MIND FOUNDATION

Does microdosing LSD influence perception of time?

DATE PUBLISHED

28 September 2019



The Paper Discussed In This Interview Is:

Yanakieva, S., Polychroni, N., Family, N. et al. The effects of microdose LSD on time perception: a randomised, double-blind, placebo-controlled trial. Psychopharmacology 236, 1159–1170 (2019). https://doi.org/10.1007/s00213-018-5119-x

Lukas: Could you tell me what it was that drove you to study altered states of awareness, like synesthesia, hypnosis, or the psychedelic experience?

Devin: I think the starting point is that I became interested in hallucinations during my undergraduate, particularly in non-clinical populations. Then I was fortunate enough to take a course on hypnosis by a really excellent person, Jean-Roch Laurence1. So then I studied suggestion and hallucinations during my Master's and then my PhD was focused on the cognitive neuroscience of hypnosis. I was always interested in various other aspects of altered states and anomalous experiences, so I did a little bit of synesthesia research during my PhD. Then I became a research fellow in Oxford and the focus there was on hypnosis and synesthesia, but I was always very interested in time perception.I feel that time perception is a really fundamental feature of conscious experience.

So, I did my undergrad in philosophy and one of my absolute favorite philosophers was Martin Heidegger. Heidegger wrote, in my opinion, one of the most brilliant philosophical texts ever, "Being and Time", in which he basically makes a really fundamental series of arguments on how critical time is for human experience. That was something that always kind of stuck with me, and when I was doing my postdoctoral research fellowship, I started doing more time perception and moved away from synesthesia research a bit.

I became interested in psychedelics primarily through my interest in synesthesia. Later I was contacted by the group that was running this microdosing study about being a consultant on a certain feature of the study. I asked them if there was any opportunity to include a time perception task directly inspired by this nice classic study by Marc Wittmann4, which showed that psilocybin led to a tendency for people to under-reproduce temporal intervals in a temporal reproduction task. So that was the origins of this particular study and that's kind of how it all came together.

Lukas: Perfect. Could you give our readers a short summary of the study, and explain your main findings?

Devin: Sure! So, based on Marc's2data, we had fairly good evidence that psilocybin leads to under-reproduction of temporal intervals, particularly longer ones, but we were interested in whether that effect would still be present with microdosing.

So specifically, we were interested in the question of whether the effects of psilocybin in Marc's study are attributable to the direct neurochemical effect on time perception versus psilocybin triggering various types of altered states of consciousness that then have an indirect or a subsequent carryover effect on time perception. Basically, the question is if the neurochemical effects are sufficiently strong to elicit a change in your perception of time even though it doesn't actually produce altered states of consciousness.

In the study we had 48 participants, they were elderly individuals so that's an important kind of confound that needs to be acknowledged. There was a placebo condition and 3 microdose conditions of 5, 10, and 20 micrograms of LSD. So when the participants completed the task, we also had them complete self-report measures of various types of subjective states. The ones that we looked at were whether they felt any kind of drug effects, any perceptual distortions, any unusual thoughts, any experience of feeling high, and whether they felt a change in attention.

What our results seem to suggest is that the participants had a sense of feeling a little bit different – like they're picking up on something. But they didn't have perceptual distortions or unusual thoughts, they didn't really feel high per se, and they didn't really notice any changes in their attention. Based on this, it appears pretty clear that there's no kind of pronounced altered state of consciousness under microdosing.

Then the principal result we looked at for the temporary production task was median reproduction times. So basically, how long the participants would hold down the space bar after encoding a stimulus interval of a circle that's presented on the screen. That gives us an idea about the extent they're under-reproducing or over-reproducing which in turn can provide us with an indirect measure of the extent to which they're underestimating or overestimating the stimulus interval. We used a wide range of intervals from 800 to 4,000 milliseconds. Marc Wittman in his study only found effects for in the range of about 4,000 milliseconds onwards. We found that when you compare the three LSD conditions versus the placebo, the participants would over-reproduce the intervals. So they would hold down the space bar longer when completing this task than the participants in the placebo condition.

Interestingly enough, the effect was only present for 2,000 milliseconds onwards. Now, there's a number of different ways of interpreting these data and I should say that I'm not firmly committed to any particular interpretation given that it's early days in our understanding of these effects. In the paper we briefly entertained a number of possibilities and suggested that given how far after they had received the dose it might be a late-phase dopaminergic effect. This idea is based on animal studies that suggest that there's an early phase where LSD functions as a serotonin agonist and then a later phase where it functions as a dopamine agonist. We were never completely satisfied with that interpretation, however.

