# TandemTrack: Shaping Consistent Exercise Experience by Complementing a Mobile App with a Smart Speaker

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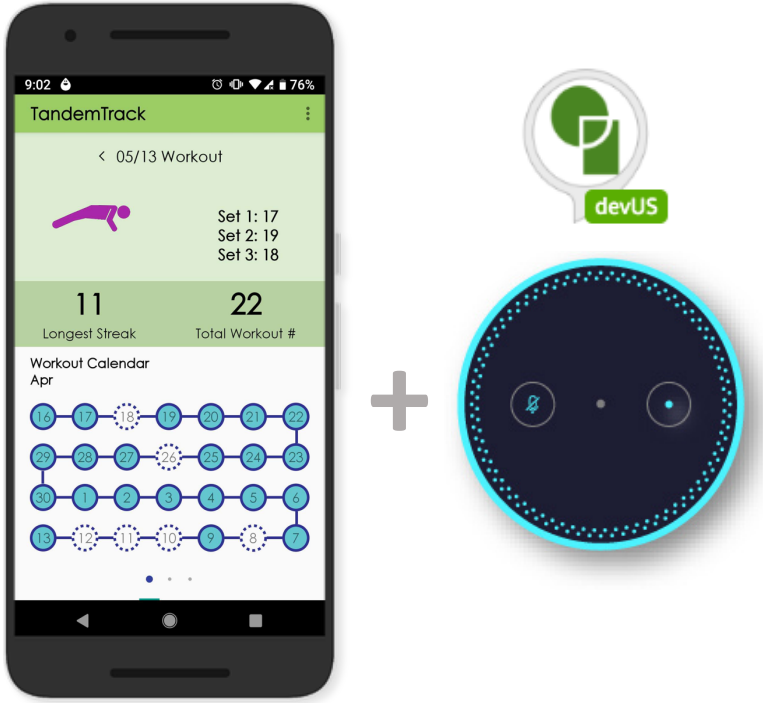
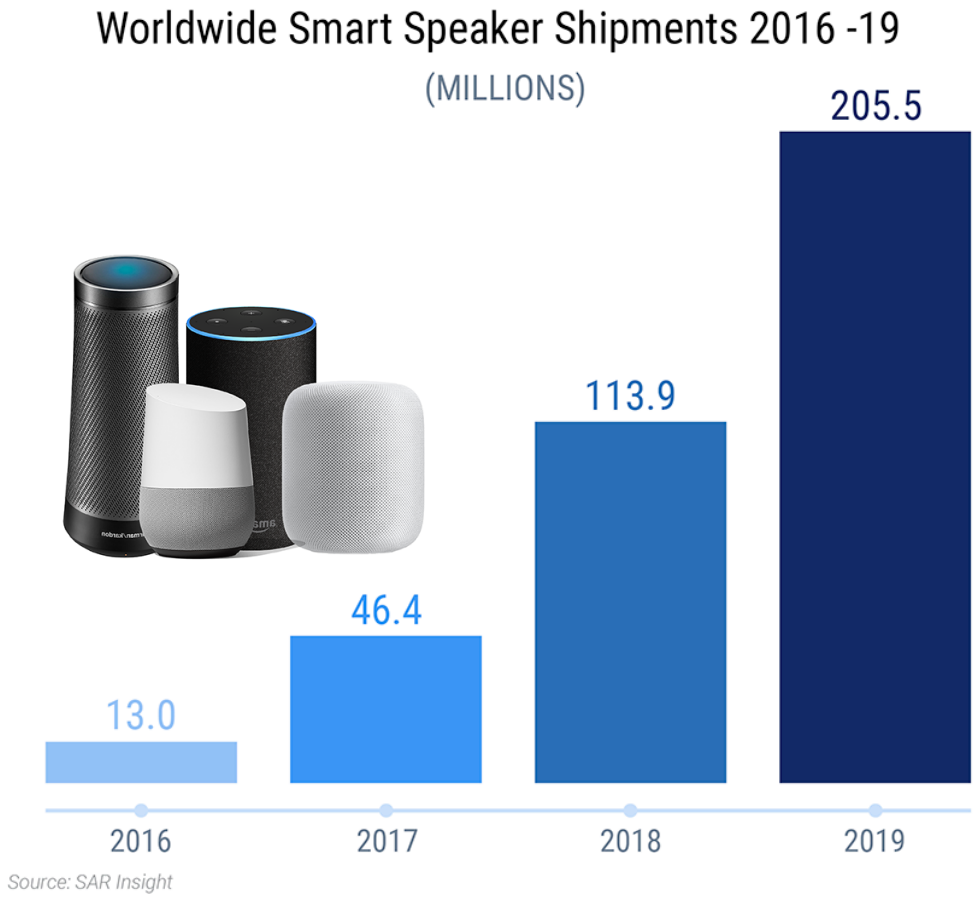
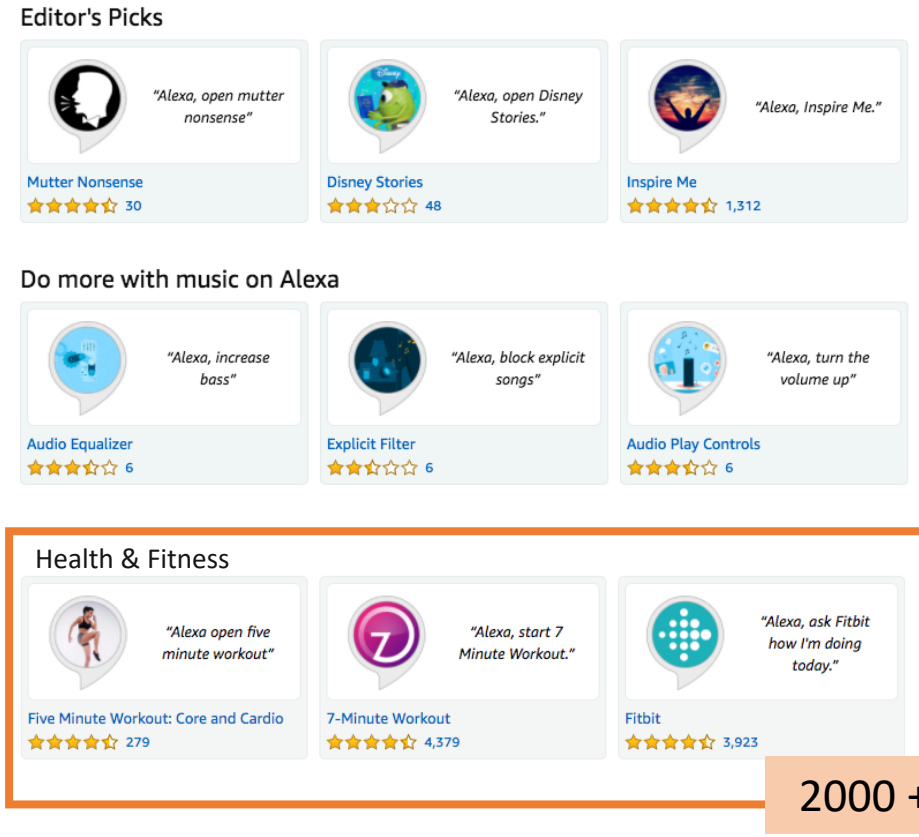


