Lawrence Neal: Dr. James Steele, welcome back.

Dr James Steele: Thanks for having me back here, Lawrence.

Lawrence Neal: How are you?

Dr James Steele: I'm really good, I'm really good. How are you?

Lawrence Neal: Good. I'm very good thank you. So thanks for joining me today. The purpose of this members only podcast is to talk about some of the recent studies that you and your staff have conducted. And I know that you've ... the listeners and the members will know that you've done a fair amount of work in resistance training. And I know that now your focus is more around efforts. And efforts is something that as you've shown in some of your recent work is kind of hard to measure and is sometimes poorly defined.

So I'd love for you to just start off by giving and overview of what we're gonna be talking about today.

Dr James Steele: Yeah, sure. So of course, we've previously work around resistance training, and one of the things we've historically been interested in is this role of failure in training. And the more we kind of worked around that, and the more we've kind of realized it's inherently tied to this concept of effort, and how much effort is required during training.

And so a lot of our work has migrated toward trying to understand what is effort, how do we manipulate the actual effort required during resistance training and what impact does the actual effort have on things like adaptations to resistance training, or any kind of exercise really.

And in also thinking about how do actually understand what effort someone requires? Talking about someone's actual perception of that effort that is required. And how good are people actually accurately perceiving the effort required for a particular task.

So we've done a lot of studies previously. A lot of this stemmed from the fact that with our colleagues in Germany, Dr. Jurgen Geissing, we have done a couple of studies where we've had people trained to failure, or trained to a point where they predicted that they would fail on the next repetition, and then they stopped before attempting that rep they thought they would fail in. So what we would call a self-determined repetition maximum. The maximum number of repetitions they thought that they could complete prior to failure.

And what we found was that the people who are training to a self-determined rep max consistently had poorer outcomes than the group that actually trained to failure. So we thought this was interesting. And we thought it might be because people potentially stopping further away from failure than they think they are. Because on the face of it, although in high intensity training realm, failure is put on this pedestal as being this kind of magical thing that's required and necessary for optimizing adaptation.

Every hour we don't actually know if that's the case. All we really know is that in general research suggests that higher efforts are better than lower efforts. But we don't know whether there is potentially a threshold.

So on the face of it, it would seem reasonable to think well maybe if you could actually start one rep short of failure you might get very similar outcomes than actually going to failure. But obviously we were finding that that wasn't the case. So we wondered whether this might be because people are actually stopping before failure and they thought about it.

So we've done a few studies now looking at how ... first of all we looked at the relationship to try to figure out how are people actually typically defining effort, and one of the problems we found was that a lot of descriptions of effort in the literature are kind of tied up with something which is ... most people think is quite similar, but there is actually very distinct, which is the perception of actual discomfort during the exercise. And the other kind of physical sensations that you have.

So anyone who has listened to the podcast will know, you're trained to failure, it's pretty uncomfortable. But they'll also probably be familiar with the fact that certain exercises feel more uncomfortable than others, and potentially certain ways of doing those exercises, so different loads, using advanced techniques and things like that will affect the degree to which the exercises causes discomfort.

But if you go to failure, at that point, you're always experiencing a maximal effort because by definition you're trying as hard as you can to actually complete the exercise. And so irrespective of that effort being accompanied by a high or low discomfort, the effort remains the same.

So we wanted to try and figure out what one, whether people can actually differentiate between that during exercise. And then two, what kind of influence were different types of exercise conditions having on that? So we first did a study where we kind of looked at people, we developed some new scales and descriptions and we showed that people can differentiate between effort and discomfort if you explain in appropriately to them. So that was really useful.

And it lets them move on to doing some studies where we looked at heavy and light loads perform to failure, and also using things like drop sets and forced reps. And in general we found that lower loads and advance techniques when performed to failure produced more discomfort than higher loads. But when you get to failure they still induce the same feeling of effort. You still feel as though you're trying as hard as you can to actually meet the demands of those tasks.

