Online supplement for Wasil et al., Examining the Reach of Smartphone Apps for Depression and Anxiety. Am J Psychiatry (doi: 10.1176/appi.ajp.2019.19090905)

1: Details About Results

Coding App Type

We coded the primary purpose of each app in top 50 search results from our depression and anxiety searches (see Table 1).

Downloads

Depression and anxiety treatment apps varied widely in their number of downloads. Using data from SimilarWeb, we calculated the average number of monthly downloads for depression apps (*Mean*=12,501, *SD*=44,539, *Median*=89.9) and anxiety apps (*Mean*=14,432, *SD*=49,480, *Median*=518). Using data from Mobile Action, we calculated the number of downloads in the month of February for depression apps (*Mean*=7,372, *SD*=32,946, *Median*=0) and anxiety apps (*Mean*=10,428, *SD*=42,829, *Median*=0).

Daily Active Users

Depression and anxiety apps also varied widely in their number of daily active users. Using data from SimilarWeb, we calculated the number of daily active users (in February, 2019) for depression apps (*Mean*=2,094, *SD*=7,935, *Median*=0) and anxiety apps (*Mean*=2,653, *SD*=9,490, *Median*=21). We also used data from Mobile Action to calculate the number of daily active users for depression apps (*Mean*=30,034, *SD*=173,604, *Median* = 0) and anxiety apps (*Mean*=53,367, *SD*=206,052, *Median* = 0).

Using data from Similar Web, 60% of the depression apps and 46% of the anxiety apps had zero daily active users. Using data from Mobile Action, 66% of depression apps and 60% of the anxiety apps had zero daily active users.

Monthly Active Users

Depression and anxiety apps also varied widely in their number of monthly active users (see Figure 1 and Figure 2). Using data from Mobile Action, we calculated the number of monthly active users for depression apps (*Mean*=193,720, *SD*=854,836, *Median*=0) and anxiety apps (*Mean*=331,963, *SD*=1,472,276, *Median*=0) on the Google Play Store. 63% of the depression apps and 56% of anxiety apps had zero monthly active users.

Figure 1 displays the number of monthly active users of depression apps; Figure 2 displays the number of monthly active users of anxiety apps.

Distribution of Downloads and Active Users across Depression and Anxiety Apps

We quantified the extent to which the top few apps are responsible for downloads and active users by dividing the number of downloads for the top apps by the total number of downloads for all 50 depression apps. The top three depression apps were responsible for between 80-95% of downloads and active users (depending on the particular metric), while most apps had zero downloads and active users (Table 2). The same trends were present for anxiety apps (Table 3).

The three most popular depression apps were Headspace, Youper and Wysa; the three most popular anxiety apps were Calm, Headspace, and Youper. Headspace was founded by a meditation teacher and an advertising agent; Calm was founded by two app developers, Wysa was founded by a managing director and market strategy analyst, and Youper was founded by a psychiatrist, a software engineer, and a computer scientist. All four apps were classified as treatment apps. More specifically, Headspace and Calm provide meditation and mindfulness lessons. Youper and Wysa both offer chatbots that communicate with users and guide users through structured activities.

Sessions Per User and Time Spent Per User

On days when users used these apps, they generally spent a relatively short amount of time. Using data from SimilarWeb, we calculated the number of sessions per daily active user for depression apps (*Mean*=1.31, *SD*=1.85, *Median*=0) and anxiety apps (*Mean*=2.23, *SD*=3.01, *Median*=1.71). We also calculated the daily time spent per daily active user (in minutes) for depression apps (*Mean*=3.49, *SD*=6.53, *Median*=0) and anxiety apps (*Mean*=7.66, *SD*=16.16, *Median*=1.11). That is, users who open an app on a given day generally open the app 1-2 times for only 3-8 minutes.

