

Marijuana Monthly

February 2018

HIGHLIGHTS

A Monthly Newsletter published by the Research Society on Marijuana (RSMj)

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57 NEW ARTICLES

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Gilbert & Diverdi (2018)

Dvorak et al. (2018)

Editor:

Matthew R. Pearson
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Gilbert, A. N., & DiVerdi, J. A. (2018). Consumer perceptions of strain differences in cannabis aroma. *PloS One*, 13(2), e0192247.
<https://doi.org/10.1371/journal.pone.0192247>

We were able to speak with Dr. Joseph DiVerdi about his recent work. See below.

Marijuana Monthly (MM): It is my great pleasure this morning to be talking with Dr. Joseph DiVerdi. Dr. DiVerdi is a Special Associate Professor in the Department of Chemistry at Colorado State University in beautiful Fort Collins, Colorado. He is also the founder of XTR Systems, which I'll let him talk about a little in a minute. I was very pleased to have Dr. DiVerdi as an inaugural member of RSMj. If you don't mind, I'd like to start with you giving us a description of your field of expertise in general and how this expertise translates to the cannabis field.

Dr. Joseph DiVerdi (DiVerdi): Certainly. I'm happy to speak with you this morning. My background is as a long term chemist. My field is physical and analytical chemistry; biophysical, in particular. And the way I've come into the cannabis space is a long term interest in the chemistry aspects of cannabis. We explore these at XTR Systems, which is a chemical R&D laboratory and consulting practice where we engage in as many interesting parts of cannabis chemistry as possible. These days that generally involves consultation with various members of the industry chain to address issues that might come up with a wide variety of problems they might be experiencing or they want to improve their processes.

MM: Great, we were happy to have you at our first conference we had out there in Fort Collins. You were presenting some research on, if I recall the term correctly, is it the inhomogeneity of cannabis? Could you elaborate a little on that?

DiVerdi: Certainly, one of the common problems faced in our new industry, our young industry, is the determination and publication of potency of cannabis products. We focus on flower and bud for the moment. State regulation requires the potency, that is the THC concentration, to be posted and labeled on the various products. There are a number of small grumblings around with regard to this aspect of the labeling. Also, our own work has identified some issues associated with it. The issues are that it is a very difficult parameter to report carefully. Sometimes cultivators remark and even complain that when they send 'identical' samples to different laboratories, they come back with different, sometimes markedly different results. It's also noted that when packaged flower or bud are examined carefully, by independent laboratories such as XTR Systems, we find that the measured concentration of THC varies significantly from the labels. The

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question often comes down to how and why this happening. So we have undertaken a series of studies to dig into this issue to develop and inform regulatory members of the state how they might address some of these problems.

MM: Would you mind discussing a couple of those things?

DiVerdi: Sure. One of the deepest issues that we've observed is that the flower itself, if one were to examine a single cannabis flower weighing, give or take a gram, the distribution of THC is not the same throughout the bud. Quite simply stated, is a very deep issue. In other words, if one were to take such a bud and sample it in different places, one would find different concentrations of THC; and so it becomes in great measure a sampling problem to make sure that it is reported well. And it if varies from spot to spot, what becomes the reported value? Some practitioners argue that the entire bud must be homogenized and the average value is taken. Others argue that this only smears out the variation into a single value. There are a number of different analogies in the agricultural world where this problem has been solved. For example, supermarkets grade wheat flour. All-purpose flour is known to be 10% protein, where bread flour is 15% protein, and cake flour is 5% protein. These are approximate numbers. As it turns out, not all wheat fields are labeled all-purpose flour and generate 10% protein. What has to be done during the manufacturing process, the process of bringing the food from farm to table, is the concentration of protein must be studied, examined, and blended together to yield consistent products. The young cannabis industry does not seem to be fully cognizant of this type of work and does not have it in practice at this point. We don't operate in that kind of a fashion. So we are then stuck with a situation where, depending on how an analyst samples a particular agricultural bud, results can be very, very different from one measurement to the next. We're looking to examine this in a rigorous fashion and to publish the results rigorously so that we can inform all the practitioners, the participants in the industry chain, and take advantage of the knowledge we have applied from other areas to address this.