# The Rapid Growth in Smart Speaker Market




Amazon Alexa skill marketplace




**Alexa Skills**

- Business & Finance
- Communication
- Connected Car
- Education & Reference
- Food & Drink
- Games & Trivia
- Health & Fitness
- Home Services
- Kids
- Lifestyle
- Local
- Movies & TV
- Music & Audio
- News
- Novelty & Humor
- Productivity
- Shopping
- Smart Home
- Social

# In supporting in-home exercise, how does a smart speaker complement a mobile fitness app?

**+ Hands-free interaction**

Lower data capture burden

**+ Attentive voice prompt**

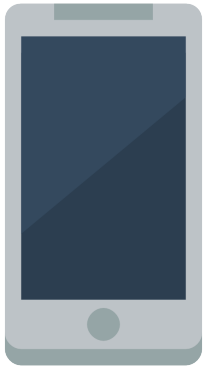
More effective in the home environment

**+ Lack of mobility**

Force a consistent exercise location

**- Limited visual elements**

Limited exercise feedback

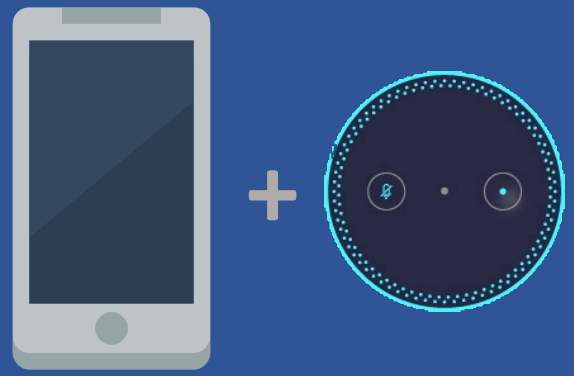


**+ Rich visual elements**

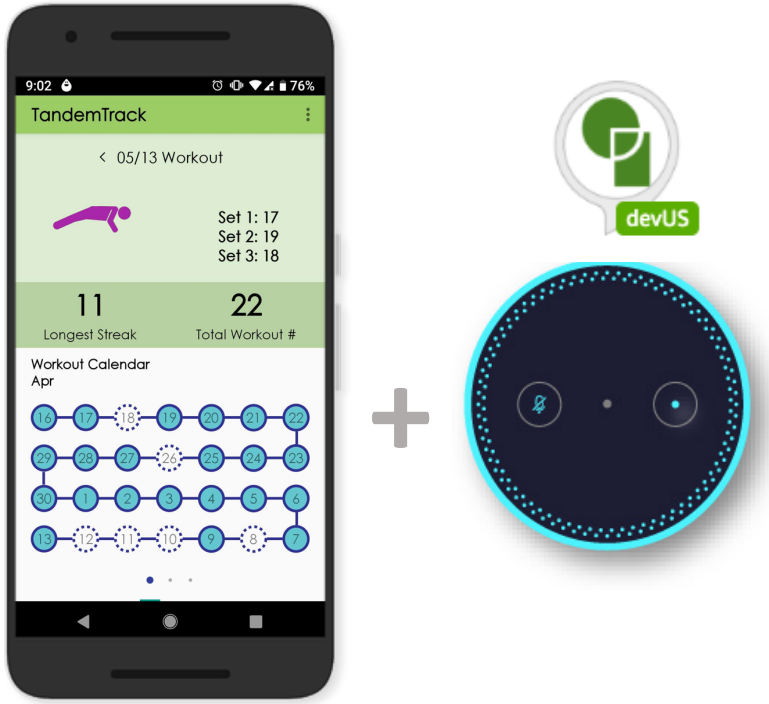
**- Hands-focused interaction**

# Research Question

How does a smart speaker complement a mobile fitness app in supporting consistent exercise?



# TandemTrack: A Multimodal Exercise Assistant





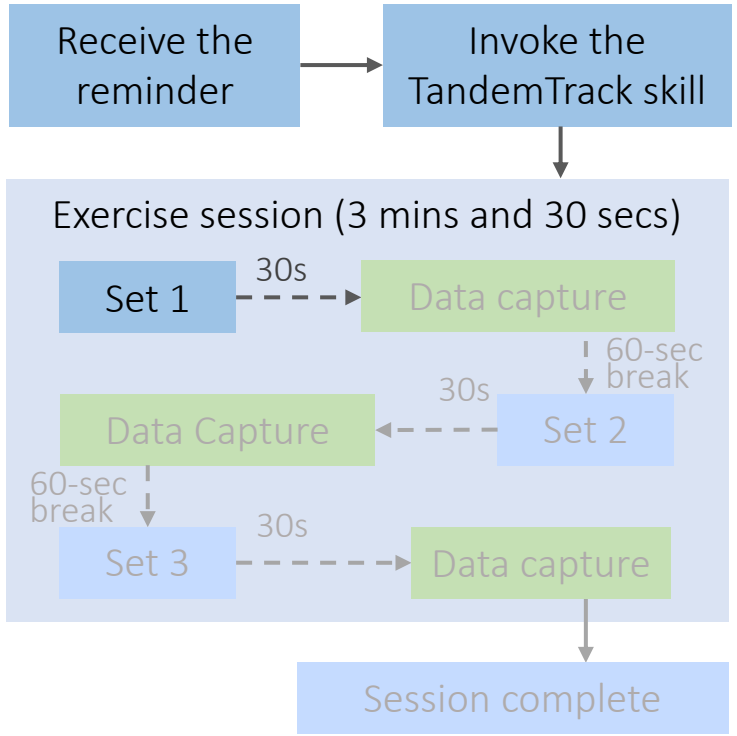




- Supporting the same key features
  - Exercise Regimen (sit-ups/push-ups)
  - Data Capture
  - Exercise Feedback
  - Daily Reminder
- Sharing the same database

