

MICROMOBILE: LEVERAGING MOBILE  
ADVERTISING FOR LARGE-SCALE  
EXPERIMENTATION  
MOBISYS 2018

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# WHO DO WE TEST MOBILE SYSTEMS ON?

A question for the audience:

Where do we get data from? Who do we test mobile systems on?

# NINE PEOPLE



Nine people. This is what often constitutes the extent of many mobile systems evaluations.

All too often we are building systems, testing them on nine people, and drawing scientific conclusions. We can often get away with this in conference reviews if the system is compelling enough.

# SCALE



what we really want to do is to scale our experiments and data gathering up to massive scale with plenty of diversity.

We also want to go \*global\*. We want to be able to conduct experiments in places where we aren't. Other geographies, other countries, with people we haven't met. May be if you work at Google or MSR etc, you have access to devices, data, and networks, that other people don't. These things aren't available to your average researcher.

So how are we going to do this? Ads.

(Container ship that carries ~20k containers at once).

# ADVERTISING

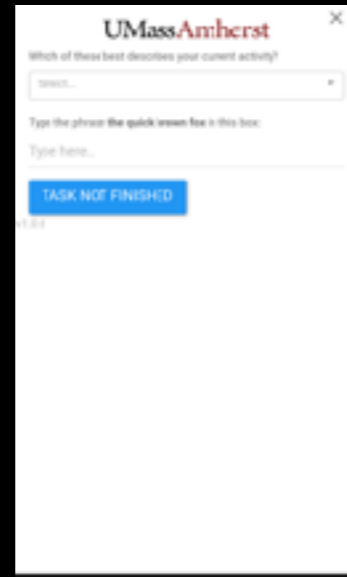


This is an ad. Ok, yeah, I have seen ads before, so what?

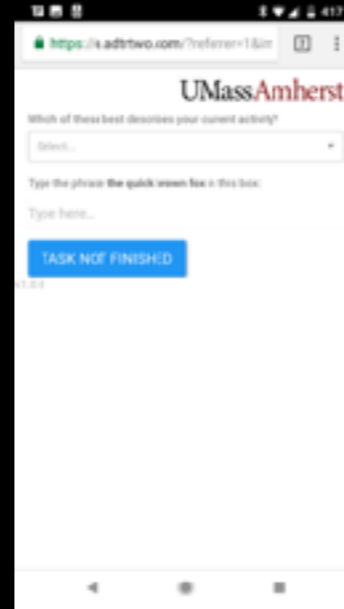
This ad will lead to an experiment or data gathering system. I am amazingly lazy and I don't particularly like trying to find test subjects. Using ads experiments can be conducted from your office on users anywhere in the world at any scale you like.

But when you click on an ad, where does it go?

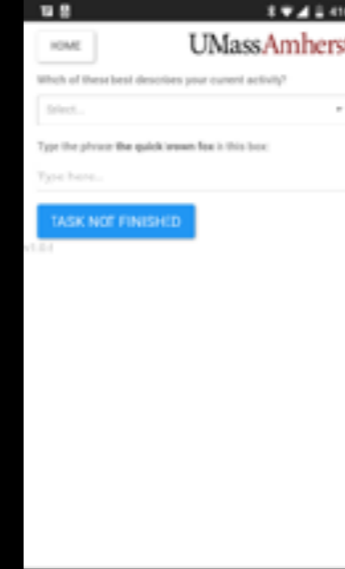
# A TALE OF THREE MEDIUMS



ADVERTISEMENT



BROWSER



NATIVE APP

When recruiting with ads you can do experiments in two places: browsers, and native apps. And one additional one, an interactive ad, which I will explain in a moment.

The inherent tradeoff here is friction vs access to sensors. You can access many sensors from ads. Additional ones can be accessed from browsers: camera, microphone, bluetooth. Even more from Apps.

But it is increasingly hard to recruit for mediums with more friction. Apps are the hardest, followed by browsers and then ads. Apps require a process of downloading and installing an app, something users may find burdensome. Using the browser will cause an animated context switch, something that also may be off putting. Ads have no such issue and the flow can continue inside of the ad.

# INTERACTIVE ADS



TAPSENSE: YOUR FINGER TAPS HAVE FINGERPRINTS EMILIANO MILUZZO,  
ALEX VARSHAVSKY, SUHRID BALAKRISHNAN, ROMIT ROY CHOUDHURY  
ACM MOBISYS 2012

Interactive ads allow you to do data gathering and experimentation \*inside\* of an advertisement.

