

JYU DISSERTATIONS 20

Olivier Brabant

Using Altered States of Consciousness in Improvisational Music Therapy

The Potential of Resonance Frequency Breathing



UNIVERSITY OF JYVÄSKYLÄ
FACULTY OF HUMANITIES AND
SOCIAL SCIENCES

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**Using Altered States of Consciousness in
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The Potential of Resonance Frequency Breathing**

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What we call "I" is just a swinging door which moves when we inhale and when we exhale.
– Shunryu Suzuki, *Zen mind, beginner's mind* (Suzuki, 1970, p. 29)

*The most beautiful thing we can experience is the mysterious. It is the source of all true
art and science.*
– Albert Einstein, *Living philosophies* (Leach, 1931, p. 5)

ABSTRACT

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Using altered states of consciousness in improvisational music therapy: The potential of resonance frequency breathing

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Diss.

Improvisational music therapy is a type of creative arts therapy in which clients are encouraged to express themselves through the symbolic and non-verbal medium of music, by creating free music improvisations together with the therapist. The present research aims at investigating whether the efficacy of this method can be further enhanced by purposefully accessing the ego-quieting properties of altered states of consciousness.

This work proceeds in three main steps. First, the notions of consciousness and its alteration are examined and reformulated, resulting in a more comprehensive theoretical model. Then, existing methods for inducing altered states of consciousness are evaluated in terms of suitability for the context of improvisational music therapy. This leads to the selection of resonance frequency breathing (RFB), a cardiorespiratory intervention known for its ability to balance the autonomic nervous system, reduce stress, and improve emotional regulation. Lastly, the effects and potential benefits of RFB are investigated through three single-case experimental studies, where 10 minutes of RFB are added at the beginning of every other therapy session, in alternation with a control intervention.

The results suggest that RFB has the ability to both deepen and support the processes naturally occurring during therapy, by either favouring the emergence of difficult emotions and therapeutically relevant themes, or helping with the regulation of excessive arousal, depending on the client's current needs and coping abilities. Therefore, RFB seems to be an adaptive intervention whose apparent therapy-enhancing effects should also result in better outcomes. This last point is currently being investigated in a randomised controlled trial of improvisational music therapy for adults with depression.

Keywords: improvisational music therapy, resonance frequency breathing, consciousness, altered state of consciousness, heart rate variability, emotional regulation

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TIIVISTELMÄ (FINNISH ABSTRACT)

Improvisaatiopohjainen musiikkiterapia on taideterapian muoto, jossa asiakasta rohkaistaan ilmaisemaan itseään musiikin symbolisen ja nonverbaalisen kielen keinoin ja improvisoimaan musiikkia yhdessä taideterapeutin kanssa. Tämän tutkimuksen tavoitteena on selvittää, voiko improvisaatiopohjaisen musiikkiterapian tehoa vahvistaa vaikuttamalla asiakkaan tajunnantilaan ja hyödyntämällä muuntuneen tajunnantilan egoa hiljentäviä ominaisuuksia.

Työ etenee kolmessa vaiheessa. Ensin työssä tarkastellaan näkemyksiä tietoisuudesta ja tajunnantilojen muutoksista sekä luodaan niistä uusi ja kattavampi teoreettinen malli. Sen jälkeen työssä arvioidaan tajunnantilan muuntamiseen tähtääviä menetelmiä sekä niiden soveltumista improvisaatiopohjaiseen musiikkiterapiaan. Tämä johtaa resonanssitaajuus-hengityksen (RFB) valitsemiseen. RFB on kardiorespiratorinen menetelmä, joka tasapainottaa autonomista hermostoa, vähentää stressiä ja vahvistaa tunnesäätelyä. Työn lopussa RFB:n vaikutukset ja mahdolliset hyödyt tutkitaan kokeellisessa yksittäistapaustutkimuksessa, jossa joka toisen terapiaistunnon alkuun lisätään 10 minuuttia RFB:tä ja joka toisen istunnon alussa tehdään kontrolli-interventio.

Tutkimuksen tulokset viittaavat siihen, että RFB voi sekä syventää että edesauttaa terapian aikana ilmeneviä prosesseja, joko tukemalla vaikeiden emootioiden sekä terapian kannalta olennaisten teemojen esiin tulemistä tai auttamalla liiallisen voimakkaiden emootioiden säätelyssä, riippuen asiakkaan senhetkisistä tarpeista ja selviytymiskyvystä. Näin ollen RFB vaikuttaa olevan adaptiivinen interventio, jonka terapiaa selkeästi vahvistavien vaikutusten tulisi myös johtaa parempiin tuloksiin. Tätä tutkitaan paraikaa satunnaistetussa kontrolloidussa tutkimuksessa, jossa selvitetään improvisaatiopohjaisen musiikkiterapian vaikutuksia masentuneiden aikuisten hoidossa.

Asiasanat: improvisaatiopohjainen musiikkiterapia, resonanssitaajuushengitys, tajunta, muuntunut tajunnantila, sydämen sykevälivaihtelu, tunteiden säätely

FOREWORD

On the intellectual and personal level, this whole project took me to places I never would have imagined when I first started it. Therein lies the beauty of doctoral studies, I suppose. One has a general notion of the direction and the overall goal, without knowing exactly which road will take us there. Some people might find this too frightening and uncertain, which is perfectly understandable. I, for one, rather enjoyed this uncertainty and the freedom that accompanied it. After all, what would be the point of research if we would always know beforehand what will be found and through what means?

I would like to extend my gratitude to certain key people who have been directly or indirectly involved in the making and shaping of this dissertation. First of all, I would like to thank Evgeny Vaschillo, Paul Lehrer, and Richard Gevirtz for doing the pioneering work that led to the development of heart rate variability biofeedback, which is the method my chosen breathing intervention is based on. Next, I am very grateful to Ourania Liarmakopoulou, Melina Bernardi, and Maartje van de Ree for acting as therapists in the three exploratory studies that constitute the core of this doctoral thesis. Then, I would like to thank Jaakko Erkkilä for believing in my work and including my ideas in the design of the No Pain No Gain study, a large randomised controlled trial aimed at further improving the efficacy of improvisational music therapy and better understanding its internal mechanisms. Finally, because everything a researcher does ultimately requires the correct and effective use of language, I would like to acknowledge the valuable linguistic input of Elsa Campbell, Kaisa Suvanto, and Chris Jarvis.

