# New Book on MOST With Linda Collins

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Aaron Wagner:

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Aaron Wagner:

Welcome to Methodology Minutes. I'm Aaron Wagner. With me today to talk about optimizing interventions is Linda Collins. Linda is the director of the Methodology Center, distinguished professor of human development and family studies, and professor of statistics at Penn State. She is the primary force behind the development of the multi-phase optimization strategy MOST. MOST is a framework for optimizing behavioral, biobehavioral and biomedical interventions. If you're unclear what that means, stick around and we'll explain. She's the author of a new book from Springer, Optimization of Behavioral, Biobehavioral and Biomedical Interventions, The Multi-Phase Optimization Strategy, MOST. Linda, welcome.

Linda Collins:

Thank you. It's great to be here.

Aaron Wagner:

So Linda, what is the problem with the status quo in intervention design?

Linda Collins:

I see three main problems with the status quo. One is that intervention science is making relatively little progress toward accumulating a coherent base of scientific knowledge. We have identified a number of programs that work, and we know that they work as a package, but we don't really know what the active ingredients of those packages are. A second problem is that in my view there hasn't been sufficient emphasis on steady, programmatic, incremental and measurable improvement of interventions. People are developing interventions, and one intervention might be developed to solve or address a particular health problem, and then another intervention might be developed, but there's no sense that the second intervention has to be measurably better than the first one. And people spend their whole careers improving interventions without empirically demonstrating that there's been a measurable improvement.

Linda Collins:

The third problem I would say is that, and this is really kind of heartbreaking, many evidence based interventions never go to scale. A lot of interventions are developed in academia and they never end up being used in the intended environments. And it's because when we develop interventions in academia, we really don't pay any attention to their expense, their length, their complexity or how demanding they are for intervention participants. And those things end up being deal-breakers later. And what's even worse, I think is that many evidence based interventions may end up being implemented, but ad hoc modifications are made to them. And then once it ad hoc modification is made, because we don't know what the active ingredients and interventions are, what ends up being taken out may have been the thing that made the intervention show an effect in the evaluation. So that I think is a very serious problem that academia is not being held accountable for the scalability.

Aaron Wagner:

Yeah. And just all that wasted potential in those great interventions that are never brought to bear.

Linda Collins:

A lot of wasted potential. Yes.

Aaron Wagner:

Could you give us a little more information about what MOST is and how it addresses the problem as you just defined it?

Linda Collins:

Well, as you said when you were introducing me, MOST is a framework for development optimization and evaluation of interventions. I would add that it's an engineering inspired framework. I don't like to say that it's engineering based because I'm not an engineer, but I certainly have drawn a lot of ideas from engineering. Some people might say, what does engineering have to do with the behavioral sciences? Actually, I would say that a lot of the methods that engineers use to develop products and systems are quite applicable in the behavioral sciences. They can't necessarily be taken and immediately applied, but with a little thought they can be adapted for use in the behavioral sciences. So MOST is definitely an engineering inspired framework.

Linda Collins:

And one important feature of MOST is that behavioral scientists and biomedical scientists can use MOST to engineer an intervention to meet a specific criterion that the intervention scientist determines head of time. For example, a behavioral scientist or a biobehavioral or biomedical scientists might want to develop an intervention and might know that that intervention in order to be scalable cannot cost any more than say $500 a person to implement. MOST is a framework that enables the scientist to engineer the most effective intervention that can be obtained given the components that are on the table for no more than a $500 a person in implementation costs.

Aaron Wagner:

Thanks. So, you and I have both said that MOST is a framework for optimization. What is optimization?

Linda Collins:

Here I'm just going to a quote from my book, optimization of an intervention is the process of identifying an intervention that provides the best expected outcome obtainable within key constraints imposed by the need for efficiency, economy and or scalability. Let's take that apart a little bit. Note that optimization is not about obtaining the best in some absolute sense, it's about obtaining the best expected outcome that you can get subject to realistic constraints. Optimization is the idea that you can't have what's best, but you can have what's best within whatever constraints are operating in the situation you're working in, which is a very worthy objective in my view.

