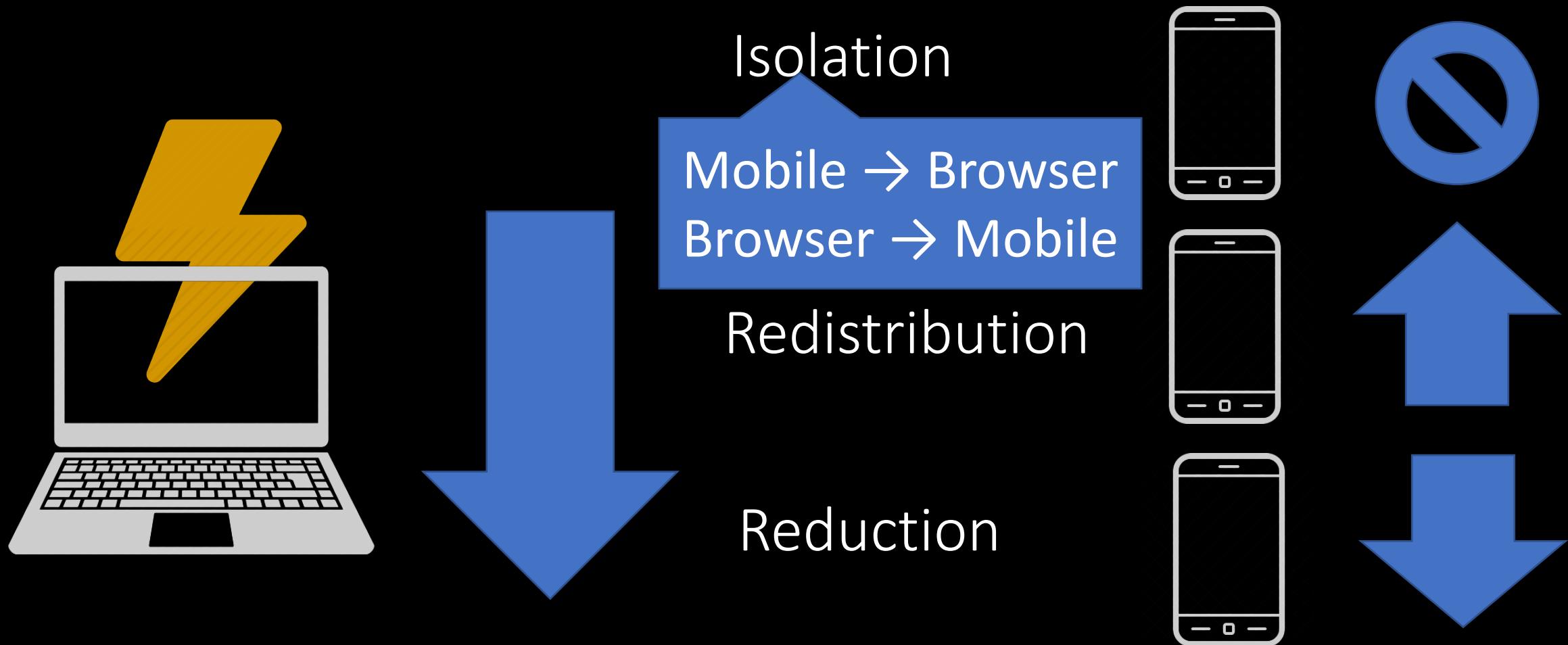
Redistribution



Reduction

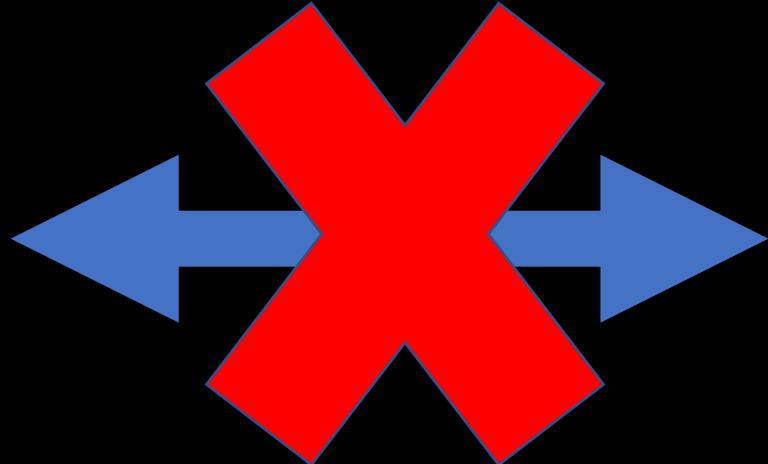
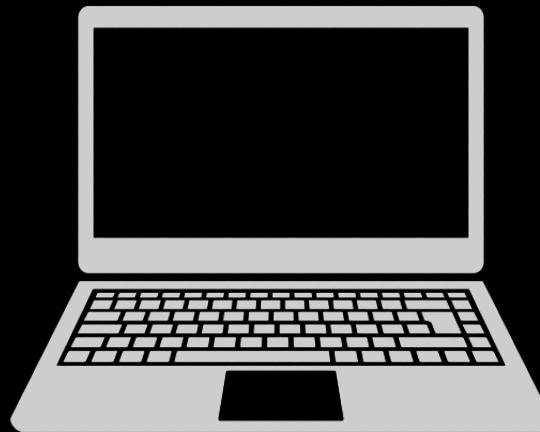


RQ2: Do interventions on one device influence time spent on other devices?



Why were there no cross-device effects?