On a more general level, I am also indebted to all the people from the Department of Music, Art and Culture Studies with whom I have interacted over the years and who created the friendly environment I was working in. A special thank you goes to Markku Pöyhönen for his availability and help with all things practical. Lastly, I would like to collectively thank the numerous spiritually-inclined scientists, researchers, authors, thinkers, and podcasters whose mind-opening and illuminating work has been a source of inspiration and support during the making of this dissertation.

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Olivier Brabant

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4. Brabant, O., & Erkkilä, J. (in press). Enhancing improvisational music therapy through the addition of resonance frequency breathing: Common findings of three single-case experimental studies. *Music Therapy Perspectives*. doi:10.1093/mtp/miy009
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1 INTRODUCTION

1.1 Setting the Stage

Although the articles included in this dissertation constitute important milestones in the development of my initial idea, they do not give a complete picture of the process involved. I will, therefore, begin by providing some context and background, and describe the steps that led me to focus on a specific breathing method as a way to promote altered states of consciousness (ASCs) in improvisational music therapy—a form of arts therapy and one of the main methods within active music therapy.

The starting point of this whole doctoral adventure was a book I read during my Master's studies, called *Shaman, jhankri & néle: Music healers of indigenous cultures* (Cook, 1997). It presented the culture, life, and work of various healers from around the (non-Westernised) world. One aspect I found particularly striking was that all the described treatments would always involve some form of ASC, either in the healers, their clients, or both. In comparison, I realised that this aspect was largely absent in our current Western therapeutic practices, with the exception perhaps of hypnosis. Another exception I was aware of was guided imagery and music (GIM), which is a receptive music therapy method where clients listen to specific music programmes while in an ASC and simultaneously dialogue with a trained guide (Muller, 2014).

So I started thinking, could it be that these altered states are unwittingly neglected in the Western world, although they actually play an important part in the effectiveness of any healing intervention? If such is indeed the case, what is so special about them and in what way do they contribute to the overall healing process?

In the case of GIM for example, the answer is very clear. Without the induction of an ASC at the beginning of the session, there would not be any GIM. Indeed, the experiences that unfold during the music journey and the simultaneous dialogue conducted with the therapist are only possible in that

form because of the ASC the client is in. In other words, the altered state is a fundamental and necessary aspect of this particular therapeutic method.

My own personal experience with GIM confirms this fact. When I completed the GIM level 1 training in 2010, the most surprising part was that my imaging experience was never disrupted by the dialogue I was having with my guide. While in that state of relaxed wakefulness typical for GIM, it was somehow possible for these two activities to occur in parallel, which is something I knew could not have happened during my normal waking state. When fully alert and awake, people can usually do either or, but not both activities at the same time. The reason behind this is that talking and imaging belong to two very different modes of information processing, namely the analytical-rational and the intuitive-experiential modes (Epstein, Pacini, Denes-raj, & Heier, 1996). However, GIM makes it possible to have the best of both worlds and operate in both modes simultaneously.

Building on this realisation, I started wondering if other music therapy approaches could benefit from the addition of some type of altered state induction, similarly to what was being done in GIM. My attention naturally turned to improvisational music therapy, since this method was already intensively practised and researched at the University of Jyväskylä. Similarly to any music therapy method, improvisational music therapy helps clients to “improve, maintain, or restore a state of well-being, using musical experiences and the relationships that develop through them as dynamic forces of change” (Bruscia, 1987, p. 5). What distinguishes it from other methods is its focus on music improvisations created spontaneously by the client together with the therapist (for a more detailed description of improvisational music therapy, see Article 4).

However, compared to GIM, the situation was slightly different with improvisational music therapy, because the latter was already known to be effective in its current form and beneficial in the case of various mental health conditions, developmental disorders, stress and anxiety, and neurological damage (MacDonald & Wilson, 2014). Therefore, the purpose of any addition would be to enhance the existing method, which undoubtedly represents a worthy and desirable aim in itself.

Step by step, the topic of my doctoral dissertation was taking shape. I knew I wanted to find a method of inducing an ASC that would be useful and beneficial for the type of work being done in improvisational music therapy, particularly in the treatment of emotional disorders. Once the induction method had been identified, I would test it in an actual therapeutic context and assess its effects on therapeutic processes. So far, so good. However, a few major questions needed to be answered before I could proceed.

First of all, what ASCs were potentially accessible by a human being? Among these states, which ones seemed most useful and desirable in the context of music psychotherapy? Lastly, what were the easiest, fastest, and safest ways to induce those desirable states? Since at that stage I was not very familiar with the topic, I began by reading *Altering consciousness: Multidisciplinary perspectives*

(Cardeña & Winkelman, 2011), a comprehensive survey that provided me with a good introduction to the complex and multifaceted topic of ASCs.

After a few weeks, it dawned on me that one cannot satisfactorily explain ASCs without first understanding what consciousness is. So I set out to find the best possible theory available in the literature, believing this would be a rather straightforward task. For that purpose, I read an introductory textbook entitled *Consciousness: The science of subjectivity* (Revonsuo, 2010). To my surprise, I discovered the existence of a raging debate over the nature and origin of consciousness. Little did I know that I was actually stepping into a rabbit hole from which I would only emerge about a year later. In fact, what seemed at first like a legitimate and harmless question (“What is consciousness?”) eventually became a painstaking investigation that profoundly affected my world-view. I will now summarise the main highlights of this investigation and also introduce what I believe is a better way to frame the consciousness question.

1.2 A Post-Materialist Conception of Consciousness

Until about 20 years ago, consciousness was not even considered a suitable topic for modern scientific studies because of its elusive and subjective qualities. Modern Western science being firmly rooted in the ideas of materialism, reductionism, quantification, and objectivity, there seemed to be no place for something so clearly illusory and secondary. However, as surprising as it may sound, this understanding of consciousness is not the result of any scientific conclusion, but of a priori beliefs regarding the nature of reality. These a priori beliefs are based in classical (Newtonian) physics and its accompanying materialist world-view.

