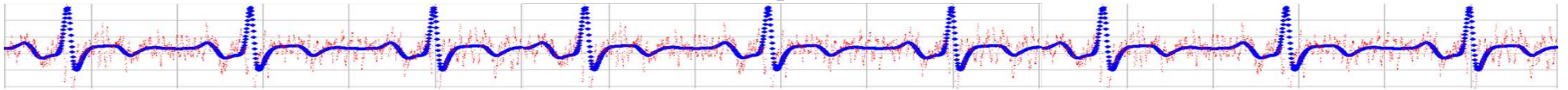


# Empirical Research Methods [in Information Science]

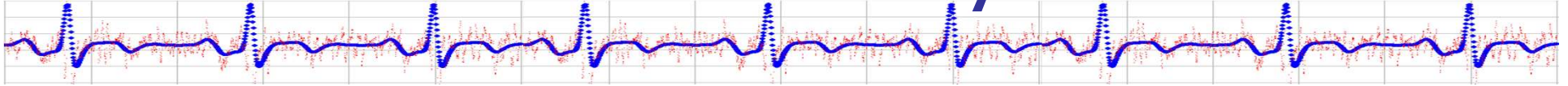
IS4800 / CS6350



Prof. Stephen Intille

With *many* thanks to  
Prof. Timothy Bickmore

# Overview for today



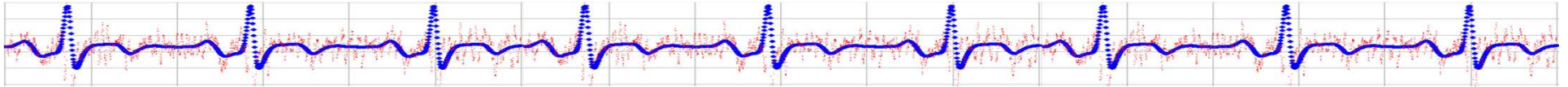
- Why we're here
- Overview of the course
- Introductions
- Homework

# How do we know what we know?



- What is a belief?
- What is knowledge?
- What is truth?
- What is a “scientific result”?

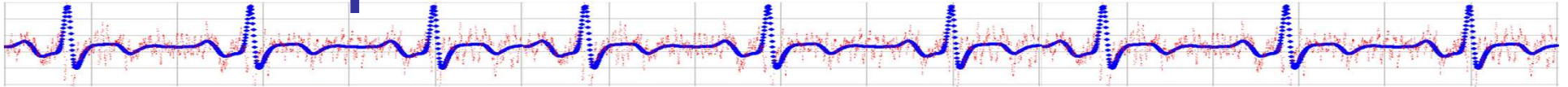
# Journey from a philosophical idea or belief to a “fact”?



- Who do you ask?
  - A friend? Expert? Book? Google? Wikipedia? ...
- What are the source's baked-in philosophical assumptions?
- What are the community standards (+ different types of communities)

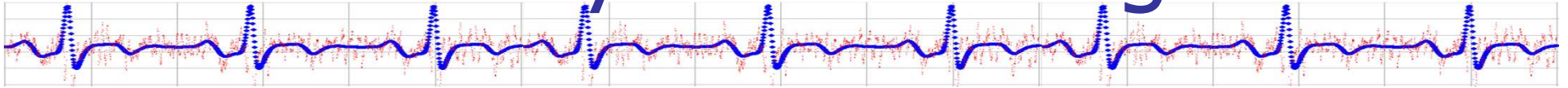
Why important? Imagine past/future job...<sup>4</sup>

# Empirical research



- Research is the process of increasing our knowledge
- Research methods are the tools and techniques considered valid by a given research community
- Empirical research involves collection and analysis of data from observation
- *Contrast with analytical research*

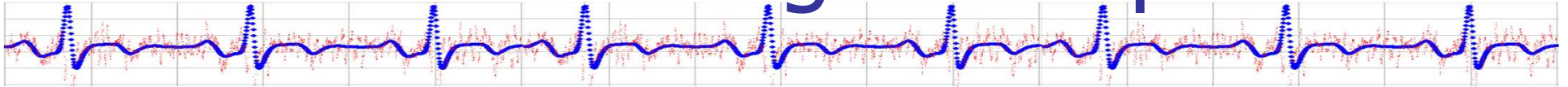
# Epistemology: The study of knowledge



Some different ways of thinking about knowledge...

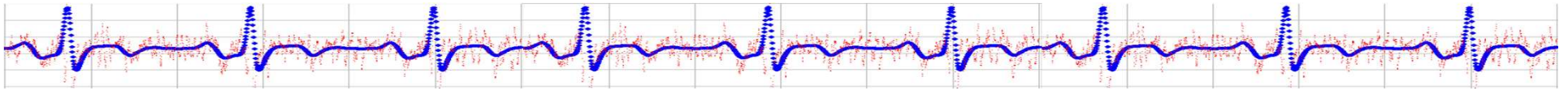
- Empiricism: Observational evidence is indispensable for knowledge of the world
- Positivism: Knowledge is gained through positive affirmation of theories following the strict scientific method (based on empiricism)
- Rationalism: Knowledge can only be inferred through sound logical reasoning and “self-evident truths”

# Our focus: Logical empiricism



- Combines empiricism with rationalism
- Only scientific, mathematical, and logical statements are literally meaningful, or have truth values

# What are the roles of research methods in...



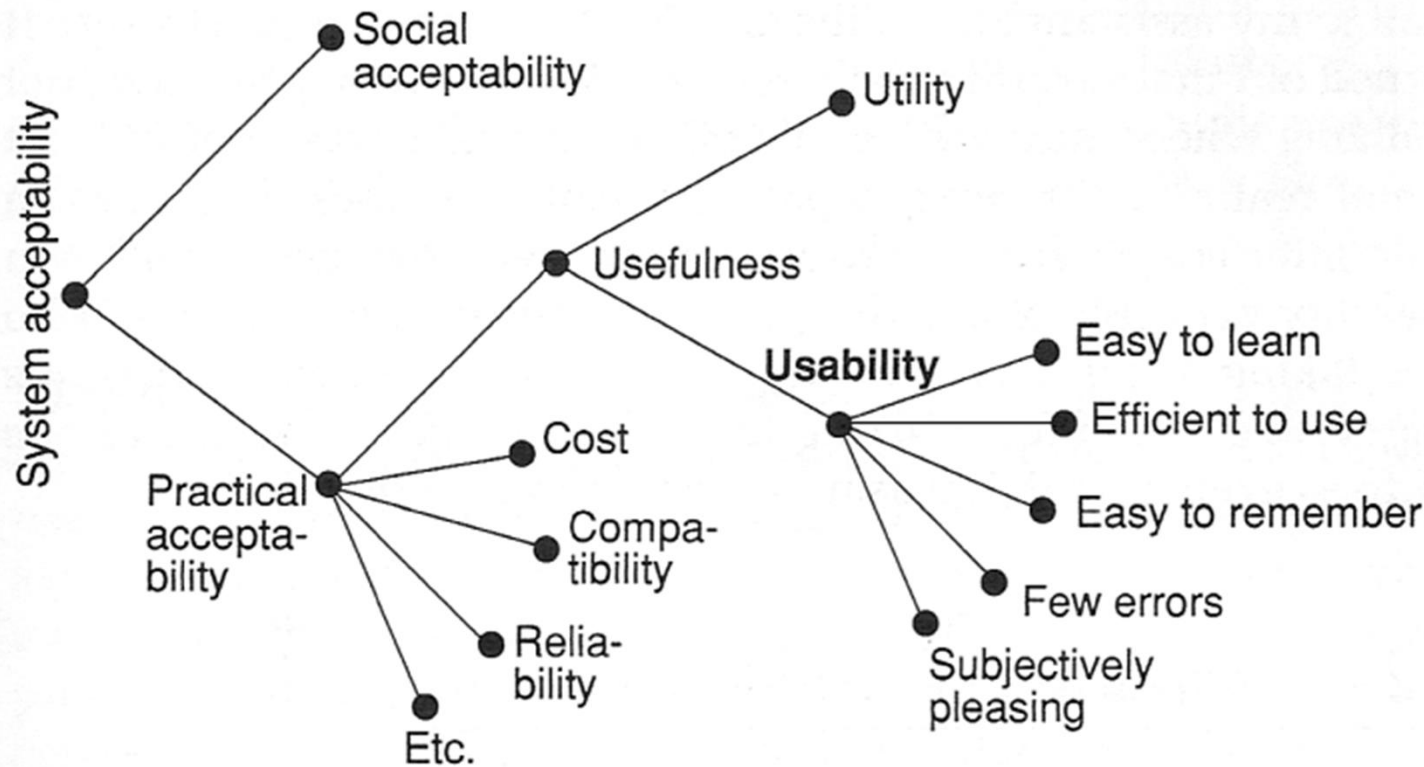
Information science?

Health informatics?

Other domains?



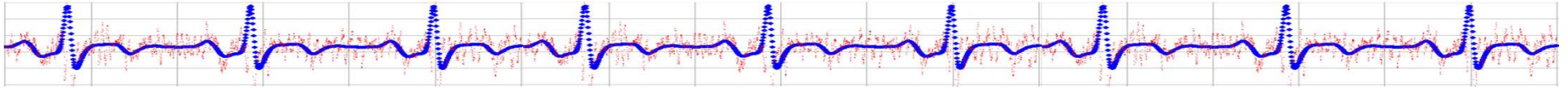
# Roles of Empirical Research in IS/PHI: Evaluation



**Figure 1** *A model of the attributes of system acceptability.*

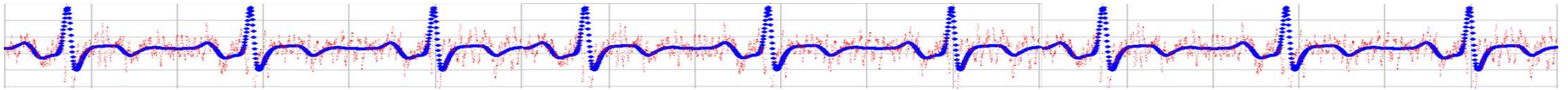
*From Nielsen, Usability Engineering*

# Empirical research in IS/PHI: Other roles

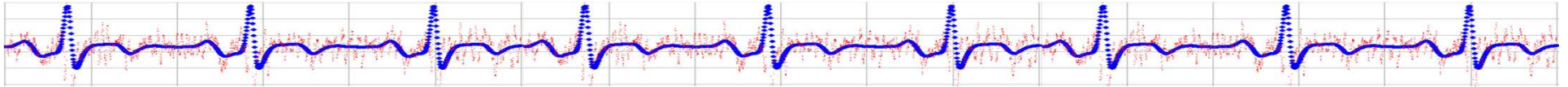


- Requirements analysis
- Assessing attitudes
- Any systematic collection and analysis of data to answer a research question
- Essential for
  - Conducting research
  - Consuming research

# Course Overview



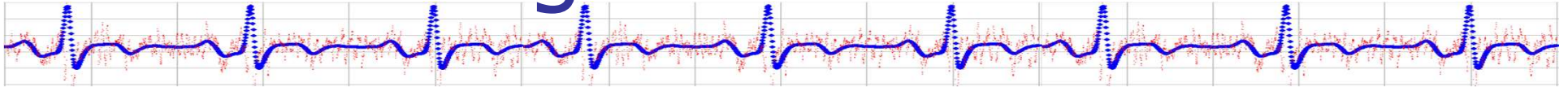
# Overview of course content



Methods to help provide objective answers to questions about system:

- Usability
- Effectiveness
- Acceptability
- Impact on individuals, work groups, organizations, and society

# Course goals



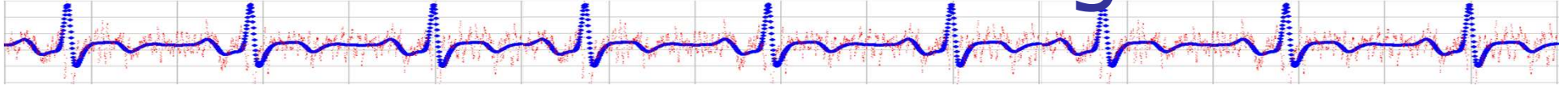
- IS: Prepare you for senior project
- PHI: Prepare you for project course
- CS: Enable HCI evaluation
- Grads: Help you with your own research project(s)
- All: Help you become savvy consumers of research results in everyday life

# Course structure



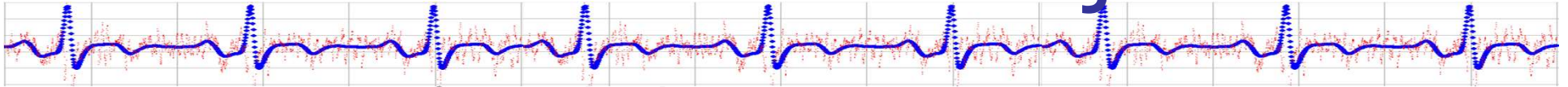
- Very hands-on:  
Significant amount of fieldwork
- Much *practice* applying methods
- Review of *applied* statistics

# Overview: Course organization



- First half – building a toolbox
  - Basics of the scientific method, building bottom-up from a survey of objective measures to the fundamentals of hypothesis testing using relatively simple research designs
- Second half – applying it
  - Alternates between team projects encompassing the design, conduct and presentation of small empirical studies and lectures covering more advanced research designs and statistical methods

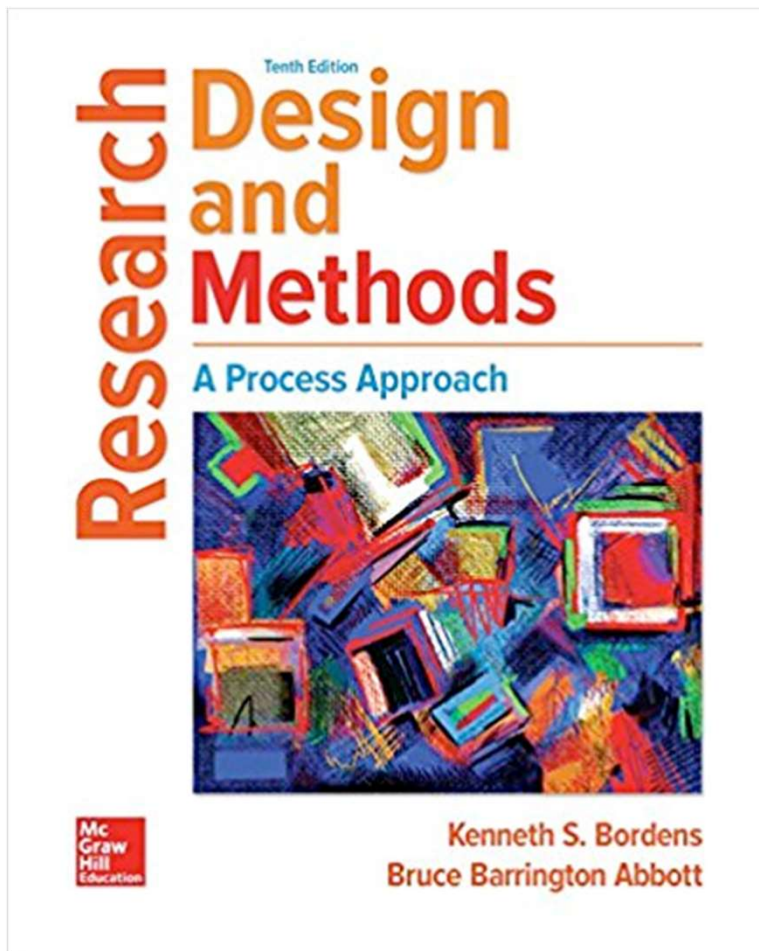
# Overview: Course objectives



- Scientific method
- Research methods used in IS/PHI/HCI
- Identify research questions that are answerable using empirical methods
- Research models, including measures, hypotheses, and statistical tests
- Fieldwork to collect data using a range of techniques
- Descriptive statistics (data you have)
- Inferential statistics (population you care about)
- Document and present results from empirical studies
- Ethical issues in human subjects studies