# Exercise with The TandemTrack Alexa Skill

## Exercise flow

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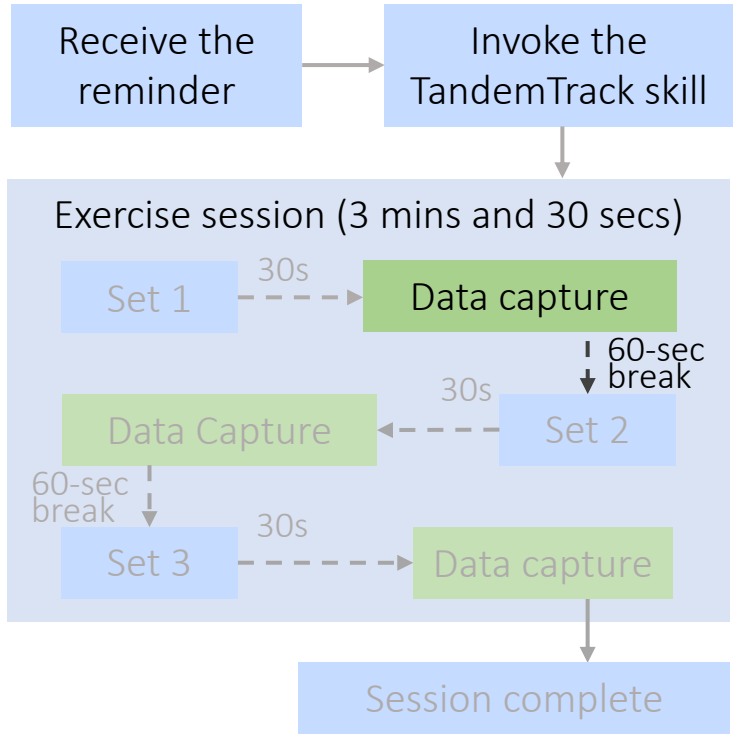


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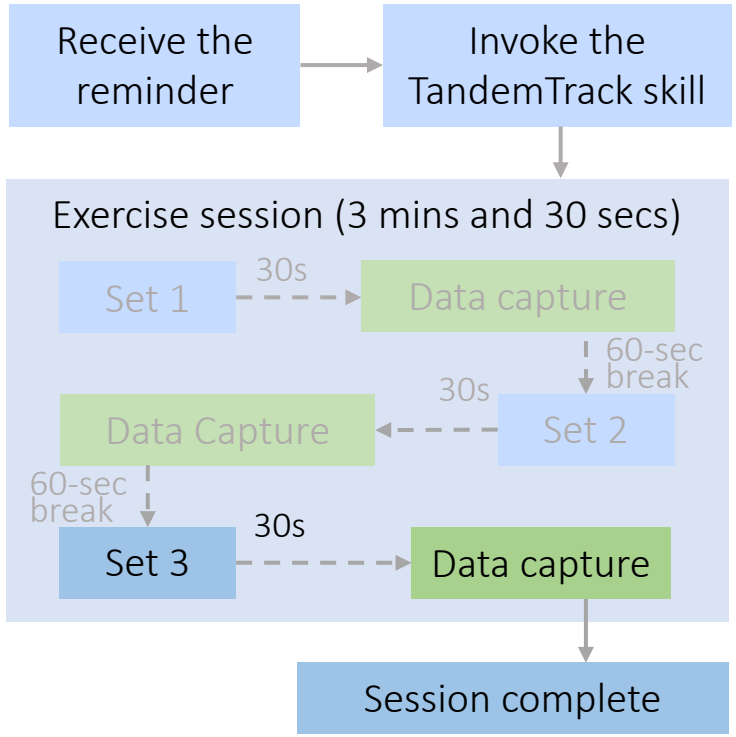
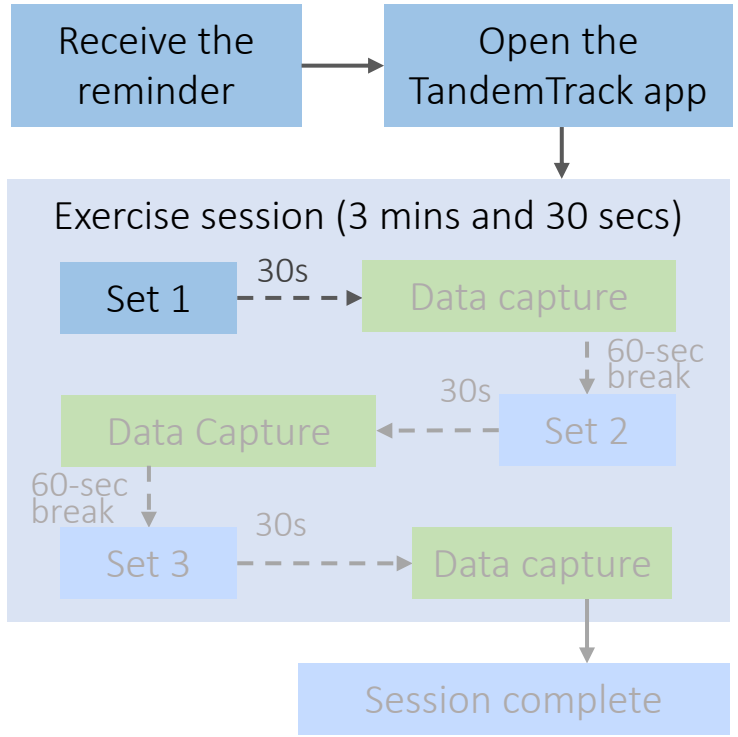


