

David Rosenboom

David Roseboom produces brainwave music during the conversation. Each "*" indicates a brainwave measurement either above or below the set range of 8 Hz to 13 Hz.

So ah could you just describe the circuit here which is established to produce alpha waves and music?

Okay. This is a fairly simple one to one set-up in that this brain wave monitor is amplifying the pulsations that occur on the scalp that are the results of millions of tiny impulses that are circulating in the head. And when alpha appears, which is simply defined as the presence of energy in the frequency band of about eight to thirteen cycles per second, a voltage appears which corresponds to the strength of the energy in that band. If there is a significant amount of pulsation in that frequency, it means that large number of neurons in the brain have synchronized * themselves. That is they've gotten in phase, in step.

And the results of all of the summation of these synchronously moving pulses is a pulsation of about ten cycles per second on the surface of the brain. And as that appears, it makes the tone that we heard appear more pure or more like a sine wave with fewer harmonics. And the less alpha there is, the more harmonics * and the more impure the wave form. * So, as a demonstration it simply allows you to follow the changes of level of the amount of alpha and therefore the amount of synchronization in that frequency range. *

So, you can just control yourself in producing more, and more, alpha, and recognizing these frequencies.

The first step in this kind of biofeedback paradigm is usually to try to produce more. And that's of course effected by notions * of nineteenth century progress, that the idea of feedback is to make more of something. But that isn't the object. It's useful to try and make more in order to try to isolate and identify or subjectively identify and tactilly physiologically identify a feeling which is associated with it. But after you have made that association, it's not necessarily * always desirable to produce more. Then the emphasis is on agility, or the ability to move in and out of various bands or various kinds of configurations. I think that....

It at first more shifts you to a state of more relaxation, that of the alpha state.

Yes, it's definitely. There are a number of ways you can look at the information you get. One of the things I'm trying to get away from is reliance on terms like "alpha waves", "beta waves" and "theta waves", which have rather arbitrarily set definitions. And what I'm looking at really is the existence of coherent phenomena or the existence of regularly pulsing energy, whatever its frequency happens to be or whatever combination of frequencies happen to be present. *

And it's related ah to a continuum that goes something like this. If there is a lot of highly synchronous activity on the scalp, it indicates that the nervous system is prepared to act or is set to act in a certain way, in a certain modality. But it's not at that precise moment involved in focusing its activities on any one action or any one sensory perception. So the

higher the frequency of this pulsation * the more it seems to relate to a propensity for the nervous system to react in a very quick, logical, fast manner, very efficient.... things like doing mathematical calculations or making very quick decisions. Ah, that is if it's coherent. If it's random high frequency energy, it relates more to things like hypertension.

Then as this frequency decreases.... And now I've been talking about high frequency beta activity which is usually between eighteen and twenty-five cycles per second....

When it slows down to the alpha range, it generally indicates a kind of um nonspecific arousal or a state in which one is active, attentive, very very attentive in fact and very conscious of the presence of anything in the environment. But one's not focusing on particular abstractions or particular objects of * attention. It's very much like kinds of activities in various kinds of Zen meditation exercises.

Then as the frequency gets even slower, * towards what's called the theta range, around four * to eight pulsations per second, (cough) it relates to more, to deeper relaxation, more yogi types of deep muscular relaxation and daydreaming and very, very extremely calm, less aroused. Then as it gets even slower, in the delta range, which is even below four * pulsations per second, ah one sees phenomena that only normally occur in states that we would call unconscious.... states like deep, deep sleep or anesthesia or types of hypnosis.

Then that summarizes the kind of regular pulsation that happens. But of course ah contained in the brain signal are also things like the background randomness of the universe and quasi-random phenomena which are really weighted sums of all of our activity, of all our activity, of all our history and development. And then there are short-term phenomena, which are transient and which do not repeat, and which relate to specific focus, either of attention or of action. And those transient phenonema can be analyzed, and a great deal of the information about very short-term functioning can be extracted.... like how one is processing sensory data, how closely it relates to ah stored images of things, ah the illicitation of imagined events and so on.

So you're going to develop the youngest technique of practicing meditation then? You just go on with your project now to find qualities you find in analyzing the response patterns to stimuli like (claps hands loudly)

Right. * Right. It became very clear that at one point in the history of this that that ah as long as all we were doing was demonstrating a phenomenon in a piece which might be a performance like what we just * demonstrate, ah it's interesting at first. But it doesn't for the spectator go very much beyond the intriguing aspect of making an electrical connection to the head. And ah beyond that it really is an internal experience for the participant only, and ah (cough) or predominantly.... which is an inherently nonsocial viewpoint.

It was a necessary viewpoint to take at one point in the early stage, because it's important like in any process of self-realization one has to go inside and find out things about his own

functioning. Ah ah but then he has to turn around and reintegrate this new knowledge with his context. And that's what we're trying to do now, by ah ah finding ways. Ah, I decided at one point that I needed to stop doing pieces that were this kind of demonstration really and ah.... except in a context where what one's really trying to do is present information, and then ah see if it's possible to extract much more meaningful information from the wave forms.

Are these meaningful qualities concerned with states of emotion? Which categories do you try to find out?

Okay, there are a number of broad categories. * Ah one group is when we look at the general state of the brainwave, we can relate it to things like ah expressions of emotion, ah ah ah a general state of being of the individual. When we look at more specific phenomena, we can look at things like how these states of being ah contribute to one's.... the very practical aspect of one's functioning in an environment, how he processes information, may exist one way in one state of consciousness and another way in another state of consciousness. But these two process lead to the building of very different images about the world.

So what do you expect when the project is finally done? How do you use the qualities that you find um ah to shift people into states of relaxation or a condition of being themselves or whatever? Do you use the system as a kind of homeostasis ?