MM: Interesting, do you think that having more standardized products would make it easier to titrate dose? I guess what I'm asking is, how much of an issue do you think that this is for the average user? Perhaps this inaccuracy would result in people not titrating their dose as well as they could have if it was a little more homogenous?

DiVerdi: I think that you've hit one of the nails right on the head with your question. Last year, during the RSMj meeting, I listened to one of the speakers indicate that his investigation shows that among users who were sampling a variety of different kinds of cannabis of different strengths, oils and buds, they all seemed to titrate themselves to the same levels of euphoria irrespective of what they actually started with. So it speaks to your question, how important is this labeling? I think that there is some merit to having some labeling. Yes, having it to a degree that makes sense is where we really want to put it. These days if you consider the analogy with the alcoholic beverage industry, we typically think of

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beers as running in the 6% alcohol by volume level, and wines are somewhere around the 15% level, and distilled spirits generally around the 40% level. From the psychoactive perspective, it doesn't matter if the alcohol is 29 or 31%. It does matter from a tax revenue perspective, and that may be the driver for some of this someday. For the folks having a few margaritas, that degree of accuracy is not necessarily meaningful. As it turns out, the precision to which the THC is reported on labels far exceeds any common sense. I routinely see numbers on labels that say something like 21.14% THC. That is two decimal places, what we call four significant figures, and that is absurd. It makes no sense at all. There is no need to be that precise. That kind of information should be discouraged from regulatory fashion, I would say, rather than accepted tacitly or even encouraged. 21% is more than sufficient in analogy with alcoholic beverages.

MM: Let me switch gears just a little bit here and discuss the paper that just came out in *PLoS One* that you co-authored with Dr. Avery Gilbert. It is entitled, "Consumer Perceptions of Strain Differences in *Cannabis* Aroma". Could you tell us a little about that paper? Could you tell us how that study came about and what some of your most interesting findings were?

DiVerdi: Certainly. My colleague, Dr. Avery Gilbert, is a smell scientist, an olfactory scientist, he's from that tradition. Our interests are both in the science of cannabis and we complement each other in our fields. So we got together and to begin the process - we hope this is the first of series of papers - and we are working on some others as I speak now. His field of aroma and sensory perception is where we get all of our olfactory products in the world. In the consumer world, there are an enormous number of olfactory products. You think of perfumes and colognes to begin with, but if you look at a supermarket shelf, virtually all products that are out there, let's say non-edible products, have a smell profile. All the laundry detergents, all the soaps, so many of our products are enhanced by their olfactory profiles. And there are folks that work in this field to give the purchasing public a wide variety of aromas to work with, there are many different kinds. So we looked at the cannabis world and said there is a rich tapestry of aromas in there. Yet, at this stage in the industry, there has been precious little done with regard to applying the methods to standards that are well established in this olfactory field to cannabis. So we began our efforts to work on that project. What we set out to do, as we note in the paper, was to begin by developing an olfactory lexicon for cannabis buds, using standard sensory research lessons. So, most of us are familiar with different kinds of descriptors for aromas coming from cannabis bud. But there is little systematic work done along the lines that would be considered standard in the sensory field. We also wanted to find out, are there measureable differences in aroma profile according to strain? This really opens up a can of worms, because then we have to start talking about definitions of strains and that is a problematic area in the cannabis world. We also wanted to take a stab at whether customer perceptions of the quality and the features of the cannabis, how dependent they were, how are they at linking to strain specific aroma profiles. It was ambitious, it was a first step, and we are continuing this work, and are going to be putting out some more articles on this.

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MM: The article, as is, seems to have several unique components together that I think in this world of salami publications, other people would have split up. I find it really interesting that you guys found these two clusters of smells. You have the earth, woody, and herbal cluster and the citrusy, lemony sweet, pungent cluster. I want to make sure I am saying this right, but I want to say that people misperceived one of these as being stronger than the other? I don't want to misstate it; it was in terms of potency.

