# Physical Activity Research

### with David Conroy

### David Conroy

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In our latest podcast, host [Aaron Wagner](http://methodology.psu.edu/people/awagner) interviews [David Conroy](http://methodology.psu.edu/people/dconroy), professor of kinesiology and human development and family studies at Penn State, and investigator at The Methodology Center. The discussion focuses on David’s research on physical activity and sedentary behavior, how physical activity impacts our lives, and the technological opportunities and methodological challenges of this research. David’s multiple, fascinating projects with other Methodology Center investigators are also discussed.

**Podcast Timeline:**

00:00 – Introduction   
00:45 – Sedentary behavior, active behavior, and your health  
06:51 – David’s background   
08:25 – Staying healthy in a sedentary society  
13:08 – ACT UP interventions to promote activity  
19:25 – Promoting health with smartphones   
24:31 – Methodological issues: Intensive longitudinal data in this research

Speaker 1: The methodology center perspective podcast is brought to you by the methodology center at Penn State, your source for cutting edge research methodology in the social, behavioral and health sciences.

Aaron: Hello and welcome to methodology minutes. I'm your host, Aaron Lagner and our guest today is David Conroy, professor of kinesiology and human development and family studies here at Penn State. He's also an investigator at the methodology center, the father of a newborn baby and a heck of a nice guy. David, welcome.

David: Thanks Aaron.

Aaron: Congratulations on [inaudible 00:00:44] birth.

David: Thanks.

Aaron: First and foremost the question that's burning in all our listeners' minds. Is sitting here going to kill us all?

David: Sitting here won't kill us, but if we always sit and we never get up that will kill us eventually, but time will also kill us eventually.

Aaron: To give context to my poor joke, David does research on physical activity and he recently looked at the impact of sedentary behavior. In fact across your research there is a thread about the benefits of activity and the detriment of inactivity. Is that fair?

David: We're really interested in motivation in my lab. We had started out doing some research a while back, looking at what motivates people to be physically active, because we know that despite national guidelines for how much activity we're supposed to get, most American adults fail to achieve the recommended levels of physical activity.

We found, what I thought was a novel perspective on that problem and we were pursuing it, looking at some of the automatic processes that motivate us and create habits. But along the way we started reading more about the effects of sedentary behavior.

I should probably make the distinction between these two types of behavior at this point. Physical activity is defined in terms of energy expenditure. We can talk about light, moderate or vigorous intensities of activity depending on how much energy you're expending during that activity.

Walking around, standing, those might be light physical activities. If you're walking briskly or jogging we're maybe moving into a more moderate intensity. Then when you're really working hard, going for a run, you're playing singles in tennis, playing squash, you might be looking more at vigorous intensity physical activity.

Sedentary behavior is a separate behavior. Sedentary behavior is defined in terms of people are being in a seated or reclined position with minimal increases in energy expenditure from a resting level. If you're sitting at a desk, working on a computer. If you're sitting in an armchair watching television, if you're sitting on the bus for an extended period of time or on an airplane for a long flight you're being sedentary.

If you're sitting on an exercise bicycle working away, that's not sedentary just because you're sitting. We often measure sedentary behavior in terms of either screen time or minutes of sitting, but the key distinguishing feature is that there's minimal energy expenditure.

what's really interesting is that physical activity and sedentary behavior have additive independent effects on health risk factors. Just because you're getting your exercise in every day doesn't necessarily mean that the amount of time you're spending sitting isn't hurting you or placing you at risk.

This has been a really interesting discovery in recent years and we've now expanded our search in the lab to start looking at factors that motivate people to sit. We're looking at habits in that sense and we're also looking at how you can motivate people to interrupt their sitting time because it's not just the amount of time people spend sitting that creates risk, but it's also the number of times that they interrupt their sitting time.

People who stay seated all day long without getting up at all are at much greater risk than somebody who sits for an equivalent amount of time, but interrupts those bouts of sitting with periodic breaks where they stand up for one or two minutes every half hour.

We're trying to understand how do you motivate people to interrupt their sitting time or limit it. Again, the message isn't that sitting's bad. There's a lot of things that you can do while you're sitting that are very enjoyable that aren't going to kill you, but if you're sitting too much and you're not interrupting it that's increasing health risk and it's an easy target for change.