Materialism is the metaphysical position that physical matter constitutes the primary reality from which everything else originates. Consequently, immaterial things such as thoughts, emotions, and consciousness are necessarily a by-product of something material. When adhering to such a paradigm, the unavoidable conclusion regarding consciousness is that it is the result of brain activity. However, the reason why most people assume that consciousness is produced by the brain is not because there is irrefutable evidence for it, but because under materialism, consciousness could not possibly come from anywhere else.

In fact, I soon found a lot of compelling evidence and arguments strongly suggesting that consciousness might be something else entirely, something that does not require anything material in order to exist. First of all, it is important to realise that nothing in this claim violates any law of nature, provided that we update these laws with the ground-breaking findings made in modern physics over the last 100 years, especially in quantum physics (the “science of the very small”). So far, these findings have had very few repercussions on the leading scientific paradigm and our culture as a whole, despite their radical and profound implications. As Henry Stapp pointed out, “scientists other than

quantum physicists often fail to comprehend the enormity of the conceptual change wrought by quantum theory in our basic conception of the nature of matter” (Stapp, 2004, p. 40).

One might say that it is precisely because the conceptual change is so radical that a paradigm shift has not happened yet. Indeed, the inferences of quantum physics regarding the nature of reality are so staggering and difficult to accept because they seemingly invalidate all the fundamental assumptions classical physics is based on, starting with materialism. Some of the other assumptions being challenged are the principles of locality (objects can only be influenced directly and by their closest neighbours), determinism (future states can be predicted from current states), and linear causality (every effect has a cause that precedes it). Lastly, modern physics is forcing us to reconsider the belief that space and time are absolute and objective dimensions.

In popular science, the counter-intuitive behaviours and phenomena occurring on the quantum level are often collectively described as “quantum weirdness” (e.g., Frenkel, 2015). One such phenomenon for example is entanglement. Entanglement refers to the situation where two particles become linked in such a way that any change that happens to one particle instantly happens to the other, regardless of distance (Jaeger, 2009; Kaiser, 2014). Recent experiments have demonstrated that entanglement can even be achieved between particles which never co-existed in time (Megidish et al., 2013), thus further confirming that both space and time are transcended on the quantum level.

The founding fathers of quantum physics were very much aware of the metaphysical, spiritual, and ontological implications of their discoveries. They wrote extensively on the subject in an attempt to define and explain the revolutionary world-view their findings were pointing at. For instance, Werner Heisenberg (Nobel prize in physics, 1932) wrote a book entitled *Physics and philosophy: The revolution in modern science* (Heisenberg, 1958). Some others, such as Erwin Schrödinger (Nobel prize in physics, 1933), noticed the many similarities between this new world-view and Eastern traditions such as the teachings from the Upanishads (Schrödinger, 1992).

In a nutshell, what quantum physics has done is to reveal the existence of another reality underpinning and producing our everyday reality. This more fundamental realm is pre-physical and its properties are the exact opposite of those normally attributed to our macro-level reality. In other words, the quantum world is characterised by non-locality, acausality, indeterminism, and the absence of space-time structures. To quote Stapp again, “[t]he fundamental process of Nature lies outside space-time . . . , but generates events that can be located in space-time” (Stapp, 1977, p. 202). This pre-physical substrate can be assimilated to an undivided whole containing only potentialities for things to manifest, in the form of information and probability distributions (Bohm, 1980; Stapp, 2011).

The idea that the universe as we know it is the result of materialised and manifested information has been gaining momentum in recent years. For Vlatko

Vedral, professor of quantum information theory, “information . . . is the building block on which everything is constructed”, and it is “far more fundamental than matter or energy because it can be successfully applied to both macroscopic interactions . . . and . . . microscopic interactions” (Vedral, 2010, p. 10). This view is echoed by Stapp (2004), who describes the physical world as “an evolving structure of information, and of propensities for experiences to occur, rather than a mechanically evolving mindless material structure” (p. 268).

With regard to elementary particles (the building blocks of matter), one very common but incorrect image is to see them as tiny billiard balls that would exist continuously on a clearly defined and predictable trajectory. This understanding might be valid for large objects in our macro-level reality, but it is not applicable on the microscopic level where all the certainty and concreteness we are accustomed to suddenly disappear. In fact, the famous double-slit experiment conclusively shows that particles only have an objective existence and a definite position when they are being observed (i.e., when information is available regarding which slit they went through). In the absence of any observation or available information, particles behave like a non-local probability wave, with no real existence or localised position (Feynman, Leighton, & Sands, 2011, Chapter 6). To put it more simply, particles are not really there until they “need” to be there.

These experimental findings seriously undermine the validity of materialism and naïve realism (i.e., the idea that our senses provide us with direct awareness of objects as they really are). If we truly lived in a reality made of objectively existing matter, the dual behaviour of particles would be an impossibility. They would not radically change their behaviour depending on whether information is collected about them or not. Granted, the term “particle” is linguistically misleading, because it encourages people to stick to a billiard-ball model of reality. However, to modern physicists, particles are just excitations in the fundamental fields (Hobson, 2013) or fluctuations in the quantum vacuum (Battersby, 2008).

Where does this leave us as far as consciousness is concerned? If matter is not what we thought it was, then all the materialist explanations of consciousness automatically become inadequate, or at least incomplete. Indeed, if matter is just an epiphenomenon arising from an underlying quantum field, the position that consciousness is itself the epiphenomenon of an epiphenomenon becomes rather problematic. This realisation has led many Western scientists to reconsider the origin of consciousness and to propose models of reality where consciousness would be fundamental (i.e., not deriving from anything else) and non-local (i.e., beyond space-time and not subjected to the laws of classical physics).