DiVerdi: Okay, what we found was the customer perception of potency of the particular strain was uncorrelated with the true potency of the strain. In other words, our test subjects could not tell how strong the concentration of THC was from the aromas, which is an important result. It could go either way, we had no predisposition to that. We really wanted to know whether or not there was any correlation between the perceptions of which one was stronger in terms of THC versus another. Certainly the aroma permitted our test subjects to tell which ones *smelled* stronger; they were able to tell the different aromas from each other. These results are our test subjects speaking in terms of their examination of the different strains and coming up with a description. We gave them a pallet of descriptors and these clusters of descriptors emerged from the results of the test panels of their own accord. There was substantial agreement. In sensory science like this, there is a lot of scatter in the results. It is not like other physical sciences where its mechanics or celestial mechanics where the scattering is much, much tighter. Here in this field there is a bit of adjustment, yet they clustered together and also had little correlation with the THC content, which is an important and interesting result. Producers who use aroma in their product do attempt to evoke certain perceptions in the purchasing public with those aromas. They rely on their understanding of consumer perception to generate some kinds of these purchasing behaviors. In order for that to take place, which we can argue is a good or bad thing, we have to understand what consumer perceptions are. Our work in this manuscript was intended to begin that process in a rigorous fashion. Taking out opportunities for prejudice and let the data speak for itself.

MM: So would you say a fair conclusion from this study is: "Hey, they can't smell THC and perhaps don't trust that second decimal point on the label?"

DiVerdi: Those are two separate conclusions, and I very much agree with both of them. I think it is possible to appreciate the aroma of a particular strain. And that's fine, all well and good. But don't make the mistake of connecting it to THC concentration. That would be my take home message to the purchasing public, and the second is, I wouldn't even think of using the *first* decimal point.

MM: I think that is interesting because we have this with say a wine connoisseur, who can detect all the different smells and all that, but they don't have the notion that the smell is connected to how many drinks they can have before they are drunk. It's simply the flavor and aroma profile. I am not going to say "because of this smell, I can tell" it has this percentage of alcohol. Maybe there are some misperceptions to be addressed out there, like aroma is assumed to be more

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important when it comes to that psychoactive effect. It's perceived to be important when it has nothing to do with the psychoactive effects of THC that we have studied at least. I should be careful. I want to stay away from getting assassinated by terpene fans.

DiVerdi: This would be a contentious statement. What we are talking about here will be contentious and debated hotly by many. The fact of the matter is that we must always follow the data where it leads. As a scientist my covenant is to follow the data where it leads me. I may have my own opinions but I mustn't ignore objective data and the conclusions that I reach. It just doesn't work. Our scientific method does not work if I really want something to turn out a certain way and it doesn't turn out that way. That's part of our covenant right?

MM: Absolutely.

DiVerdi: None of this says anything negative about pleasures of various aromas and love of certain terpenes, alpha-pinene, beta-pinene, myrcene, limonene or caryophyllene. Any of these are great aromas and should be enjoyed in their own right. They shouldn't impose too much on top of this would be my thinking.

MM: So before I let you go, is there anything else you would like to say about what you are doing, or XTR systems and services they provide?

DiVerdi: Well, XTR systems in involved in three broad areas; one of which is our analytic laboratory that we maintain. That provides an independent, objective, and rigorous resource to practitioners in the industry. Secondly, XTR also provides consultation given our extensive amounts of chemistry experience in natural products, and in cannabis products, in particular. We like to use a few descriptive phrases: "We provide Chemical Intelligence to practitioners in Colorado's cannabis and hemp industries", and "Once you've harvested your crop, all your problems are chemical", and "We're the ones to tell you about real chemistry because we have PhDs in chemistry." We also are interested in partnering in joint ventures for developing new products. So we apply our knowledge of chemistry to help develop new, interesting, and market-driven products in a joint venture capacity. That is something we work on an awful lot. If you have any questions, check us out at xtrsystems.com and xtrlabs.com.