Ads are more powerful than you think and you can do anything you can do in a browser that doesn't require permission. But many things, like the network, accelerometer, battery state will work.

We took an experiment from one of Romit Roy Choudry's papers on being able to tell what someone is typing from the motion sensors in a phone. (funnily enough, Romit tested this on exactly nine graduate students).

This advertisement can access the accelerometer and gyrometer of the phone, so we can replicate this experiment at scale. It costs around \$1.50 per data point.

# MICROMOBILE SYSTEM

- Compilation from HTML and JS to all three mediums
- Sensor abstractions to ease development
- Conducted efficacy experiments in three mediums
  - Participation rate -> \$\$\$
  - Key insight: engage with users first!

We built a system, called MicroMobile, around this concept. The system allows you to develop experiments in html and js and then deploy them to any of the three mediums.

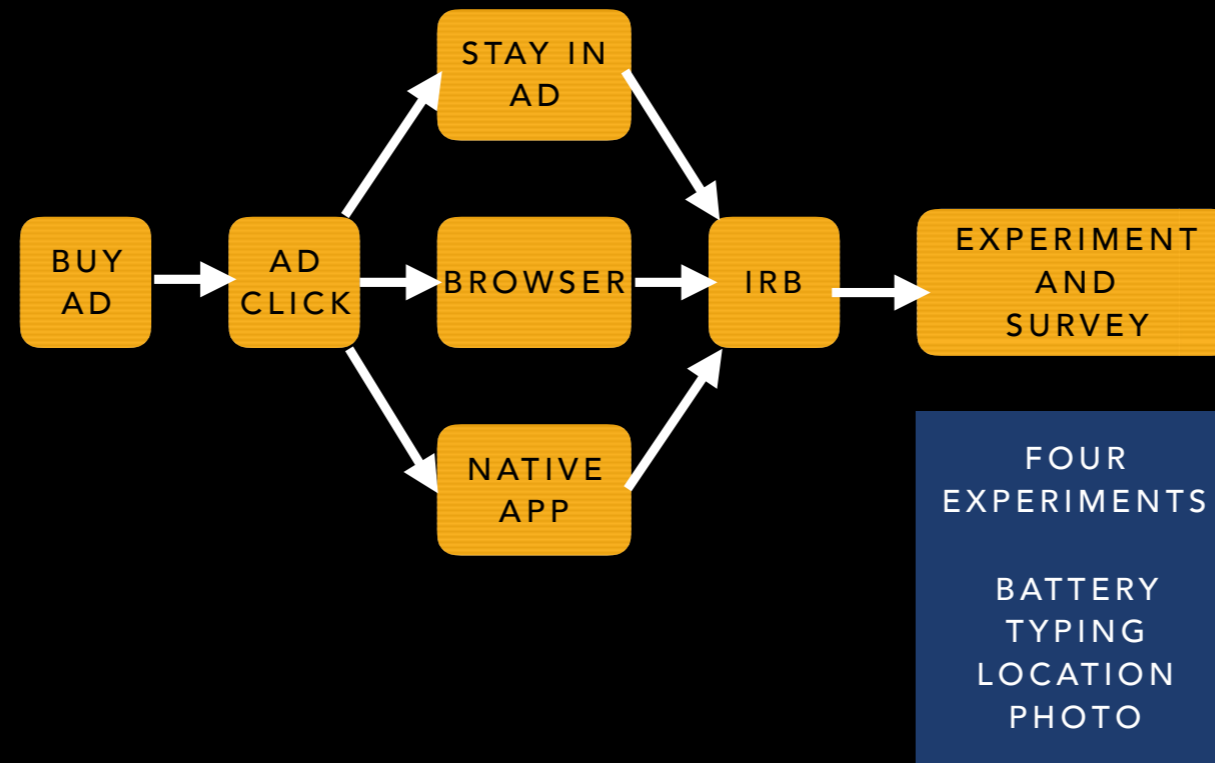
The three mediums end up being fairly identical in terms of UX. We created a sensor abstraction that allows you to build experiments, such as a typing accelerometer test, in about 100 lines of js code.

We will show you the efficacy of these experiments, focusing on the participation rate, which is proportional to how much it costs per experimental data point.

One of the key insights is that you can increase participation rates by engaging with the users in interactive ads before graduating them to a browser or native application.



# MICROMOBILE FLOW



This is the general flow that a user experiences. First we purchase an advertisement in a real time bidding network (all the details on how this works are in the paper).

