



# REBROADCAST #343: Cannabis research: The state of the science in an age of weed liberalization

## VOICEOVER

This is Up Close, the research talk show from the University of Melbourne, Australia.

## ERIC VAN BEMMEL

I'm Eric van Bommel. Thanks for joining us. Marijuana users have been catching a break lately in parts of the world where old laws prohibiting cannabis use are undergoing review, being softened or rolled back entirely. As political momentum builds towards further decriminalisation or outright commercialization of the once evil weed, what is the state of the science regarding cannabis? It turns out we're still learning about marijuana and the spectrum of positive uses that some of its active ingredients appear to offer us. From cancer patients to epileptic children, to people in chronic pain, possibly to those suffering post traumatic stress disorder, and to others, marijuana has been shown, or at least holds promise, to yield considerable therapeutic advantage. Alongside a fuller understanding of the plusses however, there is continuing research into marijuana's minuses, particularly for developing brains. To give us a clinical researcher's view of the pros and cons of cannabis as we know them today, we're joined by Professor David Castle, Chair of Psychiatry at St Vincent's Health and the University of Melbourne. David's clinical and research interests include cannabis abuse, schizophrenia and related disorders, and bipolar disorder. He's a highly cited researcher who's published over 500 papers and co-authored or co-edited some 20 books, most recently *Marijuana and Madness*, a book which looks at the broad range of issues on cannabis use and mental illness. David, welcome to Up Close.

## DAVID CASTLE

Thank you so much for having me.

## ERIC VAN BEMMEL

Now David, we live in an era in which cannabis is still largely prohibited, seen as immoral, but that hasn't always been the case, has it?

## DAVID CASTLE

Well, cannabis has been the most widely used illicit drug in the world for many, many years, hundreds, if not thousands of years. People have tended to use it mostly for

its soporific effects and as you've indicated in your intro, there's some other psychotomimetic effects and also increasingly we're understanding some of the effects on the developing brain in particular, and especially of very high potency cannabis. So, if we look at the very long history and trajectory of cannabis use, I think that we need to contextualise that that was using mostly natural plant product, which was relatively benign in terms of its psychotomimetic - and by psychotomimetic I mean the ability to induce psychotic symptoms in individuals - those effects were much softer than more recent cannabis, which is grown hydroponically and certain strains, where are really very, very potent.

ERIC VAN BEMMEL

Before we look at the cannabis plant and its effects in some more detail, let's look at the cannabinoid properties of the human body. Researchers now know that the body - the human body - and I guess other mammals, produce endocannabinoids. Can you tell us what they are exactly, and why they're in our body?

DAVID CASTLE

So, the two main systems, cannabinoid systems in the brain, one is mediated by a receptor called the cannabinoid CB1 receptor, and the other is mediated by a receptor called the cannabinoid CB2 receptor. The CB2 receptor is largely in the body and related to immune systems, so it occurs in the spleen for example. There is some central nervous system expression of that receptor, but the most important one, or the one in which most of the psychiatric effects pertain, are through the CB1 receptor - cannabinoid CB1 receptor. There is a naturally occurring substrate for that receptor, and that's called anandamide, which comes from the Sanskrit word for ?bliss?, which I suppose speaks to some of the soporific properties of cannabis.

ERIC VAN BEMMEL

Now, this endocannabinoid system in the human body was only really discovered quite recently, something like 20 years ago.

DAVID CASTLE

So, THC, which is the tetrahydrocannabinol, which is the psychoactive property or moiety within the cannabis plant, and it's a very complex plant with thousands of chemicals in it, of course. That was synthesised in the 1960s by a chap called, Raphael Mechoulam in Israel. But, you're right that the understanding of the cannabinoid system and the expression of the receptor in the central nervous system is only a relatively recent discovery and has been now investigated over the last, say, 20 years in more detail.

ERIC VAN BEMMEL

And it seems that the one plant on earth that produces a similar compound that hits those same receptors is marijuana.

DAVID CASTLE

That's correct.

ERIC VAN BEMMEL

So we're chock full of cannabis-like molecules ourselves, these endocannabinoids, and their receptors. Let's get to cannabis itself now, the plant, and a couple of the principal compounds that give the plant its fame and reputation, and its value as well. You mentioned THC, of course.

