# Ambulatory Assessment with Michael Russell

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Aaron Wagner: Methodology Minutes is brought to you by the Methodology Center at Penn State. Hi, everyone. I'm your host Darren Wagner. With me today is Methodology Center research associate Mike Russell. Mike has been at the Methodology Center since 2014, first as a postdoctoral researcher and now as a research associate. He's going to talk to us about his interest in the analysis of intensive longitudinal data, particularly ambulatory assessments. Mike, thanks for being here.

Mike Russell: Thank you for having me.

Aaron Wagner: To get started, can you tell us how you developed an interest in methods and methodology?

Mike Russell: Yeah, sure. Well, my interest in methods sort of came about quite naturally. I was trained in development and psychopathology, so you're really looking at how mental disorders develop in children over time, and comparing maladaptive trajectories to normative developmental trajectories. We were always dealing with longitudinal data, we were always dealing with complexity in terms of family effects, children-driven effects, neighborhood effects, etcetera, etcetera. In order to really answer any of the questions that I wanted to answer I needed to learn something about methods, and that's how I got there.

Aaron Wagner: Walk us through your timeline. Did this start as an undergrad, as a grad student, where?

Mike Russell: It started when I was an undergrad. I actually was lucky enough to work in a research lab that was doing this kind of ambulatory assessment stuff way before it was popular.

Aaron Wagner: Yeah, that's cool.

Mike Russell: This was back in I'd say 2005, 2006, and I worked with professor Carol Whalen at UC Irvine. She was doing some really interesting work that was looking at children with ADHD and their parents, and their interactions throughout the day. They had kids with ADHD who were medicated and then kids who did not have ADHD, and sort of looking at the parent-child interactions using, I think we used PDA devices at the time. We sampled them every 20 minutes outside of work and school to sort of understand, even among kids who were medicated for ADHD, what were still sort of the problems that they were facing, like what were the situations where they tended to act out, what were the situations that tended to stress Mom or Dad, etcetera. It was learn interesting, intensive longitudinal data then. I did a lot of groundwork with that, organizing the study, managing the data and things like that, and so I naturally started to think along those lines.

Then when I went to graduate school, I got more interested in what I like to call now traditional longitudinal data, where we sort of look at developmental trajectories over years. We did a lot of work looking at the development of antisocial behavior in low-income neighborhoods, and using things like latent growth modeling to do that. I also got really interested in growth mixture modeling, something that's happening here at the center, where we look at latent classes of growth trajectories, things like that.

Aaron Wagner: Great. That brings us up towards now. Currently my understanding is that your research focuses on understanding the causes and consequences of substance use by using ambulatory assessments. Is that right?

Mike Russell: That's right. One thing I didn't mention is I started to get, again more into ambulatory assessments during graduate school, and ever since then I've sort of been all about ambulatory assessment.

Aaron Wagner: What is an ambulatory assessment?

Mike Russell: Yeah, great question. So an ambulatory assessment is, it's a family of methods that tries to get into a person's daily life and understand things as they happen. Ambulatory I think comes from a word for walking, and so we're trying to get methods that are sort of walking along with you. Traditional methods that have done this sort of thing have been like daily diaries, where we ask you to fill out a diary, either on paper or on a computer; ecological momentary assessment, where we have you carry around a phone and complete mobile phone surveys at multiple points throughout your day; and now we're starting to see a lot of sensors that can be put on people like Fitbits, to get heart rate, etcetera, etcetera. Just sort of methods that are designed to get into your daily life and understand things as they happen.

Aaron Wagner: Specifically, what sort of ambulatory assessments have you been analyzing or collecting?

Mike Russell: The majority of what I've done has either been daily diary or ecological momentary assessment. All of those methods rely on self-report, and they're great because when you ask somebody to recall something that has happened, if you ask them to do it over a year, their recall is not going to be as accurate as if you ask them to do it over six months, right?

Aaron Wagner: Sure.

Mike Russell: We're sort of really capitalizing on that fact, and so we asked people in the last day or even in the last few years, "What has happened? How have you been feeling? Who are you with? What are you doing?" Sort of trying to limit that recall bias as much as possible. That's mainly what I've been working on. Now, I'm starting to move into this realm of ambulatory sensors and sort of pairing some self-reports with ambulatory sensors.

Aaron Wagner: Give us some details about one of those studies if you would.

Mike Russell: Okay, so yeah, I've been working on what I'm calling the alcohol habits study. What the alcohol habits study is, is we're having young adults come in and wear an alcohol monitoring device that goes on the ankle. This is a device that uses fuel cell technology to infer your blood alcohol concentration from your sweat.