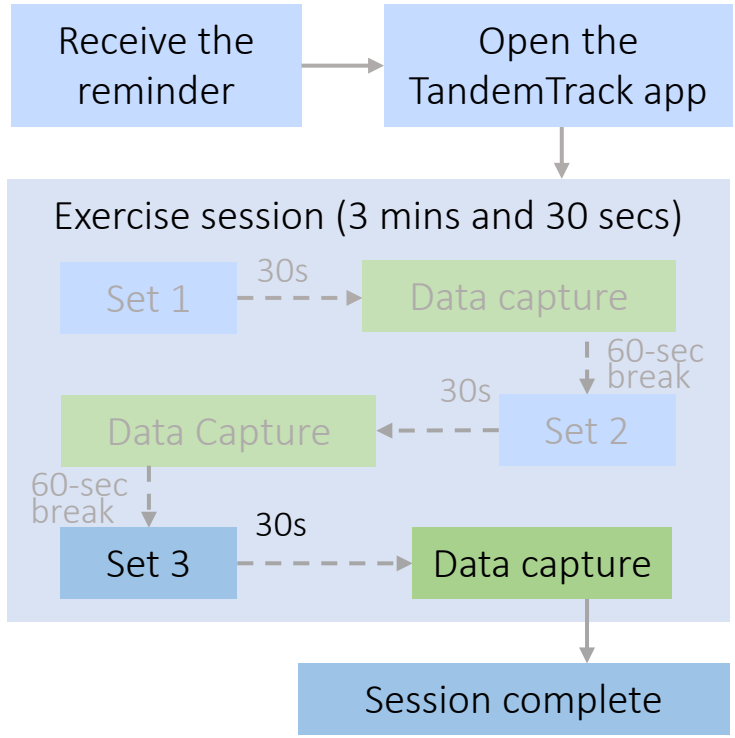

# Exercise with The TandemTrack App

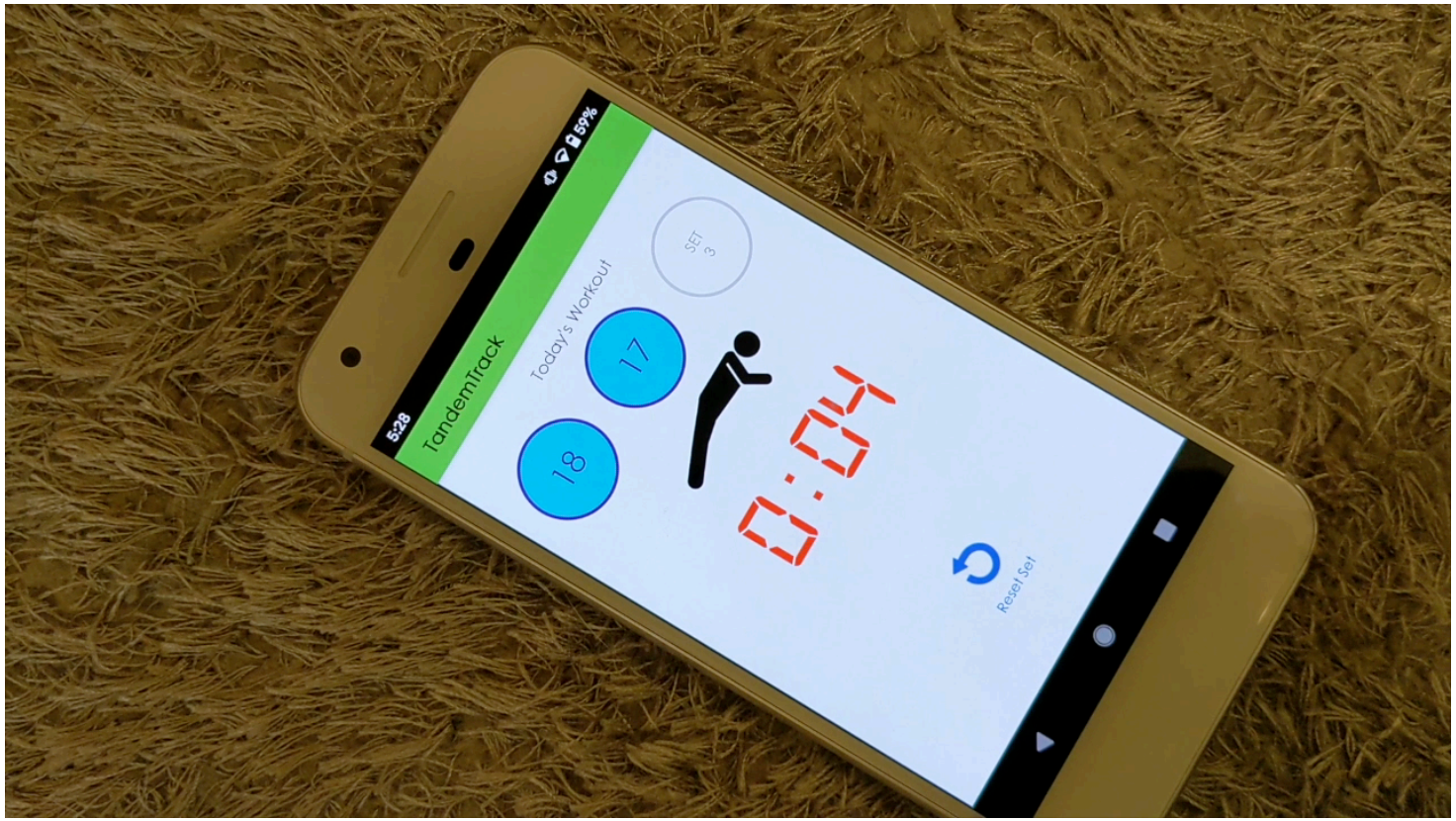
## Exercise flow




# Exercise with The TandemTrack App

## Exercise flow



# Exercise Feedback: The Alexa Skill

## Interactive Q&A

General questions

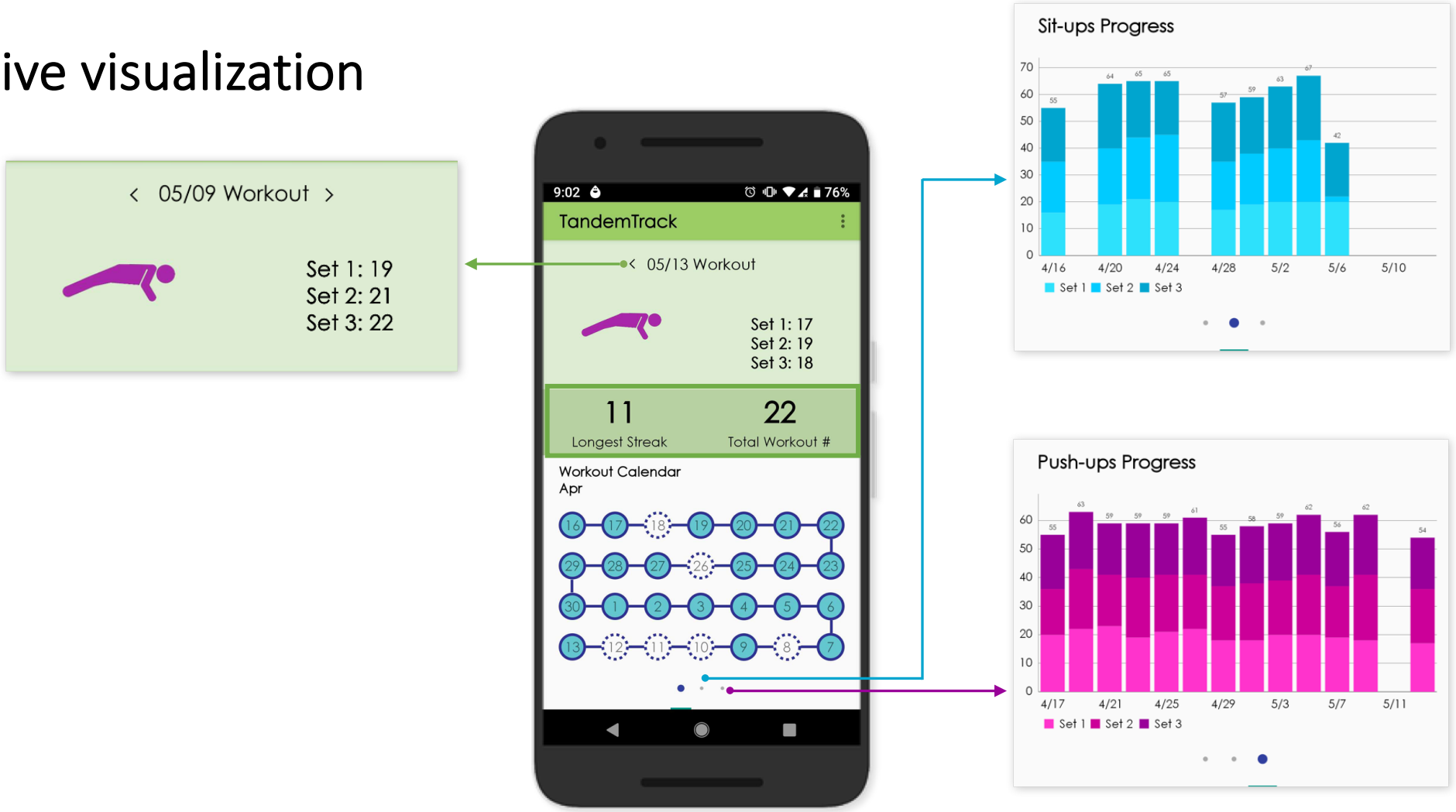
- *"Workout summary."*
- *"How is my workout?"*

Specific questions

- *"How many sit-ups did I complete yesterday?"*
- *"What is my longest streak?"*
- *"What many sit-ups did I do in average?"*
- *"What is my best push-up performance?"*

# Exercise Feedback: The Mobile App

## Interactive visualization



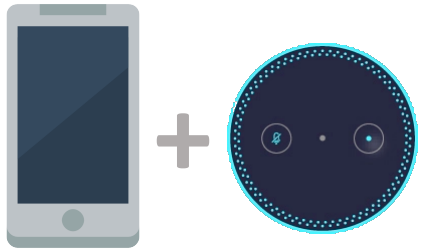
# A Between-Subjects Study with TandemTrack

**Four-week** deployment with **22** participants

- 11 female, age ranges from 18 to 61 (*M* = 21)
- Graduate students (16), undergraduate students (3), university staff (3)
- Did not do sit-ups/push-ups two times more per week at the time of participating in the study