DAVID CASTLE

Well, the two main chemicals which we are interested in, in psychiatry, I guess, the one is THC which causes the psychotic-like phenomena. Though there is something called cannabidiol or CBD, and it seems like CBD is, sort of, the softer side of the cannabis plant and it seems to ameliorate some of the effects, or buffer some of the effects of THC. Now, in the good old days, as they say, in the 1960s, natural cannabis plants would have had a relatively modest amount of THC, a matter of two to five per cent, and quite a lot of cannabidiol, so it was relatively benign. Nowadays you're seeing what's sometimes referred to as 'skunk', these are very high potency cannabis plants with very high THC, so 20, 25 per cent THC and very little cannabidiol. So, you're getting a much bigger hit of the psychoactive moiety.

ERIC VAN BEMMEL

So, this cannabidiol which, sort of, moderates the effect of THC has been bred out of this skunk, right?

DAVID CASTLE

That's correct.

ERIC VAN BEMMEL

Quite deliberately?

DAVID CASTLE

That's correct. Also, now of course, we're seeing synthetics. So, they're producing synthetic THC-like molecules and then they're basically spread onto a plant product, and they sell it, things like 'Kronic'. These are obviously very high potency because they've got no CBD.

ERIC VAN BEMMEL

Kronic is like a brand name?

DAVID CASTLE

Sure. It's one of the brands. There are lots of them and every time they get sent to the markets and then cause trouble and get legislated against, they just tweak the molecule and create another molecule. So it's very difficult to police and regulate.

ERIC VAN BEMMEL

These synthetics are effectively legal until there's legislation against them, then they're quickly changed and they're legal again, in a sense.

DAVID CASTLE

That's correct, and it's a very difficult area to try and control.

ERIC VAN BEMMEL

Now, going back to the plant though, THC, I understand is locked up in an acidic form, THC-A it's called, but you have to burn it, in other words smoke it or bake it to get the THC, right?

DAVID CASTLE

Well, you can smoke it and that's probably the most commonly used way of imbibing it, but you can eat it. So, cannabis cookies and things like that. The fact that it is smoked, often in Australia it's actually smoked with tobacco, so it carries all of those risks associated with it. It burns very, very hot. So it's associated with upper respiratory tract problems and mouth cancers and other things as well. All of the other effects?

ERIC VAN BEMMEL

Akin to tobacco.

DAVID CASTLE

Correct. But, it burns hotter than tobacco.

ERIC VAN BEMMEL

So, David, cannabidiol, that other key cannabinoid component of the cannabis plant, the one that doesn't really get us high but tends to moderate the effects of THC, can you tell us a bit more about that and its promise as an active ingredient?

DAVID CASTLE

Yes. Cannabidiol, as I said, sort of buffers the effects of THC in the plant, when it's imbibed. But there's an interest in it in and of itself because there's some studies coming out of Germany in particular, which show that cannabidiol might have antipsychotic properties. So it has been as an adjunctive treatment usually in the treatment of schizophrenia, with some efficacy and relatively few side effects. So, looking at the whole cannabinoid system in this way, I think, could not only inform our understanding more of mental illness and maladies of the mind, but also could potentially be therapeutic.

ERIC VAN BEMMEL

I'm Eric van Bommel and on Up Close this episode we're speaking about the state of the science regarding cannabis, not only the impact of its use, but also emerging understanding of its clinical value, with psychiatrist and clinical researcher, Professor David Castle. Up Close comes to you from the University of Melbourne, Australia. David, turning to some of the important medical issues that come about from sustained use of cannabis, particularly on the developing brain, can you tell us what we know about that these days?

DAVID CASTLE

There's a lot of work now - animal work, and some human work - which shows that there are impacts of cannabis on the developing brain. Cannabis does cross the placenta. It also is excreted in breast milk -- obviously those periods of exquisite sensitivity of the developing brain. There are subtle impacts of this in animal models and in humans, and they're related to things like the cortisol response. Cortisol is a

stress hormone. If you give rats in utero exposure to cannabis, they're more likely to have a high stress response, or cortisol response when they're born. There's also some transient effects on the cannabinoid receptor system itself. I should say though that you need to counter-poise this sort of discourse against the impact of other illicit and licit drugs. So undoubtedly, smoking cigarettes, nicotine has a massive effect in terms of in utero development, and alcohol of course, which is a highly available and a legal drug, has very profound effects on the developing brain and arguably much more than cannabis. So we need to counter-poise these things.

