Does Feedback from Activity Trackers influence Physical Activity? Evidence from a Randomized Controlled Trial

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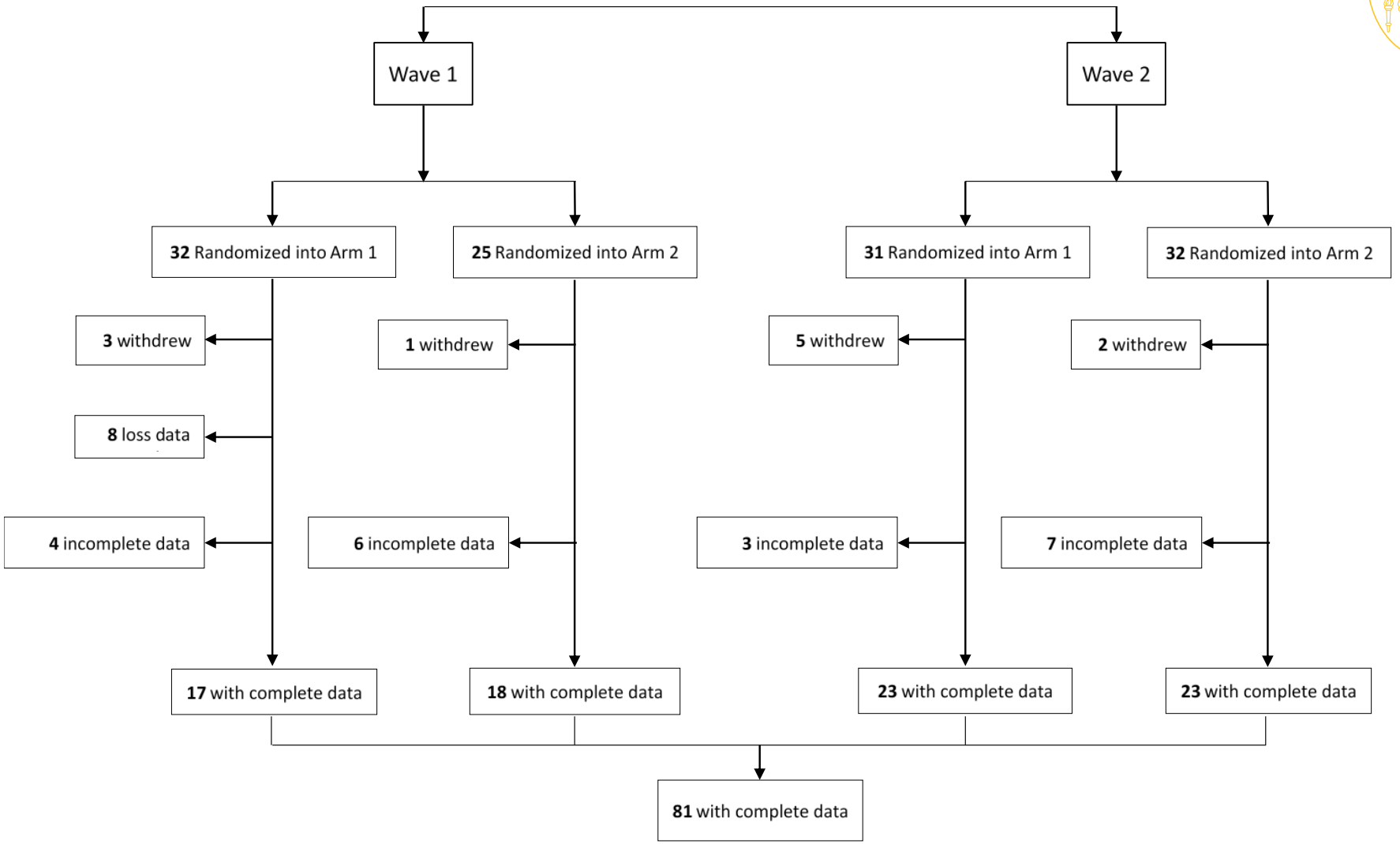
Motivation

- Physical activity (PA) is an important dimension of health behavior.
  - Self-reports are notoriously unreliable.
  - Measuring PA with activity trackers is now common.
- Research grade accelerometers (e.g. GENEActiv, Actigraph) give no feedback.
- It may be cost effective to use commercially available trackers, like Fitbit, in epidemiological studies.
  - But these provide feedback (by design).
  - Does that matter for research?
- That depends on how much feedback affects PA

Experimental Design

- In the study we randomly selected respondents to our Understanding America Study (UAS) 50 years or older.
- Respondents were asked to wear a Fitbit Versa and a GENEActiv accelerometer consecutively for eight or nine days each.
  - Wave 1: 8 days each with **one day** overlap when they were wearing both devices.
  - Wave 2: 9 days each with **two days** overlap.
- Two arms:
  - Arm 1: Fitbit first.
  - Arm 2: GENEActive first.