**Mobile app ("M") group (*n* = 11)**

- Exercise with the TandemTrack app



**Mobile app + Alexa skill ("MA") group (*n* = 11)**

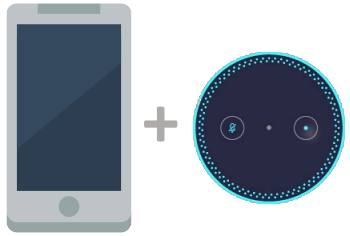
- Exercise with the TandemTrack app and the Alexa skill
- First-time smart speaker users

# Findings

1. Exercise Behavior
    - Adherence
    - Performance
2. Usage of the TandemTrack App & Skill
    - Exercise Regimen & Data Capture
    - Exercise Feedback
    - Daily Reminder

# Exercise Behavior: Adherence

# Comparisons Between the Two Groups in Exercise Adherence

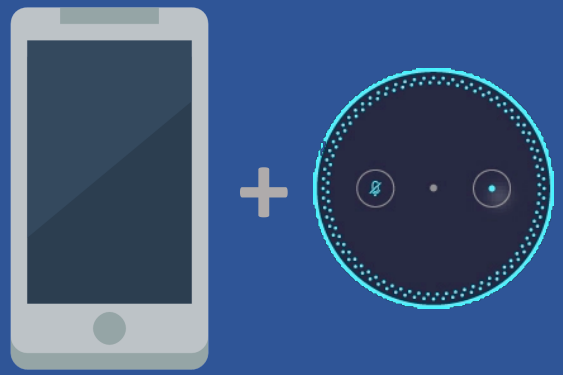


| Exercise adherence | M group | MA group | *t* |
|---|---|---|---|
| Completion days | 19.63 | 19.27 | .166 |
| Longest streak | 10.90 | 8.44 | .832 |
| Avg. streak | 8.27 | 6.02 | 1.540 |

*$p < .05$ **$p < .01$ ***$p < .001$.

No significant differences between the two groups in terms of exercise adherence.