Linda Collins:

I talked about efficiency, economy and scalability. Let me define each of those. Efficiency is the degree to which an intervention produces a good outcome, but also avoids wasting money, time or whatever the valuable resources are. Economy is closely related but a little different. It's the degree to which an intervention produces a good outcome without exceeding whatever the budgetary constraints are, like that $500 person limit in implementation costs that I talked about a moment ago. And scalability is defined as the degree to which the intervention can be implemented widely in real world settings, exactly in the form in which it was evaluated with no need for ad hoc modifications that are imposed by the situation. So if an intervention is scalable, there's no need to change it once you start to implement it.

Aaron Wagner:

So it sounds like optimization allows you to not just hunt for a P value, but really to develop something that you have great reason to believe will work in the real world as we know it.

Linda Collins:

Yes. Although that P value is important too as we'll get to in a moment.

Aaron Wagner:

So MOST, as I understand it, is broken up into distinct phases. Could you explain what those phases are?

Linda Collins:

Yes. MOST has three phases. The first phase is preparation, in which the groundwork is laid for optimization. The second phase is optimization, in which an experiment is done, experiment of some kind is done to gather the information that is needed to optimize the information, and then that information is used to identify the optimized intervention. And the final phase is evaluation, in which the effectiveness of the optimized intervention is established by means of a standard randomized controlled trial.

Aaron Wagner:

Okay. To help us unpack that a little bit, could you use an example and explain to us the preparation phase of MOST?

Linda Collins:

There are quite a few published examples now. I'm going to take one from Pellegrini Andall, which is published in contemporary clinical trials in 2014, and also there was an errata. This was the development of an intervention to help overweight adults to lose weight. In the preparation phase of MOST, as I said before, this is where you lay the groundwork for optimization. One important activity here is deriving a conceptual model. The purpose of the conceptual model is to express the process that you are hoping to intervene on, and then to show how the components that you are planning to test, that is to say the intervention components that you are planning to test, are hypothesized to effect this model. There's a figure in Pellegrini Andall that shows this. It shows that there was a core intervention that we weren't testing because that core intervention has already been shown to be effective.

Linda Collins:

The core intervention includes education about the standard things, about weight loss and you have to control the intake in terms of calories, and you also need to make sure you're expending calories. Goal setting, which is important in weight loss, and then self-monitoring. We wanted to experiment with several components that we thought would also improve weight loss. They were sessions with a coach, text messages, communication with the individual's primary care physician, buddy training. Everybody had to identify a buddy, but not all the buddies were trained in our study. And recommendations for incorporating meal replacements into one's eating plan. The conceptual model shows that these components were expected to impact several social cognitive mechanisms. Self-efficacy, self-regulation, supportive accountability and facilitation. These all were expected to improve adherence to a diet and exercise regimen, and then the result we hypothesized would be weight loss.

Linda Collins:

So, this is an example of a conceptual model and also identification of a set of candidate intervention components. I call them candidate components because they are candidates for inclusion in the intervention. During the preparation phase, one would conduct any pilot tests that would be necessary, and I always recommend pilot testing the components. The purpose of a pilot test is to make sure that you can implement the components the way you expect that you can, that subjects react to them in a reasonable way. There's nothing unexpected, that sort of thing that any pilot test would show. And another activity in the preparation phase is identification of the optimization criteria. The optimization criterion is extremely important in the next phase, optimization. The optimization criterion, well you've already heard of one optimization criterion. We gave an example before of someone who might want to develop an intervention that's the most effective that can be obtained for an implementation cost of $500 a person or less. That's one type of optimization criterion. You might simply want to identify a set of components where all the components are active. That is to say all the components are moving the outcome in the desired direction. There's no dead wood in an intervention like that. That can be an optimization criterion. There's lots of other potential optimization criteria, but those are the activities in the preparation phase.

Aaron Wagner:

Thanks. Now just moving on, once you've gathered your information and identified what optimization means in this particular iteration of experimentation, can you continue that example and explain the optimization phase?

Linda Collins:

Sure. Suppose we were taking the standard treatment package approach. We would immediately take those five components, coaching, text messages, communication with the primary care physician, buddy training and meal replacements, and combine those into an intervention along with the core intervention, and test that intervention in an RCT. That would tell us whether that set of components as a package has a detectable effect, but it wouldn't tell us what we need to know for optimization, which is which of those components are having an effect and what is the estimated size of the effect? So in MOST we don't go directly to a treatment package evaluation, instead we conduct a different kind of experiment that will enable us to gather that exact information that is needed.