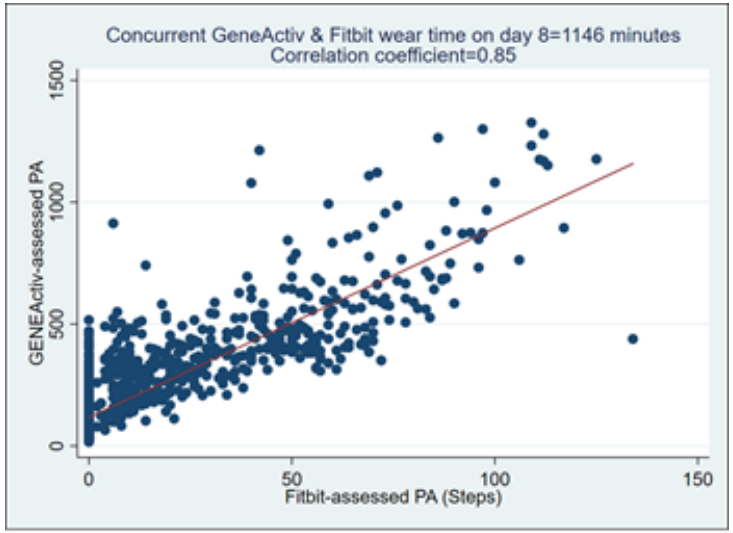
Flow chart

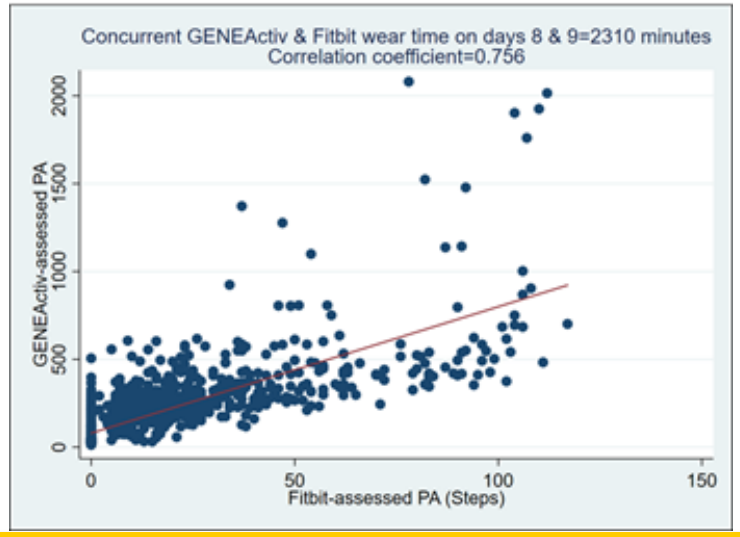

Wave 1
Wave 2
32 Randomized into Arm 1
25 Randomized into Arm 2
31 Randomized into Arm 1
32 Randomized into Arm 2
3 withdrew
1 withdrew
5 withdrew
2 withdrew
8 loss data
4 incomplete data
6 incomplete data
3 incomplete data
7 incomplete data
17 with complete data
18 with complete data
23 with complete data
23 with complete data
81 with complete data

Why do we need overlap of the wear times?

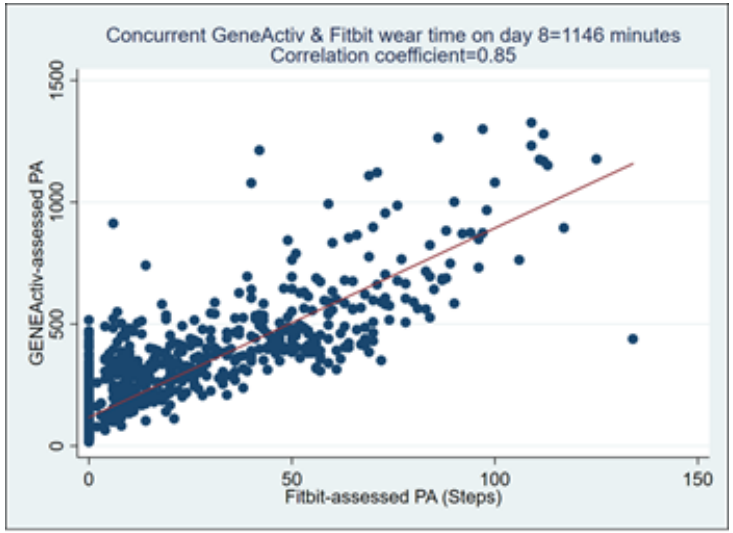
- GENEActive produces raw acceleration, but Fitbit produces steps and heart rate, so we need to calibrate the Fitbit against the GENEActiv.
- For each individual we regress GENEActiv acceleration on Fitbit steps on the day they were wearing both, so that we can predict acceleration from steps on the Fitbit days.