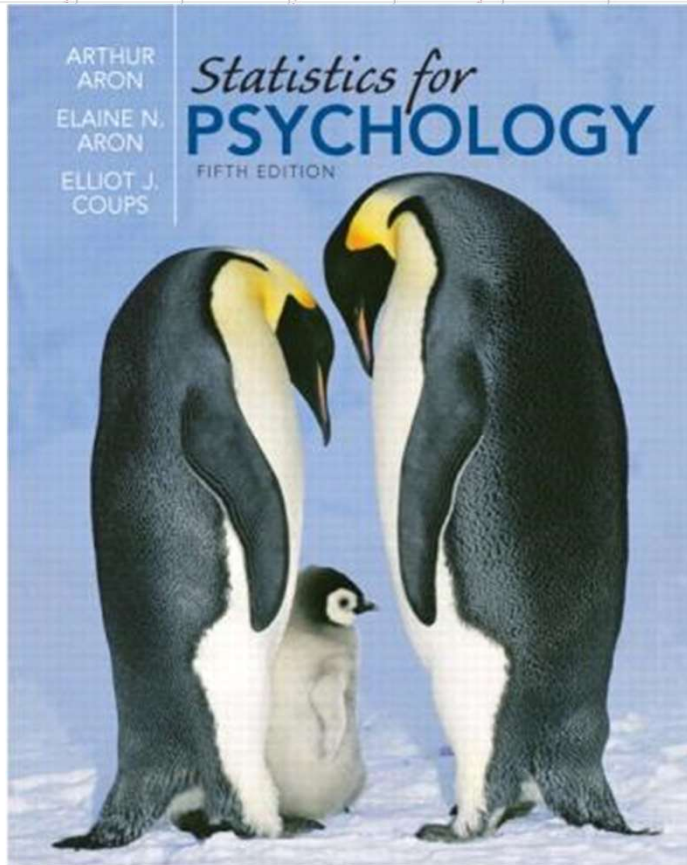
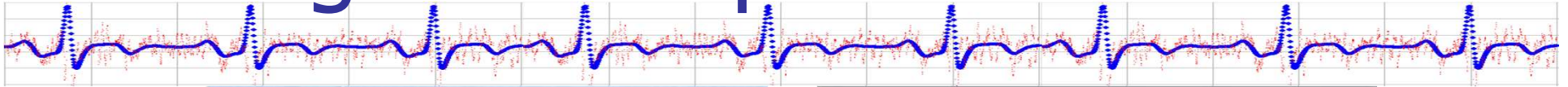
# Course materials



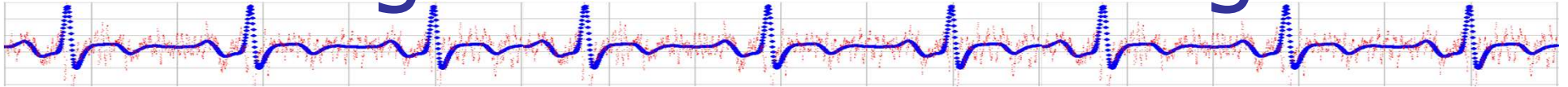
Why a text from psychology  
in an information science  
course?

+ handouts

# Might be helpful...



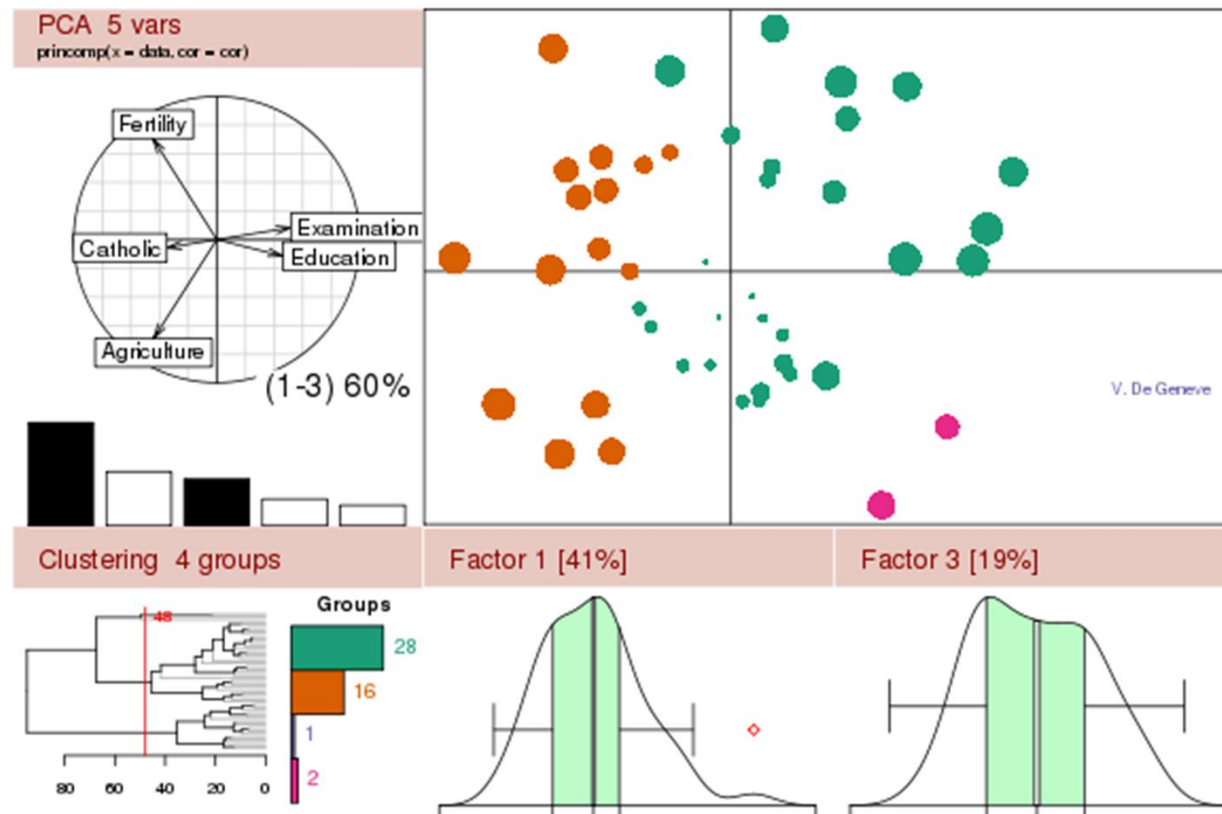
# It's good times: Amazing tools



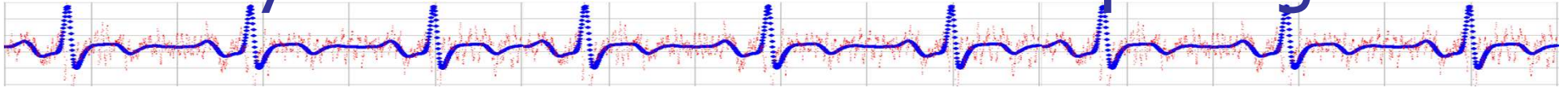
Software to help with data analysis and visualization:

- Open source
- Freely-available
- Widely used
- Robust/trustworthy
- Comprehensive (for most needs)

# The R Project for Statistical Computing



# Python for Statistical Computing

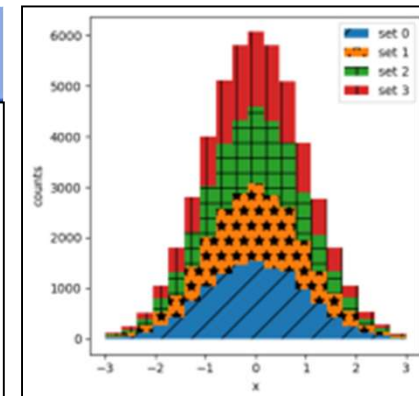


 SciPy.org



SciPy (pronounced "Sigh Pie") is a Python-based ecosystem of open-source software for mathematics, science, and engineering. In particular, these are some of the core packages:

	<b>NumPy</b> Base N-dimensional array package		<b>SciPy library</b> Fundamental library for scientific computing
	<b>Matplotlib</b> Comprehensive 2D Plotting		<b>IPython</b> Enhanced Interactive Console
	<b>Sympy</b> Symbolic mathematics		<b>pandas</b> Data structures & analysis



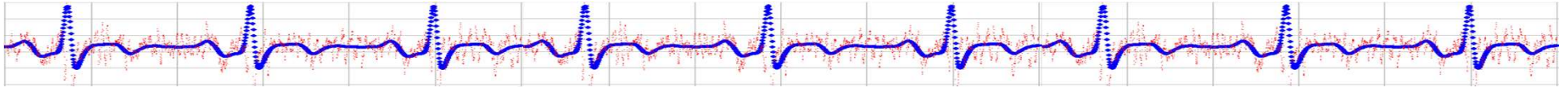


# Debate



- Python?
- R?

# Administrivia



- Course web site:  
<http://www.khoury.neu.edu/home/intille/teaching/IS4800/IS480019S.html>
- Instructor: Stephen Intille  
[s.intille@neu.edu](mailto:s.intille@neu.edu) (put [Methods] in subject)  
Office: 177 Huntington, 9<sup>th</sup> floor  
Office hours: Mon 8:30-9:30; Mon 11-12  
(email ahead for security)
- Piazza site:  
<https://piazza.com/northeastern/spring2019/is4800/home>  
(There is a “Grads” group)

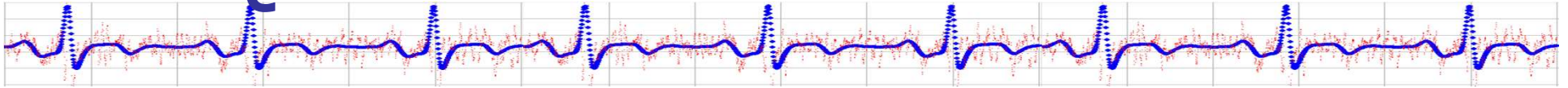
# Homework



- Email to [s.intille@neu.edu](mailto:s.intille@neu.edu) by due date/time  
(with "[Methods] Assignment X" in subject, e.g., "[Methods] Assignment I2")
- Late = automatic full grade lowering

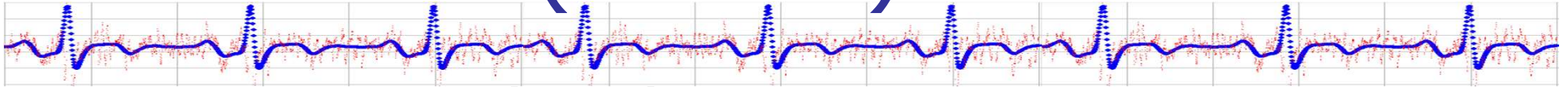


# Quizzes



- At start of most classes
- Closed book, 10 minutes (unless otherwise noted)
- Covers primarily readings assigned for that class

# Grades (IS4800)



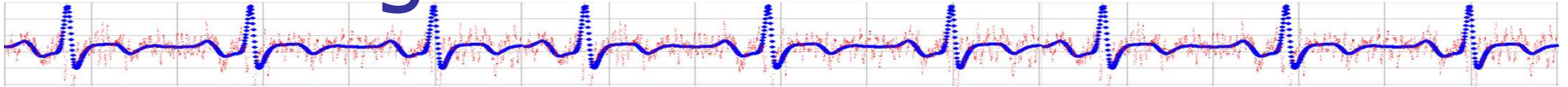
- Quizzes (10%)
- Class participation (10%), including in-class presentations
- Individual homework (20% divided equally among assignments)
- Team projects (20%, consisting of 15% project grade from the instructor and 5% peer evaluation)
- "Mid"term exam (20%).
- Final exam (20%)

# Schedule



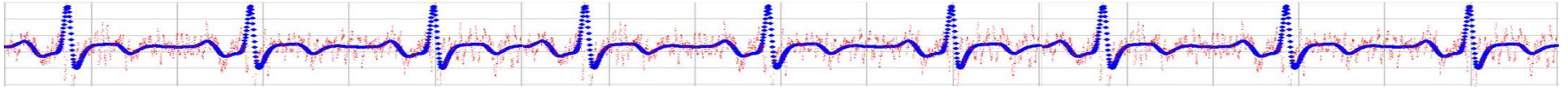
<http://www.khoury.neu.edu/home/intille/teaching/IS4800/IS480019S.html>

# Rough course outline



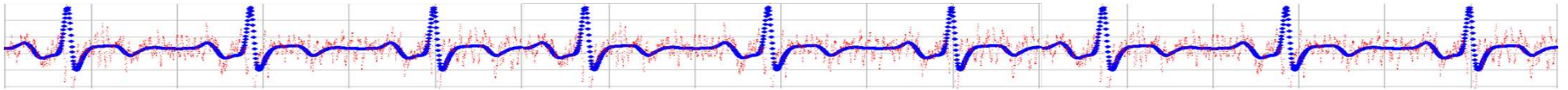
Wk 1	Scientific method, literature
Wk 2	Human subjects, ethnography
Wk 3-5	Research models, measures
Wk 6-n	Hypothesis testing, exp designs, miscellany

# CCIS Policies

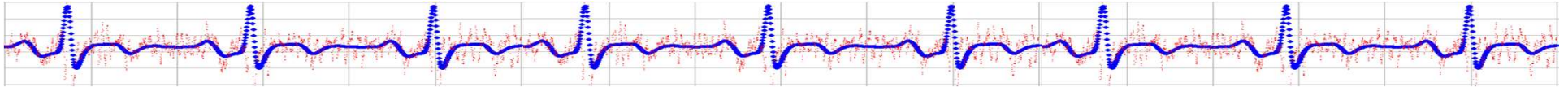


- No makeup or alternate exams
  - “Mid”term (3/13)
  - Final during finals week
- Academic integrity
  - If there is ANY suspicion of a problem, you WILL be referred to NU and CCIS ethics committees
  - Make sure you understand plagiarism

# Introductions

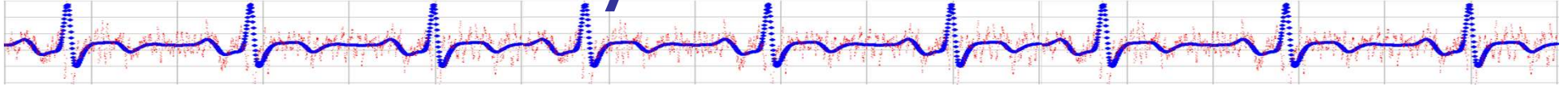


# Who am I?



- BSE in CSE from Penn
- Ph.D. from MIT (computer vision)
- “Home of the Future” and architects
- Health and House\_n
- Northeastern (Sep 2010)
  - New Ph.D. Personal Health Informatics
  - Interests: measuring and motivating behavior change using technology, person-facing health and wellness systems, disruptive health

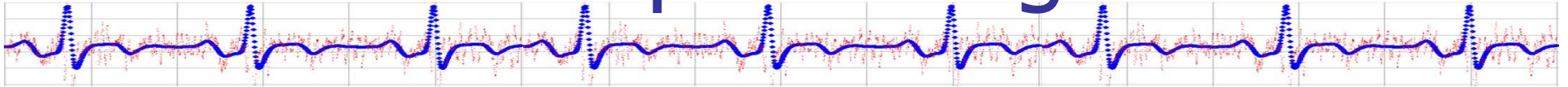
# Who are you?