Linda Collins:

In the Pellegrini Andall study that is reported in those two articles that I mentioned in Contemporary Clinical Trials 2014 and 2015, we conducted a factorial experiment. A factorial experiment is one approach that you can use to conduct an optimization trial in the optimization phase of MOST. And it's an approach that certainly not every study that uses MOST employs, but it has quite wide applicability. So in this case we ended up doing a full factorial experiment. It would be a two, by two, by two, by two, by two factorial experiment that has 32 experimental conditions. And just for the record, we've concluded that experiment and we were able to conduct it in a field setting with very, very few protocol deviations.

Aaron Wagner:

You mentioned doing a factorial experiment and you said that that has wide applicability in MOST. Why is it that MOST uses other experimental designs in addition to the standard randomized controlled trial, which I think most of our listeners will be familiar with?

Linda Collins:

Just to be clear, there's a lot of different types of optimization trial designs that can be used. The factorial experiment is one, the fractional factorial experiment, which is a special case of the factorial experiment is another, the sequential multiple assignment randomized trial, or SMART trial and the micro randomized trial. These also are special cases of the factorial experiment. One can also do a system identification experiment that really comes from a different tradition that's more a straight control engineering approach. And people also use various kinds of machine learning approaches. So there's a lot of different approaches that can be used, but none of them are RCTs. And the RCT has an important place in MOST. It is the design of choice in the evaluation phase of MOST. But the reason we don't typically use an RCT or a variation of the RCT in the optimization phase of MOST is because in the optimization phase we generally are trying to get a sense of the individual contribution of each component, and also the combined contribution of components.

Linda Collins:

In other words, whether component A interacts with component B, that is to say whether the effect of component B is the same no matter what level of component B you're looking at. So those are very good reasons for using a different kind of experimental design. And I think most of the listeners know if they think back to graduate school, we were taught as scientists that you don't use one experimental design to answer every scientific question. You can't test every hypothesis you can think of with any one type of experimental design. And yet we've been giving the RCT a workout for a number of years asking it to answer every scientific question we have in intervention science. And an important feature of MOST is just trying to get people in this framework to think about exactly what scientific questions do you have at each step along the way, and what's the most efficient experimental approach to addressing those questions. And there's a lot of different answers. It's very hard to talk about experimental design in the abstract. It's really the choice of design depends completely on a clear statement of the scientific questions.

Aaron Wagner:

Great. And continuing that example to the third phase, can you carry that forward and tell us what evaluation looks like?

Linda Collins:

Once in the optimization phase you've collected the data, you would then examine the results of course, and then in the light of the optimization criteria that you had previously selected, you would identify what combination of components and component levels constitutes the optimized intervention. Then the next step would be to move to the evaluation phase, and you would test the effectiveness of that intervention in a standard RCT. Usually a two arm RCT, treatment control RCT.

Aaron Wagner:

Thanks. And so, then what? You've gone through the three phases of MOST. Is that the end?

Linda Collins:

MOST is never over, although some people get pale when I say that. But I like to say that MOST presents the opportunity to continually improve an intervention. Once you've evaluated an intervention and we hope that the RCT shows that it has a statistically and clinically significant effect, of course at that point you hope that the intervention would be scalable and can be implemented exactly as it was evaluated in whatever the intended setting is. If you've selected the right, or I should say an appropriate for your situation, optimization criterion, then at the end of the evaluation phase you will have an immediately scalable intervention. So there should be no need for ad hoc modifications. So, one thing you would do at the end of the evaluation phase is, I hope just go ahead and implement the intervention and let it do the good that it was designed to do.

Linda Collins:

But then as a scientist, you would want to go back to the preparation phase and take a look at that intervention and say, can we now continually optimize this intervention? Can we make it even better? Suppose you had identified in the previous cycle of MOST, the most effective intervention you could get that costs $500 a person, no more than $500 a person. Well, maybe you would like now to identify an intervention that's just as effective but cheaper. Maybe for $400 a person. Or maybe you'd like to identify an intervention that costs $500 a person still, but add some components that would make it even more effective. So those are examples of how we could continually improve an intervention using MOST. And that gets back to the idea I talked about before of wanting to see incremental steady improvements. I believe that if people kept going through cycles of MOST, it would be possible to continually improve an intervention over a period of years.