Given the stark differences between top apps and other apps, we conducted a sub-analysis focused on the top three depression and anxiety apps. For the top three depression apps (i.e., Headspace, Youper, and Wysa), we calculated the number of unique sessions per daily active user (*Mean*=2.14, *SD*=0.58, *Median*=2.08) and time spent per daily active user (*Mean*=10.67, *SD* =2.08, *Median*=10.5). For the top three anxiety apps (i.e., Headspace, Calm, and Youper), we calculated the number of unique sessions per user per day (*Mean*=1.99, *SD*=0.08, *Median*=1.96) and time spent per user (*Mean*=18.13, *SD*=10.63, *Median*=13.62). That is, among users who open one of these top three apps on a given day, they generally open the app twice and spend a total of 10-18 minutes on these apps.

Tables and Figures

Table 1

Top 50 App Search Results Coded by Primary Purpose

Primary Purpose	Depression Apps N (%)	Example app	Anxiety Apps N (%)	Example app
Treatment App	35 (70%)	Headspace	48 (96%)	Calm
Symptom Trackers or Diagnostic Tests	6 (12%)	Depression Test	2 (4%)	Anxiety Test
Phone Wallpapers	4 (8%)	Depression Quote Wallpapers	0 (0%)	NA
Motivational Quotes	3 (6%)	Depression Quotes	0 (0%)	NA
Miscellaneous	1 (2%)	Beat Depression	0 (0%)	NA

Table 2

Downloads and Active Users for the Top Depression Apps

	Top App[a]	Top 3 Apps[b]	Top 5 Apps[c]	Median App
Average Monthly Downloads (% of total) from SimilarWeb	254,300 (58.12%)	372,100 (85.04%)	399,400 (91.29%)	90 (0.0002%)
February Downloads (%) from Mobile Action	192,600 (74.65%)	240,200 (93.10%)	248,100 (96.16%)	0 (0%)
Daily Active Users from SimilarWeb (%)	45,380 (61.93%)	63,210 (86.26%)	66,395 (90.60%)	0 (0%)
Daily Active Users from Mobile Action (%)	1,000,000 (68.09%)	1,364,000 (92.87%)	1,410,000 (96.00%)	0 (0%)
Monthly Active Users from Mobile Action (%)	5,000,000 (73.74%)	6,354,000 (93.71%)	65,450,000 (96.53%)	0 (0%)

[a]The top depression app (i.e., the app with the greatest # of downloads and greatest # of active users from our depression search) was "Headspace: Meditation & Sleep"

[b]The second and third top apps were "Youper – Stress, Anxiety & Depression" and "Wysa: Stress, Depression, & Anxiety Therapy Chatbot"

[c]Using our SimilarWeb data to sort apps, the fourth and fifth top apps were "Pacifica – Stress & Anxiety" and "Hypnosis for Anxiety, Stress Relief & Depression". Using our Mobile Action data to sort apps, the fourth and fifth top apps were "Moodpath – Depression & Anxiety Test" and "Hypnosis for Anxiety, Stress Relief & Depression".

Table 3

Downloads and Active Users for the Top Anxiety Apps

	Top App[d]	Top 3 Apps[e]	Top 5 Apps[f]	Median App
Average Monthly Downloads (% of total) from SimilarWeb	254,300 (36.7%)	559,500 (80.77%)	614,600 (88.72%)	518 (0.0007%)
February Downloads (%) from Mobile Action	225,100 (45.93%)	457,600 (93.37%)	469,700 (95.84%)	0 (0%)
Daily Active Users from SimilarWeb (%)	45,380 (35.6%)	106,820 (83.88%)	112,900 (88.66%)	13.29 (0.0001%)
Daily Active Users from Mobile Action (%)	1,000,000 (39.87%)	2,277,000 (90.78%)	2,388,000 (95.20%)	0 (0%)
Monthly Active Users from Mobile Action (%)	9,000,000 (56.48%)	15,000,000 (94.13%)	15,452,000 (96.97%)	0 (0%)