- Laptops and phones are used in different contexts
- Unlike browsers, there are no cross-device “links” – few apps/sites prompt you to start using the other device



Outline

- Our behavior change system (HabitLab)
- Are interventions effective at reducing time on the focal goal?
 - Effective on both browser and mobile
- RQ1: Is time redistributed to other sites on the same platform?
 - Reducing time on one site reduces time elsewhere on browser (reduction hypothesis), but not mobile (isolation hypothesis)
- RQ2: Is time redistributed across devices?
 - **Time is not redistributed across devices (isolation hypothesis)**

Discussion and implications

- We did not observe negative secondary effects of productivity interventions (on other apps, sites, or devices)
- On browsers, there's actually a reduction elsewhere, from reducing time on sites (likely due to aggregator sites)

Discussion and implications

- When designing interventions, we should consider effects not just on the targeted behavior, but the workflow as a whole

Limitations

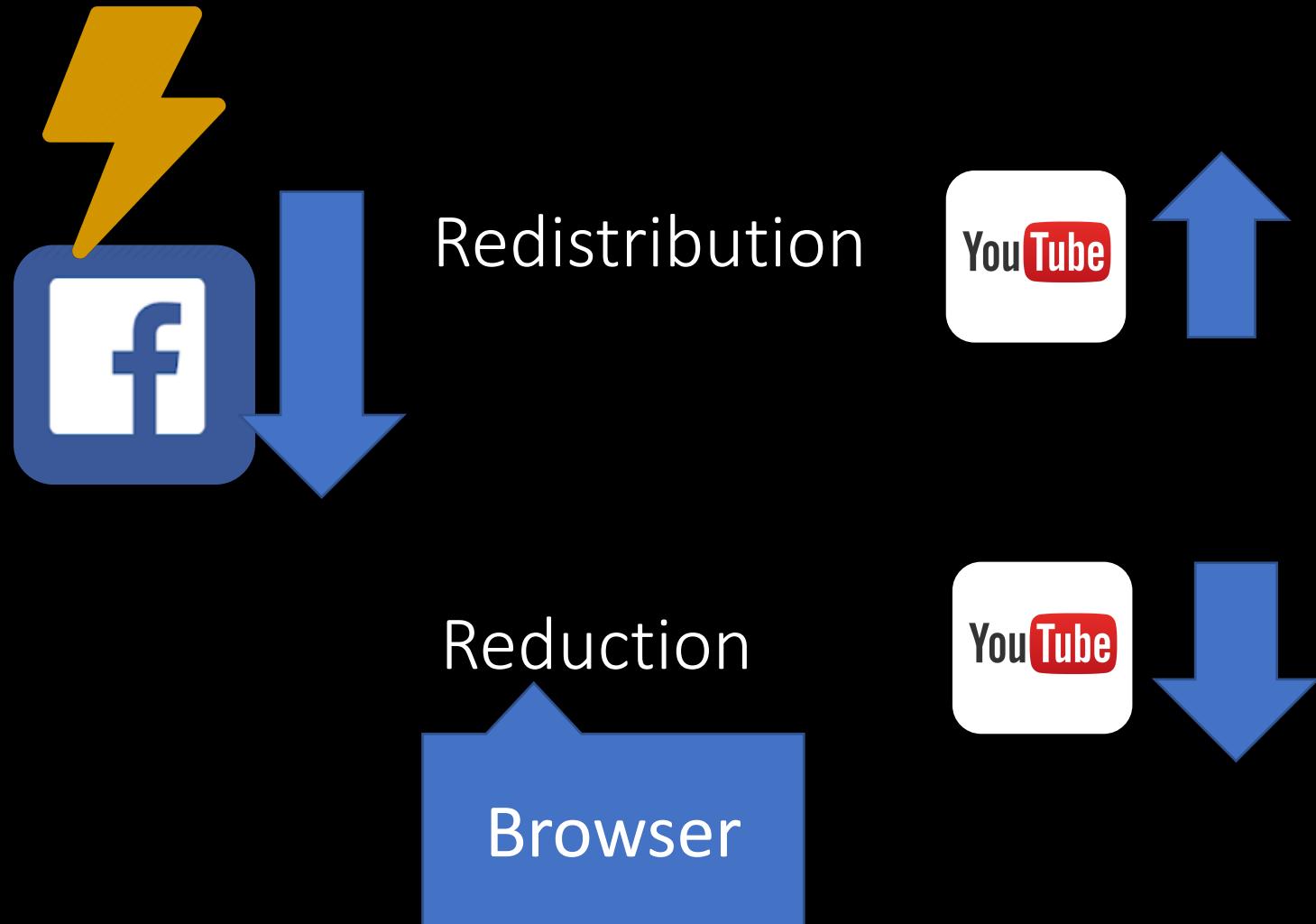
- Only monitoring time on phones and browsers
 - Cannot observe if time is being redistributed to non-digital activities
- Only studied productivity domain
 - “Absence of negative secondary effects” may not generalize to other behavior change domains

Conclusion

- Does reducing time via interventions influence time spent elsewhere?