ERIC VAN BEMMEL

When we're talking about the developing brain, we don't just mean of course the sort of embryonic or infant states, but even up into one's early 20s.

DAVID CASTLE

Well, yes. One flatters oneself that the brain keeps on developing and is more plastic for longer than we thought. But certainly up to the mid 20s, and high potency cannabis use in adolescents, I think, is a real potential concern for us because there's evidence that it can impair cognitive functioning, and if you are laying down the bedrocks of your intellect and learnings in your teens, and you are using high potency cannabis at the same time, you're going to be behind the eight-ball. That's a potential real concern.

ERIC VAN BEMMEL

Can you tell us what sort of effects we're talking about?

DAVID CASTLE

Well, there's two main areas to look at: one is association with mental illness, particularly depression because that's quite prevalent. But of course, you need to look at whether this is a causal association or not, and what leads to what. It's a bit of a chicken and egg thing, but the most evidence is that depression leads to cannabis use, rather than the other way round. The other part of it is on cognitive functioning. So there's some studies from the States and the Netherlands showing teenagers who have used very high potency cannabis for a long period of time, they do have difficulties in certain cognitive function, especially abstraction and various other cognitive functions and it seems that if you scan their brains while they're engaged in these psychological tasks, their brain is having to work harder for the same result. So, as I said, it's putting these kids behind the eight-ball.

ERIC VAN BEMMEL

We're not talking about when they're stoned, we're talking about when they're NOT stoned?

DAVID CASTLE

Yeah. When you're stoned, of course, your ability to function cognitively is undoubtedly impaired and your short-term memory is impaired. But that's during intoxication. Here we're talking about longer term, more enduring effects. The other thing though you do need to bear in mind with all of these investigations is that often there's co-morbid problems associated with other drugs as well. So, cannabis use exclusively, especially heavy use, is relatively unusual. Usually people are also

smoking cigarettes and tobacco, usually also using alcohol and potentially other drugs. The other thing is that you've got to be aware that cannabis, if you're a heavy user, sits around in your brain for a very long time because it sits in the fat in the brain, and?

ERIC VAN BEMMEL

How long?

DAVID CASTLE

Well, up to a month actually. So, that if you were to be a chronic heavy user, you could be still excreting THC in your urine for up to a month after last use. So, if you really want to assess whether there's enduring cognitive problems associated, you've got to wash people out for about 28 days.

ERIC VAN BEMMEL

So, it's difficult with the co-morbidity, the use of other drugs, perhaps, or mental illness, to tease out just what cannabis, the effect is.

DAVID CASTLE

Very difficult. There's some work in fact from our own university showing that chronic heavy users of cannabis do have some subtle abnormalities in terms of brain structure, also brain function. But this is relatively small effects, and again, putting it in context, if you looked at somebody who was a heavy user of alcohol for their whole life, their brain would be much more impaired both functionally and structurally than people who'd used cannabis. That's not to say cannabis is totally benign in this regard, but just to put it in context.

ERIC VAN BEMMEL

Sure. David, outside the scientific community at least, I'd say that opinion is divided on whether cannabis is addictive or not. What's your take?

DAVID CASTLE

There's no doubt that it's addictive. By addiction, we generally mean dependence, which means that you become somewhat tolerant with the effects, so you need more and more for the same effect. Also that you get a withdrawal. With cannabis you don't get so much the tolerance, and I think that that's partly because chronic heavy users have a, sort of, plateau of it in their system all the time, it sits in the fat in the brain, and you sort of top it up with every other exposure. So you don't get so much tolerance. In fact, a lot of heavy users say they learn to use it very effectively. What you do get though is withdrawal. It's not nearly as dramatic a withdrawal as something like nicotine, but it certainly occurs. Though some of what we see in mental health units, because a lot of people coming into acute mental health units have been using cannabis. Some of what we see and interpret as psychotic symptoms, or agitation, or anxiety, is part and parcel of cannabis withdrawal syndrome, as well as ongoing psychotic symptoms.

ERIC VAN BEMMEL

Doesn't addiction also require there to be some impact on life or on relationships?