So that's kind of where we got up to recently. And linking back into those studies were we ask people to predict their repetitions to failure, we wondered whether people without instruction were just making bad predictions because instead of anchoring those predictions on their perception of effort, they were instead focusing on the perception of

discomfort. So you take something like a low load leg extension, if you ask someone without any other description of what we mean by effort to try and stop one rep short of failure, most people are probably gonna stop when it starts to feel uncomfortable, 'cause they think that's telling them they're getting close to failure.

And so we did a study where we got people to offer a prediction of how many reps they thought they could do to failure, and this was a big study that we did with just over 140 participants. We asked them all to offer a prediction of how many reps they could do, and they we actually got them to do those repetitions to failure. And we found in general that people were pretty poor at predicting.

So I can't remember the exact range off the top of my head, let me just quickly open the study. But most people were under-predicting by around about sort of two to three repetitions. So if you think about that, it actually means if someone's stopping what they think is one rep short of failure, then really they're stopping three or four reps short of failure, at least in the exercises that we looked at in that study.

Lawrence Neal: And that's significant, isn't it?

Dr James Steele: Yeah. I mean if you take into account the training studies we did, then those suggest that maybe there is a threshold somewhere between three or four reps away from failure, and actually training to failure. That might optimize the adaptations, or it might continue to increase straight up to failure.

So we've kind of moved on from that now. We've actually done a couple, or three more studies trying to get us a better understanding of this sort of area, which are not published yet, so I'm just gonna give a kind of rundown of those for the members only podcast.

Lawrence Neal: Hot off the press. Exclusive.

Dr James Steele: Some of these studies that we've done. So I'll just talk through the three that we've got. They're all finished. The data analysis is done. We've just got to kind of work on the actual paper write ups and look at getting those published.

The first one was actually similar to the studies we've done previously, where we've looked at low loads and high loads to failure, and looked at effort and discomfort. In the previous papers, we've done dynamic exercise. We've got people to actually do repetitions. We did a knee extension study and we also did lumbar extension study as well.

And in both those studies we've found similar results. So the low load conditions produced much higher perceptions of discomfort, whereas both the high and low load conditions produced similarly maximal perceptions of effort when people work to failure.

Now in this study what we did was we actually used an isometric condition. Which is to say that what we did we had participants do what's called a maximum voluntary contraction. So we got them to push

against a knee extension machine, which didn't move, it just measured how much torque or force they produced against that fixed movement bar. And we used that to set 30 and 70% of what their maximum voluntary contraction.

So it's pretty similar to just say they're gonna warm up to their max, and using 30% or 70% of that. So it's kind a low load and a high load, or in this case a low torque and a high torque condition. And we did the same sort of thing, essentially do an isometric effort where they had a display on the screen which showed that target torque level and they had a range of plus or minus 5% around that because no one can hold exactly at that level. There's always some variation.

And so we asked them to hold it within that essential bar for as long as they could, and when the load they were dropping down they were encouraged, so they essentially kept on going until they could no longer sustain that level of torque. So they were essentially doing isometric to failure.

And interestingly what we found differentially to the dynamic conditions, was that both the high and the low load isometrics to failure produced similar degrees of discomfort which is to say they were both really uncomfortable.

So one of the reasons we think this is quite interesting is because in our previous studies, we've argued that although a lot of research that showed similar strength and hypertrophy gains from low and high loads have generally concluded with saying that what this means is that people can use low loads to failure and still produce the same adaptations. So this is good because they can reduce injury risk.

One of the things we've argued is that the flip side of this is that although low loads may theoretically have a lower injury risk, they actually produce a greater degree of discomfort which might have other unintended consequences which is to say it might put off clients, it might make people less likely to wanna stick to the program if it's uncomfortable and they don't like it.

We suspect that that discomfort has an impact on participants what's called affect which is that kind of emotional feelings or response to an exercise condition, and we think it's more likely to make them feel more likely negative affect. There's research that shows that that affective responses to exercise are linked to adherence.

So this is interesting in and of itself because this suggests that it doesn't really matter isometric conditions don't [inaudible 00:11:29] failure. They're just really uncomfortable whatever you do. As much as I'm a big proponent of doing more sets to failure, because I'm a bit of a masochist, it might suggest that you should maybe not do that with clients if you want them to stick around.