# Usage of TandemTrack:
## Exercise Regimen & Data Capture



# Overview of Exercise Sessions

How many exercise sessions did MA participants complete on the app and the skill?

| | | MA-1 | MA-2 | MA-3 | MA-4 | MA-5 | MA-6 | MA-7 | MA-8 | MA-9 | MA-10 | MA-11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| App sessions | 11 (57%) | 19 | 3 | 15 | 8 | 4 | 13 | 10 | 8 | 12 | 7 | 22 |
| Skill sessions | 8.27 (43%) | 0 | 17 | 2 | 5 | 20 | 0 | 14 | 11 | 6 | 15 | 1 |
| Total sessions | 19.27 | 19 | 20 | 17 | 13 | 24 | 13 | 24 | 19 | 18 | 22 | 23 |

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- **Five participants used the skill more often than the app**

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- Two participants did not use the skill at all
- Five participants used the skill more often than the app
- **Four participants used the app more often than the skill**

# How did the MA participants choose between the TandemTrack app and the skill to exercise?

# Personal Preferences

## Easier for hands-focused activities

"*When doing push-ups, you're putting a lot (of) strength to your hands, so it's a bit difficult to type (on the phone), but Alexa makes it easier.*" (MA-10)

## Reducing distraction for fitness fanatics

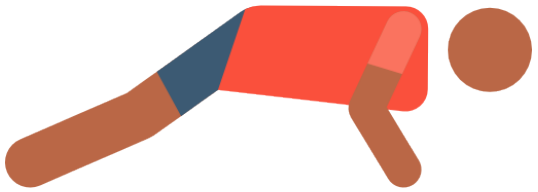
"*I don't have to look at my phone, but just listen to it (the Echo Dot) and do my exercise. It was less distracting—I got to focus on my body and my performance.*" (MA-2)

## Resistance to voice interaction

"*I just did not feel comfortable talking to a personified machine. If it doesn't have name, maybe I'll try to talk to it.*" (MA-1)

"*It's something like almost human but not. The way to interact with it is not intuitive, it's awkward.*" (MA-6)

# Proximity & Exercise Space



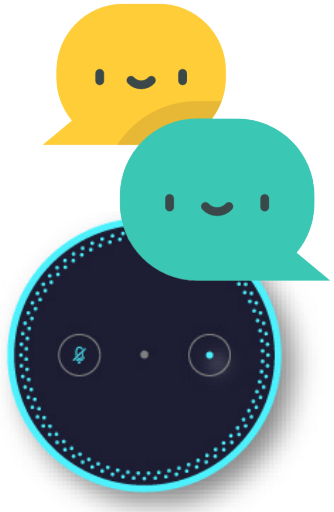
## Convenient to use when it's close by

"*I have my phone with me all the time, but if I was there when Echo reminded me, I would use it because it's convenient.*" (MA-9)

## Difficult to use when it's not close

"*I rearranged my room for some reasons, but this narrowed the space between the desk, where I put Alexa, and my bed. So I had to do exercise near the door of my room, but I couldn't use Alexa anymore—it's not close enough.*" (MA-10)

# Social Influences



## Worrying about interrupting others

"*I don't want to bother my roommates so I will just use it whenever they aren't there.*" (MA-8)

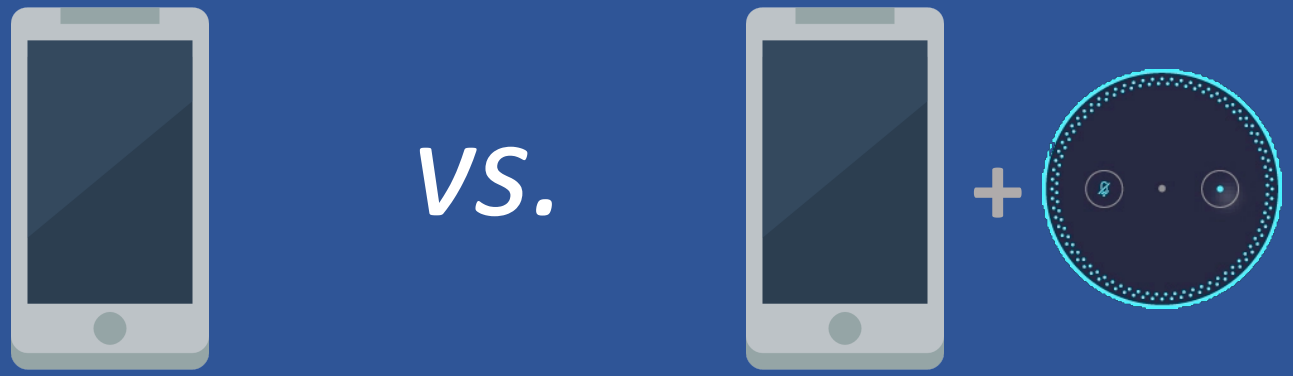
## Exercise is a private activity

"*I'm a shy person, and I don't want to speak out loud to let others know that I'm doing this exercise.*" (MA-4)

## Family dynamics

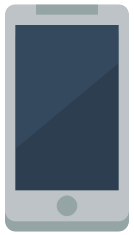
"*Ever since my four-year old son found he could ask Alexa 'Knock Knock Jokes,' he kept shouting at it every day. My husband got really annoyed so he unplugged the Echo a couple of times.*" (MA-3)

# Usage of TandemTrack:
## Exercise Feedback



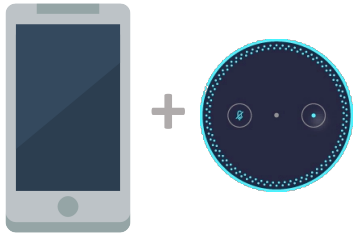
# The App's Visual Feedback

M participants spent more time reviewing their feedback on the TandemTrack **app** than MA participants, $t = 2.73$, $p < .05$.