[d]The top anxiety app (i.e., the app with the greatest # of downloads and greatest # of active users from our anxiety search) was "Calm – Meditate, Sleep, Relax"

[e]The second and third top apps were "Headspace: Meditation & Sleep" and "Youper – Stress, Anxiety & Depression"

[f]Using our SimilarWeb data to sort apps, the fourth and fifth top apps were "Wysa: Stress, Depression, & Anxiety Therapy Chatbot" and "Pacifica – Stress & Anxiety". Using our Mobile Action data to sort apps, the fourth and fifth top apps were "Wysa: Stress, Depression, & Anxiety Therapy Chatbot" and "Moodpath: Depression & Anxiety".

Figure 1: Monthly Active Users of Depression Apps

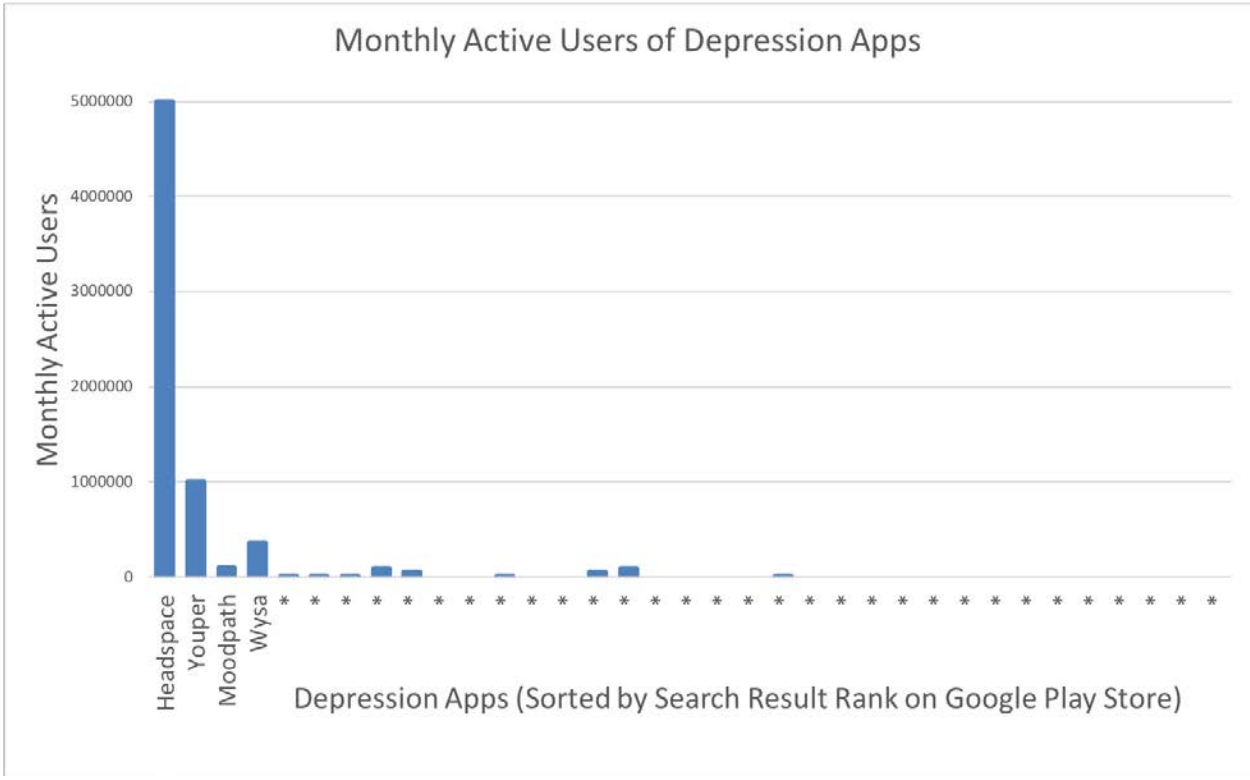

Figure 1 Caption: Figure 1 shows the number of monthly active users (in February of 2019) of the 35 depression apps. The apps are ordered according to their search result (i.e., Headspace was the first app on the Google Play Store search, Youper was the second app). Headspace, Youper, and Wysa were the most popular depression apps, responsible for about 94% of all monthly active users. 22 of the 35 depression apps had zero monthly active users.