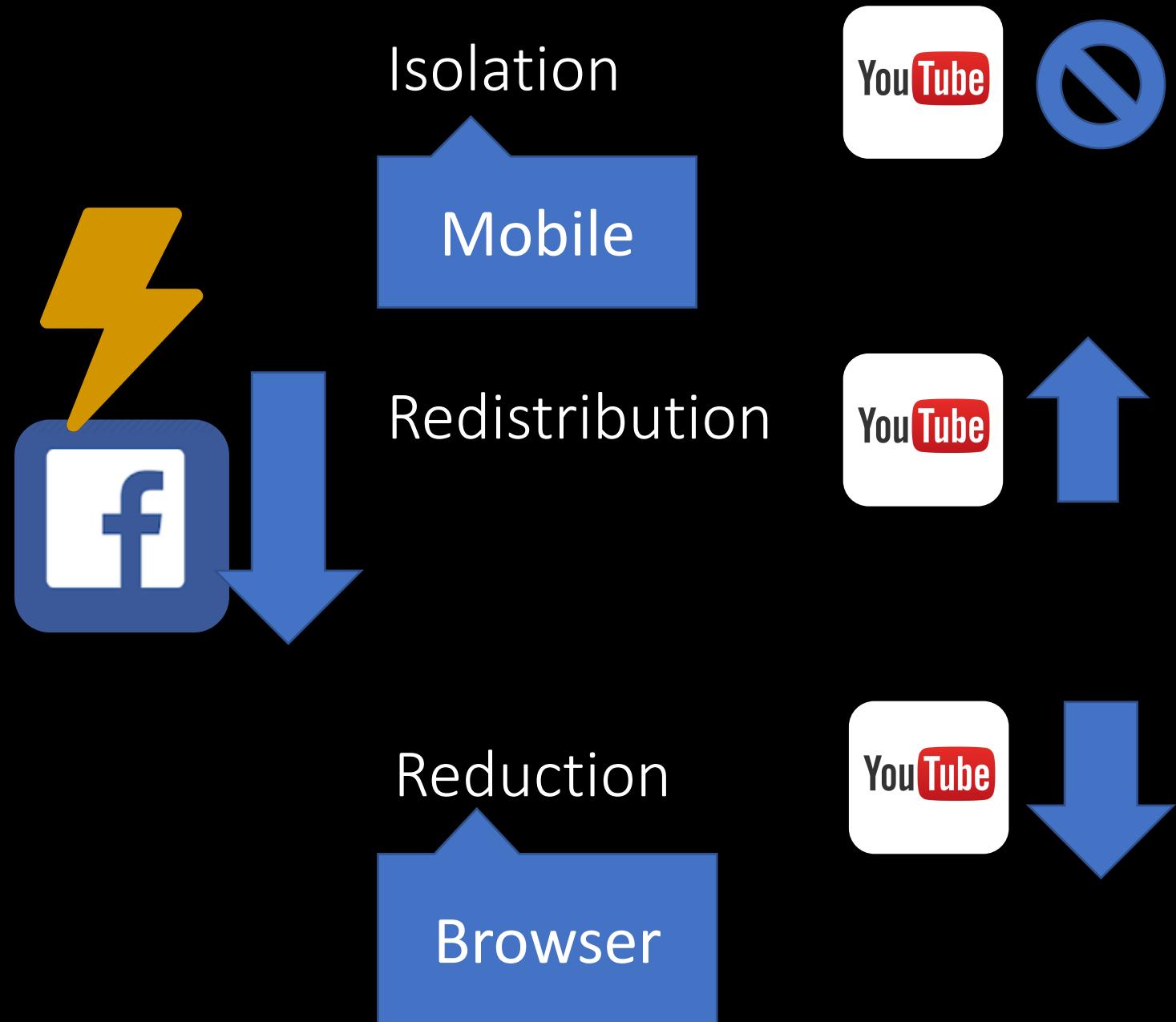
Conclusion

- Does reducing time via interventions influence time spent elsewhere?
- Within-device: reduction on browser



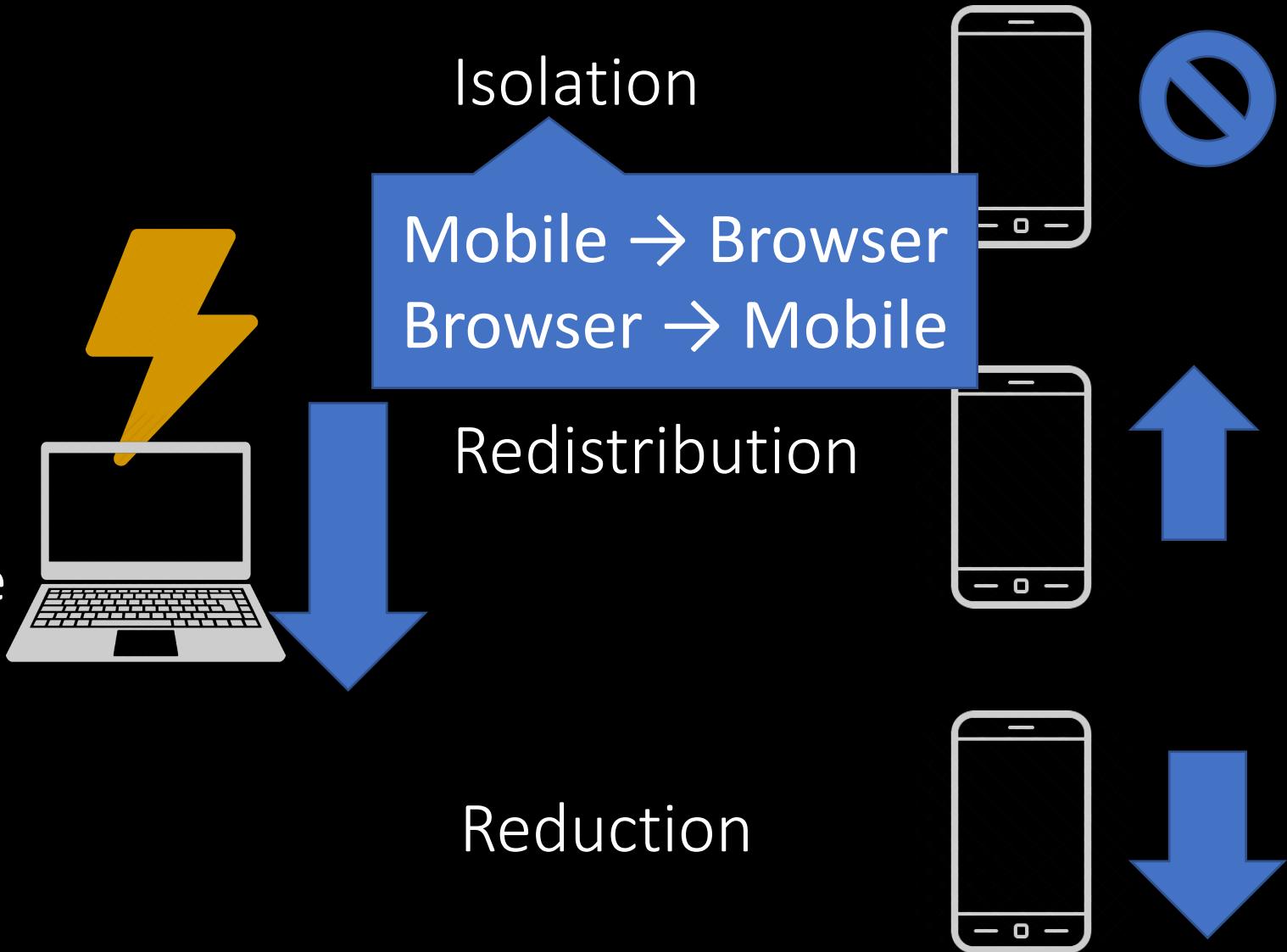
Conclusion

- Does reducing time via interventions influence time spent elsewhere?
- Within-device: reduction on browser, but not mobile