**M group: easy to tag on**

"*I just naturally swiped at the chart after exercise. I like seeing those bars as they motivated me to keep going.*" (M-1)



**MA group: forget about the app**

"*Because I was like always using Alexa to exercise, I don't remember to check my phone all the time. It just didn't pop up to me.*" (MA-2)

# The Skill's Voice Feedback

Only 5 queries in total by 3 participants over the four weeks

## Satisfied with the visual feedback

"*I felt there's no need to ask Alexa about your exercise, given that the app has already provided all the information I need.*" (MA-4)

## Easy-to-forget voice commands

"*I totally forgot what I should say to ask her questions.*" (MA-10)

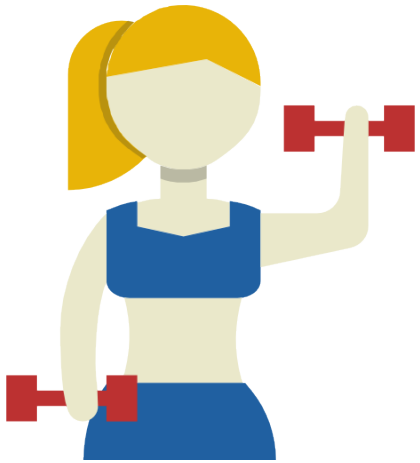
## Lack of support for data exploration

"*While I was swiping the charts on the mobile app, I don't need to think about specific questions to ask. I mean, I was just exploring my data. But with Alexa, I need a question to start, but I don't have any ideas about that.* " (MA-7)

# Lessons Learned

Simply by complementing a mobile app with a smart speaker does not increase the exercise adherence, but many opportunities exist in *enriching* people's exercise experience.

# Leveraging Hands-free Interaction to Support Exercise Diversity & Performance



**Supporting different hands-focused exercise**

e.g., plank, bodypump, etc

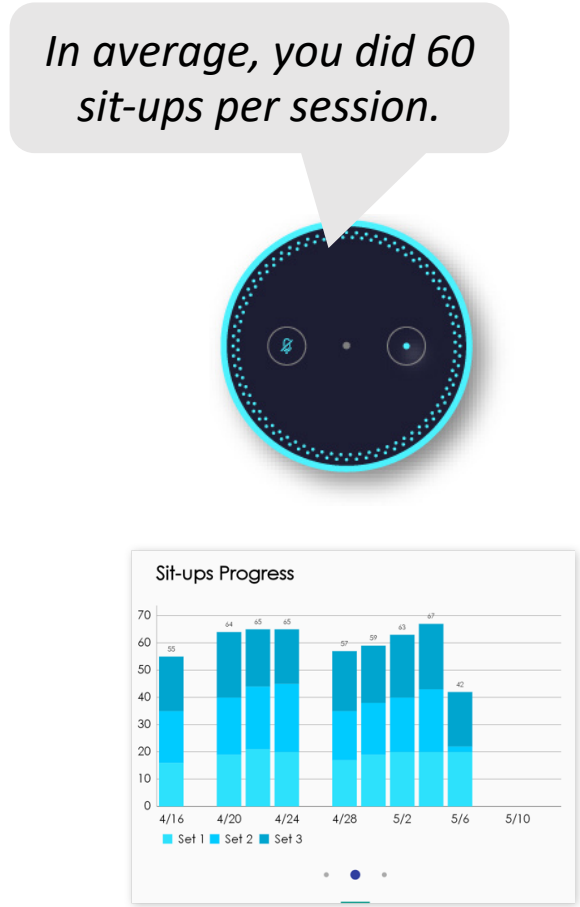
**Optimizing performance by individuals' skill level**

- Exercise novices: focusing on visual interface for correct postures and pace
- Exercise experts: focusing on voice interface to reduce distraction

# Delivering Proactive Multimodal Feedback

- **Coordination between visual & voice**
  - Prompt relevant visual feedback with voice queries
  - Support data exploration

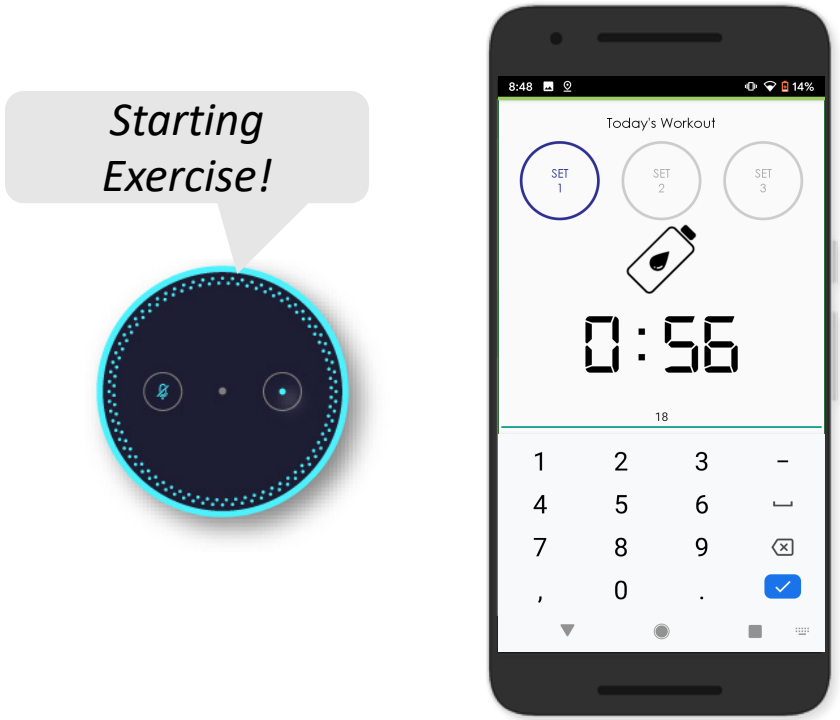
- **Leveraging the "critical reflection moment"**
  - Prompt people with interesting exercise data before & after exercise



# Building an Integrated, Multimodal Exercise Experience

**Enhance the synergy between the mobile app and the Alexa skill**

- Enabling people to control their progress on either device during exercise
- Sending proximity-based reminders



# Thanks!

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https://www.terpconnect.umd.edu/~yuhanluo/