DAVID CASTLE:

There's no doubt that cannabis can have a massive impact on people's lives. There was a lot of interest in the so-called amotivational syndrome. If you give people heavy cannabis for a long period of time, you decrease their motivation. They become very apathetic. There's some nice experiments where they gave people a reward-based task, when they gave them cannabis their interest in pursuing the task to get the reward, be it financial reward or other reward, just diminishes. So it sort of becomes a 'couldn't care less' sort of attitude. That's certainly well described, and that can impact on your life also. Unfortunately, cannabis also not unusually leads to other drug use. There's a lot of debate about it as a so-called 'gateway drug', and there's some neurobiological evidence that it primes the brain in certain ways, especially if it's used early and then in high volume. Another way in which it can impact in life in general is when it leads to depression, leads to psychotic symptoms, and especially in those people who are very vulnerable to psychosis. It can also have all the other effects associated with addiction, which include you spending more and more of your money on it, it becoming more and more THE most important thing in your life, and pursuing it relentlessly and without regard for other things in life.

ERIC VAN BEMMEL

And neglecting one's relationships to some extent.

DAVID CASTLE

Absolutely, yeah.

ERIC VAN BEMMEL

You talk about psychosis, can it induce something like schizophrenia?

DAVID CASTLE

Well, we need to be careful here because schizophrenia is a serious mental illness. People often equate that with psychosis. Psychosis is a much broader term, which refers usually to the brain manifesting and the person experiencing psychotic symptoms, which are broadly divided into delusions, which are abnormal beliefs. So, usually persecution, people being against you, trying to harm you, and so forth, and hallucinations, which are abnormal phenomena, classically hearing voices. So there's no doubt that THC can induce psychosis in just about everybody.

ERIC VAN BEMMEL

Temporarily.

DAVID CASTLE

Temporarily, and it depends on the dose and your previous exposure and so forth.

ERIC VAN BEMMEL

This is aka, being stoned?

DAVID CASTLE

Yeah.

ERIC VAN BEMMEL

It's just like the term psychotomimetic effects, is the word you use?

DAVID CASTLE

Correct, yeah. The temporary - however, in some individuals, if they're more prone to psychosis, and we know that some people in the general population, so about 10 to 15 per cent of the general population would de novo experience psychotic-like phenomena in their lives. You give those individuals cannabis, they're more likely to have a more psychotic-like reaction to it. It's a bit like somebody with glucose intolerance, but not diabetes, glucose-intolerant people eating sweets. They'd be more likely to have a spike in their blood sugar than the rest of the population.

ERIC VAN BEMMEL

They're pre-disposed on some level.

DAVID CASTLE

Pre-disposed. Then to take that analogy a little bit further, schizophrenia would be the equivalent of having fair dinkum diabetes, and schizophrenia is a disorder of the brain associated with abnormalities, particularly in the dopamine systems, and we know that one of the effects of THC is to moderate dopamine, and dopamine release. So you give somebody with schizophrenia cannabis, and people with schizophrenia use a lot of it, they become more psychotic, almost universally.

ERIC VAN BEMMEL

This is Up Close, coming to you from the University of Melbourne, Australia. I'm Eric van Bommel. In this episode, we're speaking with psychiatrist and clinical researcher Professor David Castle, about cannabis, how it works, what it does to us, and how we're better understanding its therapeutic utility. David, you mentioned that people with schizophrenia will take to things like marijuana, perhaps in greater quantities than others, or more frequently. Why is that the case?

DAVID CASTLE

We've actually done quite a lot of research in this, and when you ask people with schizophrenia why they use, it seems that the most profound driver is to diminish what we would term negative affects. So, things like boredom, anxiety, insomnia, these sort of quite general reasons for use, which are actually similar to why people in the general population use. But people with schizophrenia, unfortunately for them, have more of this negative affect, partly because of their illness, sometimes also because of some of the medications we use which make them have these feelings. So, that's mostly what drives use. There's also some social conformity reasons, and some enhancement reasons. But it used to be put about that it was to self medicate and people don't self medicate the positive symptoms of psychosis, like delusions and hallucinations. Most of them recognise that cannabis actually makes that worse. But they're self-medicating the sort of negative affect symptoms, and that's really important therapeutically. So if you want to engage somebody with schizophrenia in a discussion about the adverse reactions of cannabis for them - and it makes their illness worse, there's no doubt about it, and it's associated with relapse and



rehospitalisation and everything else. The discourse needs to start with an understanding about why they're using, and we actually do have some programs looking at that, particularly to sort of hook into a discussion. Just telling people not to use without trying to understand why they use, I think is on a hiding to nothing.

ERIC VAN BEMMEL

In the general population, do we know how prevalent cannabis use is?