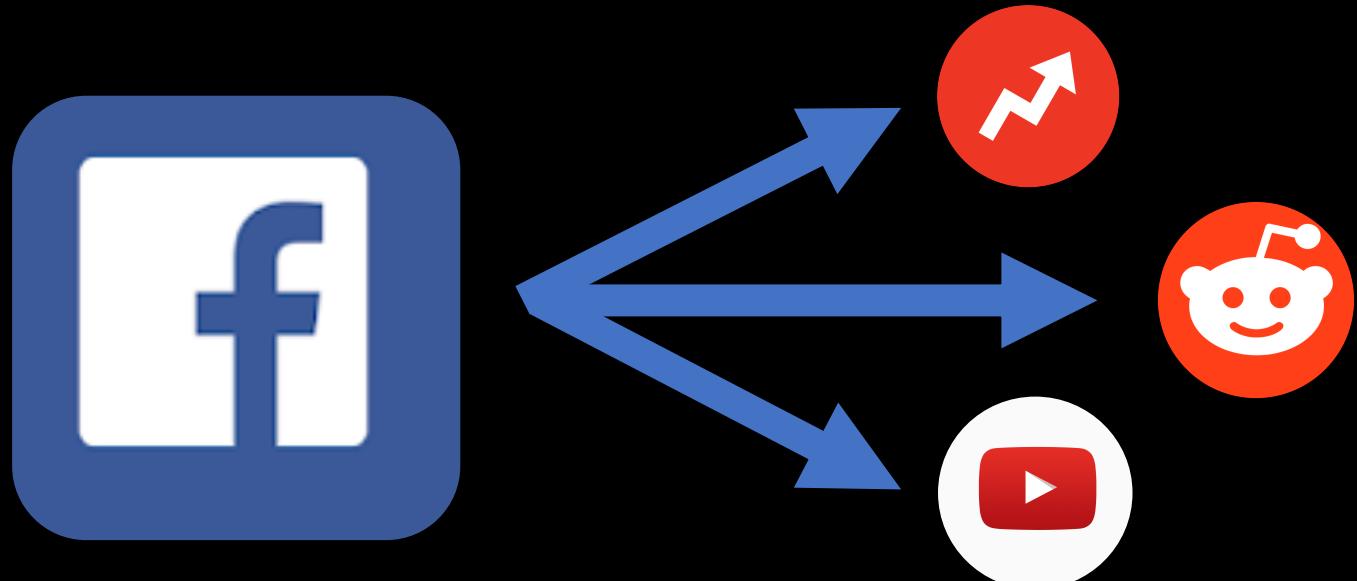
Conclusion

- Does reducing time via interventions influence time spent elsewhere?
- Within-device: reduction on browser, but not mobile
- Cross-device: no effects



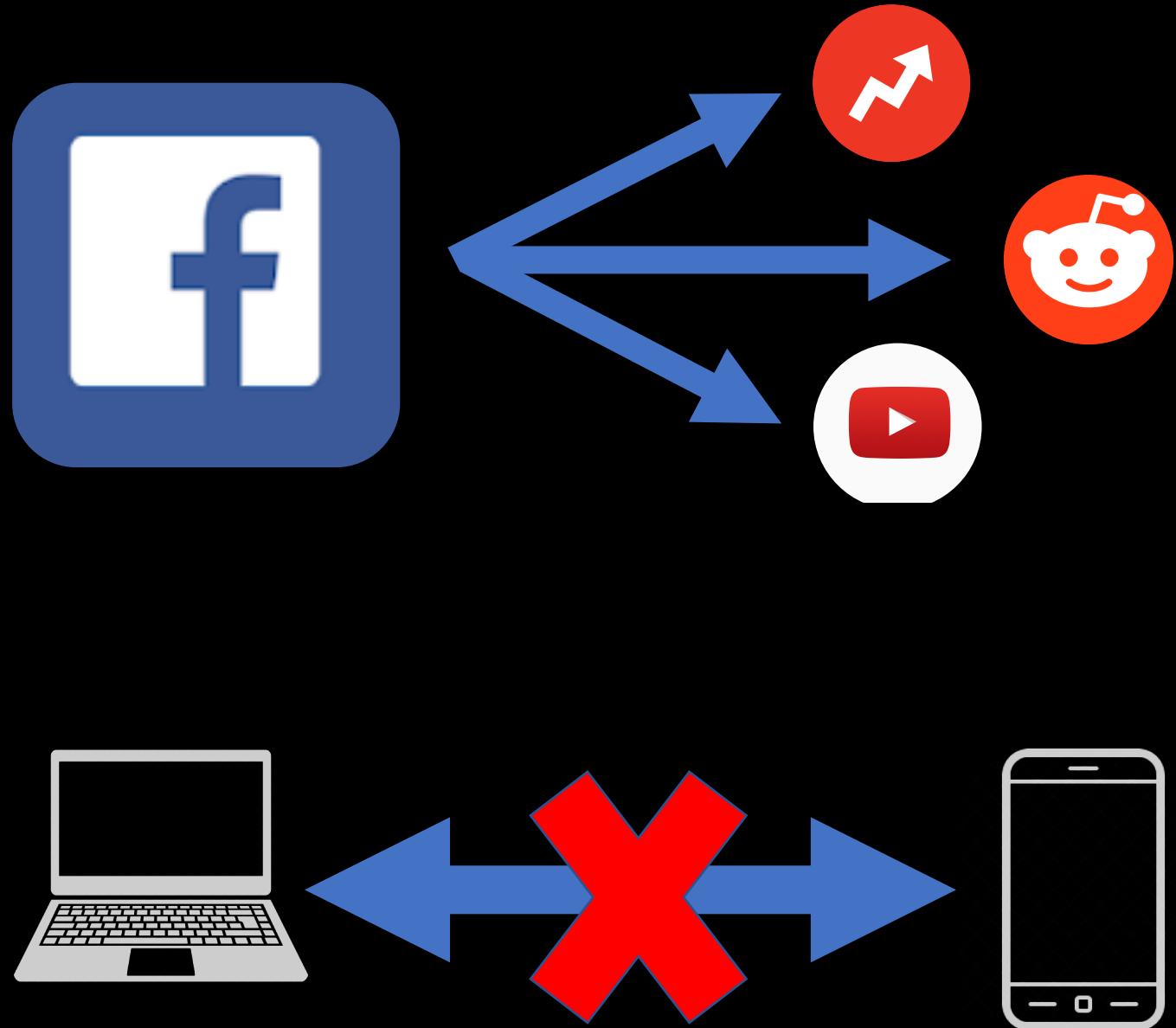
Conclusion

- Does reducing time via interventions influence time spent elsewhere?
- Within-device: reduction on browser, but not mobile
 - Due to aggregator sites driving traffic to other sites
- Cross-device: no effects



