‘It can be done, don’t be scared’- An interview with Dr. Mara Mather, invited speaker at the 2019 SPR Annual Meeting
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At this year’s meeting, I had the opportunity to chat with Dr. Mara Mather (https://gero.usc.edu/faculty/mather/) after her amazing invited address entitled, Can We Improve Brain Mechanisms of Emotion Regulation by Increasing Heart Rate Variability? Dr. Mather is a professor of gerontology and psychology at the University of Southern California. Her research focuses on emotion, cognition, and aging with particular application to how these processes affect memory and stress. In our discussion, Dr. Mather shared her thoughts on HRV methods, coordinating collaborations, and pursuing psychophysiological research.

Kaylin: For those of us less familiar with electrocardiogram, heart rate variability (HRV) can seem like a little bit of a black box—particularly in terms of all the different ways that you can operationalize this indicator. I loved the beginning of your talk where you illustrated these different operationalizations of HRV for us. If you wouldn't mind, tell me more about Why HRV? And then how you go about picking which specific measure of HRV you are going to use for particular applications?

Mara: I think that HRV is really fascinating because it is such a powerful individual difference to measure. There are literally thousands of studies about HRV. Whatever you are interested in studying, you will probably find some interesting relationships with this indicator. In terms of which measure of HRV, the vagal components of it—those that are high frequency, typically—they go with your breathing and reflect parasympathetic nervous system and are healthy. In contrast, you also have lower frequency fluctuations that are thought to reflect the sympathetic system and are more related to stress or high arousal. So it has traditionally been thought that it is the high frequency fluctuations that are most beneficial. But you can control your own breathing and move its influence from the high frequency to the low frequency domain by slowing it down. Interestingly, when you slow it down to around ten seconds per breath or .1 Hz, you can get quite large oscillations in heart rate. So you can have this impact on your own parasympathetic system by influencing your breathing. And there are many exercises and religious traditions that use this, like yoga or even chanting the Rosary, that have ten-second rhythms that then alter your heart rate oscillations.

Kaylin I didn’t put it together previously.

Mara Yes, so it seems that different traditions have found the sweet spot for creating very high oscillations in heart rate by moving your breathing to be at the same rate as your blood pressure baroreflex.

Kaylin Building then on this traditional technique, you actually designed an intervention study leveraging current biofeedback techniques. I particularly enjoyed seeing the process of this intervention boiled down—you are training people to find a certain rhythm of
breathing. Can you tell us what the process was for you in setting up this intervention study using biofeedback alongside an active control intervention?

**Mara** I had never done an intervention study before. We've done a lot of laboratory studies, and so this project was a brand new game for us. At the start, I was very concerned about having the right comparison group. Particularly because of what we talked about—if you tell people to relax, they naturally tend to get to the breathing rhythm that we are interested in targeting. Not everyone, but most people would slow down breathing and then show higher amplitude oscillations. To create an active control then, I looked through the literature and I was trying to find an intervention other studies have used. For instance, could we have people participate in a paced breathing exercise that instructs breathing at their normal pace? But this exercise presents challenges as a control condition because it would still increase the power at that frequency because it would be so regular. I didn't want to be comparing something that is a little bit beneficial to something that's more beneficial; I wanted something that would maximize the difference. And so we created a novel comparison condition.

It involved a lot of thought, planning, and innovation to create an active control condition that did not result in participants influencing heart rate oscillations. My colleagues and I took about a year after we got funding to settle on this condition. Initially, my colleagues were not enthusiastic about the idea I had to give the comparison group the opposite type of feedback—that is, one group got biofeedback to increase heart rate oscillations whereas the other group got biofeedback to decrease heart rate oscillations—but to me it seemed like the clearest comparison: something that is equivalently difficult and takes the same amount of time. Ultimately, the results came out really well in my estimation. I was worried about whether the decrease-oscillation subjects might feel worse, but they also reported feeling better. They did not experience the same improvement in HRV or emotion regulation brain regions, but we are not hurting their subjective well-being, and in fact we did not actually change their heart rate either. Thus, the decrease-oscillation intervention is not doing anything dramatic to heart rate oscillations, whereas the increase-oscillation intervention stimulates quite large oscillations in heart rate during the biofeedback sessions.

To carry out this intervention study with over 100 participants required other types of planning, too. We were concerned that the participants actually did the daily practice we asked them to do, for example. So we scheduled reminders in an app designed for the study. This app also gave them rewards for completing exercises and behavior-specific positive feedback. It was an integrated system that was meant to maximize the impact of what we were trying to do.

**Kaylin** An app created custom for your project, amazing!

One of the things that was incredibly striking about your results—I'm sure you have a lot of thoughts on this—is the gray matter changes you found after only five weeks of the intervention. At the outset of the study, did you have any predictions about how quickly these changes could occur?

**Mara** We had no previous studies allowing us to predict what the intervention would do in five weeks to the structure of the brain. We based our intervention on the behavioral biofeedback studies that have been done using around 5 weeks of daily practice. From these studies, we found that you can produce changes in this time in terms of feelings and behaviors. We based our intervention on what others using biofeedback had done. We still don't know many critical details about the brain changes we found—I mean it could be that all these effects happened in Week 1 of our study, for example, since we only assessed at pre/post and not throughout.
Kaylin What a springboard for a follow-up study, right!? I would imagine that this was quite a large collaboration. Do you have any advice for me and the SPR readers on how to establish such a strong collaboration?

Mara I learned from being part of other large collaborations, as a peripheral member, that it is really helpful to get people together in person. So we had an Investigator meeting when we were planning the study. I allocated money for this that wasn't from the grant. Three or four of the collaborators were from other places and we flew them into L.A. to start up the project and also a couple of times when we were looking at the results. We also had Skype meetings. It's interesting because it helped not only in terms of getting advice, but these meetings more importantly served as internal deadlines for my team.

Also an amazing help to carrying out this large project was the research professor in my lab, Dr. Kaoru Nashiro. She was interested in leading this project and it was a big project—it required a lot of people. She turned out to be brilliant at figuring out how to organize everything and how to manage it. She had graduate students who were involved, each leading a piece of the project, and then most of them actually had a small team of undergraduates. In addition, running the participants was quite a job too. There were behavioral sessions and scanning sessions and we had to put together our entire schedule for data collection at the outset of the study. We had to make sure the timing was right for the intervention as well as utilizing the university scanner and all of the individual pieces of equipment that are involved.

Kaylin I know we are getting short on time—could I just get your thoughts on one more thing? What advice do you have for people that are interested in using multiple physiological measures like you did in this study so beautifully?

Mara I would say get lots of advice and do lots of reading and dive in! You know, don't be scared.

Kaylin I love it! Just go for it.

Mara I mean I've been doing this all my scientific life. It's just like, 'Oh that's cool. I'll give it a try.' And it's not always me leading it, but I get someone in my lab interested and excited and they'll figure it out, with help from colleagues who are experts in that domain. You know, it can be done. Don't be scared.

Kaylin Thank you so much for meeting with me. I am very excited to follow up on your work—you are working on and presenting on such interesting studies!