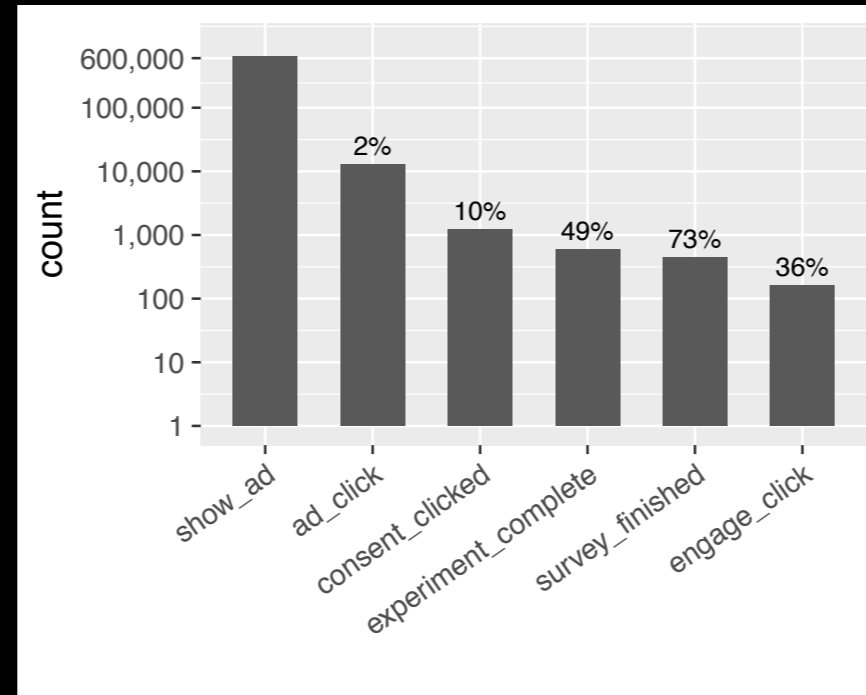
Hopefully the user clicks on the ad, and we redirect them to one of three places. For measuring the system, we randomly chose of the three mediums.

The user is presented an IRB informed consent form and they continue to the experiment.

(transition)

We created and tested four sample experiments: measuring battery levels, the typing experiment I showed before, asking the user to share their location, and asking them to take a photo of their surrounding environment. We use these throughout the evaluation in the paper. No incentives were used at all.

# PARTICIPATION FUNNEL

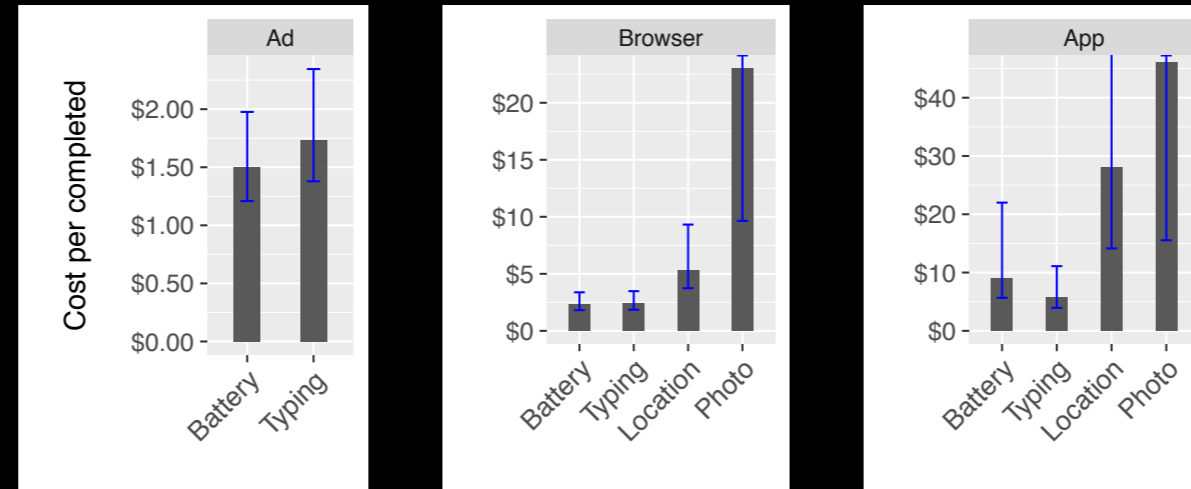


600K ADVERTISEMENTS, 500 COMPLETED EXPERIMENTS, US\$1,739 IN ADVERTISING SPEND

To give you a general picture of how these ads perform aggregated across all mediums, is what you see is that about 2% of people click and of those about 5% of those people make it through the IRB consent and complete an experiment. By the standards of Advertisement, this is fairly decent.