As unusual and extraordinary as it may sound, there is nothing unscientific or supernatural about such an assertion, quite the opposite. In fact, this post-materialist alternative is perfectly compatible with the observed phenomena in quantum physics and has already been advocated by a wide range of scientists belonging to fields as diverse as astronomy (Richard Conn Henry), physics (Amit Goswami, Menas Kafatos, Max Planck), neuroscience (Mario Beauregard),

psychology (Imants Barušs), psychiatry (Stanislav Grof), medicine (Robert Lanza, Pim van Lommel), and philosophy (Bernardo Kastrup, Thomas Nagel).¹ I will not develop this topic further; instead, I invite interested readers to consult the references in the footnote. However, since he is the most famous and revered of all the scientists I just mentioned, I will quote a passage from an interview given by Max Planck (Nobel prize in physics, 1918) to *The Observer* (Sullivan, 1931):

“Do you think that consciousness can be explained in terms of matter and its laws?”

“No. I regard consciousness as fundamental. I regard matter as derivative from consciousness. We cannot get behind consciousness. Everything that we talk about, everything that we regard as existing, postulates consciousness.” (p. 17)

We are now already halfway down the rabbit hole. In the first half of my exploration, I reviewed issues in fundamental science that represent a challenge to brain-based or materialist explanations of consciousness. The second half concerns the well-documented phenomena reported in the scientific literature which contradict the idea that consciousness is confined to the brain and that it functions according to the laws of Newtonian physics. For the sake of brevity I will present only three from a much longer list of phenomena, namely human interconnectedness, anticipatory responses to future stimuli, and near-death experiences following cardiac arrest (for a complete overview, see for example Beauregard, 2012).

Human interconnectedness refers to the phenomenon where two people display correlations in brain activity although they are physically isolated from each other. Experiments designed to investigate this phenomenon typically involve a pair of participants sitting in separate shielded rooms, with person A receiving visual or acoustic stimulation at random moments, while person B is asked to sit quietly and wait. Although no regular information exchange can take place between the participants, studies conducted since the 1960s have repeatedly shown that it is possible for person B to display a brain response that corresponds to the stimulation received by person A (Duane & Behrendt, 1965; Grinberg-Zylberbaum, Delaflor, Attie, & Goswami, 1994; Wackermann, Seiter, Keibel, & Walach, 2003). Obviously, if consciousness is understood as being confined to individual brains and dependent on our five senses, such experimental findings should not be possible.

The second phenomenon in my list—anticipatory responses to future stimuli—refers to the situation where it is possible to detect a physiological response to emotionally-engaging stimuli *before* they are actually experienced, which seems to constitute a form of presentiment or precognition (Bem, 2011; Radin, 2006). In a meta-analysis of 26 studies published over a period of 32 years, Mossbridge, Tressoldi, and Utts (2012) concluded that the measured anticipatory response is real and statistically highly significant, although the magnitude of the

¹ (Barušs, 2010; Beauregard, 2014; Goswami, 1995; Grof, 2009; Henry, 2005; Kafatos & Nadeau, 1999; Kastrup, 2015; Lanza & Berman, 2010; Nagel, 2012; Sullivan, 1931; van Lommel, 2011a)

effect is small (and will probably always remain so). Interestingly enough, the same ability has also been observed in birds (Alvarez, 2010). Again, such findings are incompatible with the notion that consciousness exists solely within the boundaries of Newtonian physics, where the arrow of time is always unidirectional and future events cannot influence the present.

The third and last example is the phenomenon of near-death experience (NDE) that sometimes accompanies cardiac arrest. Unlike other situations where NDEs also occur (e.g., coma, electrocution, or severe blood loss), the context of cardiac arrest is particularly important for the consciousness debate, because it creates a situation where the person is clinically dead for a certain period of time. Following resuscitation, between 10 and 20% of the survivors report having had vivid experiences that typically involve seeing their body and its surroundings from above, meeting deceased relatives, and re-experiencing their entire life in an instant, all the while retaining lucid thinking, emotions, and memory formation. In fact, many experiencers report higher mental clarity and enhanced awareness during their NDE compared to their regular waking state (van Lommel, 2011b).

Needless to say, such an extreme disconnect between brain and consciousness is completely at odds with the tenets of conventional neuroscience. How can there be any form of awareness, let alone enhanced awareness, in the absence of any measurable brain activity? As might be expected, many people explain the NDE accounts by seeing them as pure fabrication or hallucinations produced during the last gasp of a dying brain. However, it should be mentioned that some of these out-of-body perceptions have been shown to be veridical, meaning they refer to events that verifiably happened while the person was clinically dead (Holden, 2009; Parnia et al., 2014). The existence of these corroborated accounts strongly suggests that some aspects of NDEs are objective and real, and that certain NDEs must have occurred during the period of cardiac arrest, not before or after.

In other words, according to the available evidence from NDE research, it would appear that our consciousness can exist independently of our brain, at least for a short while. Like the two previous examples, this phenomenon seems absolutely incompatible with materialism. However, all three phenomena can easily be accommodated if we postulate that consciousness is fundamental and originates in a place where space and time are abolished.

I am fully aware that findings of the kind presented above are usually dismissed by conventional science, not because of methodological issues but simply because they do not fit into the dominant materialist paradigm. With regard to this tendency, I will only say the following: when disturbing evidence keeps accumulating, at some point it becomes legitimate to ask ourselves whether it is the findings that are incorrect or the model we use to explain them. As professor of comparative religion Jeffrey Kripal writes, “[i]t is very easy to explain everything on the table if you have put everything you cannot explain underneath it in the wastebasket” (Strieber & Kripal, 2016, p. 91). I, therefore, invite sceptical readers to examine the disturbing evidence with an open – yet

critical—mind and then decide for themselves whether the materialist paradigm has become untenable or not.

To summarise, the problem with a materialist model of consciousness is twofold: it is based on an outdated model of reality that has been proven to be incorrect by modern physics, and it does not provide a satisfactory explanation for many observations made in medicine, neuroscience, and psychology. This is why I decided to devise what I believe is a better model of consciousness, one that is compatible with modern physics and able in principle to accommodate all the anomalous phenomena I came across during my readings. This model is introduced in the first article included in this dissertation (Article 1). Coincidentally, the American Psychological Association recently published a book entitled *Transcendent mind: Rethinking the science of consciousness* (Barušs & Mossbridge, 2016), in which many similar ideas and lines of evidence are presented.