Aaron: |Briefly just to back up, with the recommended guidelines for physical activity that adults on average are missing. What are those guidelines?

David: There's a couple of components to the guidelines for adults. One is an aerobic activity component. The recommendation is that adults over the course of the week get 115 minutes of moderate intensity physical activity or 75 minutes of vigorous intensity physical activity or some combination of the two.

Basically two minutes of moderate activity equals one minute of vigorous activity. There's also a recommendation for strength training that you work all major muscle groups at least two times a week.

Aaron: That's really not that much for us to reach that target.

David: If you look at it over five days you're looking at 30 minutes of moderate intensity activity each week. There is research even showing that light intensity activity has some health benefits and can confer health benefits if it's used as a substitute for activities you would have otherwise, or for time you would have otherwise been seated.

Even if you can't get to the gym and work out just getting out of your chair and moving around or standing up, using some of those large muscles that you have to use to maintain posture, that's beneficial. We're not designed to sit all day. This is a recent development in the way our environments are created and with what technology has brought to us, but it creates a real problem when it comes to non-communicable disease risk.

There's lots of cardiovascular and metabolic problems that arise. There's even some data, in addition to heart disease and diabetes, there's some data showing that cancers, some cancers anyways may be related to the amount of time people spend sitting.

One of the classic studies is the London doubledecker bus study from the '50s where they showed a difference in all cause mortality between the drivers of the buses and the conductors. Of course, the conductors have to walk up and down stairs and up and down the aisles all day. The drivers are seated.

That kick started the field of physical activity epidemiology, but one of the hidden messages in there is about the dangers of sitting for these drivers. People have tuned into that now and it's really an exciting area of research. It's fun to be working on these problems.

Aaron: Speaking of which, how did you come to this field of research?

David: I started out in college. I was at the University of North Carolina Chapel Hill for my undergrad degree and my master's. I was looking for a focus. I took a class my freshman year on sport psychology. Found it really interesting as a reformed tennis player or a retired tennis player, just a bad tennis player basically is what it was.

I found the class really interesting and I was interested in the topics. I got involved in a lab. I got a research assistant job down the road. went to graduate school in that. Started my career here after i get my PhD at Utah, really focusing on achievement motivation.

There was a point after, somewhere after tenure where I was just looking at different things that I was doing and decided I try to apply some of the ideas that I was interested in with respect to time varying motivational processes, but put them into play in the physical activity world because I kept seeing these snapshots of behavior being taken with physical activity and physical activity motivation.

That didn't resonate very much with my own experience with physical activity motivation. My wife was training exercise psychology. She was able to talk me through some of the obvious mistakes I was going to make. We started doing some research together and now she doesn't want to work with me anymore on that, but we work on raising a family instead.

I am keeping up this new interest in applying my interest in motivation to problems related to physical activity in the sedentary behavior.

Aaron: If people want to [inaudible 00:08:27] their life and longevity what should we be doing? you mentioned simply getting off the couch and you mentioned the limits of the amount of exercise we should be getting per week. What else should we be up to?

David: I'll restrict my comments to physical activity and sedentary behavior. I could give you my broader philosophy as well, but that's probably not appropriate for this. With respect to physical activity, the national guidelines I talked about a moment ago, 115 minutes of moderate, 75 minutes of vigorous activity per week, two days with strengthening all major muscle groups.

for sedentary behavior there are no guidelines. The academy of pediatrics has put out recommendations for limiting children's screen time. The Canadian society of exercise physiology has put out some guidelines for infants up to adolescents, but they've not made guidelines for adults yet.

Part of the reason is that in order to come up with national guidelines you really need a pretty strong evidence. In fact the physical activity guidelines in the US were only published in 2008. They had to have a big process to evaluate the adequacy of the evidence first before coming up with these guidelines.

We're probably a ways away from having official national guidelines on sedentary behavior, but I could tell you what we recommend in our studies and the doses that we're interested in. We know from the population health studies that American adults sit on average 7.7 hours a day. Just about eight hours of the waking day people are sitting. That's a lot of time.

We also know thanks to our friends in epidemiology that sitting more than eight hours a day increases risk significantly relative to people who sit less than four hours a day. I think sitting less than four hours a day is probably an unreasonable target for behavior change.