- Name
- Your background
- Describe a research study you might have done (or did do) in a past job.



# Two examples using methods

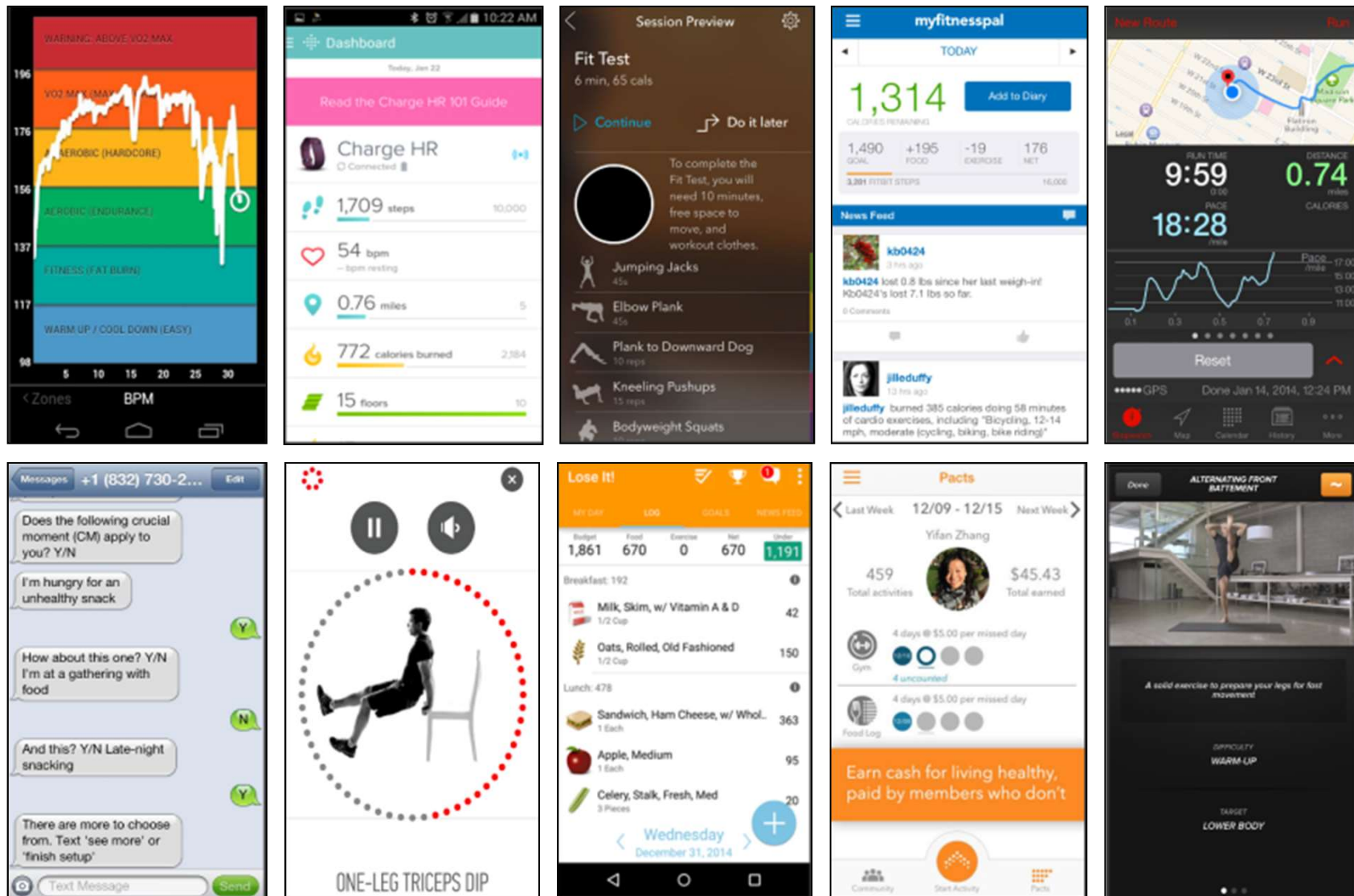


- CITY project
- uEMA project (Didn't get to it!)

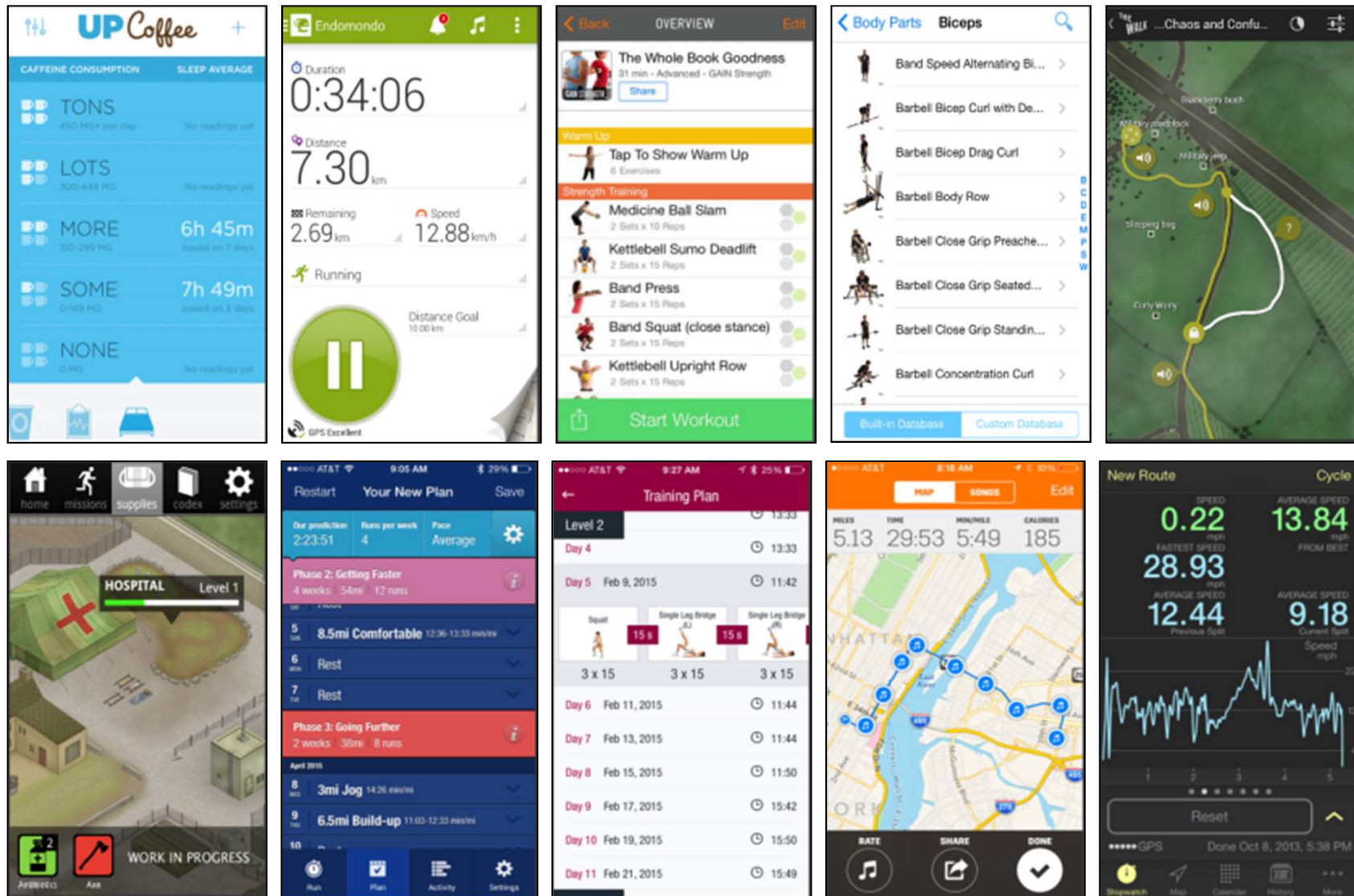
# In health tech, ideas are cheap



# In health tech, ideas are cheap

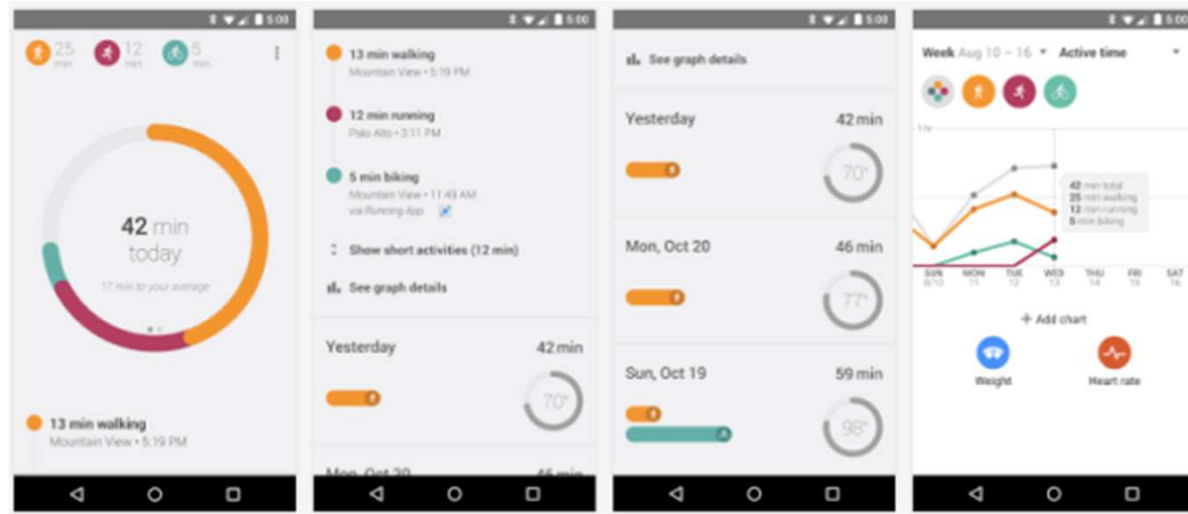


# In health tech, ideas are cheap



# Big gorillas getting in game...

Google



Apple



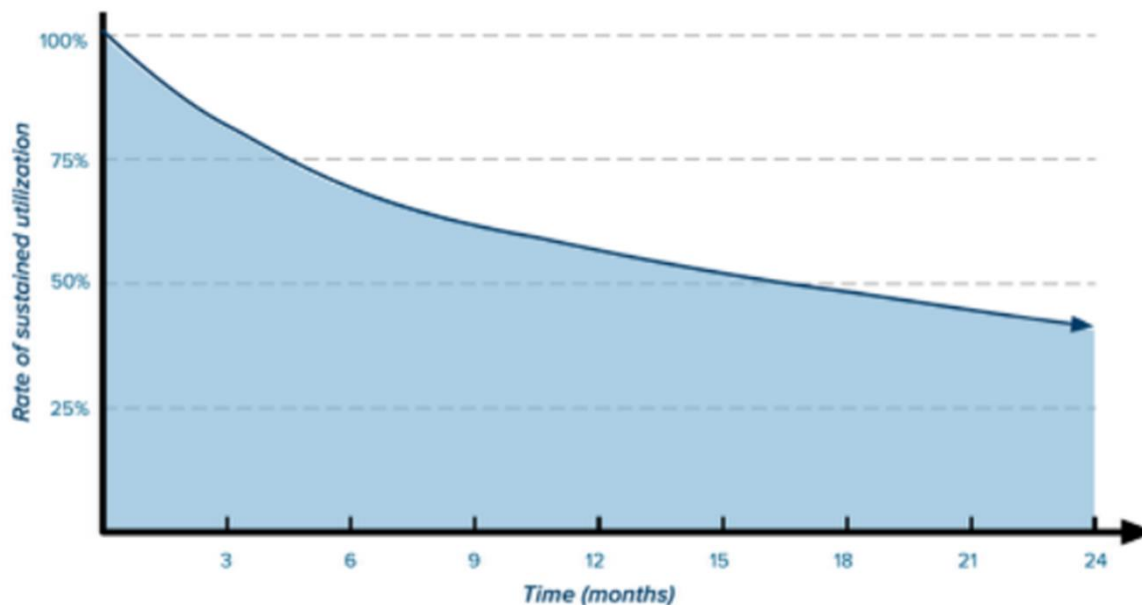


# But ... efficacy? Effectiveness?

## The Dirty Secret of Wearables

In the midst of this frenzy of anticipation, the dirty secret of wearables remains: *most of these devices fail to drive long-term sustained engagement for a majority of users.*

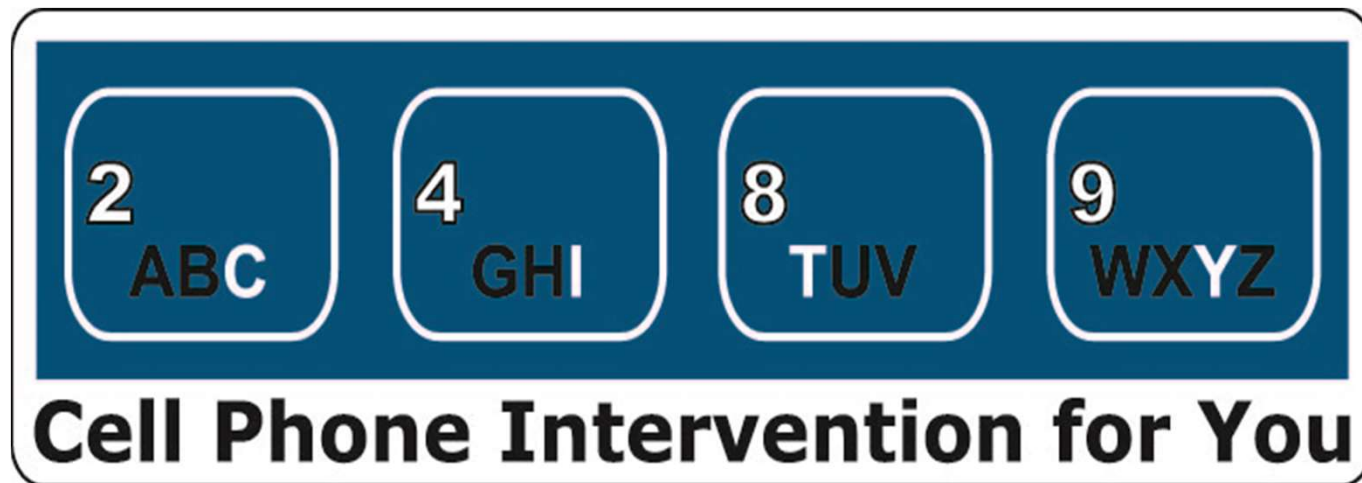
Endeavour Partners' research reveals that more than half of U.S. consumers who have owned a modern activity tracker no longer use it. A third of U.S. consumers who have owned one stopped using the device within six months of receiving it.



*Declining Rate of Sustained Activity Tracker Use Over Ownership*  
(Endeavour Partners, September 2013)

# A cautionary tale...

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# CITY goal

---

Randomized clinical trial to test a weight loss intervention delivered nearly entirely via a novel mobile phone application (+ wireless scale) in overweight and obese young adults (18-35 years old) for **two years**.