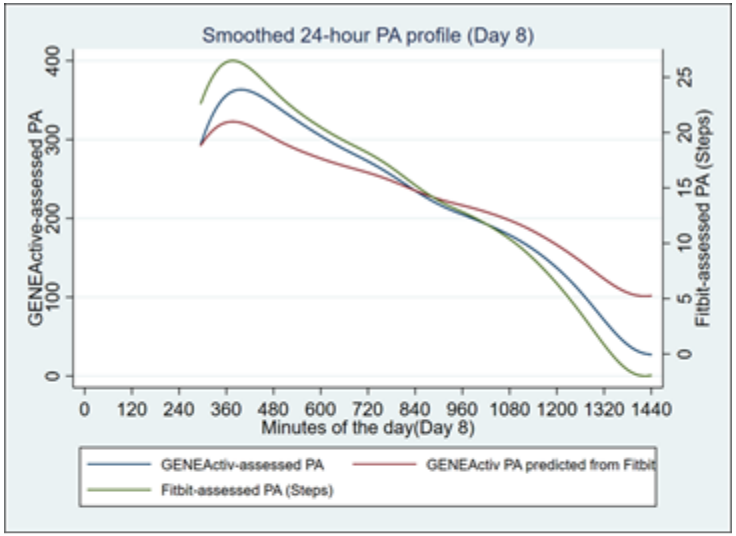
Regressing GENEActiv on Fitbit

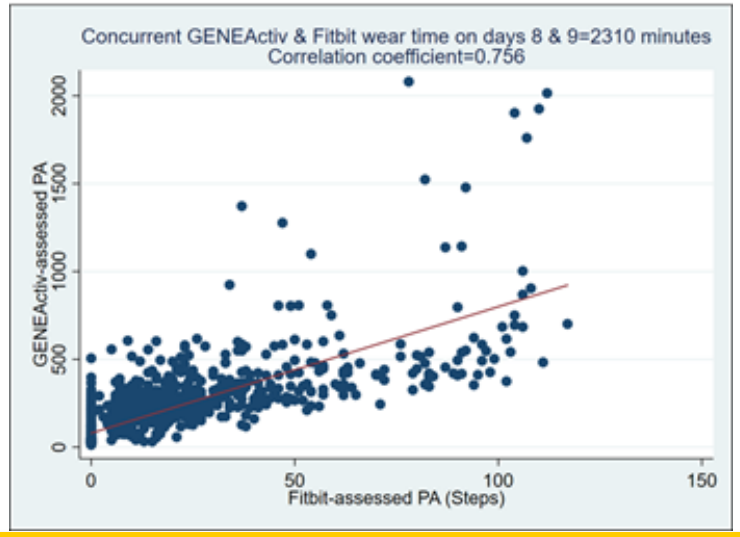


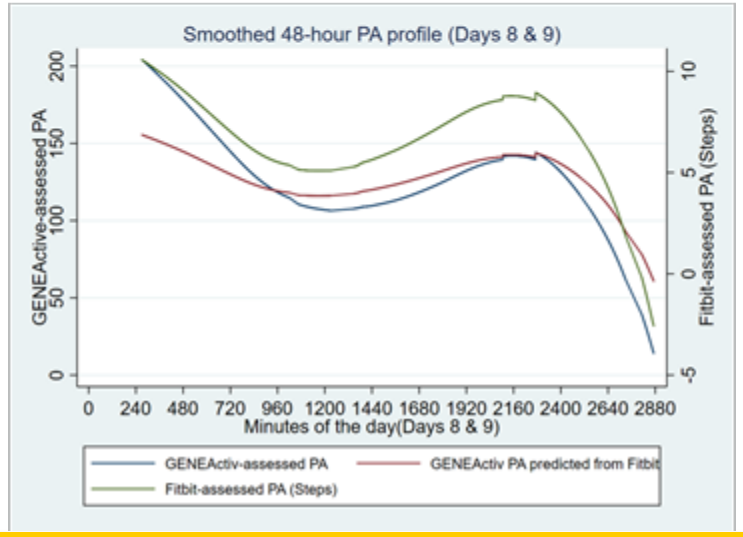


Regressing GENEActiv on Fitbit

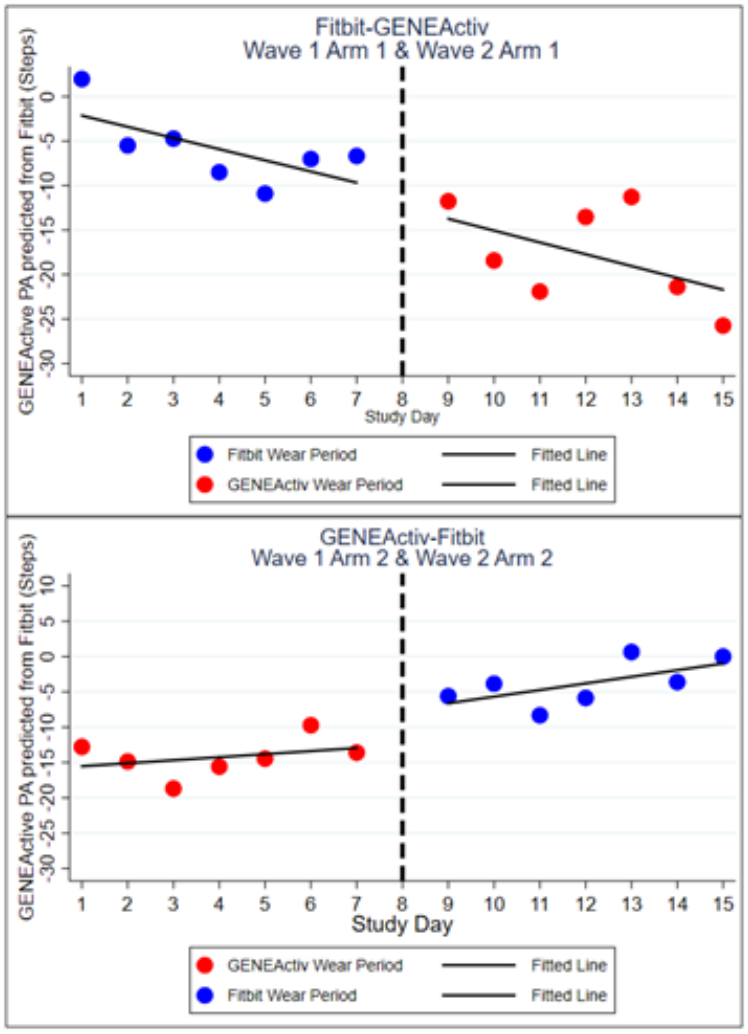








Graphical Analysis of Feedback Effects



Regression Analysis of Feedback Effects

	Daily one-minute interval PA Average				
	1	2	3	4	5
Fitbit wear period	11.953	8.277	8.131	7.44	8.977
(GENEActiv is reference)	[3.071]***	[2.813]***	[2.881]***	[3.007]**	[2.888]***
Participant days (N)	1065	966	891	840	822
R-squared	0.164	0.145	0.147	0.144	0.147
Controls for calendar month, gender, age, education					
Model 1: Full sample.					
Model 2: Wear Fitbit and GENEActiv for at least 1000 minutes/day.					
Model 3: Wear Fitbit and GENEActiv for at least 1200 minutes/day.					
Model 4: Wear Fitbit and GENEActiv for at least 1000 minutes/day for at least 5 days.					
Model 5: Wear Fitbit and GENEActiv for at least 1300 minutes/day.					

Discussion

- Results are robust:
  - Dummies for arms and waves.
  - Allowance for individual random effects.
- The estimated effect size is about 7% of average daily physical activity as measured by GENEActiv, or about 530 steps on a base of 7,560 steps per day.
  - This is in line with findings from a recent meta-analysis by Brickwood, Watson et al. 2019.

Discussion (2)

- From a pure measurement perspective, feedback effects are undesirable.
  - On the other hand increasing PA by 7% without having to conduct labor intensive interventions, is good news.
- However, these are estimated short term effects.
  - Future research should consider longer observation periods.

THANK YOU!