There are two places that would be ripe for improvement, the first is getting people to click. This is a standard advertising problem. You can make a more compelling ad etc. The second is the IRB consent. What we used ended up being a wall of text, and on some screens it wouldn't even fit on one page. But that was as well as we could do with our IRB. But we think there are some alternate presentations (perhaps a video) that would improve conversion rates.

# WHAT DOES A RESULT COST?



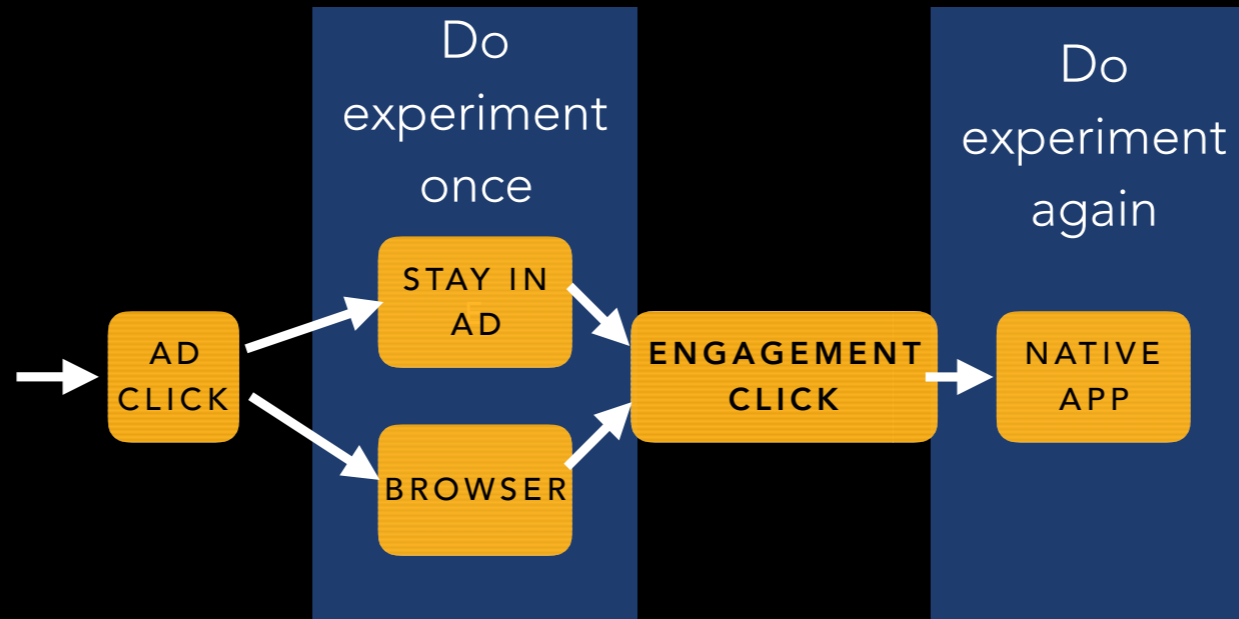
Here we show what it costs us in the end to get a result. Many details about how we bought ads are explained in the paper. Location and Photo depend on features not available in ads.

But the general trend is clear: higher friction environments cost more. And if we have to ask the user for extra permissions to sensors, that drives costs up.

At \$1.50 for a result, I think Romit could have recruited a lot more subjects.

And while you might think that \$30 seems like a lot for a result, think for a minute how long it takes to recruit experimental subjects including all of the overhead. And what I will show you in a minute, we can drive this cost down by a factor of 2.

