

**Supplementary information**

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**Deep posteromedial cortical rhythm in dissociation**

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In the format provided by the authors and unedited

## Supplementary Note 1: Clinical interview with epileptologist.

Seizure description.

PATIENT: “It would probably be better to just let you know right now that there is also a beta component to my spatial disorientation where like if you were to spin me around I would lose what is up, what is down... just throwing that out there.”

EPILEPTOLOGIST: “If I spin you around...”

PATIENT: “If I was sitting in a chair that could spin and you were to spin that chair in any direction, I would lose my understanding of ...”

EPILEPTOLOGIST: “Were you born like this?”

PATIENT: “ No, I had a very slow seizure a few days ago and it was one the most interesting experiences of my life. It was like - kinda like this, imagine if you were just like stretching it, it was not more intense, but because I can think through my seizures, I was able to experience the whole seizure slowly... it was really cool”

EPILEPTOLOGIST: “ Because you are also on medications as well, that could probably ... so what happened?”

PATIENT: “So I, the first thing I noticed was that it felt like the whole world (again, I am going to use those 6 degrees of freedom I was talking to you about... so the three spatial dimensions and then beta x, beta y and beta z), I could feel them move and then the next thing I knew, I was feeling the emotion or feeling of where in this 3D space am I? And I went through the feeling of the process very slowly of refiguring that out, but it was like listening to another conversation in my brain.”

EPILEPTOLOGIST: “Tell me more”

PATIENT: Laughs, “I really enjoyed it... um, it was kind of like, um, the experiencing, like you know, ok, there are ... I am just going to describe it like a computer because that is the best way that I know how to describe it.”

EPILEPTOLOGIST: “Yes, sure, sure”

PATIENT: “Imagine there are these two ICs speaking with each other, two components, right, but there is one data buff. Are you familiar with a data buff?”

EPILEPTOLOGIST: “I wish I were familiar, but no, consider me a complete idiot”

PATIENT: "Alright, what it does is that there is this one information highway (and what it does...) and I want to speak with this component x, y and z. A and B are speaking, but they can only speak amongst this information highway that the CPU is always able to listen to. So I am listening to A and B speak with each other to try to figure out what the hell is going on and as a result, I am listening to this conversation, the CPU is trying to figure out .... maybe I don't know what the "me" is, I don't know what that means necessarily, I personally don't believe in the idea of a soul, personally, but you know I was aware that I was listening to two parts of my brain speak to each other in a way that a third part of my brain, which I considered me, was able to listen. And what that felt like was this, it felt like a depersonalization, if you were to say... my friend asked me this recently, what would it feel like if someone else were to come into your head? That is exactly what it felt like... what I considered me shrank to this other part of me where the other parts of my brain that were talking, I stopped considering them me"

EPILEPTOLOGIST: "Interesting."

PATIENT: "So, that's why, for example, I took a blanket because I was interested in what was going on - I threw it over my body, just to see, because I knew that when I don't feel it, I don't consider it me and immediately my legs were no longer a part of me, in the way that that part of me was thinking, that part of my brain that I considering me was thinking so it was kind of like I was closed off, but I could hear the conversation - just like if you two were talking and you were saying "No we're upside down" and she was saying "No we're left side up", you know, I was listening to that and getting information that you two could not get so that's why I would do things like grab or throw something so that these two could say "oh look that just fell" and to try to convince them that what I am getting from here... it was really weird, but I thought you would find it interesting."

## Supplementary Note 2

One characteristic of seizures is increased synchrony. While the ketamine-induced rhythm involved increased synchrony in neuronal firing, the initiation, spread, maintenance/termination, and behavior were distinguishable from typical seizures. Seizures display abrupt transitions in activity at onset and exhibit uncontrolled, variable duration; in contrast, the ketamine-induced oscillation emerged gradually over 2 minutes and decayed reliably and predictably over ~15 minutes (Figures 1, S1). Moreover, while seizures spread from the focus to other areas and across layers<sup>1</sup>, the ketamine-rhythm did not spread beyond layer 5 neurons in retrosplenial cortex—neither to other layers nor to nearby cortical regions; cells at the periphery of the retrosplenial cortex were not recruited later, and ketamine-induced activity did not spread laterally to visual cortex, and no rigidity, convulsive movements, absence-like states, or salivation/rearing/falling were observed in response to dissociative doses of ketamine.

1. Wenzel, M., Hamm, J. P., Peterka, D. S. & Yuste, R. Acute focal seizures start as local synchronizations of neuronal ensembles. *J. Neurosci.* 3176–18 (2019). doi:10.1523/JNEUROSCI.3176-18.2019