Conclusion

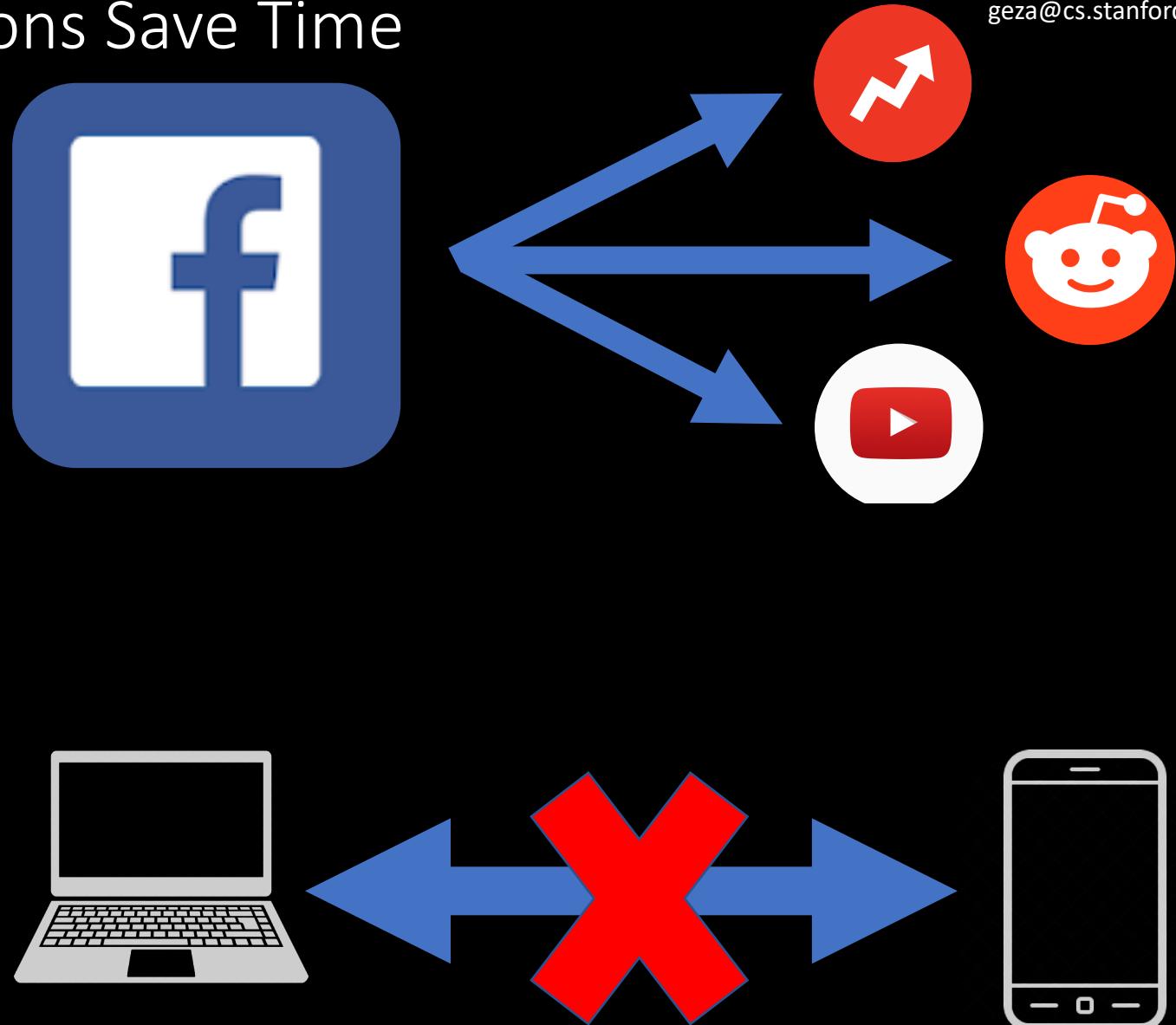
- Does reducing time via interventions influence time spent elsewhere?
- Within-device: reduction on browser, but not mobile
 - Due to aggregator sites driving traffic to other sites
- Cross-device: no effects
 - Devices used in different contexts