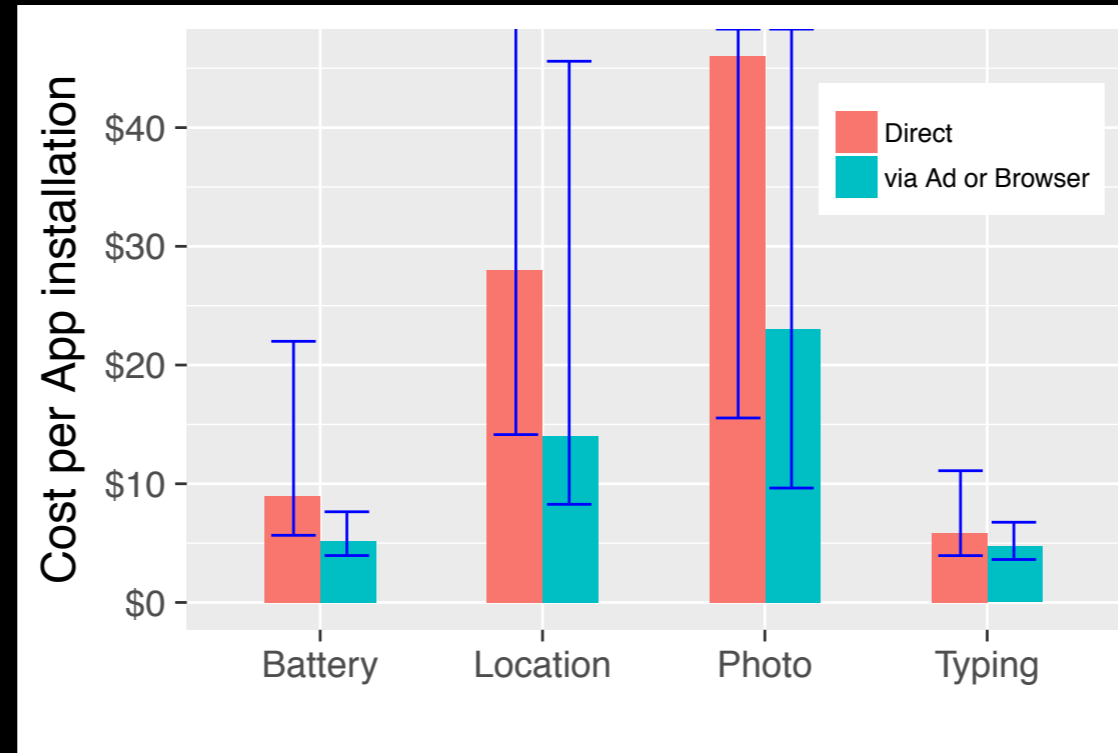
# ENGAGE FIRST, THEN REPEAT



Here we do something additional. After having the user complete an experiment we ask them to do the experiment again, but we ask them to install the native app and do the experiment there.

Intuitively one might think this is worse. Instead of sending the user directly to the app store to do the experiment, we have them do it once in the ad or browser and then have them do it again.

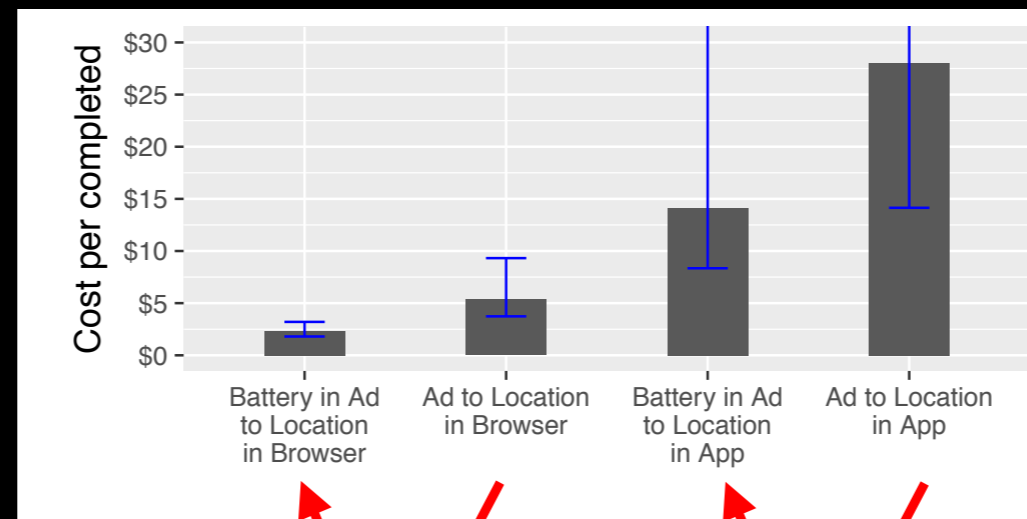
# ENGAGE FIRST



But... what we can show here is that in contrast with sending them direct to the app store, doing an experiment in the ad/browser first, lowers the cost of doing a native experiment by a factor of almost 2x in many cases.