We focus on trying to get people to sit less than seven to eight hours a day. More importantly, because short term feedback on behavior is really important, we're trying to target the idea of interrupting sedentary time every 30 minutes and take two or three minutes every half hour to stand and walk around, avoid getting trapped in your chairs.

If we were to make a recommendation for sedentary time it would be try to limit total sedentary time in the day to less than seven or eight hours and the less you can be sedentary the better. Make sure you avoid prolonged bouts of sedentary time where you're sitting at the desk without standing up and moving around. We think that every 30 minutes is a good time for people to stretch their legs and move around.

Aaron: My fifth grade teacher with whom I always got in trouble for standing up in class, I was saving my life.

David: It's really interesting. There's some schools now that are experimenting with getting rid of desks. Desks are really functional in classrooms for helping structure some activities. They give you a surface to write on. They serve as holding pens for children who might otherwise wander. Maybe you were that child, I don't know.

As far as what's going on at schools, we've cut out school based physical education dramatically in this country. Kids aren't getting exercise during the day because of time demands, testing demands, and so on. There's a lot of factors that contribute to that.

One of the consequences is that kids aren't functioning optimally from a cognitive perspective. We know that kids who are fit and kids who get physical activity have both short term acute and long term chronic benefits from a cognitive perspective.

When we put kids in desks all day and we cut out recess and we cut out physical education we're making it harder for these kids to pay attention. We're making it harder for them to learn and recall information, store and recall information effectively.

There are some studies now looking at what happens when you take desks out of elementary schools and you have the kids standing more frequently for activities and looking at the cognitive benefits of doing that. It's very early stages in that work, but this is something we can do.

Even if we can't have physical education in schools and we can't have recess in schools because of the other contextual constraints there's no reason we need to be confining kids to chairs and desks all day long. It doesn't mean you have to have everybody standing all day long running around in a madhouse, but bringing in some opportunities to break up all that sitting time could help to enhance some of the learning outcomes for these kids and the cognitive function of these kids.

Aaron: In order to promote some of these healthy behaviors we've been discussing you have been working on a suite of interventions referred to collectively as Act Up, is that correct?

David: That is. Act up is kind of the brand for our different intervention project.

Aaron: Can you tell us a little bit about what you got going on with Act Up.

David: Certainly. Act Up itself has a couple of connotations to it. First the name, activity, getting up out of chairs and also being disruptive, acting up. Looking at intervening in novel or innovative ways where we haven't done before to disrupt habitual behaviors that are really well learned and ingrained patterns in people's lives.

We are trying to develop interventions like that for a variety of populations to both increase physical activity and to reduce sedentary behavior. One of the first studies that got us started along those lines was looking at automatic processes that motivate physical activity and sedentary behavior.

What goes into making a habit for somebody? We have a lot of basic research in our group looking at automatic evaluations of activity. When people think of physical activity do they shrink back or do they get excited for it? Is it a pleasant association?

We found that these automatic evaluations that happen in milliseconds end up predicting behavior over one, two week periods. It's a really amazing finding in my eyes. Now we're working on how do you train people to have more positive associations with physical activity.

We started looking at how do you train people to have more unpleasant associations with sitting, but we found that doesn't work so well. Now we're trying to make standing seem more pleasant to people instantly. That's one of our lines of work in Act Up. Is looking at how do we make physical activity more automatic and how can we make standing more automatic in place of sitting.

Another project that we have underway is a collaboration with a surgical oncologist, doctor Niraj Gusani at Penn State Hershey Cancer Institute. He's the head of the liver, [inaudible 00:15:08] and pancreas program there.

We're working with his patients who have pancreatic and hepataboliary cancers, looking at how we can introduce a stand and walk intervention in the pre-surgery period to help prepare these relatively frail patients for their surgeries and then maintain that behavior to the extent that it's possible in the perioperative period while the patients recover from a pretty major surgical procedure and then following them up for a few weeks after discharge with the intervention as well.

We've just started that. We've got our fourth patient enrolled in the study now. It seems to be going well. We haven't looked at any of the data yet, but we're in the feasibility stage with that kind of work.