Original plan was to use mobile phone sensors (motion and GPS) to create a novel *persuasive* application

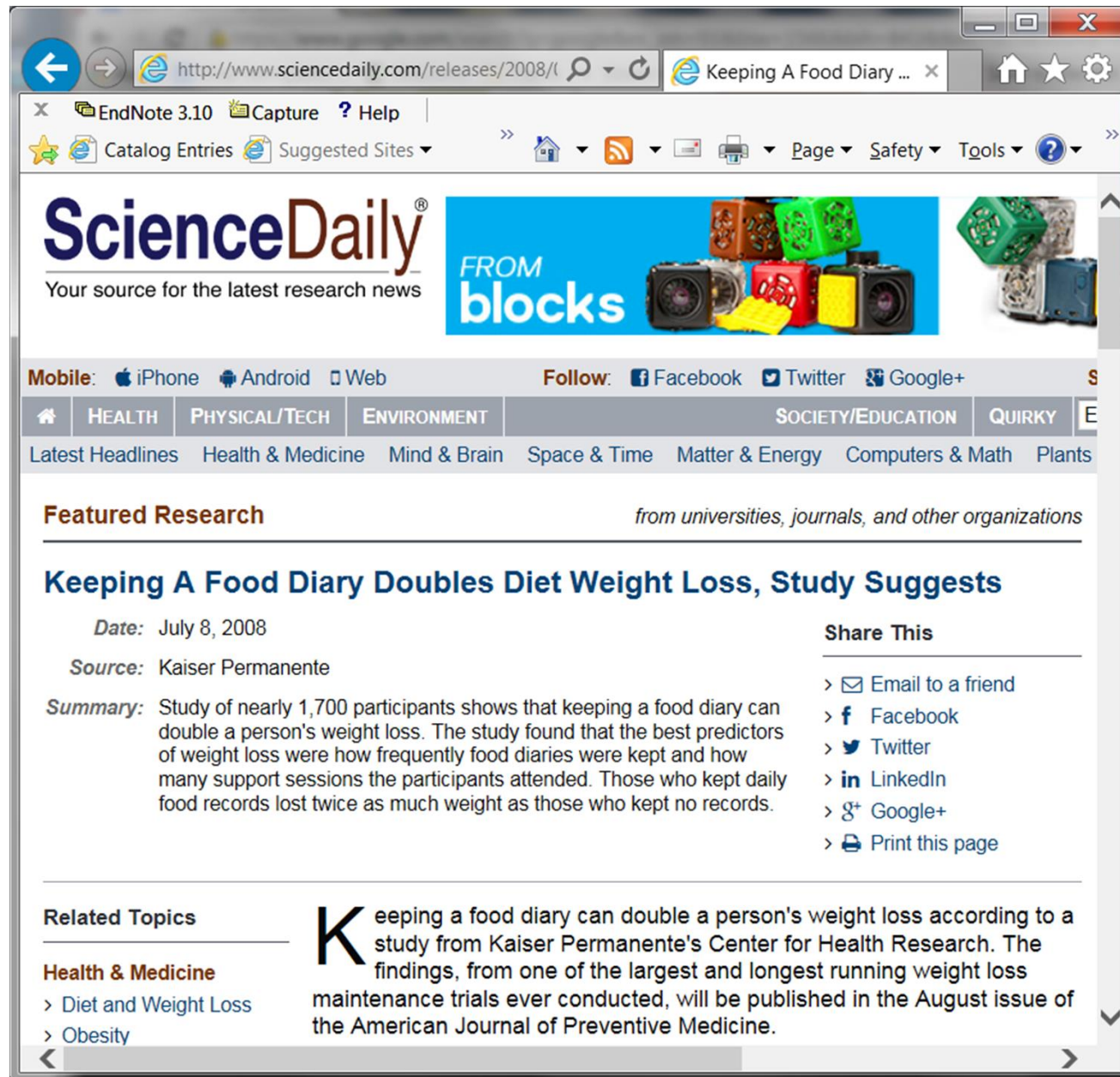


“It’s easy to help someone to lose weight”

**My expert colleagues**

“Helping the person to keep it off long-term is the biggest challenge”

“Doing it cost-effectively is the problem”



The screenshot shows a web browser window displaying a ScienceDaily article. The browser's address bar shows the URL: <http://www.sciencedaily.com/releases/2008/07/>. The ScienceDaily logo is at the top left, with the tagline 'Your source for the latest research news'. A banner image with the text 'FROM blocks' is visible. Below the banner, there are navigation links for 'HEALTH', 'PHYSICAL/TECH', 'ENVIRONMENT', 'SOCIETY/EDUCATION', and 'QUIRKY'. The article title is 'Keeping A Food Diary Doubles Diet Weight Loss, Study Suggests', dated July 8, 2008, from Kaiser Permanente. The summary states: 'Study of nearly 1,700 participants shows that keeping a food diary can double a person's weight loss. The study found that the best predictors of weight loss were how frequently food diaries were kept and how many support sessions the participants attended. Those who kept daily food records lost twice as much weight as those who kept no records.' A 'Share This' section includes links for Email, Facebook, Twitter, LinkedIn, Google+, and Print. A 'Related Topics' section lists 'Diet and Weight Loss' and 'Obesity'. A large 'K' is used as a drop cap for the first sentence of the article text: 'Keeping a food diary can double a person's weight loss according to a study from Kaiser Permanente's Center for Health Research. The findings, from one of the largest and longest running weight loss maintenance trials ever conducted, will be published in the August issue of the American Journal of Preventive Medicine.'

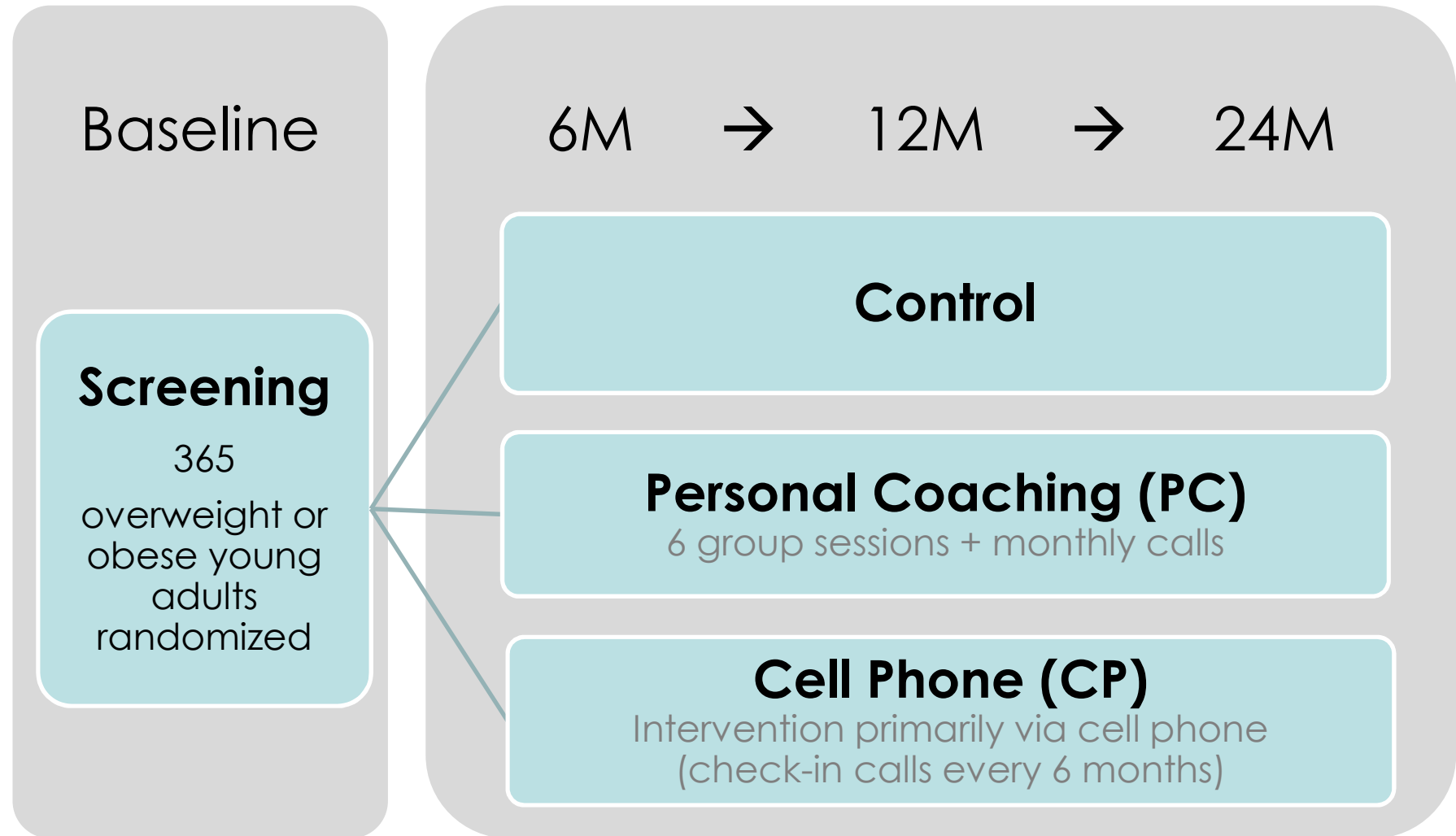
Why's this work?

Why do so few people do it?

***"Weight Loss During the Intensive Intervention Phase of the Weight-Loss Maintenance Trial."***

Jack F. Hollis, Christina M. Gullion, Victor J. Stevens, Phillip J. Brantley, Lawrence J. Appel, Jamy D. Ard, Catherine M. Champagne, Arlene Dalcin, Thomas P. Erlinger, Kristine Funk, Daniel Laferriere, Pao-Hwa Lin, Catherine M. Loria, Carmen Samuel-Hodge, William M. Vollmer, Laura P. Svetkey and Weight Loss Maintenance Trial Research Group.  
*American Journal of Preventive Medicine* Volume 35, Issue 2, Pages 118-126 (August 2008)

# CITY RCT design



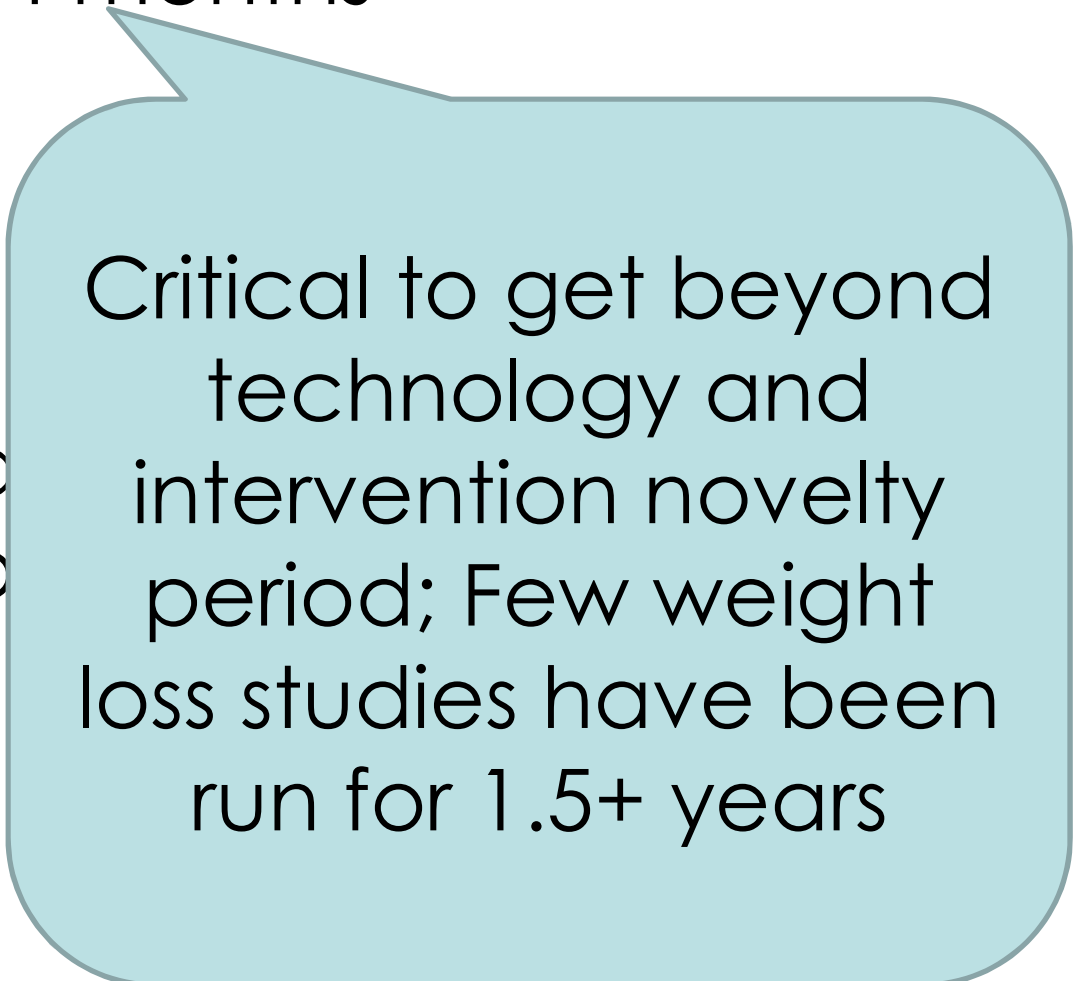
# Primary outcome measure

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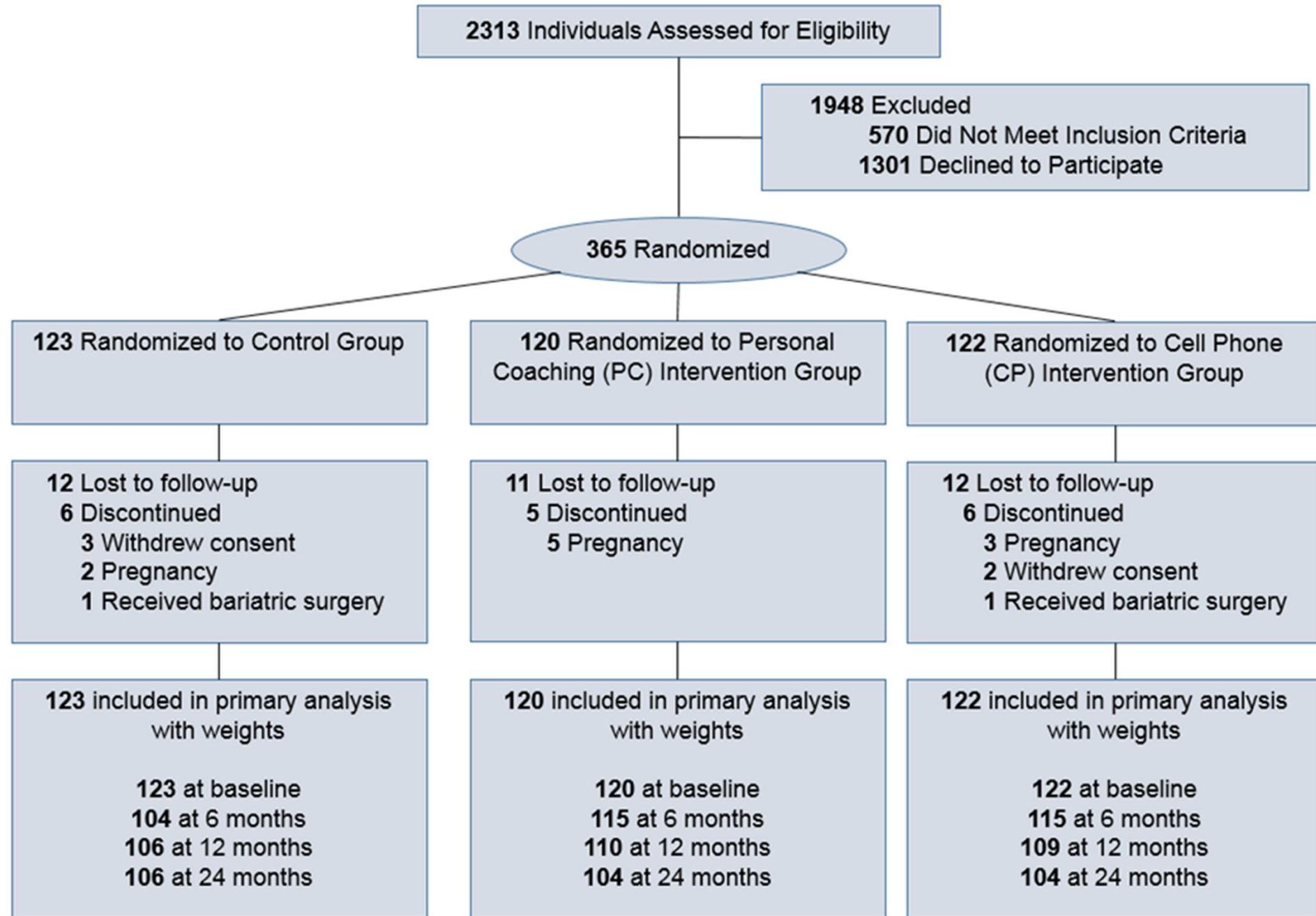
Weight loss after 24 months