This is a psychological effect of engagement. Get the user “warmed up” in a low friction environment before sending them to the high friction app install.

# ENGAGE FIRST



~ 2x reduction

~ 2x reduction

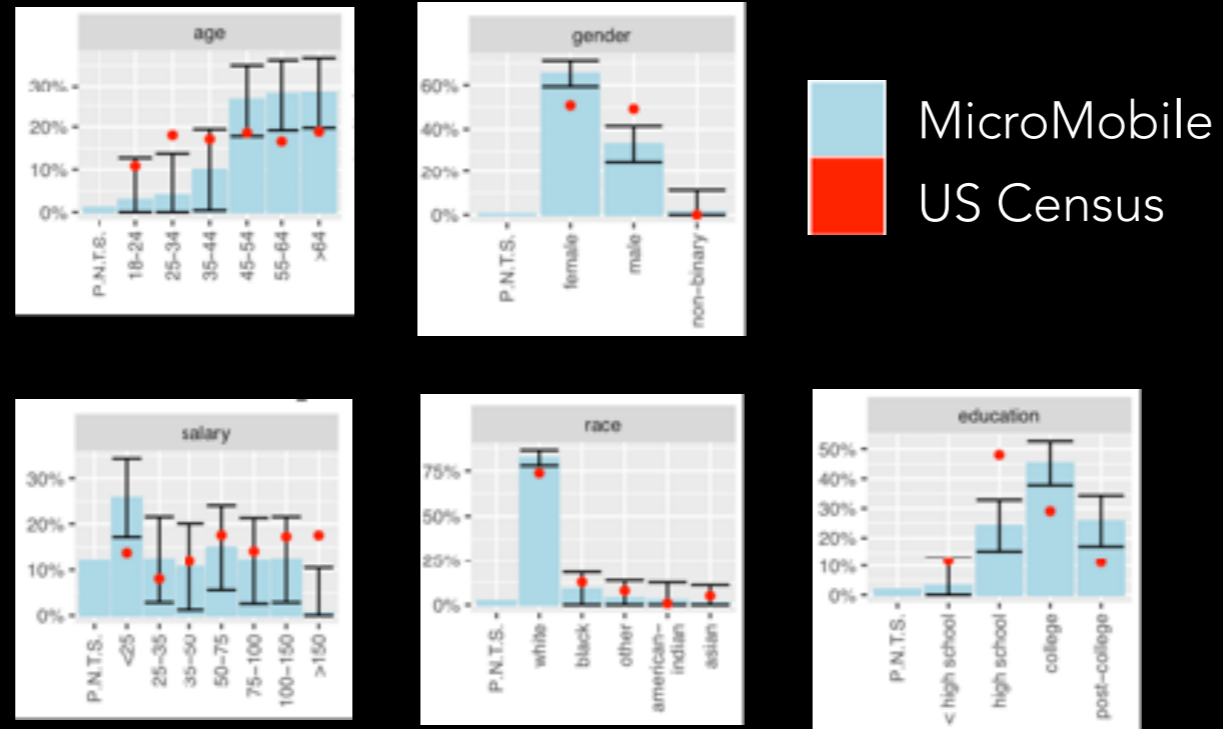
But... it doesn't even have to be the same experiment, or anything that you need. For example, it is tough to get users to consent to sharing their location as it requires a system dialog box in the browser, or permission when running the app.

So if you wanted location information from users, you can ask them for their battery information in an ad or browser before sending them to the browser or app. It is counterintuitive, but having them do more work actually lowers cost.

(transition)

Here we have lowered it by 2x.

# IS IT DIVERSE?



We also conducted a survey of demographics while doing experiments. We can show the subjects are far more diverse than a typical experiment, across race, ethnicity, gender, age, etc. Almost everyone has a smartphone now.

## TAKE-AWAYS

- Look to using advertisements and MicroMobile to gather data and run experiments.
- Open source, please contact me
- Engage with your users in interactive ads

### ALSO SEE:

ADVERTISING-BASED MEASUREMENT: A PLATFORM OF 7 BILLION MOBILE DEVICES. MARK D. CORNER, BRIAN N. LEVINE, OMAR ISMAIL, ANGELA UPRETI.  
ACM MOBICOM 2017

If you need data you can get from an app or a browser or an ad, you should think about using ads to achieve scale and diversity. Contact me please I would love to deploy more experiments.

When you do this, then you should think about how to engage with those users before asking for tasks that require an app or extra permissions.



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