

**RESEARCH ARTICLE****No such thing as virtual reality!****Author**

G.J.F. de Haas

Neuropsychologist, NAR-Lab The Netherlands

Email: [haasgjfd@nar-lab.eu](mailto:haasgjfd@nar-lab.eu).**Abstract**

Telemedicine is used more and more in health care. To be efficient, several aspects that treatments depend on, such as client – therapist relation, have to be applied in a virtual context. As it appears our brain can be very easily fooled. Step by step basic principles of the brain, such as feedback and feedforward mechanisms, general pattern generators, integration of cortico-lymbic loops and consequences for usefulness of Telemedicine will be discussed. The overall conclusion is that the human brain is very well suited for treatment through Telemedicine.

## 1. Introduction:

### 1.1 Telemedicine and scope of the article

Medical Health Informatics (MHI) is used more and more in research and treatment of patients. One form of MHI is known as Telemedicine (or Telehealth). Telemedicine applies to the 'the distribution of health-related services and information via electronic information and telecommunication technologies'<sup>1</sup>. In this article I will discuss the basic neurological background of the systems that are needed to make use of Telemedicine. We shall find out if it works, and if, why.

### 1.2 Neurological synchronization and the therapist patient relation

In a therapeutic relation, participants cooperate along a timeline towards a goal that they agreed upon. Therefore, this cooperation can be seen as synchronization between therapist and patient. In neurological synchronization, two or more organisms (or parts of organisms) move along the same timeline in such a way that the brain can no longer tell them apart<sup>2</sup>. What was two becomes one. If this situation is evaluated as positive, our brain will respond positively with rapprochement. When this synchronization poses a threat, our brain will react with a stress response and try to discontinue the synchronization. Neurological synchronization can therefore occur between two organisms. The perception of that other organism is created by our brain. We build a representation of the other organism with the systems we have. If

we had other systems, the representation would change. So, the image in our brain is always an interpretation of reality, never reality itself.

### 1.3 So easily fooled

If this is the case, how easy can it be to manipulate our brain by feeding it with stimuli chosen to bring it in a certain status to our advantage? Apparently very easy, as systems such as Netflix and YouTube are able to bring us in virtually any preferred status. They make us happy, sad, fearful, relaxed and tense by presenting visual and acoustic stimuli. Still, these are very sophisticated systems. As it turns out even a line drawing can easily evoke empathic or other feelings evoked by our synchronization with some lines in two dimensions. For an excellent example, see [https://www.youtube.com/watch?v=6iw\\_rdx11V0](https://www.youtube.com/watch?v=6iw_rdx11V0). Apparently, that's how simple it is. Certainly, my more rational, neocortical structures can detect that it is not a real human being that I am being presented. Still, somehow my brain experiences the stimuli as real. How is this possible?

## 2. Neurological principles and systems allowing for planning and evaluation

### 2.1 Feedforward & feedback

If I lift my left arm sideways to 90° I will need counterweight so as not to fall over. For this I use, among other things, the muscles in my flank on the opposite side of my body. Interestingly, these muscles tighten before I

lift my arm. In other words, they enable my body to lift my arm. This can only be possible if my brain interprets the command 'arm lifting' more broadly, in other words; do what is necessary to lift my arm without toppling over<sup>3</sup>. So the better I define a goal, the better my brain can take all the measures necessary to achieve this goal. This is known as feedforward<sup>4</sup>. Also, only if my brain has aimed at some goal, it can evaluate a rate of success and adapt if necessary. In other words; create the usefulness of feedback. So manipulating a brain, makes demands on goal setting. As stated earlier, this is also known as using feedforward. Feedforward creates the possibility of optimal integration of circuits and use of feedback. The actual planning and execution are done by Central Pattern Generators (CPG's).

## **2.2 The role of Central Pattern Generators**

Elementary CPG's can detect and produce rhythmic oscillations. In humans they are located in the spinal cord and the brainstem. They allow for identification and execution of synchronization in and outside the body<sup>5</sup>. Optimal functioning depends on how they are deployed; whether they are given the opportunity to carry out their organising skills. It immediately becomes clear that there is a relationship between goalsetting and synchronization. After all, if I don't know what I'm going to do, how am I going to prepare properly and evaluate performance? I could do a huge amount of work to be prepared for anything. Extreme redundancy would result and evaluation would be impossible. I could also decide not to do anything, representing system overload by

the impossible task awaiting. A well-functioning CPG therefore exists by the grace of targeted action. Only then the right preparations can be made to allow for meaningful preparation, integration, synchronization, evaluation and adaptation.