- PC vs. Control
- CP vs. Control

Also plan to look at  
various app comp



Critical to get beyond  
technology and  
intervention novelty  
period; Few weight  
loss studies have been  
run for 1.5+ years



# Baseline characteristics

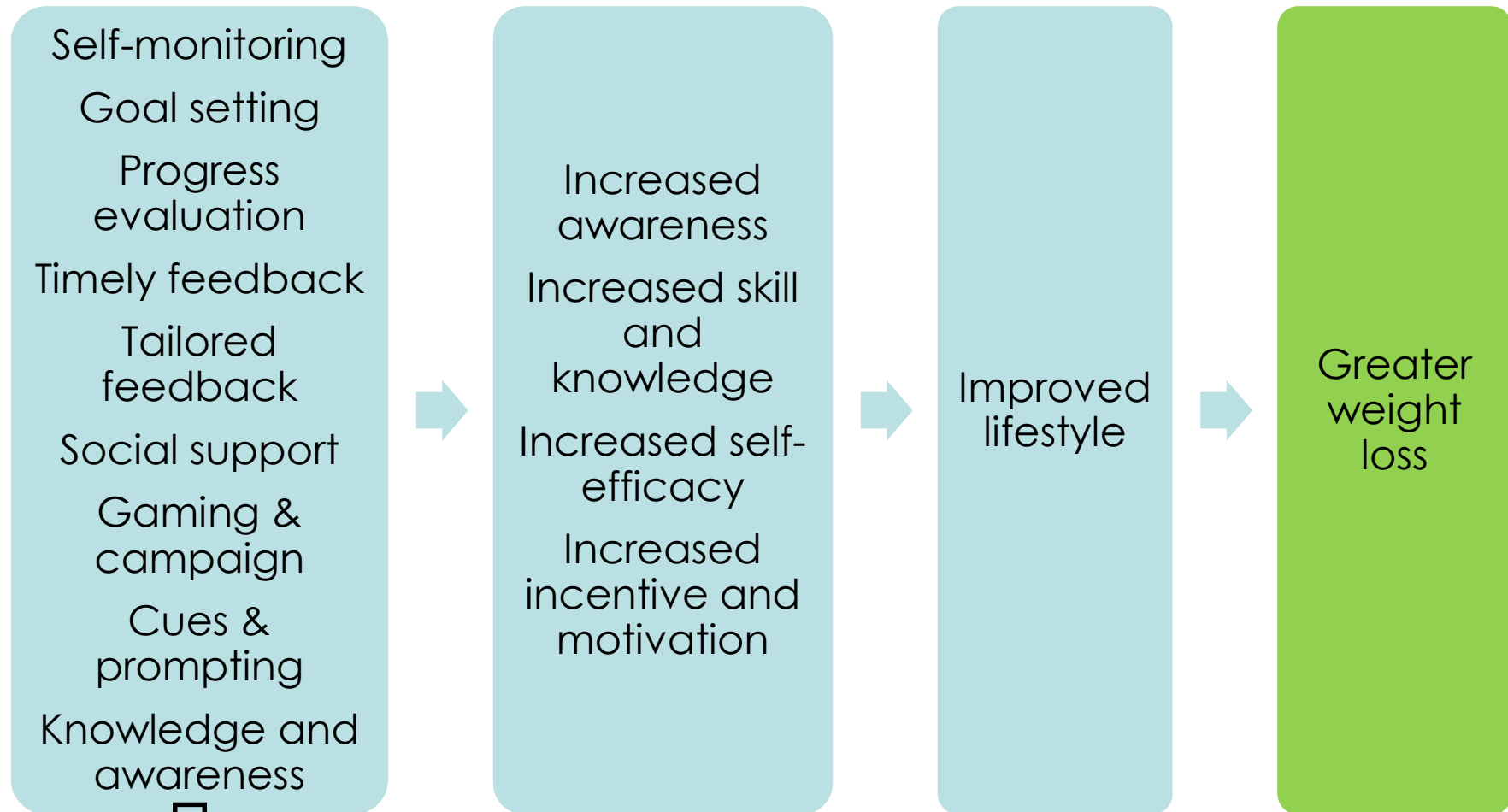
	Overall	Control	CP	PC
Total, no.	365	123	122	120
Weight in kg, mean (SD)	101.0 (23.7)	101.3 (22.6)	102.4 (25.2)	99.3 (23.4)
Body Mass Index (kg/m <sup>2</sup> ), mean (SD) [min, max]	35.2 (7.8) [24.9, 62.4]	35.1 (7.5) [25.3, 61.6]	35.7 (8.2) [25.1, 62.4]	34.9 (7.5) [24.9, 58.9]
BMI Category, no. (%)				
Overweight, 25-29.99 kg/m <sup>2</sup>	109 (29.9)	38 (30.9)	36 (29.5)	35 (29.2)
Class I obese, 30-34.99 kg/m <sup>2</sup>	110 (30.1)	33 (26.8)	34 (27.9)	43 (35.8)
Class II obese, 35-39.99 kg/m <sup>2</sup>	52 (14.2)	19 (15.4)	16 (13.1)	17 (14.2)
Class III obese, 40+ kg/m <sup>2</sup>	94 (25.8)	33 (26.8)	36 (29.5)	25 (20.8)



# Baseline characteristics

	Overall	Control	CP	PC
Total, no.	365	123	122	120
Age (years), mean (SD)	29.4 (4.3)	29.6 (4.3)	29.2 (4.2)	29.4 (4.3)
Female, no. (%)	254 (69.6)	85 (69.1)	84 (68.9)	85 (70.8)
Race Category, no. (%)				
White	205 (56.2)	72 (58.5)	68 (55.7)	65 (54.2)
Black	132 (36.2)	42 (34.1)	42 (34.4)	48 (40.0)
Other	28 (7.7)	9 (7.3)	12 (9.8)	7 (5.8)
Hispanic Ethnicity, no. (%)	21 (5.8)	5 (4.1)	9 (7.4)	7 (5.8)
Education Level, no. (%)				
Some college or less	130 (35.6)	40 (32.5)	39 (32.0)	51 (42.5)
College Degree or higher	235 (64.4)	83 (67.5)	83 (68.0)	69 (57.5)
In Committed Relationship, no. (%)	217 (59.8)	72 (59.0)	72 (59.0)	73 (61.3)
Student, no. (%)	124 (34.3)	42 (34.1)	43 (35.8)	39 (32.8)
Working, no. (%)	308 (85.1)	96 (79.3)	107 (88.4)	105 (87.5)

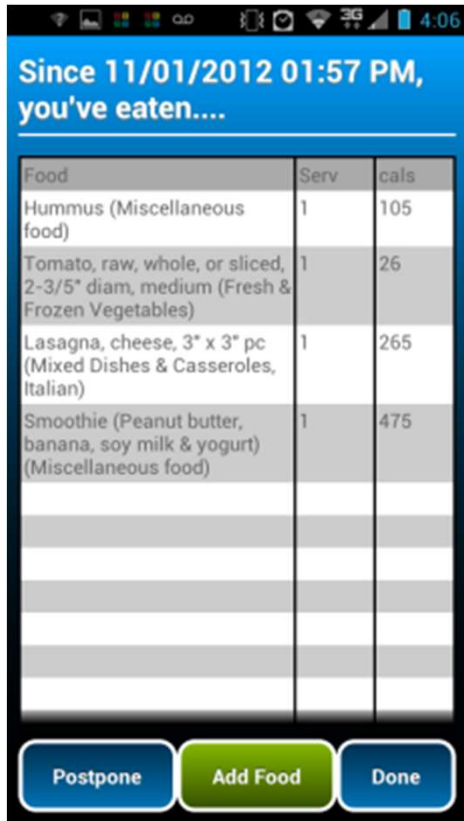
# Behavioral framework



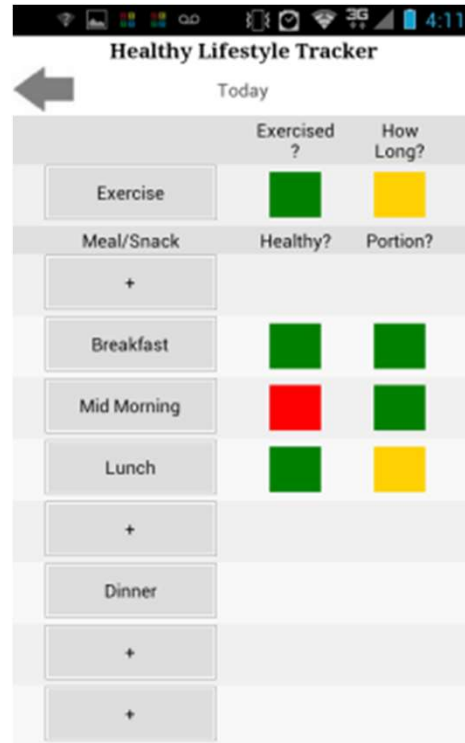
Delivered by proactive cell phone with limited coaching (CP) or a coach with passive phone software (PC)