1.3 Research Aims

Now that the stage has been set, I proceed to the main research question of this dissertation: is it possible to improve improvisational music therapy by purposefully inducing a helpful type of ASC in the client, similarly to what is being done in GIM? As I have mentioned above, answering this core question requires that we define non-ordinary or altered states of consciousness, identify states that appear suitable and valuable for improvisational music therapy, choose an appropriate induction method, and then test this method in an actual clinical context. I will proceed in that order, starting with a general definition of ASCs.

2 WHAT ARE ALTERED STATES OF CONSCIOUSNESS (ASC)?

The purpose of this section is to offer a conceptualisation of ASCs that would satisfy the requirements to be neutral, universal, and in line with my proposed model of consciousness. As we will see, definitions commonly used by Western researchers are not as neutral as they purport to be. I will, therefore, begin by highlighting the pitfalls present in the typical Western understanding of ASCs. Then, I will explain how ASCs are discrete configurations existing on a continuum, and introduce a map of the various states of consciousness that are potentially accessible. Finally, I will combine that map with my post-materialist model of consciousness and provide a definition of ASCs that takes into account all the previous elements.

2.1 General Definition

The following definition is frequently mentioned in the literature. According to Ludwig (1969), an ASC is

Any mental state(s) induced by various physiological, psychological, or pharmacological manoeuvres or agents, which can be recognized subjectively by the individual himself ... as representing a sufficient deviation in subjective experience or psychological functioning from certain general norms for that individual during alert, waking consciousness. (pp. 9-10)

This definition is very general and represents a good starting point for describing ASCs, although it is not without some problems. Its key elements are “mental states”, “recognized subjectively”, “sufficient deviation”, “general norms”, and “waking consciousness”. The first two elements are self-explanatory and do not present any ambiguity. The last three elements, however, need to be critically examined because they are either too vague or contain a certain level of cultural bias.

First of all, how much of a deviation constitutes a “sufficient deviation”? This is obviously a very relative concept, as the same amount of deviation might be noticed by one individual and ignored by another. As we will see below, factors such as someone’s birth culture play an important role in defining what counts as an ASC. For the purpose of a general definition, we can at least agree that some kind of contrast or difference in mental functioning has to be present, and that this difference must be large enough to be consciously registered by a given individual.

As to the concepts of “general norms” and “waking consciousness”, they imply that there is consensus about a standard from which one can then identify deviations. The problem with this perspective is that it creates a hierarchy among the various states, with the waking state seen as the reference from which all the other states are measured. The associated risk is that we end up seeing only the waking state as normal and acceptable, while all the others are considered abnormal or even pathological.

It is important to realise that this way of understanding ASCs prevails in the Western world but is not universally valid. This fact becomes very visible if we consider ASCs from an anthropological perspective, dividing the world’s cultures into two categories known as monophasic and polyphasic (Laughlin, McManus, & D’Aquili, 1992). In monophasic cultures, only waking rational consciousness is institutionally valued, people’s perceptual and cognitive processes are oriented outward, and their view of reality is derived almost exclusively from the “normal” waking condition. As we can see, Western culture can be categorised as monophasic. By contrast, in polyphasic cultures, multiple states of consciousness are recognised, valued, and utilised, people’s inner or subjective world is considered as real as the outer world, and they derive most of their understanding of reality from these multiple states. In other words, polyphasic cultures would not see ASCs as deviations from a single standard, since their “standard” consists of multiple states.

The lack of universality in Ludwig’s definition becomes even more apparent if we consider the proportion between monophasic and polyphasic cultures. An anthropological study conducted in the 1970s revealed that the monophasic view is in fact a minority view among the world’s cultures (Bourguignon, 1976). In that study, Erika Bourguignon analysed a sample of 488 human societies worldwide and compared how they use institutionalised ASCs, meaning ASCs (other than the waking state) that are culturally sanctioned and regularly experienced in a structured setting. The sample included all parts of the world and societies at every possible level of technological development. She found that 89% of these societies routinely used one or more ASCs besides waking consciousness, usually within a ritual or religious context. This led her to conclude that “[s]ocieties which do not utilize these states clearly are historical exceptions which need to be explained, rather than the vast majority of societies that do use these states” (Bourguignon, 1976, p. 51). In other words, we in the monophasic West are the exception, not the other way around. This is an

important point to acknowledge if our aim is to formulate a definition of ASCs that is at the same time neutral and universal.

With regard to the formulation of a neutral definition of ASCs, several solutions have been proposed that all involve replacing the term “altered” with another term, for instance “alternating” or “non-ordinary”. My favourite solution is the one suggested by Zinberg (1977). He proposed we replace the term “altered” with “alternate”, because the word alternate “makes it clear that different states of consciousness prevail at different times for different reasons and that no one state is considered standard” (Zinberg, 1977, p. 1). Although I do very much like this idea, the concept of altered state of consciousness has become so widespread that I will keep using it for the sake of simplicity, while remaining fully aware of its limitations and intrinsic cultural bias.

2.2 Describing and Mapping States of Consciousness

Now that we have a general understanding of ASCs, the next step is to further describe the various states of consciousness attainable by humans and attempt to organise them in a systematic and useful way. First of all, states of consciousness are not static mental events or configurations but ever-changing dynamic events that exist on a continuum (Fischer, 1971). Yet they appear to the individual as discrete and relatively stable states that can be clearly distinguished from each other (Tart, 2001). Therefore, to adequately describe ASCs, we need to acknowledge their dual nature and talk of discrete states that exist on a continuum.

2.2.1 ASCs as Discrete States

Charles Tart defines a state of consciousness as “a unique *configuration* or *system* of psychological structures or subsystems” where the structures interact with each other and the environment in such a way as to “stabilize each other’s functioning by means of feedback control”. As a result, “the individual parts of the system may vary, but the overall, general configuration of the system remains recognizably the same” (Tart, 2001, p. 58). In short, states of consciousness are recognisable experiential patterns that become clustered together and tend to co-occur in a systematic and predictable way.

The various patterns and structures that constitute any given state of consciousness typically belong to the following core areas: sensations, perceptions, cognition, and emotions. In other words, these are the areas of experience in which a person will notice certain changes and the “sufficient deviation” mentioned earlier. These changes will, in turn, affect more abstract and high-level areas, most commonly people’s sense of identity (self, body, relation to other people), and sense of space and time.