Figure 2: Monthly Active Users of Anxiety Apps

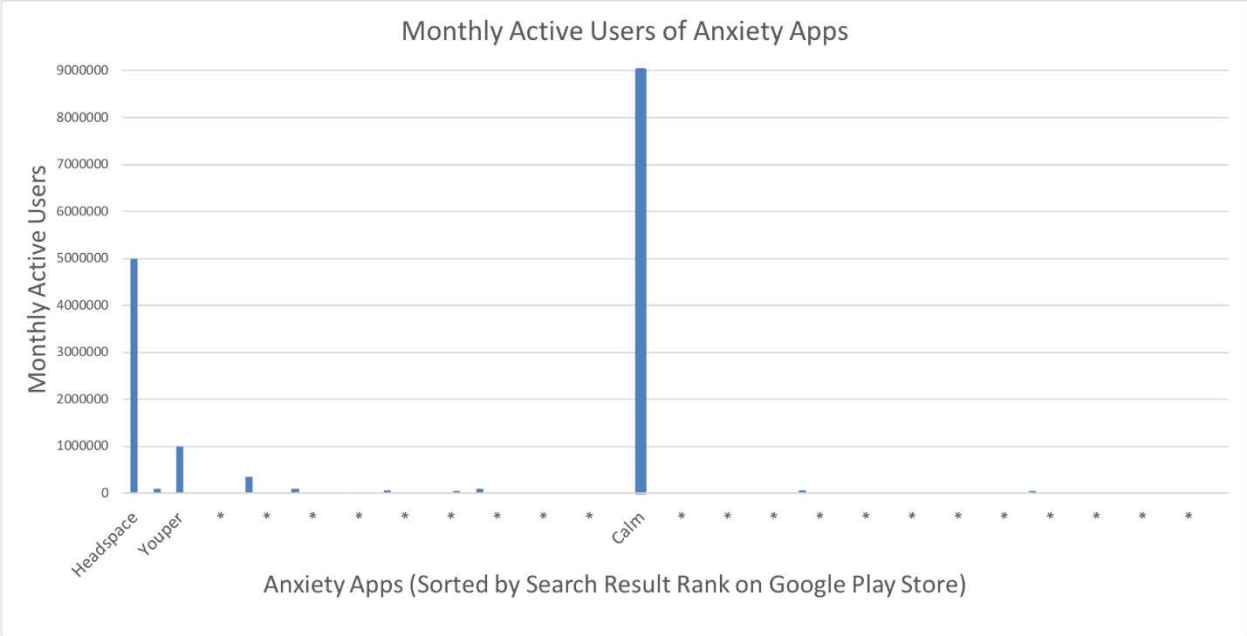

Figure 2 Caption: Figure 2 shows the number of monthly active users (in February of 2019) of the 48 anxiety apps. The apps are ordered according to their search result (i.e., Headspace was the first app on the Google Play Store search, Youper was the third app). Calm, Headspace and Youper were the most popular anxiety apps, responsible for about 94% of all monthly active users. 28 of the 48 anxiety apps had zero monthly active users.

2: Details About Methodology

Search Strategy

We searched the Google Play Store[1] in March of 2019. We conducted one search using the term "depression" and another search using the term "anxiety." For each search term, we screened the top 50 apps. Due to a wide variation in the types of apps identified by the Google Play Store algorithm—from intensive, CBT-based apps to phone wallpapers—we coded the apps according to their primary function.