Lawrence Neal: One question on that before I let you resume. Is the reason for essentially for the greater discomfort associated with lower loads, is it

just because the time of the load is far longer, generally speaking? And so you're suffering for a longer period of time or did I misinterpret that?

Dr James Steele: I think it's probably more to do with the fact that it's ... so what we did was we looked at continuous isometric contraction. And when you're performing continuous isometric contraction, you almost have ... it's almost a little bit like blood flow restriction training. There is a degree of restriction with respect to blood flow, and so you get similarly sort of substantial changes in the metabolic "stress" and that the muscle experiences. And we know that is linked to what's called affirm feedback which is essentially the nervous feedback that goes from the muscles to the central nervous system, which the brain then uses to interpret that you should feel discomfort or pain or whatever from that.

So I think it's likely because there's greater affirm feedback because it's more metabolic stress when you're doing a continuous isometric contraction because it essentially produces its own kind of aclusion back to the muscle essentially. Whereas with the dynamic one you're kind of contracting and relaxing, and eccentric, concentric repetitions allow for continued blood flow in and out of the muscle which alleviates to some degree, at least earlier on in the exercise particularly some of that metabolic stress.

Lawrence Neal: Didn't you also say though that lower loads were more uncomfortable during the dynamic, or are they the same?

Dr James Steele: No. In the dynamic low loads are much more uncomfortable. And then I think that that may be because of the greater time of load. It may be because it's greater again, metabolic stress. We don't know exactly why that's the case. It might be because they cause more fatigue. And so when you fail at a lower load you typically lost more of your force producing capacities, so by definition that is more fatigue, since that's how we define fatigue. And so it may be that there's some feedback mechanism with respect to that. So we don't know exactly what's causing it. But we just know that ... I suspect it's more to do with the metabolic stress of those kinds of conditions.

Lawrence Neal: Okay. I'll let you receive. Do you still need to cover off the rest of that first study or are we moving onto the second one there?

Dr James Steele: No, no. I think [inaudible 00:14:21]. So the second one is actually some work that we've done with our colleague [Pallagintu 00:14:27], and one of his students has done some work looking at what's called velocity loss. So this study hasn't got a typical protocol that any kind of high intensity training that enthusiasts will probably follow, but there's a big body of literature now which is looking at the velocity of a repetition and using that as an indicator of the degree of fatigue experienced, and therefore the degree of actual effort required during that exercise.

So to kind of explain that and ... when you're looking at using velocity loss, you would typically have something like an accelerometer attached to say a bar or a movement arm or even to the limb that's being used, and you would be performing maximal intended velocity repetitions essentially.

So you're trying to move as fast as you can. Of course with a heavy load you're moving slow, sorry that's my cat was just running in if anyone heard a bell. He's always interrupting us.

And so you perform a maximum tend of velocity repetition and then as you fatigue, obviously your ability to actually move fast reduces, and so the loss of velocity gives an indication of the degree of fatigue that you're experiencing under those conditions.

Now velocity loss doesn't work very well when you're going at a fix or a slow kind of movement. Speed or repetition duration only really works when you're looking at maximum velocity stuff, so this study is actually less applicable in terms of the training protocols that we used. But we found something really interesting about how people perceive effort. And looking at ... I mentioned earlier this idea of actual effort and our perception of effort, because obviously we can kind of objectively define the actual amount of effort required to perform a task. So in this case, moving a weight. And that's defined essentially by our current ability to meet that task.

So it's defined in kind of a relative sense, and so obviously as we fatigue the actual effort required to continue performing the same task increases. So take a squat at 70% of one rep max, the first repetition will need 70% effort, and then every repetition as you continue performing them will require more and more and more relative effort, because you are fatiguing and so relatively speaking the demands are increasing.

In normal conditions we would expect that your perception then of that effort should match up with the actual effort required, so the first rep feels easier than the second rep. And the second rep feels easier than the third rep and so on and so forth.