Given the numerous parameters in the equation, their potential variations, as well as their possible combinations, the theoretical list of ASCs is virtually

endless. How come, then, that people are only able to experience a limited number of ASCs, and usually always the same recurring ones? As explained by Tart (2001), this is the natural consequence of enculturation, the phenomenon whereby humans automatically adopt the values and behaviours of the culture into which they are born. Enculturation works by validating and reinforcing certain behavioural and psychological potentials seen as good and desirable, while rejecting and suppressing those considered dangerous and taboo. These inhibited potentials then either become dormant, with the possibility of still being activated later in life, or disappear completely for lack of adequate and timely stimulation.

The benefit of enculturation is that it transforms us into well-adapted and fully functioning members of our culture. Unfortunately, it also limits the kind of experiences we will be able and allowed to have. To quote Tart (2001) again, “[w]e are simultaneously the beneficiaries and the victims of our culture” (p. 33). Thus, most adult members of any society are only able to experience the states of consciousness that are compatible with their culture’s consensus reality, “that specially tailored and selectively perceived segment of reality constructed from the spectrum of human potential” (Tart, 2001, p. 33). Consequently, the amount of easily and safely achievable ASCs is directly related to the breadth and depth of that consensus reality.

Under those circumstances, it is not surprising that members of a monophasic culture will be familiar with fewer ASCs than members of a polyphasic culture. If we take the Western world as an example, the belief that the universe is purposeless and mechanistic automatically excludes from our consensus reality many other realms that polyphasic cultures accept as real, such as the spirit world or the afterlife. As a result, members of polyphasic cultures commonly experience various types of contemplative, possession, or trance states that are rather rare in the West. When they do happen to Westerners, these states are often pathologised—especially the possession and trance states—because the lack of familiarity and social acceptance turns them into distressful and uncontrollable experiences. There is even a category for them in the DSM-5 (*Diagnostic and statistical manual of mental disorders*, 5th edition), called “Other specified dissociative disorder” (American Psychiatric Association, 2013, diagnostic code 300.15).

Nonetheless, it is important to keep in mind that these (to us) unusual states are not intrinsically good or bad. Rather, the outcome largely depends on how people are framing and appraising the experience, which is directly related to the enculturation process described above. For example, in places where they are accepted cultural practices, possession and trance states are often experienced as valuable and meaningful, and seen as an important component of someone’s spiritual life (Moreira-Almeida & Cardeña, 2011). The DSM-5 acknowledges this fact and does not consider dissociative trance pathological if it is “a normal part of a broadly accepted cultural or religious practice” (American Psychiatric Association, 2013, p. 307). Evidently, the value attributable to any given ASC is never absolute but very much person- and culture-dependent.

As already stated, it is clear that the list of ASCs readily available to a Westerner is much shorter than the list of those available to a non-Westerner. If I were to try to specifically name them, I would say that a majority of Westerners are only familiar with those states every human enters every day out of biological necessity (the waking state, deep sleep, and the dream state), plus a few other states that are culturally acceptable, such as being drunk or in a state of flow. The flow state is often experienced by creative people and athletes, and can be defined as being completely immersed in an effortless and enjoyable task, accompanied by a sense of mastery and the absence of reflective self-consciousness (Csikszentmihalyi, 1990).

However, things have been changing over the last 50 years, with the introduction of psychedelics in the 1960s and the widespread adoption of yoga and Eastern-type meditation practices by Western cultures. The latter have increased the familiarity and acceptance of contemplative states among the population, a fact that has not remained unnoticed by the mental health profession, as can be seen by the current popularity of mindfulness-based therapy methods such as mindfulness-based stress reduction (Salmon, Sephton, & Dreeben, 2011), mindfulness-based cognitive therapy (Sipe & Eisendrath, 2012), and acceptance and commitment therapy (Hayes, Strosahl, & Wilson, 2011).

2.2.2 ASCs as a Continuum

As I mentioned above, ASCs are not only discrete states but also dynamic events that exist on a continuum. Back in the 1970s, psychiatrist and psychopharmacologist Roland Fischer published a series of articles in which he developed a very useful cartography that allows us to map all the ASCs potentially accessible to a human being (Fischer, 1971, 1975, 1976). An adapted version of this map is shown in Figure 1.

Fischer's map can be divided in two parts, with the "I"-state of regular waking consciousness at the top centre. On the left-hand side, we find what Fischer calls the perception-hallucination continuum, characterised by ever-increasing arousal levels. He uses the term *ergotropic arousal*, which literally means "turning towards energy expenditure" (from the Greek *ergo-*, work, and *tropos*, a turning). It is nowadays more common to talk about sympathetic arousal, in reference to the branch of the autonomic nervous system (ANS) that activates the fight-or-flight response.

On the right-hand side, we find the so-called perception-meditation continuum. This path takes us in the opposite direction, with ever-decreasing arousal levels. Again Fischer uses an unusual term, namely *trophotropic arousal*. *Trophotropic* means "turning towards the preservation and restoration of nutritional supplies" (from the Greek *trophe-*, nourishment, and *tropos*, a turning). It is thus the equivalent of parasympathetic activation, the parasympathetic branch of the ANS being the one responsible for the rest-and-digest response.