As I've thought about these data a bit more, I've begun to think that these results might be better understood within the context of Bayesian models of interval timing. Essentially, these models stipulate that our perception of time arises from sensory information regarding a stimulus that is shaped in part by priors, which we form from the statistics of our environment. The extent to which the prior influences our perception is referred to as "prior weighting". Prior weighting or de-weighting will be greater in certain individuals or may differ across contexts, psychedelic states, and so on.

Prior weighting, more generally, provides an elegant explanation about how our expectations can often shape our perception. Applied to temporal reproduction tasks, the prior would be the mean stimulus interval. An interesting consequence of prior weighting is that longer stimulus intervals are under-reproduced because the prior draws the reproduction time closer to the mean whereas shorter intervals are over-reproduced, again, drawn closer to the mean. This account provides a very nice explanation of a classic effect in the time perception literature: Vierhordt's law, which is that we tend to over-reproduce shorter intervals and under-reproduce longer intervals. If we apply this type of account to our data, a simple interpretation is that microdosing produced a tendency to down-weight priors, that is, reduce their influence. This then led participants to over-reproduce long intervals. That may also explain why the effect is restricted to the longer intervals.

If this interpretation is true, microdosing should have also led to under-reproduction of the shorter intervals. Interestingly, there was a very weak tendency for this to occur although it was nowhere near statistical significance. What makes this interpretation even more interesting is that it aligns very nicely with a recent model of psychedelics by Carhart-Harris and Friston, which proposes that psychedelics produce a down-weighting of high-level priors3. For anyone that is interested, I presented this newer interpretation of our dataat Breaking Convention in August.

Lukas: You already mentioned Marc Wittmann's study on time perception and there was another study by Wackermann et al.4that you also cited. In this study they also found under-reproduction of time intervals in a very low dose of psilocybin compared to a placebo condition. How does that fit in with your results showing an over-reproduction with a low-dosed psychedelic?

Devin: So there is a bit of an inconsistency across the studies. I don't have any concerns about it being an artifact or anything like that. In terms of why there's a discrepancy: There might be differences between psilocybin and LSD of course. I think a lot of people just put them in the same camp all the time I think that's something we want to be careful of. Another argument is of course the level of the dose and how comparable these doses are across the two different drugs. The third would be the possibility that there might be different phases with LSD but not with psilocybin. Lastly, I believe their test was conducted 60 to 90 minutes after dose, whereas our testing took place almost three hours after dosing.

Lukas: Another thing that you mentioned in your paper is that this over-reproduction was the most pronounced at a 10 microgram dose. Could you say why you think this dosage would produce the biggest effect?

Devin:I wouldn't want to say much about that to be honest. Again, this gets back to this issue that we basically have 12 participants in each condition which is actually pretty good for a psychedelic study but it's not super sensitive. I wouldn't overinterpret the fact that the effects are most pronounced in the 10-microgram condition.

One possibility is that because we don't have baseline effects that we just randomly ended up with a few people in that group that have a baseline tendency for over reproduction and that they just started a little bit higher and then the LSD effects are uniform across the different doses. Because if you look at that figure what

we tend to find is that the 20 microgram tended to almost always be higher than the 5 microgram, hinting at some dose effects there. But they might have been disrupted a bit by potential baseline differences.

If you follow the Bayesian model outlined above, focusing on the reproduction times might not be the most valuable way to look at the data. Rather, according to such an account, with greater prior de-weighting, you would expect that the slope of the reproduction times would become steeper (again, reflecting over-reproduction of the longer intervals and under-reproduction of the shorter intervals). Interestingly, we analyzed the slopes of the reproduction times and found that the slope was indeed steepest in the highest dose. Again, we have to be careful given the sample sizes, but this suggests that this interpretation might be more parsimonious.

Lukas: How has conducting this experiment influenced your opinion on microdosing as a practice that supposedly induces all kinds of psychological benefits?

Devin: I don't think this study has really informed my opinion on that per se. I think it does provide a good starting point for indicating that there do seem to be some effects on a fundamental feature of consciousness which is time perception. Nevertheless, we have to be careful because time perception is intrinsically linked with attention and working memory and other types of core cognitive functions and it is possible that these effects are totally attributable to changes in attention or working memory. It's theoretically possible that we are basically modulating attention or working memory and that's having subsequent kind of carryover effects on time perception.