And as we've shown when you hit failure everyone feels a sense of max effort. So there's obviously like a ceiling affect, where if you go to failure, but nine times out of 10, people will say, "That failed on max effort, but I was trying as hard as I could." What's interesting though is whether or not people are any good at actually matching up their perceptions with the actual effort required when it comes to some maximum reps.

So this feeds back into this idea of how good are we at actually predicting how close to failure we are. Because if the relationship between the actual effort and our perception was one to one, then we would be able to perfectly extrapolate to how far away from failure we are.

So you see what I mean? So if there was that perfect linear increase from rep to rep to rep in terms of how much effort was required and how much we perceive the effort to be, then we would be able to always say, "I'm this far away from ..." or "I feel this perception of effort. I know the rate of which my perception of effort has been increasing and I can predict then in two reps I'm gonna fail. Or in three reps I'm gonna fail. Or in one rep I'm gonna fail based on that increase."

So we looked at this data as an option to be see whether or not that was actually the case. So we had participants do ... this is actually kind of looking at some data from a wider study. In the wider study participants did either maximum velocity squats to failure, and so we matched up so we were able to see at the point of failure how much their velocity dropped, so we had a kind of objective measure of the amount of fatigue that they experienced under those conditions.

And then we also have them do a set of maximum intended velocity squats until they're dropped by 20% of their maximum velocity. So once they drop to 20% we stopped them so they didn't go to failure.

But what that allows them to do is say the maximum amount of velocity is lost, so the maximum amount of fatigue they could experience in the failure condition, we could use that to look at what percentage of actual effort they require in the not to failure condition.

And what we have our participants do is under both the failure and the non-failure conditions give a rating of both discomfort and effort. That's important that we ask them to measure both of them, because if you just say effort, they would have mixed it up with their discomfort. So the fact that we have effort independent of discomfort meant that we could look at their perceptions of effort accurately and then match that up with their actual effort required based on the amount of fatigue they've experienced relative to the maximum amount possible fatigue they could experience if they went to failure.

And so what we do is we worked out with these things, we looked at the perception, we looked at the actual effort, metric, and we essentially just looked to the correlations between these. We wanted to see whether or not there was a correlation between the perception and the actual effort.

Because if it was accurate, we'd expect there to be a perfect correlation. Now in reality, we thought that probably wasn't gonna be the case, but we thought we should expect to actually see at least a positive relationship. So as actual effort increased, perception of efforts should increase as well.

But when we looked at the data, there was essentially no correlation between them whatsoever, which essentially suggests to us that if people are not going to failure, their ... at least in these conditions, their perceptions of effort are really crappy indicators of how much actual effort is required to perform the exercise.

Which is really important because it …throws a spanner in the works to try and get people determine how many repetitions they're gonna do, or how hard they're gonna train based on their self maximal perceptions of effort. Because the two evidently don't match up, the actual effort and the perception of effort.

So there's some quite significant practical implications from that. And now the last study kind of then leads on to almost testing the practical implications of that, because the study I mentioned earlier where we

got people to predict their repetitions to failure, but we asked them to give a prediction before they did the exercise. We even criticized that study ourselves by saying if you ask someone before they do the exercise, they've not got any feedback which they would normally have during the exercise which might help them predict how close to failure they are.

So like if I asked you now, Lawrence, how many pushups do you think you could do to failure, and then I actually got you to do those pushups to failure, and then asked at a certain point during them, now give me a prediction, now give me a prediction, you'd think that your predictions would get better and better and better the closer you actually got to failure, because you've got all the feedback and the experience, you can feel the fatigue, you can think about all the sensations, you have a perception of effort, and how hard you're trying for each repetition.

So in theory your accuracy of prediction should get better and better and better the closer to failure you're actually getting. And so we kind of said well maybe our first study wasn't a fair experiment of how good people actually are at predicting how close to actual failure they are. So maybe if you actually get people to try and stop one rep short of failure, maybe they are really good at doing that.