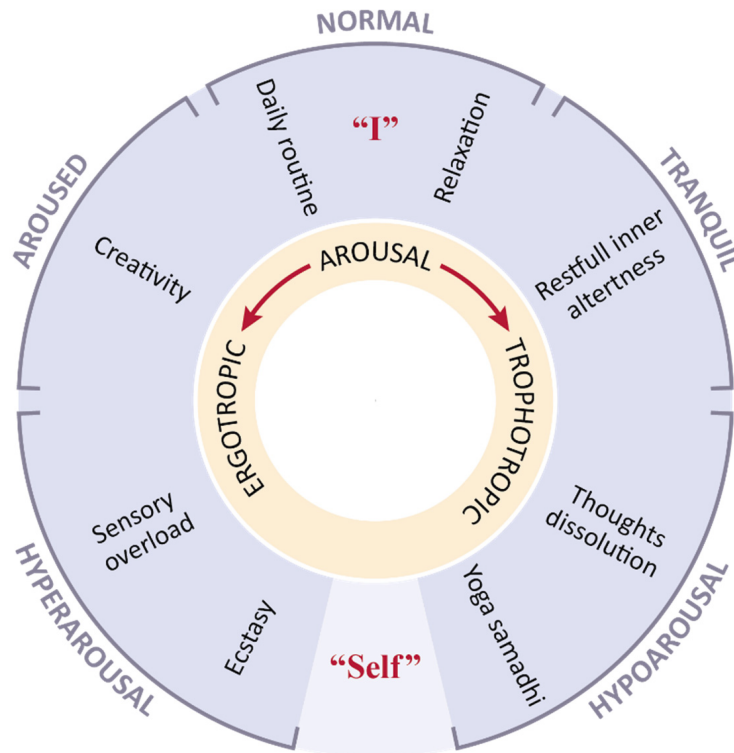


FIGURE 1 Continuum of all the theoretically achievable states of consciousness (adapted from Fischer, 1976).

In terms of ASC, when moving along the ergotropic path, one experiences a progressive loss of ordinary ego functions through the saturation of sensory perceptions. It begins with a mild arousal typical of creative states, followed by ever-increasing stimulation and loss of control, until the person reaches a point of sensory overload where it becomes possible to experience an ecstatic state such as the mystical raptures described by many Christian saints (McColman, 2010). To use a computer metaphor, this is akin to a continuous acceleration in data processing until the whole system jams and shuts down, allowing the person to temporarily experience a state of complete egolessness (what Fischer calls the “Self”, the point diametrically opposed to the “I” in Figure 1).

People on the trophotropic path also experience a progressive submergence of the ego, but for the opposite reason. Here, the ego does not lose its grip because of overstimulation, but because of a reduction in external sensory perceptions. This is the path typically taken by those who meditate and go inward. The various Eastern traditions have created very complex systems where they describe many levels of ASCs corresponding to different depths of meditation and stages of ego dissolution (Fontana, 1998). What these traditions all have in common is to guide practitioners through a fading away of mental content by teaching them how to quiet the mind and grow their inward attention. Ultimately, practitioners can achieve a complete disappearance of the observer/observed duality, and reach a state of oneness, clarity, perfect stillness, and egolessness. This state is called *nirvichara samadhi* in the yoga tradition and *satori* in the Zen

tradition. In the West, these concepts are often translated with the general term “enlightenment”.

This cartography of consciousness contains an interesting paradox, as can be seen in Figure 1: although it describes two mutually exclusive arousal patterns that proceed in opposite directions away from the I, both journeys ultimately lead to the Self. Fischer (1971) makes it clear that this endpoint is the same in both cases: “[T]he ‘Self’ of ecstasy and the ‘Self’ of samadhi are one and the same ‘Self’” (p. 900). How are we supposed to understand this concept of Self, and how does it relate to the I of ego-consciousness?

In the accounts of people who have reached the Self through a peak or mystical experience, they usually report a disappearance of space and time, a feeling of peace and joy, a sense of oneness and unity with the universe,² the impossibility of describing the experience in words (ineffability), and the feeling of having attained some sort of ultimate reality (Barrett, Johnson, & Griffiths, 2015; Hood, 1975). According to Fischer, “the ‘Self’ of exalted states is that which sees and knows, while the ‘I’ is the interpretation, that which is seen and known in the physical space-time of the world ‘out there’” (Fischer, 1971, p. 902). Elsewhere, he simply calls the Self “The Knower and Image-Maker”, and the I “The Known and Imagined” (Fischer, 1971, p. 901). In other words, the Self is the true knower and the core of our being, while the I is a limited and artificial construct projected outward into the world of duality and materiality. This is very much in line with the ideas of Carl G. Jung, to which we will return shortly.

In terms of their relationship, the I and the Self represent two ends of the same spectrum, their influence and role varying in proportion to each other. This means that in order to experience more of the Self, one has to experience less ego, and vice versa. Actually, while fully in the I-state, we are not even aware of the existence of a Self, because it has completely retreated into the background. To use a cosmological analogy, it is like the stars at noon: we cannot see them but they are there nonetheless and their light is still reaching us.

Conversely, the same can be said about the I of ego-consciousness. When we are in a state of ecstasy or samadhi, it is not that the ego has actually disappeared. It is just that we have temporarily left our ego behind and shifted to another level. Our ego structures are still there, waiting to be again “inhabited” and experienced. We can see this happening every time we return to the regular waking state, be it after a peak experience or simply a night’s sleep. More generally, one could say that all the points on Fischer’s continuum are always available and at least in theory accessible. They are simply experienced selectively, our current state of consciousness occluding all the others.

From a scientific perspective, one advantage of Fischer’s map is that it allows us to formulate a simple, clear, and concise definition of ASCs. Assuming that the I-state of daily routine is the “normal” state that most people start from

² I am using the term “universe” because it is neutral and generic, but others will use other terms, depending on their cultural background and belief system. Possible synonyms in this context include the Source, the Ground of Being, God, the Void, the Pleroma (Christian Gnosticism), Wuji (Taoism), or Brahman (Hinduism).

and return to, an ASC can be defined as a departure from ego dominance that brings us closer to an experience of Self. The rest would then simply be a matter of degree (how much the ego has retreated and the Self advanced). This means that in theory, each ASC could be described in terms of a unique Self-to-I ratio expressing the proportional relationship between the ego and the Self. Another logical implication of this model is that whatever benefits people derive from ASCs are associated with this increased contact with the Self. I will return shortly to the salutary qualities that can be attributed to the Self.

One final remark concerning the detriments or benefits of ASCs: as I remarked earlier concerning ASCs conceived as discrete states, no point on Fischer's map is in itself negative or positive. Moreover, it is natural to move along the continuum and eventually return to the "normal" state. What is usually experienced as distressing and pathological is the situation where someone is unable to make that return. In Fischer's words, "[p]atients are those individuals who get stuck on the left or the right side of our continuum and are incapable to rebound or otherwise return to levels of arousal which correspond to the normal state of daily routine" (Fischer, 1976, p. 6).