Coding App Type

We developed and applied a codebook to characterize the primary function of each app. The first and second author independently reviewed the titles and descriptions of each included app. This led to the development of a codebook with several categories (see Table 1).

After establishing the codebook, the first and second authors independently applied the codebook to the 50 depression apps and 50 anxiety apps. Using Cohen's kappa, inter-rater reliability ranged from k=0.90 to k=1.0. Disagreements were resolved through a discussion between the first two authors.

Inclusion Criteria

We included treatment apps, broadly defined as apps that claimed to offer some skills or support to help individuals reduce depression or anxiety. We excluded apps[2] primarily designed

[1] We limited our search to the Google Play Store because data from SimilarWeb (https://www.similarweb.com), such as average time spent per user and sessions per user, is currently only available for Google Play Store apps.

[2] These apps were excluded because our aim was to characterize treatment apps; additionally, these apps may skew estimates about daily and monthly active users, as a single use may be sufficient to acquire a diagnosis or wallpaper.

to offer diagnoses (*n*=8), phone screen wallpapers[3] (*n*=4), motivational quotes (*n*=3), music (*n*=1), or non-treatment gaming (*n*=1).

This led to a final sample of 35 apps from the depression search and 48 from the anxiety search. Combined, there were 72 unique apps: 24 apps exclusively from the depression search, 37 exclusively from the anxiety search, and 11 that appeared in both searches.

Data Collection

For each app, we collected data on downloads, monthly active users, and average time spent per user using two mobile application intelligence platforms that track real-world app usage: SimilarWeb[1] and Mobile Action[2]. Both services collect public data (e.g., an app's ranking in a given category[4], an app's overall ranking, star ratings, user reviews) and private data (e.g., information gathered from app developers) to generate estimates of real-world app usage. Because the different platforms access data from different sources and use different algorithms, estimates from the two platforms can differ. We decided to collect and analyze data from both platforms, in order to examine whether trends could be reliably detected across multiple platforms.

Some data were available on both programs, and some data were only offered by one of the two programs. From SimilarWeb, we retrieved the average monthly downloads since the app was released[5], the number of unique daily active users[6], the average number of sessions per day per daily active user[7], and the average amount of time spent per daily active users[8]. From

[3] For example, "Depression Quote Wallpapers" is an app that offers phone screen backgrounds that are meant to resonate with depressed individuals.
[4] Both the Google Play Store and the Apple App Store release rankings within certain categories (e.g., "Health and Fitness") as well as overall rankings. An app's ranking is determined by a variety of factors, including the app's user ratings, download counts, installs and uninstalls, and growth trends.
[5] The number of total downloads divided by the number of months the app has existed
[6] The number of unique users who opened the app on a given day
[7] The number of times users opened the app on a given day divided by the number of daily active users
[8] The amount of time users spent on the app in a given day divided by the number of daily active users

MobileAction, we retrieved the number of downloads in February of 2019, unique daily active users, and unique monthly active users. For daily active users, monthly active users, sessions per user, and time spent per user, we averaged data over the month of February 2019 (Feb 1–Feb 28), the month prior to our search. We also retrieved app star ratings from the Google Play Store.

Tables and Figures

Table 1

Top 50 App Search Results Coded by Primary Purpose

Primary Purpose	Depression Apps N (%)	Example app	Anxiety Apps N (%)	Example app
Treatment App	35 (70%)	Headspace	48 (96%)	Calm
Symptom Trackers or Diagnostic Tests	6 (12%)	Depression Test	2 (4%)	Anxiety Test
Phone Wallpapers	4 (8%)	Depression Quote Wallpapers	0 (0%)	NA
Motivational Quotes	3 (6%)	Depression Quotes	0 (0%)	NA
Miscellaneous	1 (2%)	Beat Depression	0 (0%)	NA

References

[1] https://www.similarweb.com

[2] https://www.mobileaction.co