This is a group of patients that are really neglected. They have a dire prognosis. The survival rates for pancreatic cancer patients are pretty desperate. We're really excited about the possibility of a lifestyle intervention that's manageable behavior change for them, given their condition, being something that could improve quality of life and maybe prognosis, as well as surgical recovery.

That's another one of our act up interventions, is getting patients to use physical activity and standing to get ready for surgery and recover from it better.

Another project that's going on now is a collaboration with a number of colleagues here at the methodology center where we're looking if physical activity and alcohol use and heavy drinking college students. We've just completed a secondary analysis of some existing data that we have that we had that were intensive longitudinal data on a community sample of adults who for 63 days over three 21 day measurement bursts rated at the end of the day their physical activity and their alcoholic consumption.

We've linked daily physical activity and daily alcohol use. One of the things that's really interesting is that people who are more active tend to drink more alcohol. There are some exceptions to this now where people have been more active and certain doses of activity have produced reductions in alcohol consumption.

What we're trying to do now is figure out how can you reverse that coupling or at least decouple these behaviors so that by increasing one you may not lead to an increase in the other.

Aaron: Are you looking at this across age ranges? Are you looking at this in a collegiate population or among whom?

David: In the secondary data analysis we just completed we had a community sample of adults who ranged from 18 to 89 years old. This pattern held across the whole adult lifespan, which was really remarkable.

In our intervention work though we're going to focus on heavy drinking college students. Heavy drinking, high risk drinking behaviors peak between ages 21 and 25. We're on a college town, we see this here, it becomes a real problem in psychology. Certain times of the year in particular there are some social events, cultural events in town that really bring it to the forefront.

We're interested in how we can hit a couple of student health behaviors that would really enhance their experience and their development, given what is important in their lives. Helping students become physically active has a number of benefits both for immediate health and long term activity trajectories.

Cutting down on high risk drinking during a period where people seem to engage in more of it than any other time in their life seems like it would be a valuable outcome. The things that's really pernicious about alcohol use is the consequences aren't just for the user.

If I'm not active, okay, my health is at risk. Maybe you could say that society will bear some healthcare cost for me if I'm poorly insured. But if i go out and go on a bender and have a few drinks and get behind the wheel of a car I've placed everybody else at risk.

It really seems important to figure out how we can get a handle on that, especially living in a small town where the majority of the people are in that 21 to 25 age group. Not that they're all heavy drinkers or high risk drinkers, but it only takes one to change a family's life forever.

Aaron: Absolutely. You're doing a study with smartphones to promote activity. Is that correct also?

David: Yeah. We're trying to take advantage of some of this new technology. Very often people point at Tvs and computers as the enemy. These keep us in our chairs. These keep us from being active, but they're part of our lives and we might as well figure out how to use them.

We are using some of this technology to try to deliver interventions now. This is part of a broader international movement called mobile health. What we're doing is setting up interventions using a variety of different behavior change techniques that can be delivered and disseminated through phones or tablets.

Basically making it easier for us to get to people where they live instead of requiring them to come to us or to have highly specialized well trained providers in the field. Interventions that require personnel are much less likely to get disseminated broadly and there's a lot of people that live in parts of the country that are very rural, like central Pennsylvania who may not have access to those kinds of providers.

We want to take advantage of these technological advances to increase the reach of our interventions, but the big question is will they work as well. We know that we can increase physical activity with supervised exercise programs. We also know the government's not going to pay for everyone to be enrolled in a supervised exercise program.

People do pay for their own smartphones though. If we could find ways to use this technology effectively it could be really valuable. A reason report came out in October from a private company that there are over 40,000 healthcare related apps on the market right now.

The Pew Internet and American Life Project has been looking at mobile health pretty carefully for a few years now and tracking how people use smartphones and tablets more recently. With smartphones they find that approximately one in five people have downloaded a health related app.

That was as of 2012, so those data are now outdated. It probably is even greater proportion. The most common app that people download when they've downloaded these apps involves exercise. 38% of the health related apps that get downloaded are for exercise.

Now, when you look at that you think "Wow, this is great. People are using technology to change their behavior" but we have very few studies out there examining whether those apps do a darn thing to change behavior.