# Self-monitoring



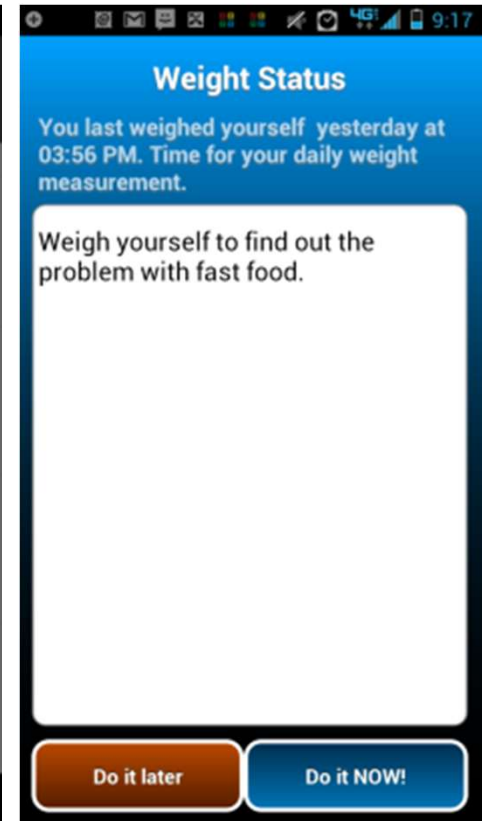
Detailed food tracker: type and amount



Simplified lifestyle tracker: single food and meals

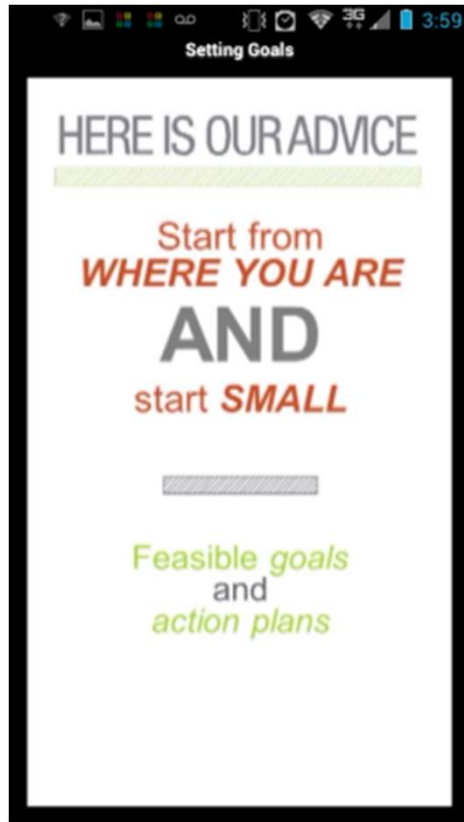


Physical activity tracker: type and minutes

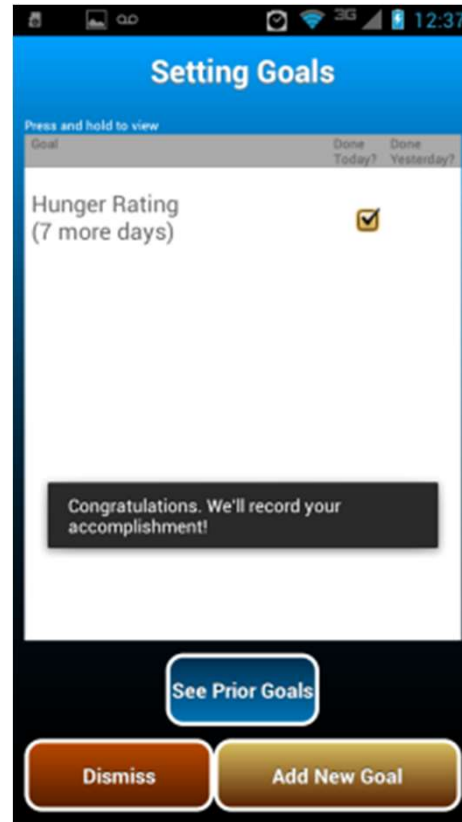


Weight tracker

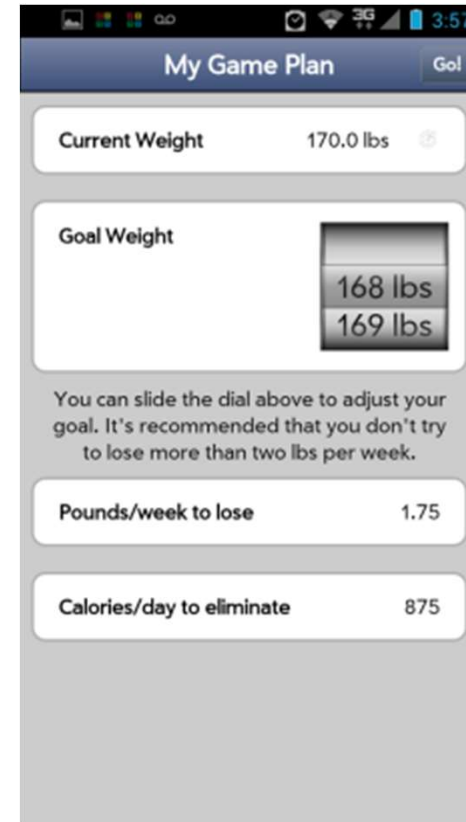
# Goal setting



Goal-Setting  
Tutorial



Goal-Setting  
Tracker



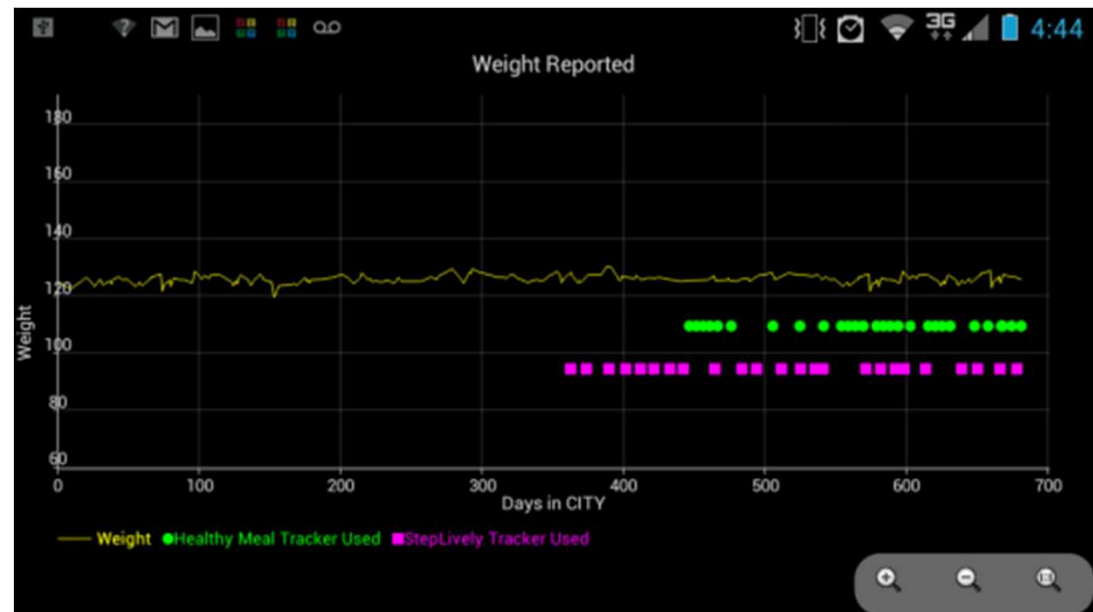
Countdown  
App

# Progress evaluation

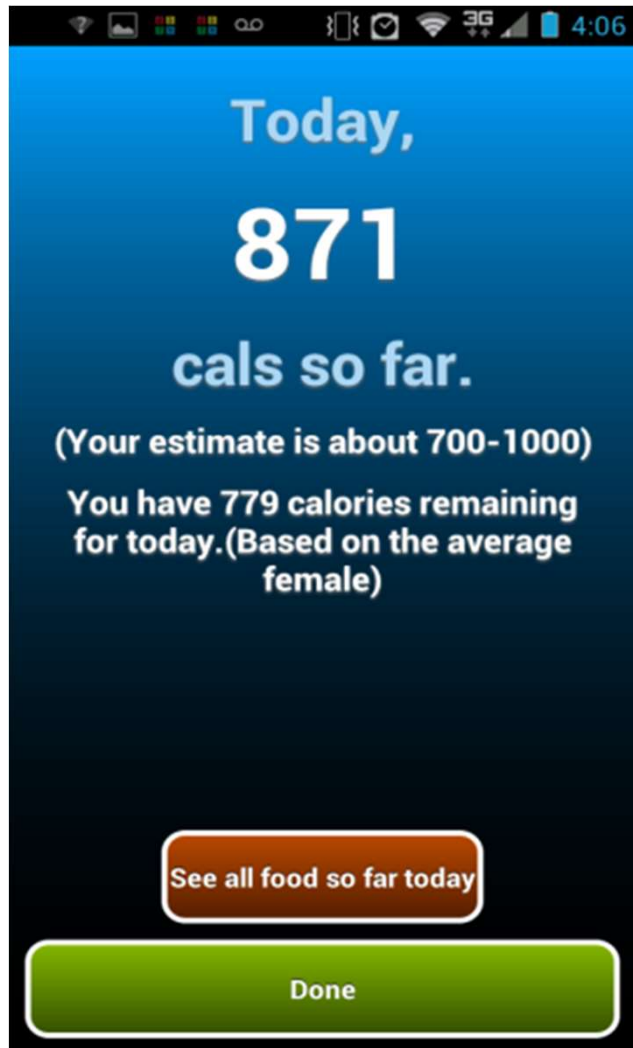


← Progress check tutorial

Historical weight graph,  
food and physical activity  
tracking progress

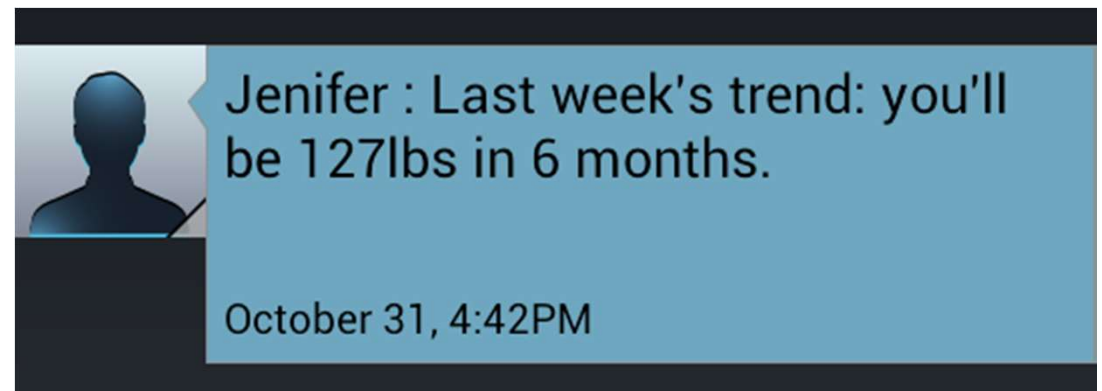


# Timely feedback



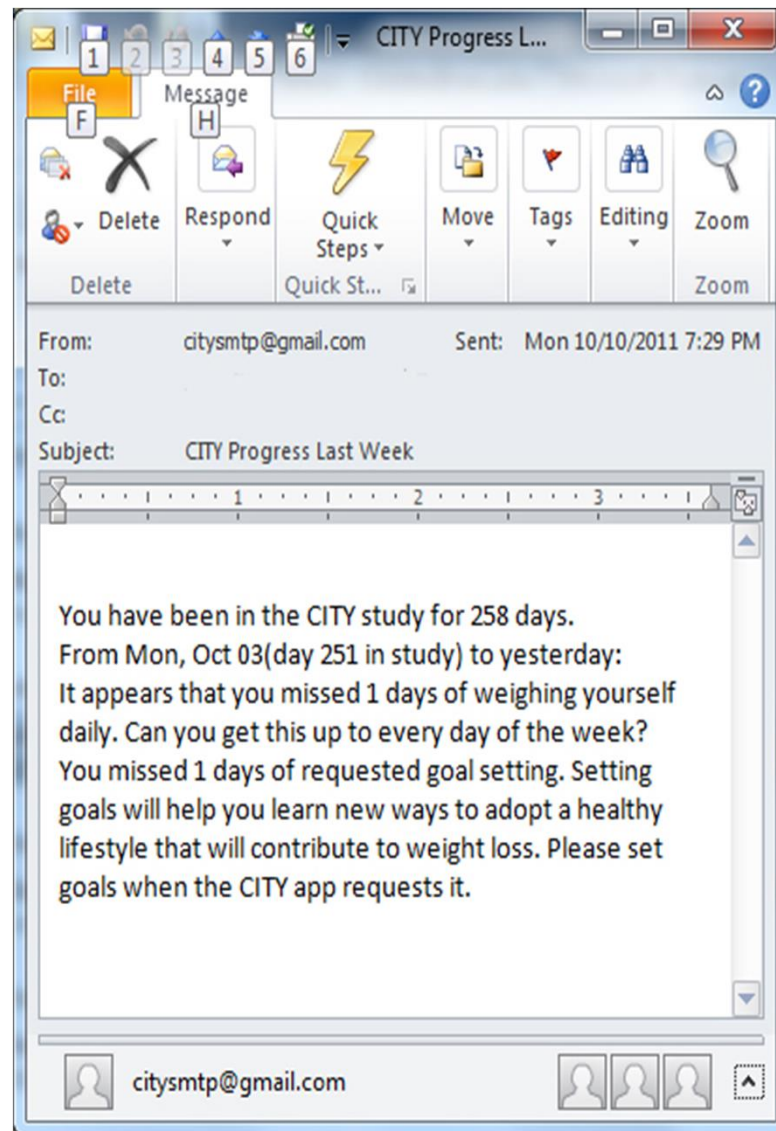
Feedback from detailed food tracker

Screenshot of a text message from CITY with weight projection.

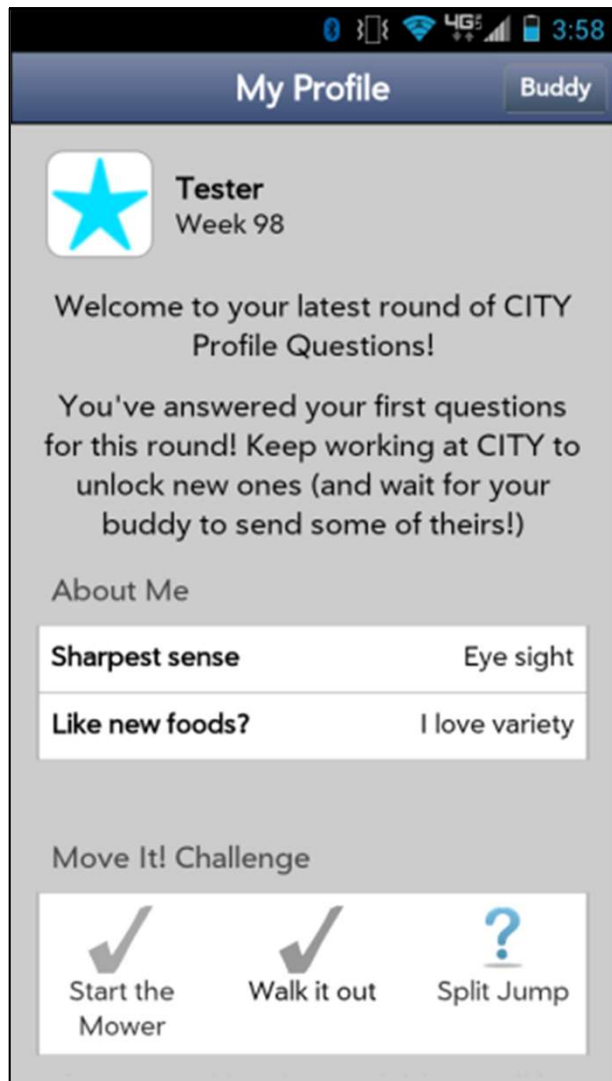


# Tailored feedback

Tailored feedback from the study every 10 days regarding progress in responding to study promptings



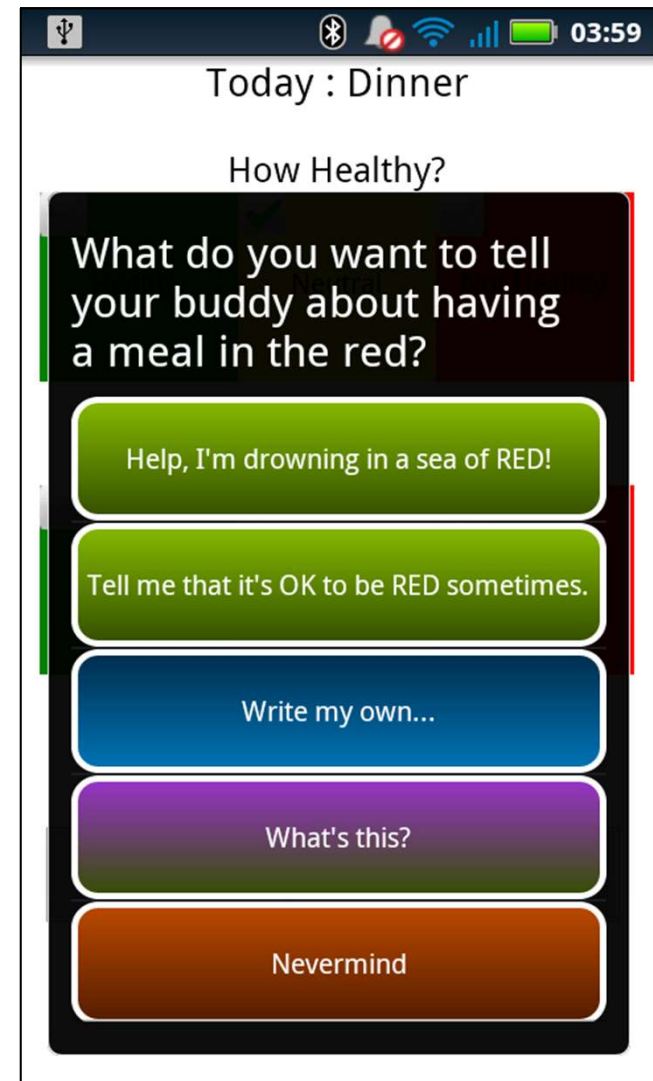
# Social support



After month 10,  
paired with an  
anonymous  
“buddy”

Send prompting  
to buddy

Receive support  
from buddy

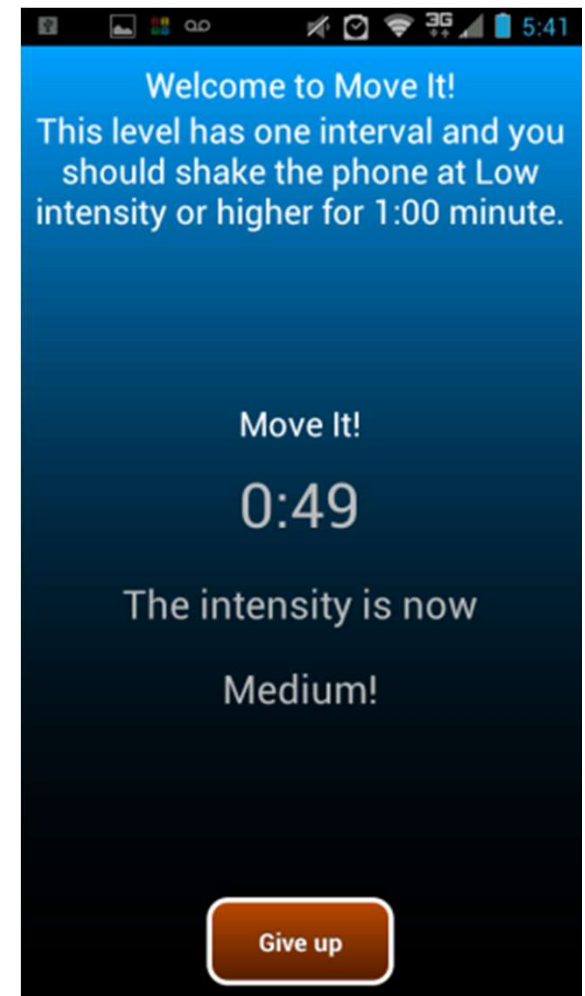
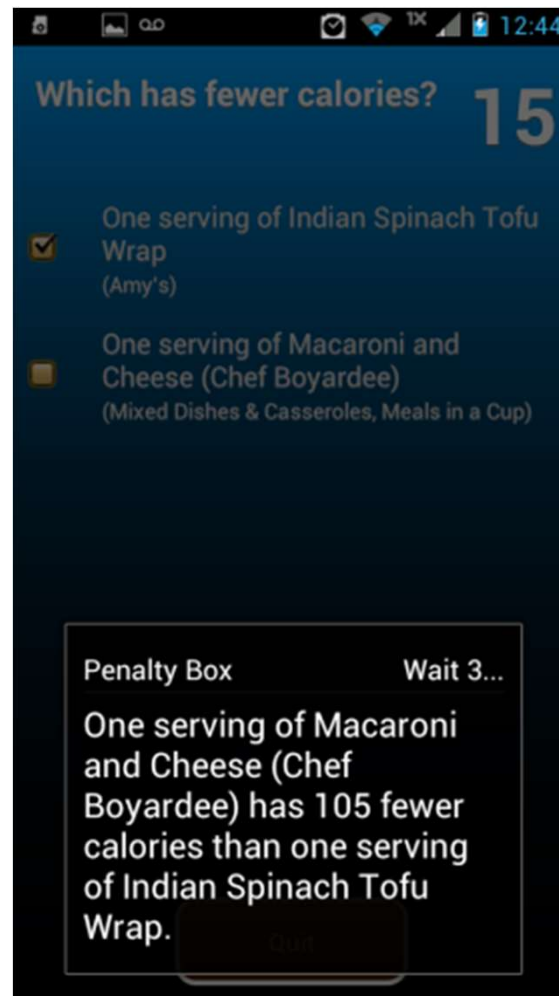