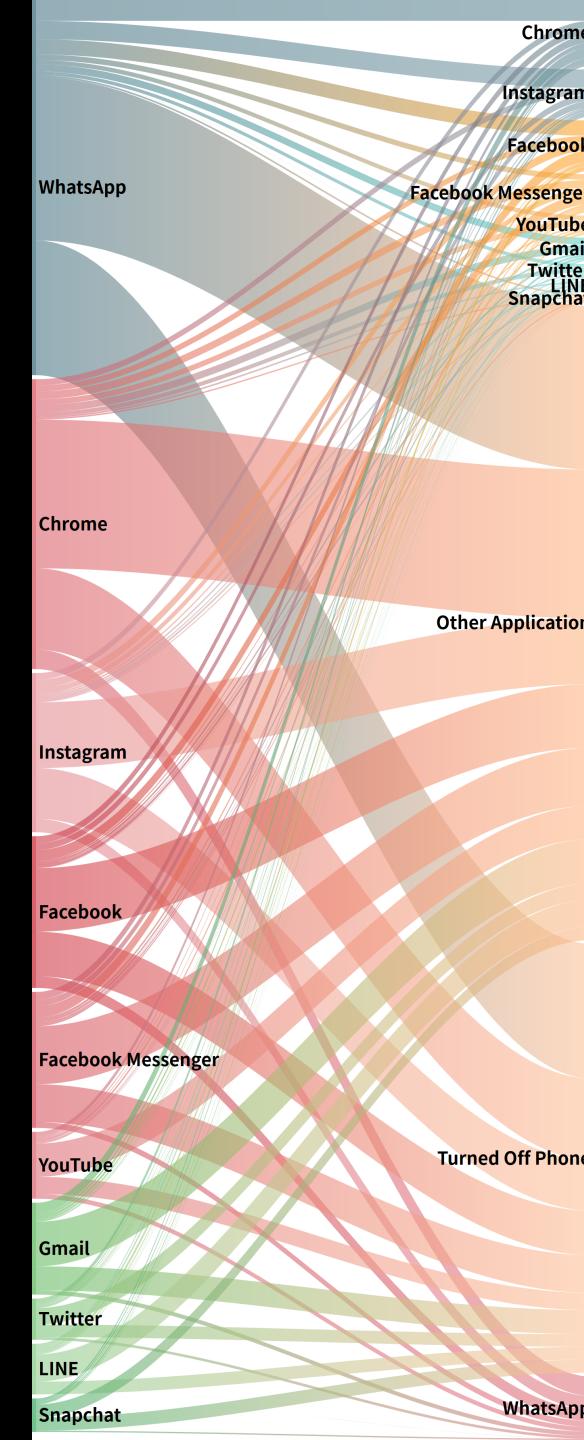
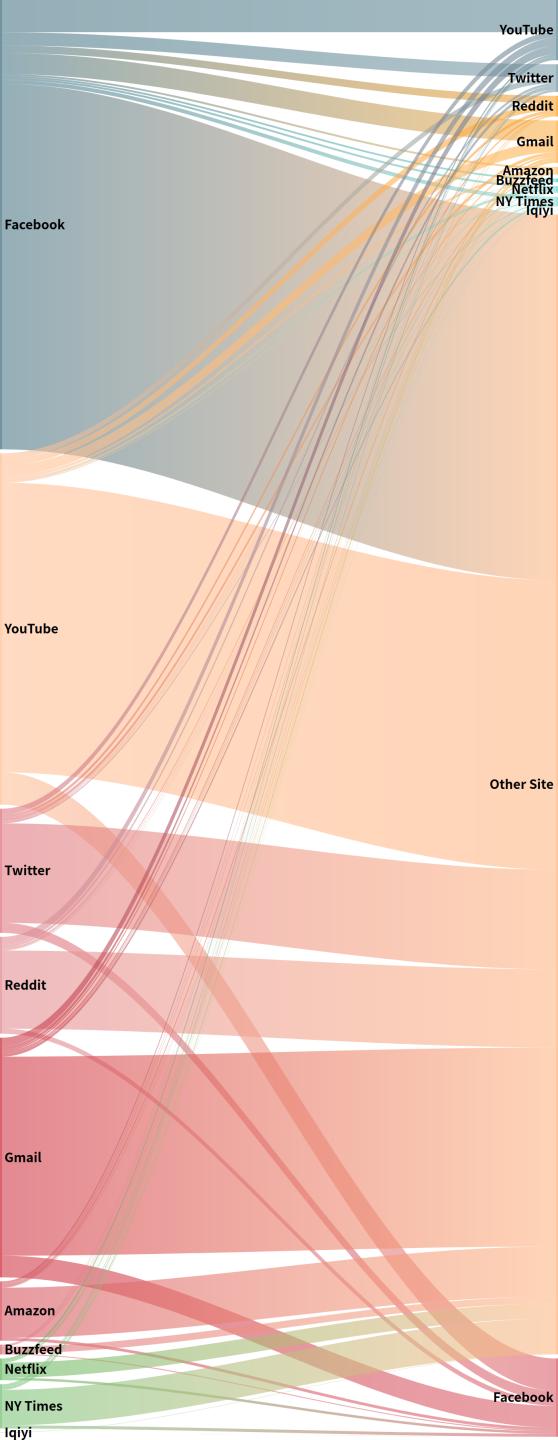
Conservation of Procrastination: Do Productivity Interventions Save Time or Just Redistribute It?