In fact, in a recent study we did we audited how the apps are described, the top selling apps in the iTune store as well as in Google Play. We found that there are relatively few behavior change techniques described in the marketing materials for these apps.

We're now, we've bought a bunch of the apps and we're actually auditing the contents of them to see which behavior change techniques are in there. I don't suspect the results will be very different, but the fact of the matter is we don't know if these apps work and it appears that they're designed around user concern, usability functions, rather than around behavior change techniques that should actually support increases in activity.

THere's a gap out there and there's a real danger that mobile health is going to be more hype than anything else if we don't applying some rigorous scientific methods to evaluate how it's being used and improve its efficacy for a change in health behaviors.

Aaron: Toward that end, you're working with a team that has developed an app promoting activity. Correct?

David: Yeah. We're actually using apps in a couple of our projects now. We've developed apps for our Automaticity project in collaboration with colleagues at the Center for Healthy Aging. I'm also working with a group of folks who have pretty close ties to the Methodology center. Constantino Lagoya from electrical engineering, Stephanie Menza from the Methodology center and Josh Smite from bio behavioral health.

We just got some seed funding to apply control systems engineering techniques to develop a text based intervention system for increasing physical activity and decreasing sedentary behavior. We've been applying to NS staff and their smart health initiative for funding and this is really going to be helpful for us in getting some of the preliminary data that we need to show that we're capable of doing this kind of work.

The goal of that project is to develop tailored interventions based on people's past data. We would know which messages you've responded to individually and be able to select the optimal sequence of future messages for you based on your past behavior and your recent behavior.

This is really, really fascinating work to me, the idea that we can apply some of these engineering principles to create more effective, more efficient, more intelligent behavior change interventions that will be more likely to be helpful in changing behavior. That's a really exciting project. I'm looking forward to getting deeper into it.

Aaron: Even though you're in the preliminary stages what are some of the challenges and opportunities related to working with this sort of data?

David: That's a really good questions. I may not be the best person to ask about that, but from my perspective one of the things that's really going to be interesting to deal with is the volume of data. We're not going to collect data on many people yet, but we're going to collect a lot of data on each person.

The activity monitors that we use sample data at 20 hertz. 20 times a second we're going to get motion and posture data on people. If you're collecting data over a six month period or four month period that fills up a lot of memory on the drive.

Not only do we need to find ways to store it, but we need to manage that and make sense out of it and figure out what the right level of aggregation is for that data. In the physical activity world if you remember from earlier in our conversation, one of my impressions early on was that we lost a lot of information just by aggregating up to the level of the person.

You'd say there's a more active person and a less active person. With our approach we're really trying to capture the dynamics of physical activity, recognizing that there are perhaps more and less active people, but there are also more and less active moments within every day. There are more and less active days within every week. More or less active weeks within every year and so on.

We want to capture the ebb and flow of physical activity and how that ebb and flow shifts in response to our little experimental manipulations when we send text messages out. It's really interesting thinking about ideas related to how instantly you would expect somebody to respond to one of these messages.

Whether there might potentially be some messages that lead to more instant effects and others that have longer latency before they change behaviors. Whether the sequencing of messages makes a difference and different sequences could be more effective for different types of people.

We're getting into some really interesting types of questions that people haven't really been addressing in a systematic way to date. I think it's going to be really fun to work on that.

Aaron: It's a thumb for us because as you describe these things, it just maps so neatly onto so much of the research that's going on here.

David: This is where the pilot program at the Methodology Center's been so valuable for me. Initially I'd approached Lynda about working together on this Automaticity project. That spun into our grant proposal, but more importantly it spun into the alcohol project.

By coming to the center more frequently to participate in brown bags and business meetings I got to connect with Constantino who I knew from faculty senate, but didn't know from research. Through that interaction he invited me to be part of a project he had been talking about with Stephanie and Josh.

It's really been a wonderful opportunity to expand beyond my initial interests in working with Linda at the center, but connecting with Donna Coffman, looking at how causal influence methods could be applied to some of our questions, working with Stephanie, looking at these issues that I've just talked about with the control systems engineering. Then my initial interest in optimizing of behavioral intervention.

Aaron: David, it's been a real pleasure talking to you. Thank you very much for your time.

David: Thank you very much.