DAVID CASTLE

Prevalence of cannabis use varies a lot across different jurisdictions. There was a study of 16 year olds across Europe; the highest rate of use interestingly was in France, where it's about 14 per cent, I think, and in Sweden was very low at one per cent.

ERIC VAN BEMMEL

Compared to, say, the Netherlands where it's essentially legal.

DAVID CASTLE

It's about mid range in the Netherlands, and Netherlands is not dissimilar to Australia.

ERIC VAN BEMMEL

The legal drugs out there, tobacco and alcohol, are comparatively far more dangerous than cannabis, are they not?

DAVID CASTLE

Well, our government has actually done very well with regard to reduction in cigarette smoking, so we're down to about 15 per cent in the general population, which is actually very good. We still have a big problem with people with mental illness smoking cigarettes. About half the cigarettes smoked in Australia would be associated with mental illness, and about 70 to 80 per cent of people with schizophrenia smoke cigarettes. Again, probably driven by cognitive and other problems associated with the illness. But alcohol is a massive problem and, you know, if you think about it, you go to a football match, kids with you at your football match, everyone's drinking and also they're advertising alcohol. Alcohol is so available, and alcohol is a nasty, nasty drug. A lot of people can use it in moderation reasonably, but a lot of people can't, and most of the violence and aggression which we see in the streets on a Friday night are not due to cannabis. It's due mostly to alcohol and then increasingly crystal meth use as well.

ERIC VAN BEMMEL

So road fatalities as well?

DAVID CASTLE

Yeah. They are implicating cannabis in some of the road fatalities too, but as it happens, although cannabis intoxication does impair your ability to respond effectively in a driving environment. People actually are rather more aware of this and will tend to slow down or take aversive action. Alcohol has the opposite effect, it makes you sort of more, as they say, face the traffic with confidence. You go out and you tend to speed and you tend to be more likely to jump red lights and so forth. Of

course, speed - or crystal meth, is one of the variants - that really leads to very bad driving behaviours.

ERIC VAN BEMMEL

Does it?

DAVID CASTLE

Absolutely. Because you're sped up and revved up and I mean, the scariness of thinking about how many long haul truck drivers are using variants of amphetamines?

ERIC VAN BEMMEL

To stay awake on the long haul?

DAVID CASTLE

Yeah.

ERIC VAN BEMMEL

In the United States annually, 560,000 people die from tobacco and alcohol, if we group those two together. We don't really have any figures on cannabis related deaths, do we?

DAVID CASTLE

No, and it's difficult to see it apart because, as I said, cannabis use is often associated with other things, tobacco smoking, alcohol and so forth. But the other side of this, which we haven't spoken all that much about, is the medicinal uses of cannabis. You alluded to this in your intro, and I think it's a bit unfortunate that this drug, which has very profound effects on the brain and can undoubtedly be useful medicinally. So you mentioned pain syndromes, nausea associated with cancer, spasms associated with multiple sclerosis. These are horrible for people, and for them to be able to use cannabis in a medically controlled way, I think is something which we really should be exploring with a much more open mind, and not be as distracted by the potential adverse consequences associated with the mental illness problems.

ERIC VAN BEMMEL

Does medical marijuana actually present a credible alternative to conventional drugs for these various applications?

DAVID CASTLE

Oh yes. We use drugs, like opiates, which are highly addictive, and cannabis could come into the mix in a similar sort of controlled manner in my view. The other thing which is not spoken about all that much is the environmental benefits of cannabis. You can breed strains of the cannabis plant which has pretty much zero THC, as they say, you can smoke a whole field of it and all you'll have at the end of the day is a headache. It's very easy to grow, it doesn't take much rain to make it grow, it can be a substitute for woodchip and various other things.

ERIC VAN BEMMEL

Hemp? [Hemp clothing for example].

DAVID CASTLE

Yeah. Well, it used to be used for all sorts of things, soaps, all the sails in the world used to be made out of hemp. I think it's rather tragic that we're logging old growth forests and making woodchip out of trees when we could be potentially growing cannabis in a controlled manner, cannabis without any THC, and using that instead.

ERIC VAN BEMMEL

David, as I indicated earlier, cannabis is being decriminalised, or fully legalised, commercialised in parts of the world. We're seeing in the United States in particular, recreational use is now legal in four states. That will probably grow. Medicinal use is legal in 23 more states. There are marijuana start-ups. There's now Willie Nelson and Bob Marley branded, trademarked marijuana, ready to go for when this commercialisation hits big time. I guess that leads to the question, if it's going to get easier to get - become normalised in society - are we going to see more cannabis use? Are we going to see addiction perhaps skyrocket?