## **2.3 The layered brain**

Our brain can functionally be divided into different layers<sup>6</sup>. From our spine forms the brainstem, mostly involved in somatic and reflexive circuits. The upper part of the brainstem is surrounded by circuits involved in emotional behaviour and automated learning. At their turn, they are surrounded by grey and white matter involved in rational behaviour. Most people have experienced that the deeper and more inward (emotional) parts of our brain are stronger than the higher and more outward (rational) parts. We know sugar isn't good for us, but we do eat it, a lot. We know we have to go to bed on time, but we don't. We know smoking is bad, but we don't quit. This happens because in the moment itself our emotion causes our higher braincentres to be overruled.

## **2.4 Coexistence of emotion & reason**

The same applies to the difference between knowing what we see and experiencing what we see. We know movies are not reality, but evenso we do experience the emotion that is evoked in us. Emotion and reason can apparently coexist. This phenomenon is also used in therapies. One example is in the use of mirror therapy as a treatment for so-called phantom pain. If the right hand is affected,

that is, if the patient experiences pain in the not existing right hand, pain treatment can sometimes be done using a mirror<sup>7</sup>. The patient sits at a table while in the sagittal field just in front of him there is a mirror with the reflective plane to the left. The patient then moves with the not affected left hand and looks at this in the mirror. To his astonishment, he now experiences a right arm including a right hand. This effect works even more strongly if the left arm (with hand) and the right arm (with phantom hand) move in synchrony. The movements coincide in such a way that the hand in the mirror is experienced by our brain as a real hand. Rationally, the patient knows that the hand in the mirror is not real. The emotional part of his brain accepts the hand as real, allowing the accompanying experience to occur. The emotion overruled the mind (The reader may have correctly noticed that the actual treatment of pain is not discussed here as it has no relevance to the subject of this article.). Another example where literally remote synchronization of a patient takes place is in EMDR psychotherapy. EMDR (Eye Movement Desensitisation and Reorganisation) is a therapy commonly used in PTSD (Post Traumatic Stress Disorder)<sup>8</sup>. An essential part of the therapy is that a (mostly) visual pulse is offered. The therapist moves his hand coronal from side to side in the visual field of the patient. The patient is to follow this movement with his eyes. This also appears to be effective when the therapy is offered remotely via a digital connection on a computer screen. Both the representation of the therapist and the representation of the stimulus are accepted by the patient's brain.

## **2.5 Associative, executive and modulating integrated circuits in the brain**

In addition to structuring our brain from caudal to rostral from older to newer layers, a parallel arrangement can also be made along that line. The organization of associative tracts, executive tracts and modulating or motivational tracts. These parallel circuits are extant at every level of our brain. These associative, executive and modulating circuits partly overlap. As a result, if one of these circuits is activated, due to the overlap, the other circuits are also activated<sup>9</sup>. It is for this reason that execution, for example through motor skills, always also has an associative and motivational component. Depression not only affects the emotional or thought component, but also motor skills and motivation. We know this and think it is normal, but this fact exists by the grace of inescapable integration of systems. For this reason, execution (e.g. motor skills) can also be stimulated by appealing to the associative circuit. Another consequence is that execution (e.g. running) can be used to improve mental health because movement, executed by CPG's, inevitably appeals to association and motivation<sup>10</sup>. When offering a stimulus, in fact, all older and newer circuits are activated, but also within each layer the different associative, executive and motivational (modulating) circuits. This makes it possible to influence people (read 'treat'). It is now known that treatment of e.g. PTSD, Social Fobia and Panic Disorders can just as well be done with virtual exposure as with exposure in vivo<sup>11</sup>.

### **3. Conclusions**

So, some conclusions on the subject of Telemedicine can be drawn from all this. The first is that in virtual reality people can synchronize and transfer thoughts and emotions in all kinds of ways. Second, these emotions, or emotional associations influence and activate other circuits as well. Third, the optimal effect can be reached by focussing on

optimal goalsetting, thus allowing for optimal feedforward and feedback. Last, and maybe most interesting of all, the fact that treatment in Telemedicine through so called virtual reality in any form works should not surprise us, because in our brain the only reality is virtual reality.

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