YES, using it for kinds of homeostasis which essentially tend to stabilize things, either for * purposes of achieving a state of being or for purposes of looking at something and examining it, is very much a part of it. What we're doing right now is building a very large catalogue. Ah, I was inspired by the work of MANFRED CLYNES, who suggested the building up of a dictionary of essentia forms, which he describes in his writings and have to do with the relation of physiological events to qualities of expression in music and in language.

hm

And I've tried to extend the idea into these things. So that we will have ah a catalogue of events that relate to say expressions by an actor of say grief or of joy, and will relate to the processing of information. THEN that's just the information, and how we use it is what's important. So, what I've tried to do is develop a way of researching just exactly what the usefulness of all this really is. And that means, the way I've tried to go about that is to find a way to establish groups of participants drawn from the community of both artists and nonartists in various locations across the country.

And what these groups will do is to take sections of this dictionary and through ah discipline practice explore what the experience is like. So that in hopes that there will be a fallout of knowledge, let's say, that may not depend of technology, which I hope that might then be useful for others to apply in various kinds of group dynamic situations, where we're interested in accessing more communication. *

And then there are many things of course which are individually specific, that is things that

repeat themselves within a given individual but don't necessarily repeat themselves across individuals. However, that's still useful, ah especially for that particular individual. And that's why the instrument that we're building ah is designed really to be able to start from scratch, and look at every person from a pattern recognition viewpoint, and develop an analog in its output, which is in this case music, or the patterns which it finds coming from that person. So, the information is shown to him, and he has this unique map, which is an analysis of a broad range of his functioning.

So could you describe the details of the group application?

um, the immediately obvious thing is making music. Another ah ah possibility is exercises that may be developed that promote group communication on a very high level, synchronous activity of that kind of high gamelan consciousness that you might associate with improvisation. Then, ah also the development of exercises just for personal growth.

For example, here's one exercise that was discovered to actually be as enhancing for the production of alpha than any machine that I've ever used. And that is simply first of all teach someone to concentrate on his ringing patterns in his ears, which ah are closely allied to the color patterns one sees when he closes his eyes. Most people don't listen to them because the environment is so noisy. But if you do, then it becomes a rich chorus of sound. * When meditating on these sounds, they grow to be very stable. However, when you open your eyes suddenly, you notice that these sounds will suddenly disappear and then come back slowly, because when you open your eyes, you are involved in in ah objective perception, which means a separation of you and the object of perception. And that causes a decrease in the sound. The exercise then is very simple. It means just to first listen and establish these sounds and then learn to open and close your eyes in such a way that the sounds stay absolutely stable and do not disappear.

One thing we've done is taken method actors and ask them to produce a cycle of recurring emotional expressions, like take a cycle of four or five, like love, joy, grief, ah * whatever. And then ask them for certain specified intervals of time to express the best way they can do this emotion, and then move to the next, and then move to the next. And what's happening is, that the computer analyzes the wave forms, and on the end you have an average of the kinds of states of, the way in which the nervous system environment for the psyche lives in changes. * And that would be something which would be contributed to the catalogue. But what happens then is, in complex situations you see something which recurs that relates to a past * experience. And it helps to elucidate the new experience. * And so in this way one tends to develop exercises * or patterns that are quite useful. * hm

*Do you think that these exercises could replace the wide-spread use of drugs * or alcohol ?*

I would think yes, that many of the applications could lead towards more methods. Of course we have *But I would never say, that * all one has to do is buy an alpha-machine, and then he no longer needs drugs or anything like that.

Because the * thing about feedback is that all one does is provide information. The application to which one puts the feedback, or how he uses the information to change * the * input, the original structure * is entirely individual. * But I certainly do believe * that many of these techniques * could certainly replace at least psychological dependence on * certain kinds of drugs. * And I think that's a positive step. * *

Ya To ah get more * precise information about the project you're doing in your laboratory * for Experimental Aesthetics now. * Could you just describe the way * towards finding these qualities? I see that you have an interdata * computer, a teletype, a Buchla synthesizer, and yourself, hahaha.

ahhahaha

And you have your electrodes * on, and we just listen to sounds made by your brainwaves. So how do you interconnect this layout here to get brainwave feedback? What is your research method?

The mechanics of the research. Yes ah, well, we're using vast amounts of technology right now, as * you can see. Ah, that's something which I think sort of gives a certain responsibility to those who possess it to try and use it to * develop things which don't necessarily depend on it. But I am in the process now of developing an instrument which is two things. It's a research instrument, which is ah * capable of analyzing brain signals in great detail. It uses an * Interdata Model 74

minicomputer, which is interconnected to ah electronic music generating equipment, which ah is designed by DON BUCHLA and myself, and brainwave data conversion equipment.

Now, the computer is capable of dealing with compositional language, that is the defining and developing of musical relationships of the type that one deals with in transformational grammars and ah ah generation of syntax, let's say. And then the hardware interface to the electronic music generating equipment ah essentially is hardware designed to remove from the computer those kinds of calculations which take enormous amounts of time, so that it can be done economically. And ah an interface between the compositional programs, and programs which are used to set patches, make settings in synthesizers, and generate an arbitrary number of arbitrarily complex functions, is being constructed.

Then, on the input side the brainwaves undergo a FOURIER analysis, which does things like extract correlations between brainwaves, autocorrelations of the single brainwave, which is a way of producing an average or characteristic or prototype of brainwaves. And then that information is fed to the computer. And then the computer essentially deals with discovering the order that exists. So the tendency is away from randomness in the brain signal, and then composing essentially. And so it's two things. It's an analysis instrument, and then it's a straightforward, simple instrument, which for me is like a highly personal paintbrush.