Aaron Wagner: Is this like what somebody would wear if they were on a house arrest, that sort of thing?

Mike Russell: It looks a lot like that, yes. It doesn't do the same thing that the house arrest band does. The house arrest band is based on GPS and so it knows if you've left the general vicinity of where you're supposed to be. The alcohol anklet relies on the fact that every time you drink, 1% of the alcohol that you drink gets expelled through your skin, and it gets expelled through something called insensible perspiration, so it's sweat that you don't necessarily sense. What the device does is it uses fuel cell technology to infer the amount of alcohol that's in your blood through your insensible perspiration, and the measure that it gets from that is called transdermal alcohol concentration, which is a direct analog to BAC. We call it TAC for short. A .08 TAC is at the legal limit, above .08 is above the legal limit, etcetera.

We've designed this study to address a kind of perplexing problem head on, and that is what you have someone fill out ecological momentary assessments about their drinking and you have them do it as they're drinking, this really kind of funny problem starts to happen, where the more a person drinks the less accurate their reports are going to become. But we don't really know how inaccurate their reports become or when they start to become inaccurate. One of the things that we're doing is pairing their self-reports with this device to sort of determine where and when that happens.

Aaron Wagner: People are wearing the bracelet and they're also self-reporting. How are they doing that?

Mike Russell: Yeah, great question. We have them do three surveys throughout the day. We have them do one in the morning, just to sort of check in, get their general mood, what's been happening, who have they been hanging out with. We do an update in the afternoon, and then we do one in the evening, which sort of gives a retrospective throughout the day. We also ask them to initiate a survey when they've started drinking. What we tell them, as soon as you have the first sip, initiate one of these drinking surveys.

Aaron Wagner: You're gathering that data on a smartphone?

Mike Russell: Yes, we are.

Aaron Wagner: Okay.

Mike Russell: Once they initiate that survey, we ask them every half an hour after that point, "How much have you had in the last half an hour? How's your mood generally? Who are you with? Where are you?" etcetera. The goal is to link up those self-report assessments with the frequency of the anklet assessments, which are also about every half an hour, in order to really understand when self-report starts to drop off.

Aaron Wagner: Yeah, and I would imagine that as someone researching alcohol you'd be more interested in problem drinking, so you're most interested in the data that is currently the least accurate, right?

Mike Russell: That's absolutely correct. I think I'm not the only one. I think many alcohol researchers who study alcohol are interested in problem drinking, and that is specifically when the problem arises.

Aaron Wagner: Yeah. What are some of the issues that come up as you're doing this? What's the challenge, I guess?

Mike Russell: Well, there are quite a few challenges, one of which is designing a survey that can be filled out repeatedly without much resentment on the part of the participant. Because the thing that is often not really talked about, or it's talked about, but I think it's not really appreciated fully, is that ambulatory assessments are burdensome and they're intrusive. It would be better to be able to observe a person just from a strictly scientific standpoint, just to be a fly on the wall and observe them, which is essentially what we're trying to do in EMA, but when we do that, when we prompt them for questions we're always interrupting what they're doing. What the challenge has been is, if we want to assess somebody in a drinking episode and we want to do it numerous times, we need to come up with a survey that's easy to use, that's quick, that minimizes that burden as much as possible. Because when you're out with your friends having a beer you don't want to be filling out the survey again and again, and we appreciate that and we try to limit our intrusion as much as possible.

Other issues are the device itself. I do get concerned that people won't want to wear it because it looks like one of those house arrest bands. I'm actually afraid that people being part of the study will wear the device, try to go to a bar and not be able to get in because of the device. There are a number of challenges that we have to work through in terms of the participant experience, not to mention a lot of the ethical considerations that also come into play.

Aaron Wagner: What about any methodological considerations, anything there that has you scratching your head?

Mike Russell: Well, yes. There are a few things that are really tricky about this. One from a more practical standpoint is, the device, because it works on the fact that your body is eliminating alcohol, it doesn't pick up a non-zero TAC, right. It doesn't pick it up right away, so it has to actually be processed by your system, so there is a delay from when you were actually .08 to when the device says that you're .08.

Aaron Wagner: If I were to be wearing one of the devices and to take a breathalyzer, we wouldn't expect direct correspondence between the two measurements, is that correct?

Mike Russell: We would not expect it at the same time.

Aaron Wagner: That's what I mean, simultaneous, yeah.

Mike Russell: Yes. We would expect the correct correspondence-

Aaron Wagner: The courage to be exactly the same shade.