DAVID CASTLE

Well, I wouldn't like to see a situation in which we're advocating cannabis use to people in the sort of way in which you are indicating might occur. But if we take a step back from that, sort of, free marketeering, if you like, and profit making, you could again make the point certain foodstuffs are extremely bad for you but are marketed and readily available. Alcohol, as I said, is very strongly marketed. Again, I think there needs to be more consistency of approach around these things. We should probably respond to this sort of question by looking at the experience in other countries. So, the Netherlands is the obvious example. There wasn't a massive increase in use after it was made more available, and it's made available in a fairly restricted manner. You also know what you're getting. So, if you go into the coffee shop in the Netherlands, you would know what you're getting and you know how much THC and how much cannabidiol is in the product which you're getting. It carries all the health warnings, and all this sort of stuff. It seems that there might be some benefits to that in not leading people to get involved in the sort of underclass of drugs and illegalities which can often, if you're scoring cannabis, you can also be introduced to other drugs. Whereas if it's a more controlled sort of environment, you can get away from that potential risk, to some degree at least. Also, it could be, as is the case in Australia with tobacco, very highly taxed and regulated, and there obviously should be this, to my mind anyway, the same caveats around its use, certainly as a smoked product, that you can't do that in public places because you've got passive smoking and all of those issues which go on. People need to be very aware of the potential risks associated with cannabis use, as they need to be aware of the potential risks associated with alcohol, and we don't do that well enough, I don't think, with the potential risks associated with certain foodstuffs which have additives and have high sugar loads and are really, really bad for you. I think that we need to be much more pushing public awareness across the board with regard to these things, rather than having very mixed approaches where some things are vilified, like cannabis, and other things are actively promoted, like alcohol. Alcohol is

a nasty bad drug when it's used in excess. It really is.

ERIC VAN BEMMEL

We've got now a chance, now that we're on the cusp of fully liberalising it, if trends are to continue with cannabis, to get the social engineering right, where we haven't perhaps in the past with junk foods and alcohol. Just finally, David, cannabis research, it's ongoing obviously. There's some promising stuff out there. I've read recently, in Spain they're looking at the potential of using cannabinoids to retard the growth of brain tumours for example. Canada is considering a clinical trial on testing medical marijuana for military and police veterans with PTSD. I've read about heroin addicted rats given cannabidiol; it decreases their willingness to work hard for heroin, which may have some application for human heroin addicts. A lot of promising stuff out there. I'm sure there's a lot more. But, remember that marijuana, it's got a stigma attached to it. It's immoral. I imagine it's hard as a researcher to pass ethics committees to even access material. What are we to do?

DAVID CASTLE

I think this touches on a very important issue, and I've written elsewhere, it's unfortunate that the medical investigations and psychiatric investigations of the potential benefits of marijuana gets lost in the political furore and the public perception and almost stigma against the drug. Look at the opiates, I mean they're nasty addictive drugs in many ways, but we use them in a controlled manner and they are regulated and so forth. We could have a similar thing. Certainly we'd need to do much more research in this area. I mean, we are still not very good at treating a whole lot of things like chronic pain syndromes, a lot of mental illnesses, posttraumatic stress disorder you've mentioned, sleep disorders. A lot of these things, if we can investigate them properly and we could make cannabis or cannabinoid derivatives available in a controlled and sensible way, that to my mind would be better than people just doing it themselves, using a plant product which is now very difficult to know what's in it, and using it in a very uncontrolled way and without proper education around it of the risks associated. I think that we really need to take another look at this.

ERIC VAN BEMMEL

Professor David Castle, thanks for being our guest on Up Close.

DAVID CASTLE

Thank you very much indeed.

ERIC VAN BEMMEL

We've been speaking about cannabis use and abuse with Professor David Castle, chair of psychiatry at St Vincent's Health and the University of Melbourne. For a full transcript and more information on this and all our episodes, head to the Up Close website. Up Close is a production of the University of Melbourne, Australia. This episode was recorded on 20 May 2015, and produced by me, Eric van Bommel. Audio engineering by Gavin Nebauer. Up Close is created by Kelvin Param and me. Thanks for joining us. Until next time, goodbye.

## VOICEOVER

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