MM: Great, well thank you so much for taking the time to speak with me today. I've really enjoyed it. Keep up the good work, and I look forward to see where this line of inquiry continues to go.

DiVerdi: Thank you so much for your work in your publication and promotion of these important topics in cannabis science.

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Dvorak, R. D., Raeder, C. A., Kramer, M. P., Sargent, E., Stevenson, B. L., & Helmy, M. (2018). Using deviance regulation theory to target marijuana use intentions among college students. *Experimental and Clinical Psychopharmacology*, 26(1), 29–35. <https://doi.org/10.1037/pha0000159>

We were able to speak with Dr. Robert Dvorak about his recent work. See below.

MM: It's my pleasure today to be speaking with Dr. Robert Dvorak, Assistant Professor of Psychology at the University of Central Florida. Not only was Dr. Dvorak an inaugural member of Research Society on Marijuana, he is the Vice President and co-founder of RSMj and is currently serving as the editor of our society's peer-reviewed journal, *Cannabis*. Could you talk a little bit about your research program in general as it relates to cannabis?

Dr. Robert Dvorak (Dvorak): Sure, most of the stuff that I've done, with regards to cannabis, has been associated with emotion regulation. Of course, you know I was part of our big project a few years ago, Project Most, but aside from that, most of my personal research has been associated with self-regulation broadly: impulsivity, behavioral self-regulation, and emotional self-regulation. I've been doing a similar trajectory with alcohol use, and then a few years ago, I started getting into this social psychological theory, Deviance Regulation Theory, and applied that to alcohol, and eventually, we have now applied that to cannabis both in the U.S. and a study in Egypt, which has been an interesting project.

MM: Great, how about you start by telling us a little about what Deviance Regulation Theory is.

Dvorak: It's a social norms theory. Most of the time when we think about social norms, we have this general idea that, as people's belief about a norm becomes more common, they just engage in that behavior more. So we expect some sort of positive correlation between the perceived norm and the behavior. However, Deviance Regulation Theory is a little bit different in that we can give you messages based on what your belief of that norm is, and change your behavior so that you are engaging in more of some sort of behavior even at low levels of a norm, or conversely, don't engage in that behavior even at high levels of a norm. It is based on the idea that sometimes people like to deviate from the norm rather than always fitting in. The interesting thing is that with regard to people, minority groups stand out. The norm is not what you see [as salient]. You see the one person that's not in the norm, that's a very salient group. DRT says that we can use targeted messages towards those small groups to push people or nudge people in a particular direction. For example, if you believe that no one spits on the ground and you see someone spitting on the ground, that person stands out. DRT

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says that if we want to decrease the likelihood that you will spit, we give you negative information about that person, the one person out of a hundred who spits because in your mind, that person stands out in a negative way, and that decreases the likelihood that you spit because you don't want to stand out in a negative way. You don't want to be that one out of a hundred that's standing out in some sort of bad way.

MM: Great, how have you applied this to marijuana?

Dvorak: We've done two studies, the one that was just published and another that is currently under review. We looked at intentions to use marijuana in the next 3 months. The study that we did was done completely online and we were looking at a fairly large sample of college students, almost 700, and we randomly assigned these students to receive a positive message about people who do not use marijuana or a negative message about students who do use marijuana. They completed brief assessments of their history of marijuana use and they get these messages about marijuana users or marijuana non-users. We developed these messages from focus groups with students while I was at North Dakota State University before coming to the University of Central Florida. We learned a few different things. We obtained information about how students viewed marijuana users and non-users, and used that information to develop targeted messages. Generally, the messages about marijuana users are that they are lazy, impulsive, or tend to have lower GPAs. These are not things that are necessarily true, and we actually debrief the students telling them that these are the perceptions of other students, this is not necessarily what research actually shows. Because we were using targeted messages, we didn't choose messages that would show marijuana users in a positive light. Conversely, when it came to non-users, we chose messages that would show non-users in a positive light because we are trying to be consistent with the theory. The hypothesis was that, based on your normative beliefs, the messages would have differential effects such that if you received a negative message and you thought marijuana users were rare (i.e., low marijuana use norms), your intentions to use marijuana in the future would be significantly lower. Consistent with the theory, the rationale being that if there are few marijuana users out there and they are viewed as really bad by other students, you would be less likely to use because you don't want to be seen as really bad by the rest of the student body. In contrast, if you thought that everybody was using marijuana (i.e., marijuana use was really common), then a positive message should result in lower use intentions because you could then stand out in a really positive way [if you didn't use]. If there is only a small proportion of people that are marijuana non-users, but everybody sees them as really positive people, then you think, "Hey, I can be one of these really positive people." Our results were somewhat consistent with that. We do see that at the lowest end of use norms, a negative message showed the lowest marijuana use intentions, and at the highest end of use norms, a positive message showed lower marijuana use intentions. Generally, use norms are associated with marijuana use intentions over the next 3 months.