But obviously our previous study that I mentioned with the max velocity squats suggested that people's perceptions don't match up with the actual effort. So we thought well maybe this means that people are gonna be pretty crappy actually. But let's do an experiment to test it out. And we actually did two experiments for this study. It's one of the first studies we've done where we've done two experiments. Sorry my cat's biting at me. Say hi [inaudible 00:23:31].

So this study what we did was, this is a really cool study. I really like this because we did something which is a bit more common in [inaudible 00:23:42] college literature where we did a deception study. So we recruited people and we told them the study was looking at one thing, when actually it was looking at something different. Because we didn't want their knowledge of what we were looking at to affect the results.

So what we did was we told the participants that we'd previously talked about self-determined rep max, and training to failure. And we told them we use these definitions a lot in our studies, but we aren't sure how reliable they are. So what we wanted to do was get participants to come in, and on four separate occasions and do two occasions where they did self-determined rep max, and two where they did reps to failure. And what we're gonna do was compare the two sessions where they did the reps to failure, see how well the number of reps they did match up, and also the same with the self-determined rep max.

So the participants thought what we were doing was a reliability study to see how good day to day their reps to failure are and their self-determined rep max is. What we were actually doing was taking the number of reps that they did in the failure conditions, sorry in the self-determined rep max conditions, and comparing them to the actual

number of reps that were one rep shy of failure in the failure conditions.

So the participants weren't aware of this and we interviewed them all afterwards and asked them what they thought the study was about, and most of them seemed confused because they thought we'd told them what the study was about, and so confirmed to us that none of them knew what the study was actually about which was useful.

You always need to do what is called a deception check with these kind of studies, because you wanna know that it's actually worked. And the first experiment, what we did was we did a ... participants came in and did a one rep max on a knee extension and then we set 70% of their one rep max and they came in on four separate occasions after that. Two were self-determined rep max so they stopped when they thought they were one rep shy of failure.

And so that was just explained to the participants we want you to keep doing repetitions until you feel that if you tried the next rep you would fail to complete it. But we want you to stop and not actually try that rep. So they all confirmed they understood that, and then they did failure conditions, which was described as essentially we really pushed them to proper failure. We said essentially our definition of this is you need ... every time you complete a rep you need to attempt the next repetition and you need to get to a point where despite you trying as hard as you can, you can no longer continue performing that repetition.

And we told them that we didn't want them to suddenly think I'm failing and stop, they needed actually grind to a point where despite the fact that they were trying to perform a concentric action, it became an involuntary isometric action, so it became a static hold essentially, and that they kept pushing just to really check that there definitely was failure. And then we let them stop.

So they did those four conditions in a randomized order which again we told them that's necessary to check the reliability, and then what we did was, we then used what's called the standard error of measurement, or typical error of measurement. And we took the self-determined rep max repetitions and the reps that were one rep shy of failure from the momentary failure conditions, and we compared those two to see what's the typical error between the prediction, as in the self-determined rep max and the actual number of repetitions one rep shy of failure they could do. And just because I'm realizing, my mind's going blank on the actual numbers, I'm just gonna quickly open up the ... tell you what the actual figures were. There we go. So for this first study, we essentially found that participants under-predicted by between one and a half to two and a half repetitions.

So that's to say that the difference between their predicted repetition maximum and their actual repetition maximum was one rep shy of failure was off by about one and a half to two and a half repetitions, which actually means if they were stopping, if they thought was one rep short of failure, they're actually more like two and a half to three and a half reps short of failure.

Lawrence Neal: Right.

Dr James Steele: Now one of the things we thought with this study, this experiment was there was a problem in that if we test some of them one day, and then use 70% of that test load on four separate days, they might come in and one day they might be quite tired, one day they might feel particularly refreshed and strong, so that might be actually affecting the range of repetitions. So that might be our predictions that we were getting. And you know, one and a half to two and a half reps, some people might think that's a massive difference, some people might think it's not so much.

And so we thought if it's not that much, maybe if we did a better design, more controlled design, we might actually find that people that are good at predicting. So what we did was we stopped at that point and we said we're gonna then move to a new study design where we essentially did the same four conditions, but instead of testing their one rep max on a separate day, every time they came in they did a single maximum voluntary contraction so we could test how strong they were on that day. And then we set them 70% of how strong they were on that day. So they were always using 70% of how strong they actually were on that day.