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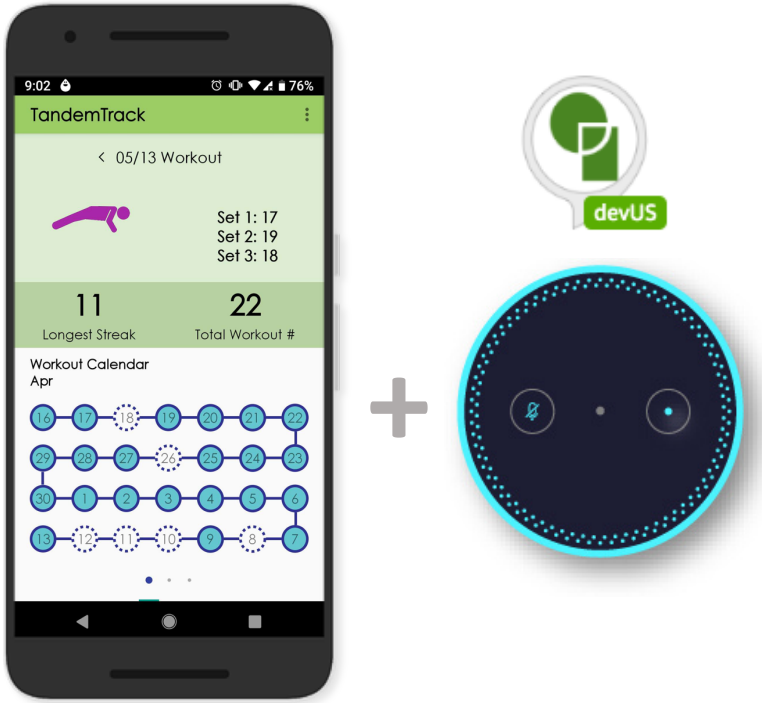
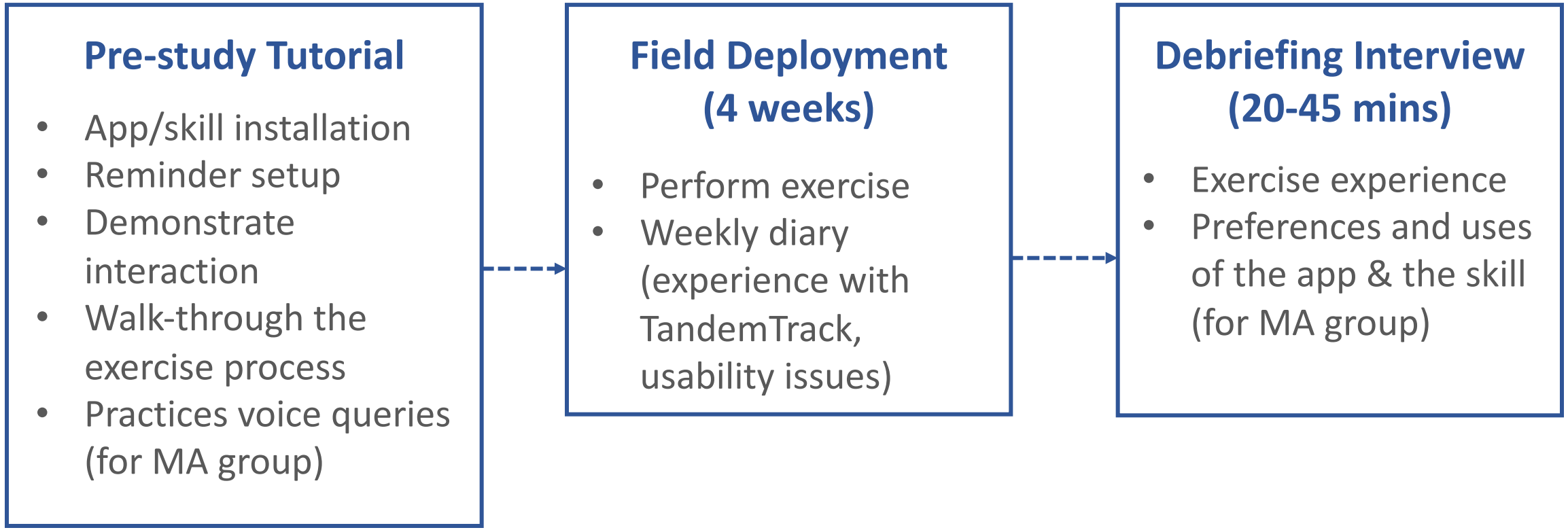


# Appendix

# Study Procedures




M group: participants assigned to use only the TandemTrack app

MA group: participants assigned to use both the TandemTrack app and the skill

# Data Analysis

## Quantitative Data

- 428 exercise records
- 2,892 interaction logs with the app
- 445 utterances with the skill

Compare the two groups (independent *t*-test):

- Exercise adherence
- Interaction with the app

Examine the factors affecting exercise adherences (multiple linear regression)

## Qualitative Data

- 66 weekly diaries
- 22 interview verbatim notes

Deductive approaches

- Likes & dislikes about the four components
- Choices between app & skill to exercise in different contexts

# Detailed Usage

- 428 Exercise sessions
  - 217 sit-ups
  - 211 push-ups

| M | M-1 | M-2 | M-3 | M-4 | M-5 | M-6 | M-7 | M-8 | M-9 | M-10 | M-11 | Avg. | Longest streak | Avg. streak |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| App sessions | 28 | 20 | 28 | 17 | 24 | 12 | 27 | 13 | 15 | 15 | 17 | 19.63 | 10.90 | 8.27 |
| **MA** | **MA-1** | **MA-2** | **MA-3** | **MA-4** | **MA-5** | **MA-6** | **MA-7** | **MA-8** | **MA-9** | **MA-10** | **MA-11** | **Avg.** | **Longest streak** | **Avg. streak** |
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| Skill sessions | 0 | 17 | 2 | 5 | 20 | 0 | 14 | 11 | 6 | 15 | 1 | 8.27 | | |
| Total sessions | 19 | 20 | 17 | 13 | 24 | 13 | 24 | 19 | 18 | 22 | 23 | 19.27 | | |

- 2,892 interaction logs with the TandemTrack app
- 445 utterances with the TandemTrack skill

# Reasons for Missing Exercise

- **Busyness or prior commitments**
  "*I skipped a couple of days because the capstone really made me crazy*." (MA-6)

- **Physical difficulties** (e.g., sickness)
  "*I got sick during the third week, so I didn't really exercise*." (MA-9)

- **Forgetfulness**
  "*I have class at 9 on Thursday so I was like rushing out and totally forgot about it*." (MA-4)

- **Procrastination**
  "*There are a couple of times I was working for an exam and when I thought of exercising. It's already midnight. I did do the exercise, but it's another day*." (M-3)

# Reminder time, exercise time, and time of reviewing exercise feedback