Mike Russell: Yeah, exactly, once we've figured out what the delay time was. The thing that's tricky about it is, it's probably going to differ from person to person. As a matter of fact, from our preliminary tests we know that. And it's probably going to differ from occasion to occasion within that same person. We have real challenges in sort of determining what the lag is for each episode. Our solution so far has been to have participants, like I said, immediately, as soon as they take that first sip, to tell us that they've started, on the phone. What that does is it gives us a time stamp for when the drinking episode started, and then we can take the difference between that time stamp and the first non-zero TAC, and that's the lag for that episode. It's admittedly imperfect, because we won't know exactly how long it took to get through the system, because the device might not prompt at the exact moment, but it's a close enough proxy.

Analytically there are also a number of challenges. One of them is that one of the things that we're also interested in doing with this study is identifying which drinking episodes lead to problems. Not every drinking episode is going to result in problematic outcomes, like you got in an argument with somebody, you got arrested, you got sick, you got a hangover. We want to be able to identify from the alcohol concentration curves which drinking episodes will result in one or more drinking consequences. That requires us to model the alcohol function for each episode, and then use that function as a predictor of the outcome.

When I'm talking about modeling a function, what I mean is we're interested in the characteristics of the alcohol episode as recorded by intoxication. For example, we want to know perhaps the maximum level that the person achieved; that's a potential predictor of consequences. But it might also be the speed at which they got to that maximum point that's important. It might be how long it takes the alcohol to decay from the system. There are a number of functional parameters that you can only get from this type of longitudinal curve, and understanding what those parameters are and how to model it is going to be a challenge.

Aaron Wagner: Yeah, and especially if you want to map those things onto sense of well-being, anxiety, negative affect, things like that as well.

Mike Russell: That's right.

Aaron Wagner: That's a steep hill to climb. Good luck.

Mike Russell: Thank you.

Aaron Wagner: What do you think the implication of internal review board and data collection challenges are for researchers as data collection technology evolves, and protections of research subject data become more complex than ever before?

Mike Russell: Well, one of the things I just mentioned, because a lot of this research is interested in using cutting-edge technology to get at these ambulatory assessments, to monitor biometric parameters, things like that, there needs to be discussion about how researchers at universities versus third party vendors manage these situations and how we manage the interaction between the two, and do it in a way that's productive for all parties involved, while also protecting the identities of the people who allow us to do research with them.

I think another challenge is that technology moves so fast that what we say is cutting-edge now will not be cutting-edge in six months.

Aaron Wagner: You mean those PDAs from 10 years ago are no longer cutting-edge?

Mike Russell: You got it, yes, that's absolutely right, yeah. As a matter of fact, the devices that we will use for the alcohol study, there's something that's going to be coming out in the next few months I think, or something that we're actually on the waiting list to get, and it won a mobile app challenge with NIAAA. It's something called the BACtrack, the B-A-C-track, and it's actually an alcohol monitor that looks like a Fitbit. We're really excited about potentially using that product when it hits the market. Like I said, these things are constantly evolving, so by the time we get out into the field and we collect data with the SCRAM device, which is a fantastic device and is well-validated, there will be something else that comes along that might be easier for participants to use than this SCRAM device. We won't really know until we do it. Things are constantly evolving, constantly changing, and I think that's a challenge for research.

Aaron Wagner: Yeah, absolutely. Over the next several years, what do you see as the changes on the horizon in data collection and analysis in the social health and behavioral sciences?

Mike Russell: Yeah, that's a great question. I think there are a few things. I think one is optimizing the experience for participants in these studies. What I mean by that is EMAs that are more seamlessly integrated into their daily flow, I think smaller, wearable devices that the participant doesn't notice as much.

I think another thing is closer integration of these devices, perhaps devices that can talk to each other in some way. For example, if we want to sense moments when you're stressed, we could use device data, we could use some sort of electrodermal activity, we could use heart rate, we could use stress triggers that you've mentioned in your diary, and then maybe predict those moments when you are about to feel stressed out, or maybe rather than that just identify those moments empirically and then start to think about what I think is the third potential innovation.

Research is actually happening in this area right now, but I think it's a huge area that will show a lot of potential moving forward, is mobile intervention. I think, especially when you think about adolescents and young adults, these individuals carry these devices in their day-to-day lives, and P reports showed that most every adolescent and young adult has one of these devices. It's the technology through which people are increasingly experiencing the world. Being able to deliver intervention services at moments when people need them, through these devices through which they're increasingly seeing the world, I think has tremendous potential for health and human development.

Aaron Wagner: When you talk about these devices, you're talking about their phones, right?

Mike Russell: Yes, exactly. Yes. Smartphones, tablets, etcetera.

Aaron Wagner: Uh-huh, yeah. Thanks, Mike.

Mike Russell: Thank you for having me.

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