And we did find that people were much more consistent in terms of their repetitions and things like that so the two days that they did sets to failure, they were much more close in terms of the numbers of repetitions as far as the variation. Until we thought that this is gonna be much better, so if people were good at predicting, this study's gonna show it.

Similarly if people are bad at predicting, this study's also gonna show it. And what we found was that actually in that second experiment, the difference was actually more like two and a half, to just under four and a half repetitions difference. Which suggests that at least in this study, we used 70% of their max strength on the knee extension machine. If someone thinks that they're stopping one rep short of failure, it's more likely that they are probably somewhere between two and a half to four and a half-ish reps away from failure really. Which is huge.

Lawrence Neal: Yeah.

Dr James Steele: So trying to bring all this together in terms of practical applications, obviously trainers would be aware that from their own training and also from working with clients, that some people mistake their discomfort for effort. And so people will tend to give up shy of failure because it starts to feel uncomfortable. And this can affect people's ability to go to failure, and it can affect their ability to predict how close they are to failure.

But even when we control for that perception of effort by getting them to think about effort and discomfort as being different things, we find that people's sub maximal perceptions of effort are actually really poor. They don't match up with the actual effort required to complete the exercise.

And moving into that, we find that people are really crap at predicting how close to failure they actually are. So what this evidence doesn't suggest is that going to failure is best in terms of producing limitations. So I think it's worth stating that. Because I know that's a big mean in the high intensity trainings there. And I think a lot of people potentially think that that's my perspective on it as well, but actually we don't know. What we do know is higher effort is better. Lower effort is sub-optimal. But we don't know where that threshold is. It could be that failure is best for adaptation. But it could be that sub failure is best for adaptation.

What this evidence does suggest though is that it's very, very difficult, it's gonna be very, very difficult to figure out what that optimum threshold is for sub failure, because people are so bad at accurately predicting their sub maximal effort. And so from a practical perspective, it suggests that we should potentially just get people to continue to training to failure, because if we at least know, we pass the threshold if indeed a threshold does exist.

And if a threshold doesn't exist, we're potentially missing out on adaptation and stimulus if we don't go to failure. So I think essentially that's the kind of practical take away from this. If you want to try and control someone's effort during training, then really there's only one objective way of doing that, and that is to have people train to failure, whilst getting them to differentiate between their discomfort and their effort and making sure that they don't allow their discomfort to allow them to prevent them from going to failure.

Lawrence Neal: Any views on how you might communicate that to the client?

Dr James Steele: So I think that using examples and using ... I love this Gestalt experience, a Gestalt anchors, a Gestalt just means all the sensations that are associated with an event, an experience. So the idea that you should talk the clients through what's happening during the exercise or what's going to happen during the exercise, so that they have their expectations set appropriately.

So for example, when we're doing these studies and we get people to differentiate between effort and discomfort, we use a series of scripts and scales which are specifically worded to get people to differentiate between the sensations of discomfort, the burning and whatever descriptors you wanna use, and the perception of how hard they're actually trying to do the exercise. And making sure they are very distinct things.

And we give them examples of where you can have a maximum, really high feeling of effort, but a low feeling of discomfort, but also vice versa. That you can have a high feeling of discomfort but a low feeling of effort. And so once they start to realize that it's possible to have the two very, very different, they can better distinguish between the two, we also made sure that we used clear anchors for them as well. So we let people realize that their maximal effort happens when they're trying as hard as they can, but they can't meet the demands of the task anymore. Which in this sense, they literally and a lot of it has to be

said, this does rely entirely on the participant giving an honest intent to actually continue performing, attempting to perform the exercise.

So I think that's worth stating as well. When you work with clients you should stress to them that you can't force them to go to failure. At the end of the day they still have to make that choice to put the honest volition in there. And you can help nudge them and explain that and give them the tools to try and get there, but that is still something they have to do. And you have to assume that that's what they're gonna actually attempt to do.