Geza Kovacs
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- Does reducing time via interventions influence time spent elsewhere?
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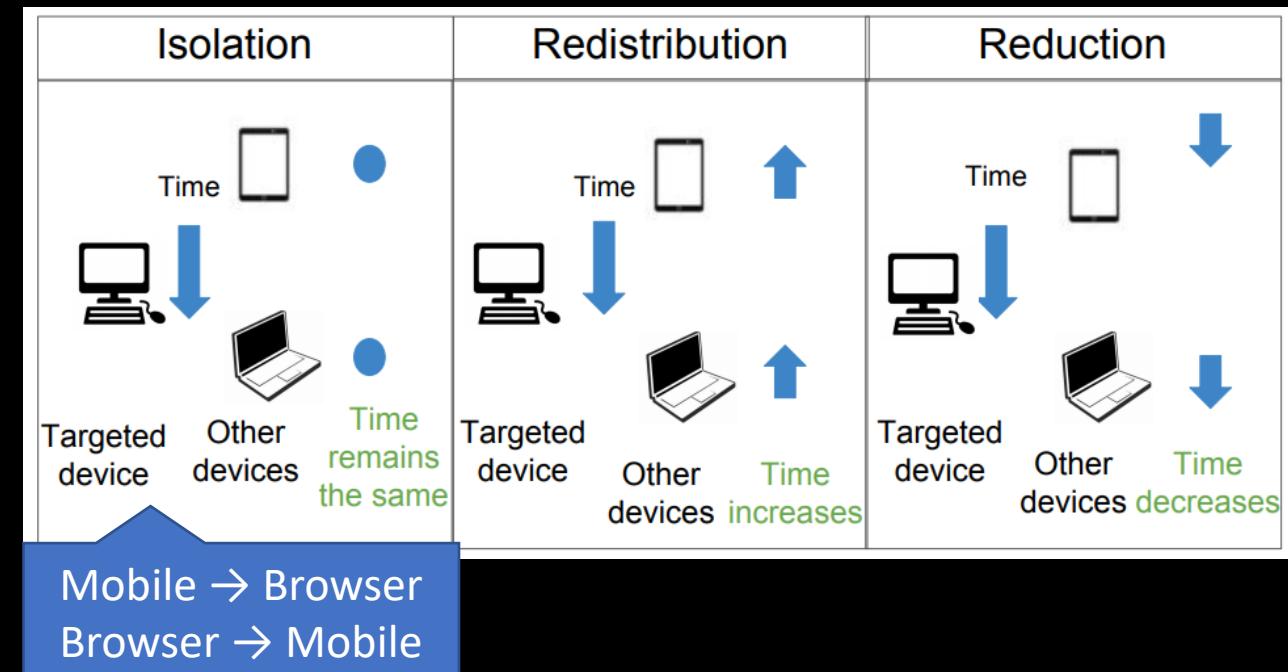
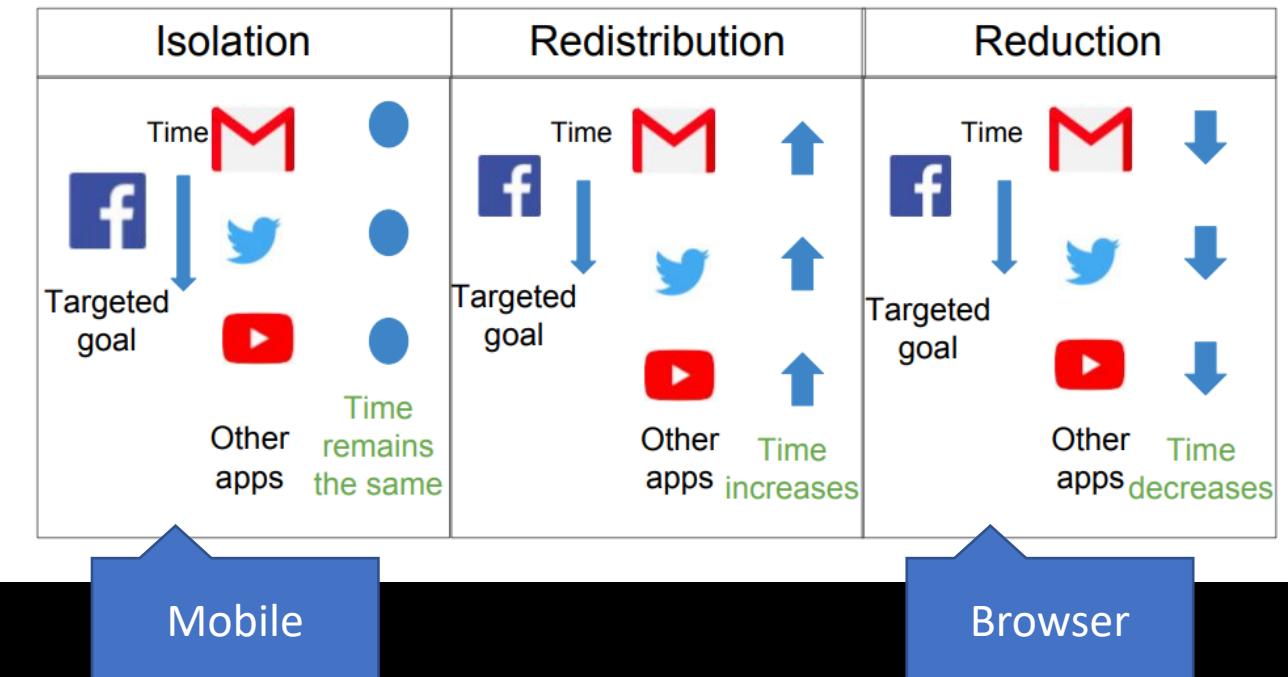
Backup Slides



1.	(not set)	701 (5.63%)
2.	New York	202 (1.62%)
3.	Bogota	135 (1.08%)
4.	Madrid	132 (1.06%)
5.	London	126 (1.01%)
6.	San Francisco	124 (1.00%)
7.	Moscow	118 (0.95%)
8.	Stanford	110 (0.88%)
9.	Los Angeles	100 (0.80%)
10.	Sydney	98 (0.79%)

Conclusion

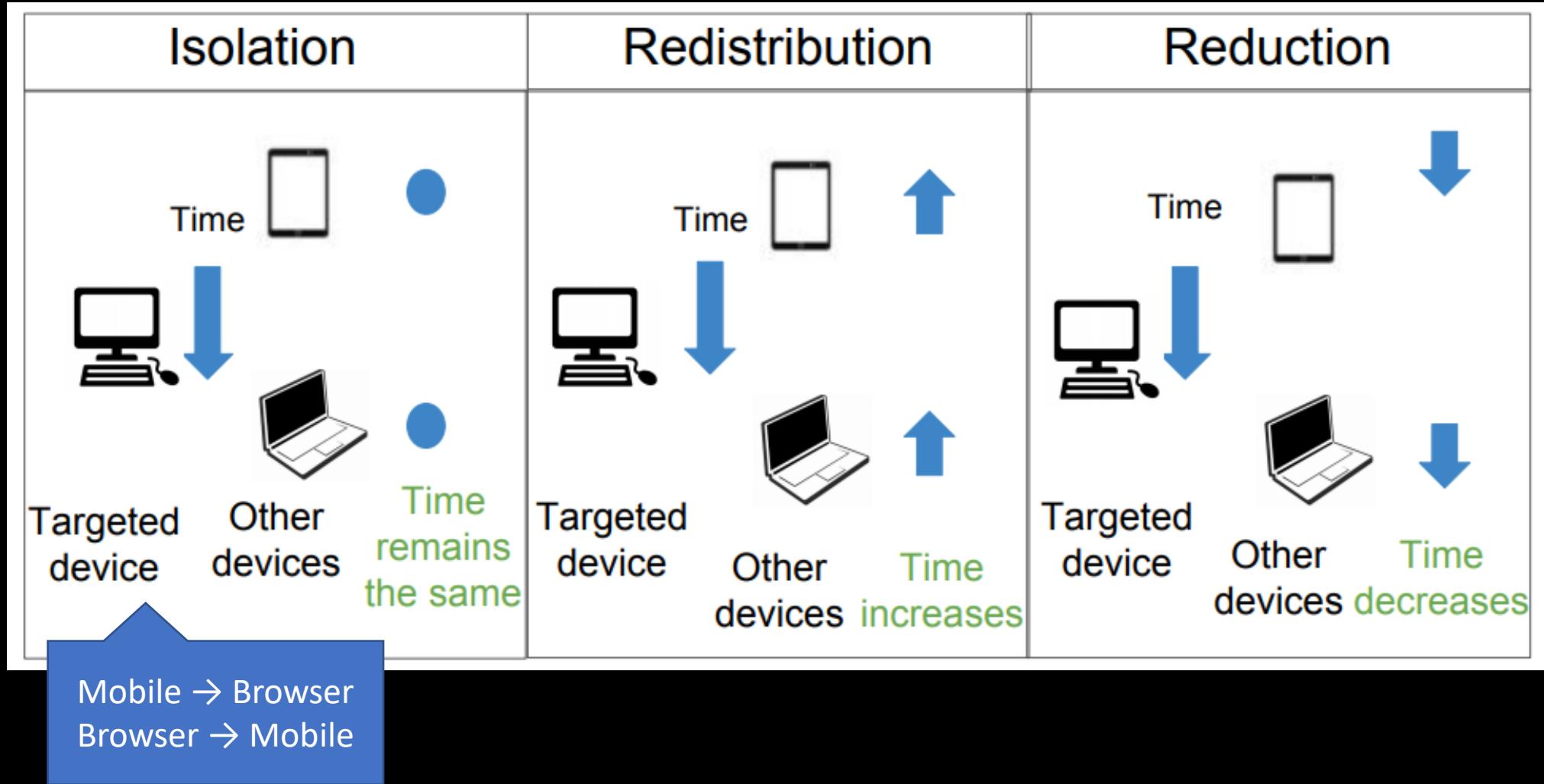
- Does reducing time via interventions influence time spent elsewhere?
- Within-device, we observe reduction on browser, but not mobile
 - Perhaps due to goal sites driving traffic to other sites
- Cross-device, we observe no effects