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MM: Obviously normative interventions are common for college student interventions, largely with alcohol but now expanding to other drugs. How would you characterize DRT as it relates to typical personalized normative feedback interventions? Are these DRT-based interventions showing things that are in contrast to normative feedback interventions, or could complement normative feedback interventions?

Dvorak: Let's be honest, normative interventions are important and they've been shown to be effective, though perhaps not as effective as we initially thought. DRT brings another component into this, which is that it 1) offers a very theory-driven approach to changing behavior, which typical norms-based interventions are not all that theory-driven, and 2) it allows you to target a lot more behaviors. For example, the thing I've been working on quite a bit lately are protective behavioral strategies. Trying to increase protective behavioral strategies is difficult with typical norm-based interventions. With alcohol, if you think people are drinking 15 drinks per week, and we say, "Guess what? They are actually drinking 3 drinks per week," that is very easy and we see a huge discrepancy there. But with protective behavioral strategies, if you think people are using these strategies "sometimes," and we tell you that they are actually using them "almost always" on some sort weird scale that nobody understands, it is a more difficult application of personalized normative feedback. I think the range of behaviors that we can target with DRT is greater and opens up new avenues. I don't think it replaces norms-based interventions, and perhaps it can be an adjunct. In some of my papers, I have discussed the possibility of using norms-based interventions to push people toward higher or lower poles in terms of norms. The magnitude of the effect of DRT-based messages varies based on where you are at with norms. Let's say you're sitting at the 50th percentile and we can push you to the 70th percentile using personalized normative feedback, the DRT-based message we provide you should have a stronger effect on your behavior than if you were still at the 50th percentile. So there are opportunities to combine these two things, but for me, that's down the road a bit.

MM: Is there anything else that you want to mention about the work that your lab is doing?

Dvorak: I'll briefly mention that one of the interesting things that we're finding. With DRT, we have this idea that standing out in a good way or not standing out in a bad way is really important. However, when we have examined this in Egypt, we have actually found the exact opposite effects where the messages that target the minority group are not nearly as salient as the messages that target the larger majority group. The way we're thinking about that right now is that it might have something to do with the fact that in the United States, we are in a very individualistic culture, and Egypt has a far more collectivistic culture. The importance may not be on deviating, but instead on fitting in with the larger group. So I think that's some interesting future avenues. We're also doing some stuff with marijuana protective behavioral strategies that is similar to the work we've been

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doing with alcohol protective behavioral strategies, and I'm really looking forward to that. I think that's probably about it.

MM: Great, well, thank you for doing this, I really do appreciate it. Thanks for your service to RSMj obviously, and keep up the good work!

Dvorak: I appreciate it. This has been fun!

Marijuana Studies Published in February 2018

Allan, G. M., Ramji, J., Perry, D., Ton, J., Beahm, N. P., Crisp, N., ... Lindblad, A. J. (2018). Simplified guideline for prescribing medical cannabinoids in primary care. *Canadian Family Physician*, 64(2), 111–120. Retrieved from <http://www.cfp.ca/content/64/2/111>

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