And so it's setting up all of these expectations about where the anchors fit, what they're gonna experience, giving them examples, and then actually taking them through experiencing that. So take them through a heavy load to failure, so they can experience effort with lower discomfort. It will prove a low load to failure, and get them to experience high discomfort, and that difference in fact failure.

Get them to understand these things and then you're more likely to get the clients to be able to do that on a continued basis I think. So there are obviously other ways of potentially almost coaxing people into that as well. Using things like advanced techniques can be useful for if someone looks as though they're giving up a little bit short of failure, then maybe a drop set's useful, maybe some forced reps, maybe getting them to do an isometric hold. A negative at the end of a set. These sorts of things can be useful for trying to push them a little bit extra towards max effort. Particularly if you're concerned that they've stopped pretty far away from failure.

I think that expectation and then that Gestalt experience are probably the two most valuable things for coaching clients to be able to achieve that.

Lawrence Neal: Awesome. That's awesome James. Thank you very much for expanding all of that. Appreciate getting the exclusive on some of those unpublished studies. In terms of ... when will those studies actually be published so I can link to those?

Dr James Steele: Well okay, so that's a difficult thing to predict. Ironically. The academic world is very fickle, so I'm hoping that we'll have the studies written up in the next month or two, time permitting. I've got great ... the last study I mentioned was actually conducted primarily by a fantastic research intern I had. He was visiting from the University of Amsterdam and did a placement with me and helped with that study. So he's writing that up at the moment. And then the other two studies, I'm gonna be writing up. Hopefully over the next month or so time permitting.

One of the things I'm potentially gonna do is what's called pre-print the studies, which is for those who aren't familiar, there's a big movement for open science at the moment, and of course most research is done in universities or tax-funded, et cetera, et cetera, et cetera.

And a lot of that research then gets published in journals which people have to pay to access and it's kind of all sort of issue with the whole

publishing sphere at the moment. But there's a movement towards rapid dissemination of findings, so that people can write up the study, publish it on an open access platform prior to peer review, so the study would be non-peer reviewed, and people would take it with a pinch of salt, but people can see the studies, they can comment on it, they can critique it, they can pre-publication, provide feedback, comments, things and then get it finally published.

So what I wanna do is start to do that more with a lot of our work, we just pre-print it, make it available to people as soon as possible, as soon as it's written up essentially because sometimes it can take ... to give you an example, I've got one paper which has taken me over two years and I've still not got it published yet.

Lawrence Neal: Yeah, sounds like a great idea. So hopefully you can make that work. But yeah, as soon as these ... well that's great because I feel quite fortunate that we get to talk about some of these papers then. And yeah, as soon as they are published, obviously let me know, and I will be looking out for that and I'll put them in the show notes for this.

James, what's the best way for people to follow you and find out what you're up to?

Dr James Steele: Probably best way is by Twitter. So I tend to be pretty active on Twitter. So I'm @JamesSteeleII and I've recently started using Instagram. Which was suggested to me by my wife, so that is ... I think that's also ... that might be James.SteeleII-

Lawrence Neal: That's okay. I can add that to the show notes, don't worry.

Dr James Steele: I'm sorry. And Twitter I generally share papers, research, that sort of stuff. It's a personal account as well, so I just share stuff that I find interesting and fun and personal interests of mine, but mostly it's kind of research and stuff. And I'm in the same with sort of Instagram as well. I've recently taken to try to place some videos and shots of workouts and stuff as well.

Lawrence Neal: Which I highly enjoy. I said to you I'm more excited about your next video workout, than I am Tim Ferris's next podcast, which is actually true, I think for the most part. Unless he's got something really good coming. But yeah, I highly recommend you check out James's square for inspiration for high intensity training workouts, machine based on body weight of all sorts. It's really fun to watch. So I do encourage you to check that out.

James, thank you so much for taking the time today. I really, really appreciate it. And all the best review and your future work and look forward to talking again on a similar subjects.

Dr James Steele: Brilliant. Thanks for having me again, Lawrence.

Lawrence Neal: Cheers. Take care James.

Dr James Steele: You too.