# Gaming and campaign

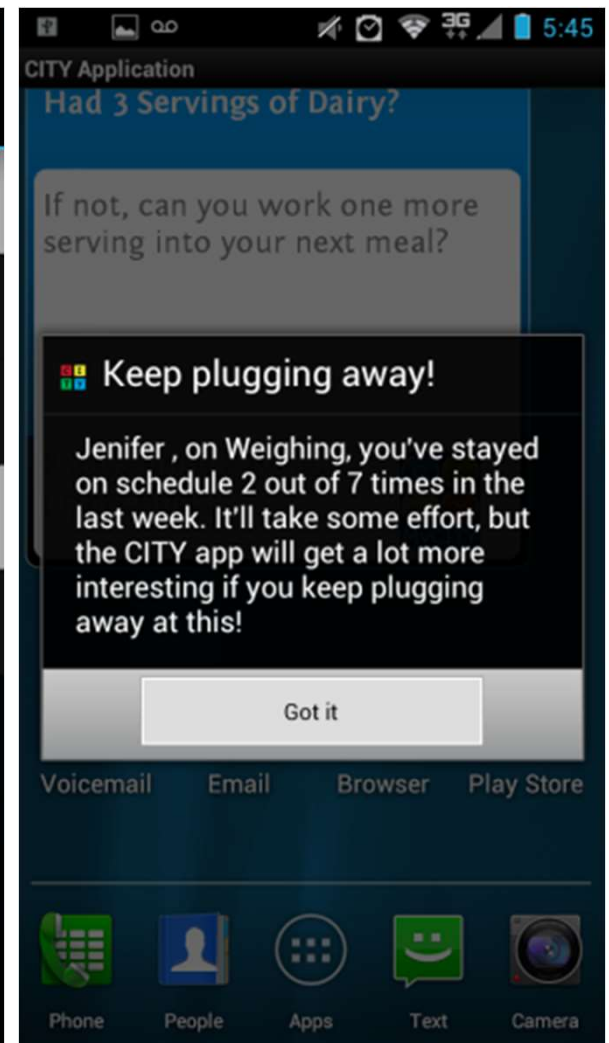
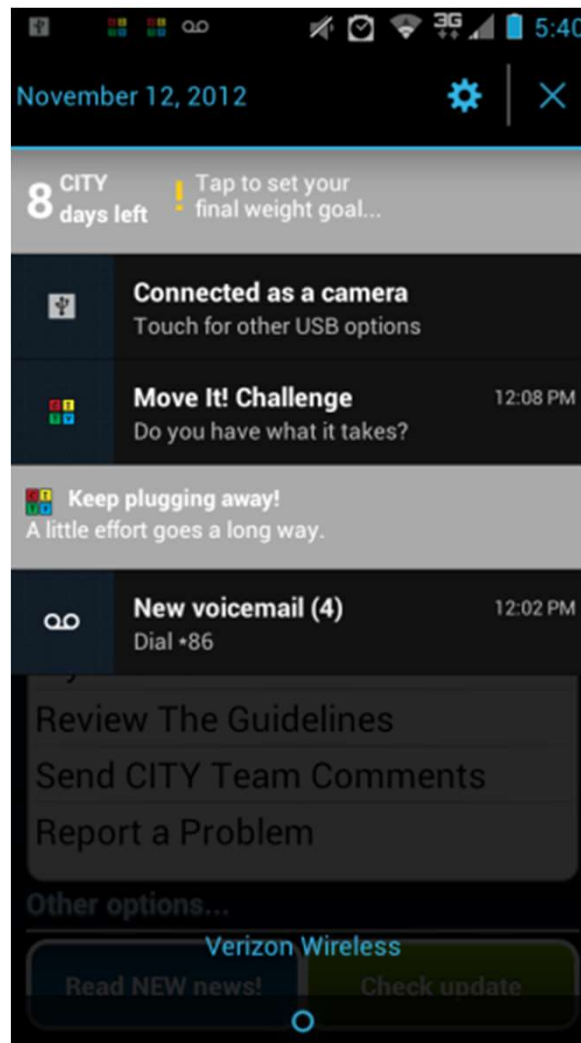
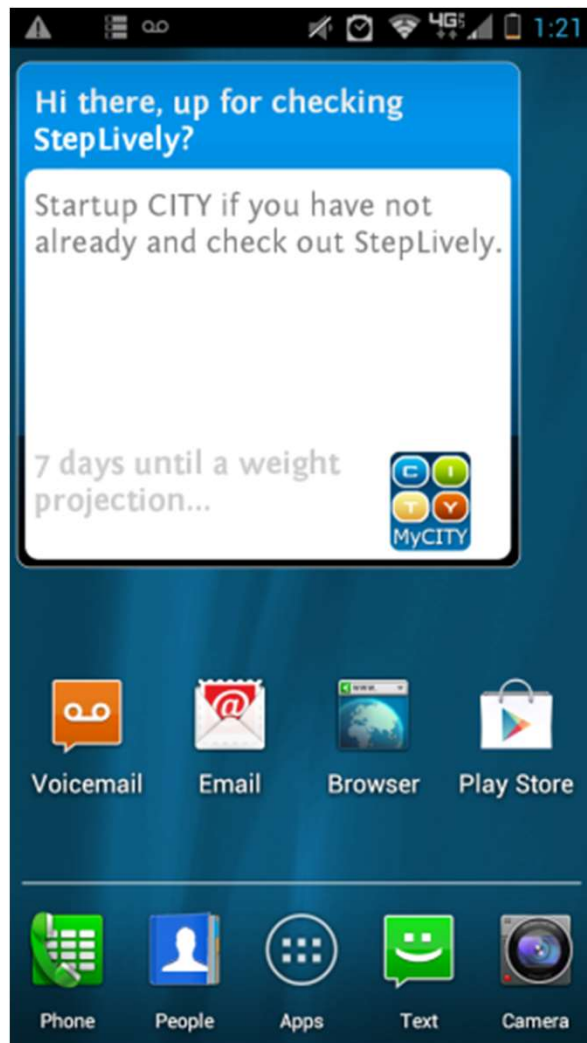


Food quiz



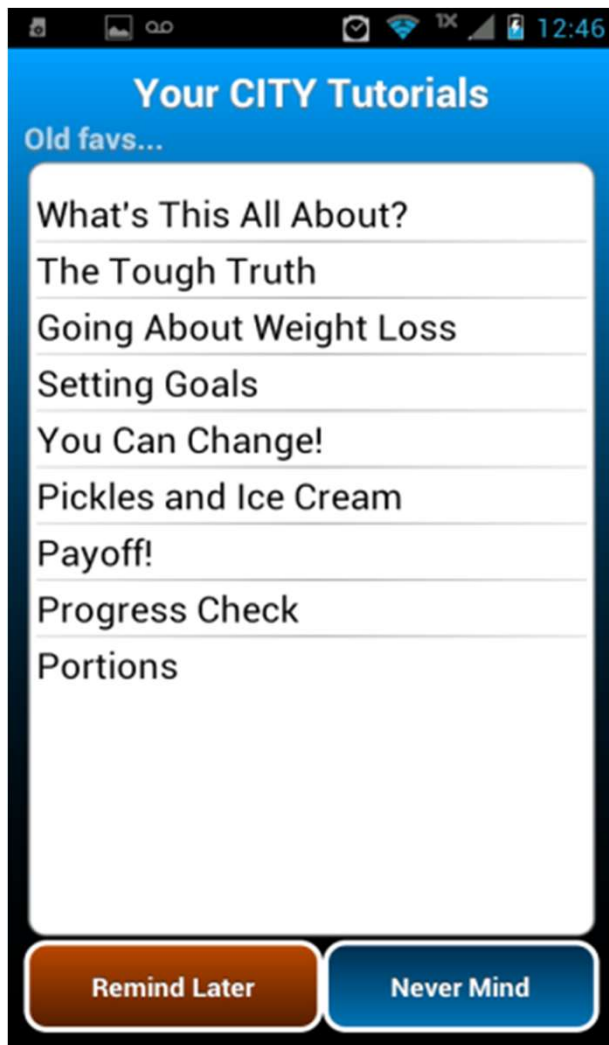
Move it challenge

# Cues and prompting



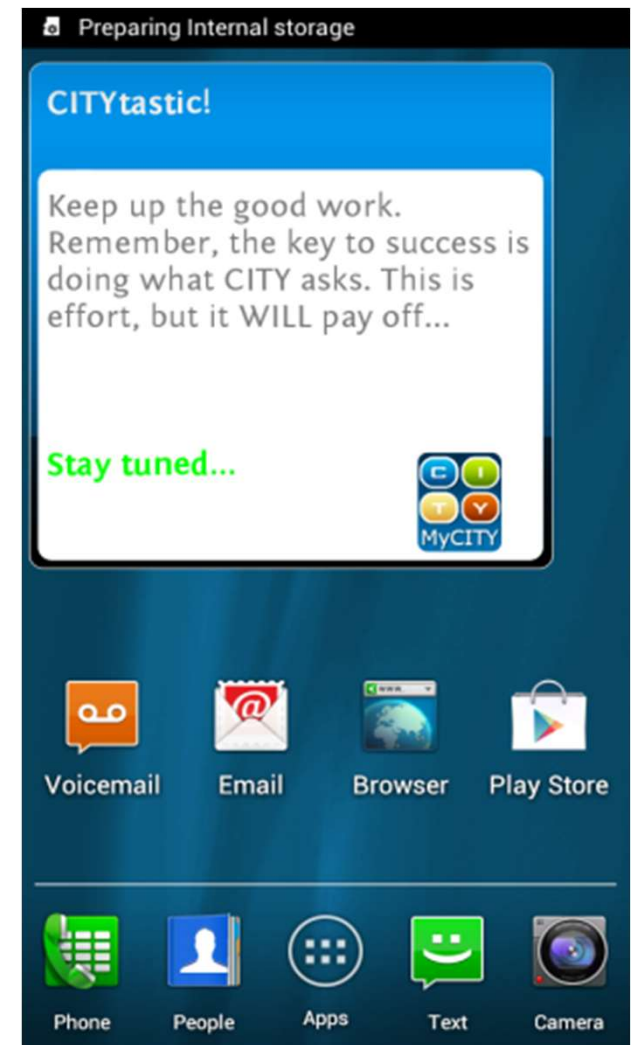


# Knowledge & awareness

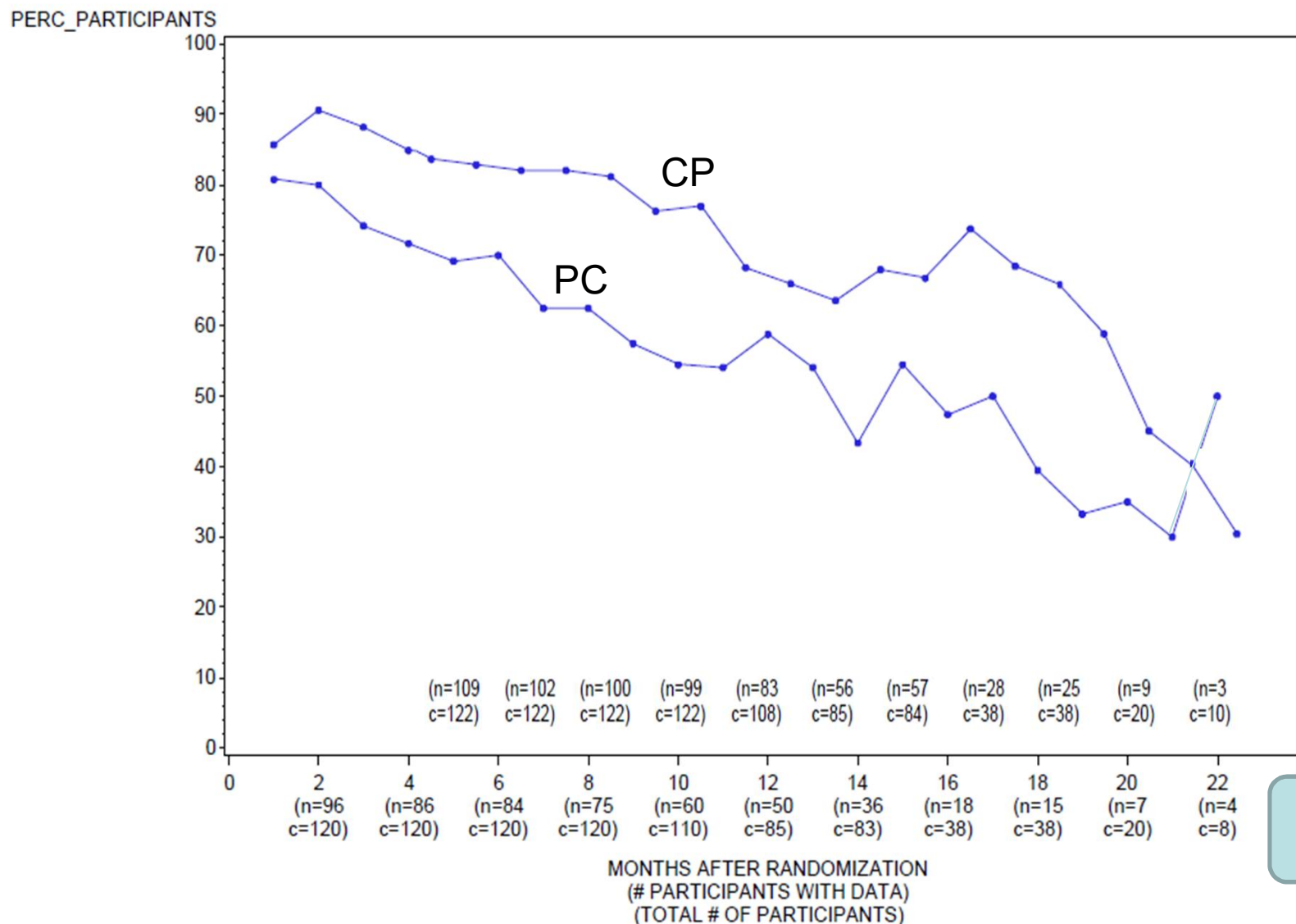


← Tutorials

Live wallpaper  
screen with  
tips, news, and  
inspirational  
quotes rotating  
every few  
hours