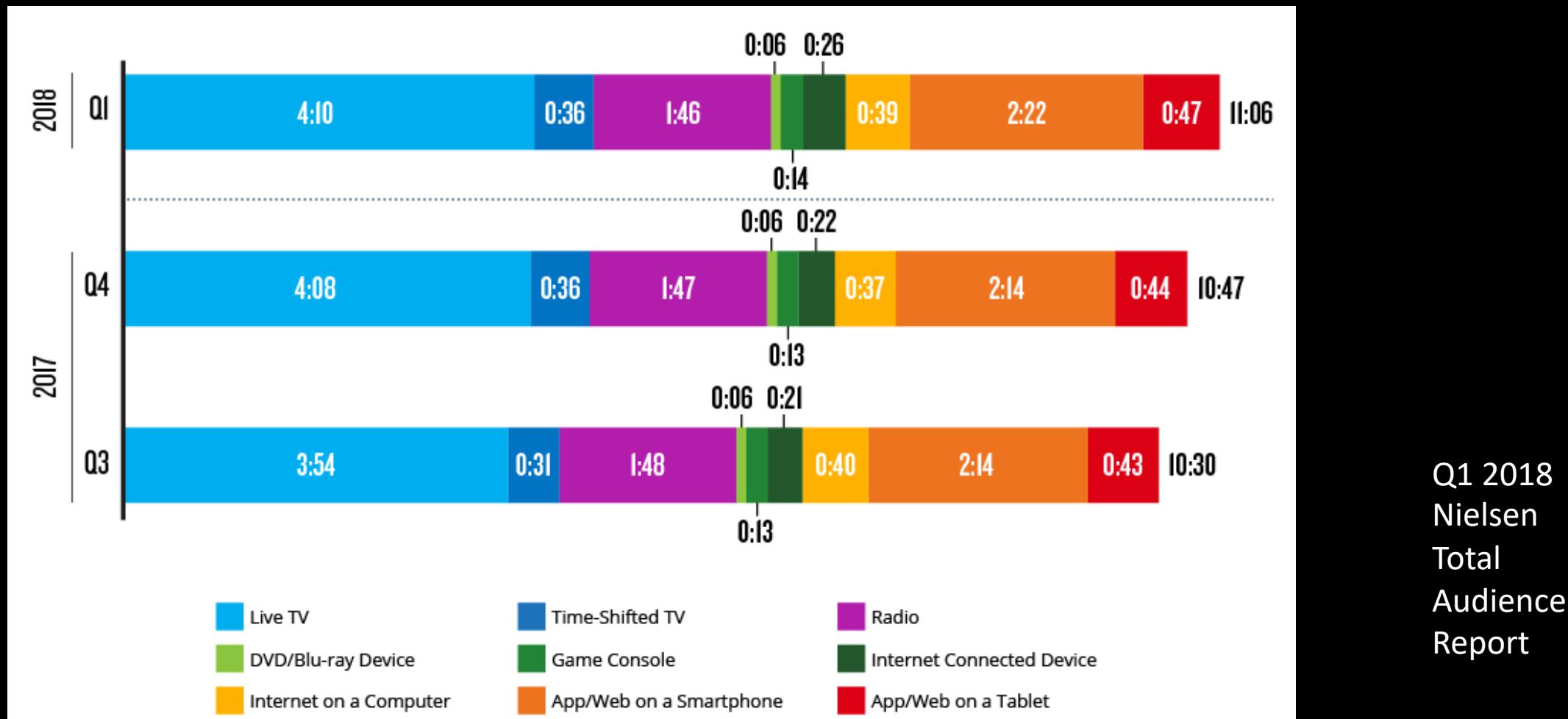
Conclusion

- Does reducing time via interventions influence time spent elsewhere?
3 possibilities:
 - No effect (isolation)
 - Increases time spent elsewhere (redistribution)
 - Decreases time spent elsewhere (reduction)
- Within-device, we observe reduction on browser, but not mobile
 - Perhaps due to goal sites driving traffic to other sites
- Cross-device, we observe no effects

RQ2: Do interventions on one device influence time spent on the other device?



US adults spend 4.2 hours each day browsing the web and using phone apps



People spend increasing amounts of time online

Average US adult spends 5.9 hours per day with digital media

Daily Hours Spent with Digital Media per Adult User