Linda Collins:

If we look back over the last 40 years of the automobile, you see a steady improvement in the automobile. Today's automobiles compared to automobiles that were 40 years ago are more fuel efficient, they're safer, they last a lot longer, they're better. I think if we look back over 40 years of intervention science, we can't really say that the interventions we have today are measurably better. We can't really characterize, oh, today's interventions are way better in this particular way than interventions were 40 years ago, but I would hope that 40 years from now we'll be able to look back on today's interventions and think of them as kind of quaint, and in 40 years the interventions will be just so much better.

Aaron Wagner:

It seems like a really realistic goal if we're systematic about our approach to designing intervention.

Linda Collins:

I think it is.

Aaron Wagner:

So, you've been working on the development of MOST for a number of years now. How has your thinking about it changed?

Linda Collins:

It has changed over the years and in some important ways. Vijay Nair, and Susan Murphy and I first cooked up the idea of MOST in, I think it was 2004. And the original version of MOST, if you look back at our early publications you'll see this, had a different set of three phases. Those phases were taken pretty directly from engineering, and that's an example I think of where the basic ideas from engineering were helpful, but it wasn't a good idea just to simply take those ideas and try and apply them in behavioral science without amending them in some ways. I was finding that behavioral scientists were having a hard time kind of latching onto the ideas. I got a lot of blank stares and people saying, I don't really see how this connects with my work.

Linda Collins:

And so, I eventually reconceptualized MOST to have the phases that it has now, preparation, optimization and evaluation, which I think amount much better onto what intervention scientists actually do. And once I reconceptualized most of this way, the uptake of it really started increasing. So I think that was the right thing to do. Of course, along the way, behavioral scientists and intervention scientists have had some really good questions that have pointed my collaborators and me in helpful directions. For example, in the beginning we didn't have any advice to give people who had to use cluster randomization. An example of cluster randomization is when you are working in a school setting and you need to randomly assign entire schools to experimental conditions. But we worked that out and there are a couple of publications about that. So that's an example of where our thinking didn't exactly change but certainly was refined and expanded in response to excellent feedback we got from behavioral scientists.

Aaron Wagner:

So, what was it that made right now the proper time for a book about MOST?

Linda Collins:

I've been working, my collaborators and I, have been working on MOST for more than 10 years, and a couple of years ago I started feeling that there was a need for a comprehensive introduction to the topic. We'd published a lot of journal articles on it, and that was great, we were happy to do it, but they seemed a little bit scattered in different journals, different literatures. And I was giving workshops on MOST and realizing that I wasn't able to cover everything, even in a workshop that took place over several days. So the time was right for a comprehensive introduction that people can have on their shelf so that if they are planning to write a grant proposal using MOST or are actually implementing MOST in their work, they would have something to refer to.

Aaron Wagner:

Thanks. And so, how do you hope people use the book now that it's coming out?

Linda Collins:

Of course, I hope that they'll read it from cover to cover, and I guess every author hopes that. But I especially hope that with this book, because MOST is not only a framework, but a very different way of thinking compared to how intervention scientists have mostly been trained to think. I believe that reading the book from cover to cover, at least reading most of it will help people to get oriented to that different way of thinking. Also, I hope the book will be very useful for people who are writing a grant proposal using MOST. Generally speaking, someone who wants to use MOST in their work will be to write a grant proposal to some organization to obtain funding for the work. And the book contains some information that is intended to be helpful for people who are planning to do that.

Aaron Wagner:

Great. Well, Linda, thank you very much for your time and congratulations on the book.

Linda Collins:

Thank you.

Aaron Wagner:

Once again, the title of the book is Optimization of Behavioral, Biobehavioral and Biomedical Interventions, The Multi-Phase Optimization Strategy, MOST. The book is available from Springer and is available through Springer link on Amazon or anywhere one would get academic books. The citations for the book and the articles that Linda discussed are available on the page where the podcast was downloaded.

Aaron Wagner:

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