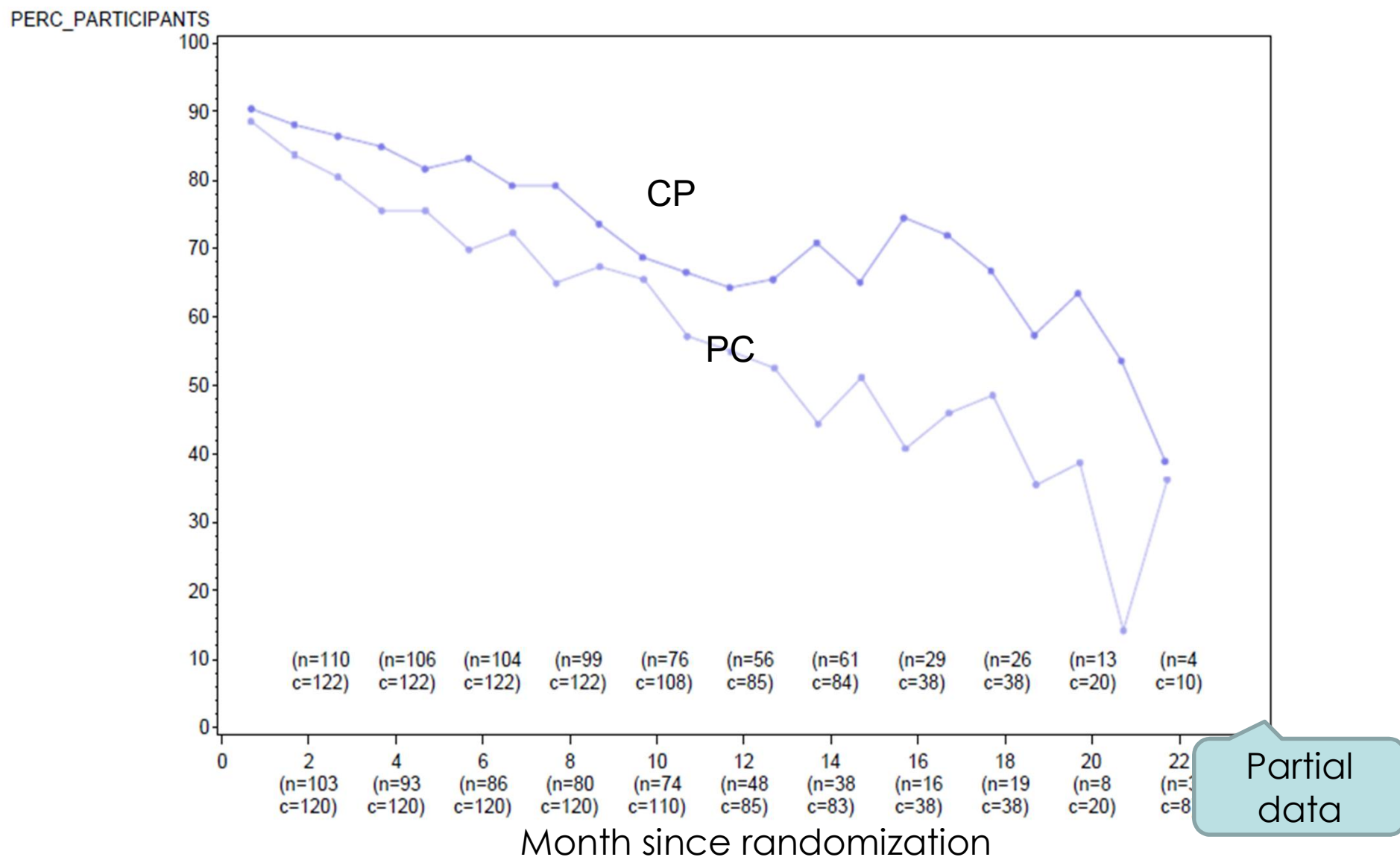


# Engagement: % 1+ weighing/mo

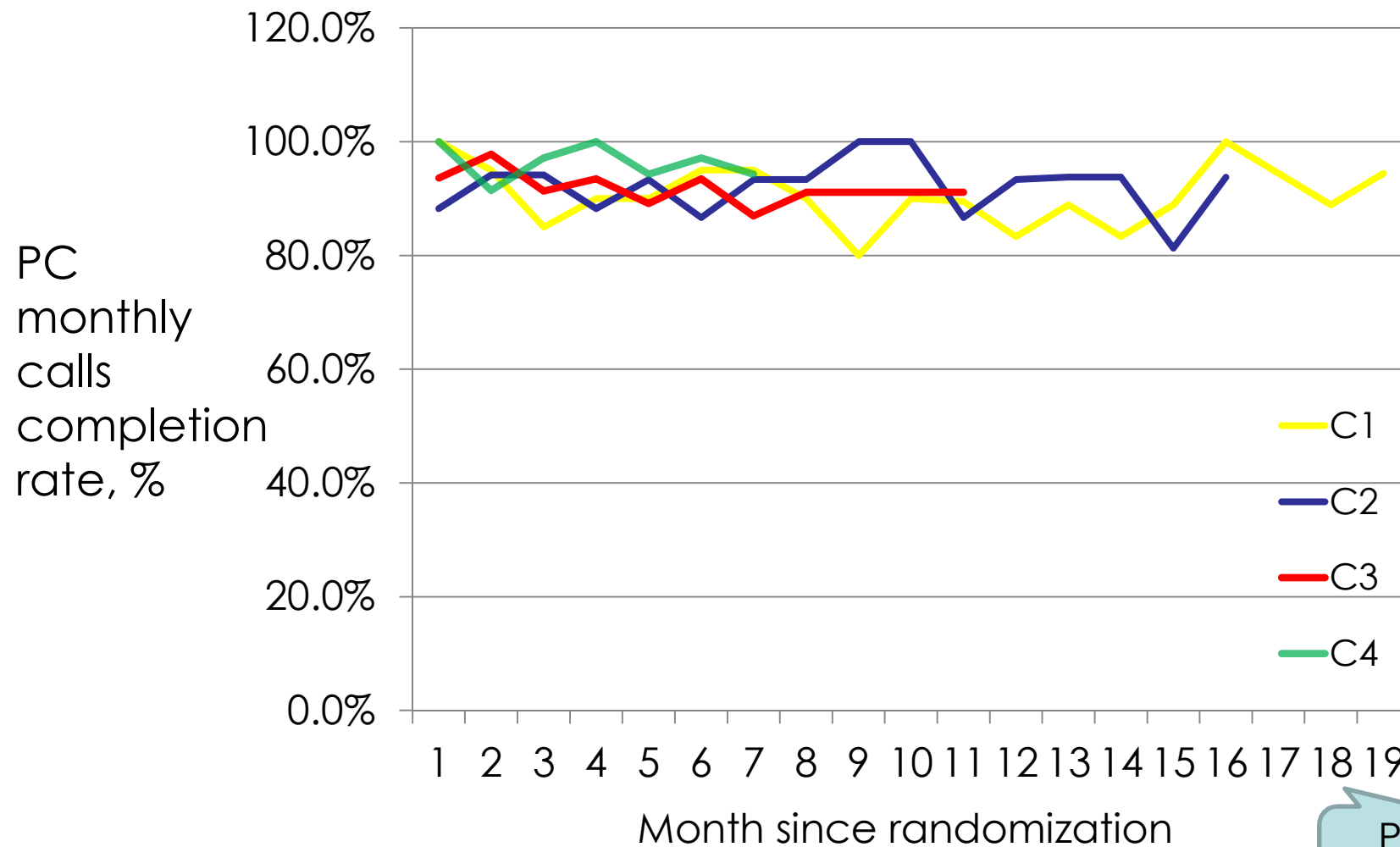


Partial  
data

# Engagement: App used 4x/mo



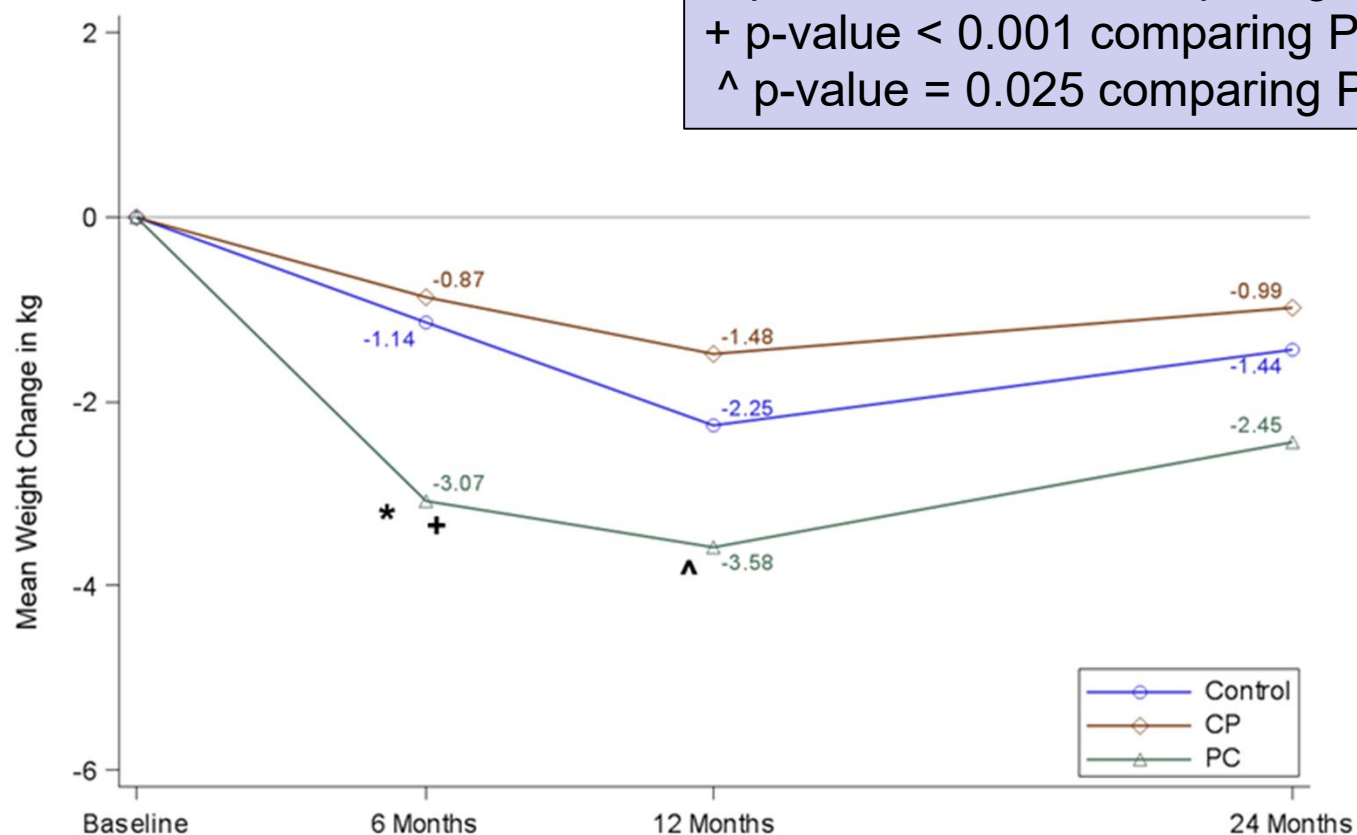
# PC: monthly calls completion



Partial  
data

# Main outcome (all data)

A Mean Weight Change by Arm



\* p-value = 0.003 comparing PC and control  
+ p-value < 0.001 comparing PC and CP  
^ p-value = 0.025 comparing PC and CP

# CITY Intervention Team

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## Duke:

- Laura Svetkey (PI)
- Pao-Hwa Lin
- Rachel Bordogna
- Leonor Corsino
- Kate Pilewski
- Jenifer Schwager

## Northeastern

- Stephen Intille
- Tony Lazenka
- Lei Wang
- Elica Farjadian
- Kati Phillips

# CITY co-investigators

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- Gary Bennett
- Hayden Bosworth
- Corrine Voils
- Steve Grambow
- Bryan Batch
- Leonor Corsino
- Crystal Tyson
- Jacqueline Bagwell

**Obesity Symposium**  
CLINICAL TRIALS AND INVESTIGATIONS

Obesity

**Cell Phone Intervention for You (CITY): A Randomized, Controlled Trial of Behavioral Weight Loss Intervention for Young Adults Using Mobile Technology**

Laura P. Svetkey<sup>1,2</sup>, Bryan C. Batch<sup>3</sup>, Pao-Hwa Lin<sup>1,2</sup>, Stephen S. Intille<sup>4,5</sup>, Leonor Corsino<sup>3</sup>, Crystal C. Tyson<sup>1</sup>, Hayden B. Bosworth<sup>6,7,8,9</sup>, Steven C. Grambow<sup>10</sup>, Corrine Voils<sup>6,9</sup>, Catherine Loria<sup>11</sup>, John A. Gallis<sup>10</sup>, Jenifer Schwager<sup>1,2</sup>, and Gary B. Bennett<sup>1,2,13</sup>

**Objective:** To determine the effect on weight of two mobile technology-based (mHealth) behavioral weight loss interventions in young adults.

Design

**CLINICAL  
TRIALS****Adaptive intervention design in mobile health: Intervention design and development in the Cell Phone Intervention for You trial**

Clinical Trials  
2015, Vol. 12(6) 634-645  
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DOI: 10.1177/1740774515597222  
ctj.sagepub.com  


Pao-Hwa Lin<sup>1,2</sup>, Stephen Intille<sup>3</sup>, Gary Bennett<sup>4,5,6</sup>, Hayden B Bosworth<sup>7,8,9,10</sup>, Leonor Corsino<sup>2,11</sup>, Corrine Voils<sup>7,8</sup>, Steven Grambow<sup>7,12</sup>, Tony Lazenka<sup>3</sup>, Bryan C Batch<sup>2,11</sup>, Crystal Tyson<sup>1,2</sup> and Laura P Svetkey<sup>1,2</sup>



# Expect more soon...

Ann Intern Med. 2014 Nov 18;161(10 Suppl):S5-12. doi: 10.7326/M13-3005.

## **Effectiveness of a smartphone application for weight loss compared with usual care in overweight primary care patients: a randomized, controlled trial.**

Laing BY, Mangione CM, Tseng CH, Leng M, Vaisberg E, Mahida M, Bholat M, Glazier E, Morisky DE, Bell DS.

### **Abstract**

**BACKGROUND:** Many smartphone applications (apps) for weight loss are available, but little is known about their effectiveness.

**OBJECTIVE:** To evaluate the effect of introducing primary care patients to a free smartphone app for weight loss.

**DESIGN:** Randomized, controlled trial. (ClinicalTrials.gov: [NCT01650337](#)).

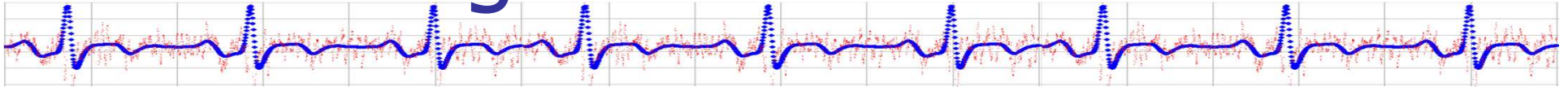
**SETTING:** 2 academic primary care clinics.

**PATIENTS:** 212 primary care patients with body mass index of 25 kg/m<sup>2</sup> or greater.

**INTERVENTION:** 6 months of usual care without (n = 107) or with (n = 105) assistance in downloading the MyFitnessPal app (MyFitnessPal).

**CONCLUSION:** Smartphone apps for weight loss may be useful for persons who are ready to self-monitor calories, but introducing a smartphone app is unlikely to produce substantial weight change for most patients.

# Getting started



- Read B&A Ch 1 (all) & 3 (pg. 67-100)
- Read sample research plan (linked from syllabus)
- Do Homework 1 (not graded)
  - Read through course website
  - Find & do homework 1 (easy!)