Now in terms of microdosing more broadly: Probably due to my background in philosophy, I'm by nature a very skeptical person about everything I hear about in science, and I am consistently bombarded with very strong claims and it makes me very nervous. Personally, I wouldn't just start microdosing in the hopes of enhancing my creativity or cognition or something like that without any kind of evidence base to back that up.

I doubt that there's going to be like any negative or harmful effects of microdosing. It's probably going to be, for the most part, harmless. But I think that people just generally should be more skeptical and not jump on some kind of random bandwagon or craze when there's little empirical base for it. As a scientist I try to base my decisions on the empirical evidence in front of me, and what I can say is I think microdosing is sufficiently interesting from a therapeutic and cognitive standpoint to be conducting more multi-faceted research on.

I'm certainly excited to see more research and I hope that I'll be able to be involved in some of it, but it always depends on what kind of opportunities arise. I'm hoping that we'll get a chance to do further research on either microdosing, suprathreshold or even psychedelic doses of these drugs.

Lukas: If you could do whatever you like, what would be your next scientific project?

Devin: The ideal study I would like to do, if practical limitations were not in place, would again involve a temporary reproduction task. Have the participants complete a task at baseline and then have them complete the task approximately every, say, 45 minutes and go up to in the range of maybe about at least three or four hours and to see the effects there. But I would also do it at multiple microdoses as well as psychedelic doses, so that way we can then dissociate the dosage effects.

Also, I would do a more systematic investigation regarding self-reports of altered states of consciousness. Attention is one thing; we also don't have any information on emotion. Emotion is known to impact your perception of time, so basically when someone is elated, they may experience time as passing more rapidly and they might underestimate time, whereas if somebody is very depressed then time tends to kind of drag on. I would probably ask some questions about mind wandering and attentional lapses, as well. If we did that

we could compare psychedelic versus microdoses and we'd also be able to explore these different phases of the drug and potentially be able to say something more intelligent and more informative regarding if there is robust evidence for these different phases or not.

Also, the self-report measures would be able to tell us in a more systematic way to what extent these effects might be attributable to some type of alteration of consciousness. I feel pretty confident that they're not attributable to an altered state, but I wouldn't rule that out completely because we only got to measure a few different dimensions of conscious experience. The effects seem to be independent of the ones we measured but of course we didn't measure everything; so, there's a number of things that are unexplored.

Lukas: One final question: We have a lot of students reading the blog, can you give any advice to students looking to work on altered states of consciousness?

Devin: Working in these fields, I think that you're at a disadvantage in terms of getting a job and staying in academia, so I think that you have to overcompensate perhaps by publishing more and maybe getting a bit luckier. Nevertheless, I think it's all about the supervisor and the environment, so anyone that wants to work in these fields should identify a passionate supervisor. Someone who works in the field and can provide appropriate mentorship.

I think there's also something to be said for doing some mainstream research alongside this type of work to have a kind of a proper grounding in in other research areas. My PhD was on cognitive neuroscience in hypnosis but in the context of that I did a lot of work on executive functioning and cognitive control and a lot of the work I do on time perception is concerned with more conventional aspects of time perception. I think it can be a bit dangerous if you're working solely on fringe topics because of how you might be perceived by your colleagues. However, beyond all else I tell all my students that it's critical to identify something you're passionate about and then pursue that!

References:

1. Jean-Roch Laurence:https://www.concordia.ca/artsci/psychology/faculty.html?fpid=jeanroch-laurence
2. Wittmann M, Carter O, Hasler F, Cahn BR, Grimberg U, Spring P, et al. Effects of psilocybin on time perception and temporal control of behaviour in humans. J Psychopharmacol. 2007 Jan;21(1):50–64.
3. Carhart-Harris RL, Friston KJ. REBUS and the Anarchic Brain: Toward a Unified Model of the Brain Action of Psychedelics. Barker EL, editor. Pharmacol Rev. 2019 Jul;71(3):316–44.
4. Wackermann J, Wittmann M, Hasler F, Vollenweider FX. Effects of varied doses of psilocybin on time interval reproduction in human subjects. Neuroscience Letters. 2008 Apr;435(1):51–5.