2.3 Overall Model

It is now time to bring together all the ideas introduced so far, and present an overall model of human consciousness and its alteration. I will do this by superimposing Fischer's and Jung's notions of ego and Self onto the post-materialist model of consciousness that I propose in Article 1. I will begin by summarising the main ideas from this article and then explain how all these constructs can be combined. Lastly, I will derive from this combination a general definition of ASCs.

As explained in Chapter 1 as well as in Article 1, the main idea underpinning my model of consciousness is that psychology needs to be reconciled with quantum physics. Since quantum physics gives us valuable insights into the fundamental nature of reality, these insights should logically apply to everything that exists, including human consciousness. Furthermore, such a reconciliation would offer a valid scientific framework in which to understand the anomalous phenomena mentioned in Chapter 1 (Barušs & Mossbridge, 2016; Beauregard, 2012), making it possible to accommodate them and perhaps explain them. Besides, let us not forget that other fields have already developed by the inclusion of quantum phenomena in their models and procedures, for example life sciences with quantum biology (Lambert et al., 2013) and information technology with quantum computing (Nielsen & Chuang, 2010).

The main lesson learned from quantum physics is that our macro-level reality is in fact a limited manifestation of a much larger pre-physical reality where the conventional laws and rules of classical physics do not apply. For convenience, I will call this underlying reality the quantum world and our macro-level reality the classical world. These two worlds display properties and laws

that contradict each other, which makes them appear completely incompatible and creates a well-known explanatory gap. Physicists today are still debating the nature of the boundary between these two worlds. There is for example no certainty yet as to when and how the quantum-to-classical transition happens. However, what we do know is that the classical world is the result of processes originating in the quantum world, that a demarcation exists between the two, and that this demarcation is more fuzzy than clear-cut.

The central proposition of my post-materialist model is that human consciousness has its roots in the quantum world and represents a localised manifestation of it, in the same way as do all the physical structures of the classical world. Such an approach is a departure from the conventional brain-based explanations, because it treats consciousness as a fundamental and irreducible component of the underlying level of reality. If this is indeed true, it follows that some parts of the human mind are permanently below the manifestation threshold earlier described. In accordance with contemporary psychological concepts, the strongest candidate for these submerged parts would be what is commonly called the unconscious mind.

Different schools of thought exist regarding the content and functions of the unconscious mind (Melechi, 2017), some even denying its existence except as a social construction. The model I present here is obviously dependent for its efficacy and coherence on the assumption that the unconscious is real. Considering the various accounts of the unconscious, I have chosen as the variant that is most suitable for my reconciliation the Jungian interpretation, because it is perfectly compatible with the interconnected and holistic reality described by quantum theory. This compatibility is the result of seeing the unconscious and the Self not merely as personal and limited, but as collective, transcendent, and universal. The latter aspect is expressed through Jung's notion of the collective unconscious, seen as a shared repository of species-specific memories and instincts, as well as of structuring principles which he calls archetypes (Jung, 1991).

Interestingly enough, the kind of reconciliation I am talking about has already been attempted by Jung himself, in collaboration with Wolfgang Pauli, one of the architects of quantum theory and a recipient of the Nobel prize in physics (1945). Over the course of several decades, as documented by their prolific correspondence (Jung & Pauli, 2014), they developed what has been called the Pauli-Jung conjecture (Atmanspacher & Fuchs, 2014). In essence, this conjecture is an attempt philosophically and metaphysically to unify the realms of mind and matter. It is achieved by proposing that the psychological and the physical are two aspects of the same underlying reality which is psychophysically neutral, yet able to generate both mind and matter. In philosophy of mind, such a position is known as dual-aspect monism (Atmanspacher, 2012). Incidentally, my post-materialist model of consciousness is based on an identical position (see Article 1, Figure 1).

One direct implication of seeing mind and matter as originating from the same unified substrate is that, on the fundamental level, both are governed by

the same principles of non-locality and interconnectedness. In addition, it means that the boundary between unconscious and conscious is the same as the boundary between quantum and classical (see Article 1, Figure 2). This is why in all my figures, this boundary is represented by a single undulating red line, with the classical world of mind and matter above it and its unmanifested source underneath.

It naturally follows that the human mind can be represented by a triangle consisting of a submerged part and a visible part, very much like the iceberg metaphor commonly used to depict Sigmund Freud's model of the mind. However, one major difference from the Freudian model is that in my model, the unconscious mind belongs to a larger and interconnected whole, rather than being purely personal and confined to individual brains (see Article 1, Figure 3). In my figures, this idea is rendered by the absence of solid-colour fill and the use of dashed lines to represent the submerged parts of the mind.

One note on terminology before I proceed. I use the terms subliminal and supraliminal to distinguish between the unconscious mind and the manifested mind of ego-consciousness (Article 1). This alternative terminology is borrowed from Frederic W. H. Myers (Kelly et al., 2009), who thereby wanted to stress the existence of a threshold between the submerged and emerged parts of our mind ("subliminal" and "supraliminal" derive from the Latin *sub-*, below, *supra-*, above, and *limen*, threshold). The pair subliminal-supraliminal has the advantage of being more general than unconscious-conscious, as it can be applied not only to everything psychological but also to physical manifestation. It is thus very suitable for describing the unified boundary under which both mind and matter are born.

Another major departure from Freud concerns the inter-dependence between the conscious and unconscious parts. For Freud, the conscious exists side by side with the unconscious without being generated by it, whereas in my model (as well as in Jung's), ego-consciousness is completely dependent on the unconscious for its existence. For Jung, the ego is an outgrowth of the unconscious that has stabilised and developed an illusory sense of separation from its source and from the Self. The following quote nicely summarises this idea:

The ego stands to the self as the moved to the mover, or as object to subject, because the determining factors which radiate out from the self surround the ego on all sides and are therefore supraordinate to it. The self, like the unconscious, is an *a priori* existent out of which the ego evolves. (Jung, 1970, p. 259)

According to Jung, the Self is a transcendent factor of the human mind that is located at the centre of the psyche in its totality (conscious plus unconscious), holding the entire system together while remaining forever unmanifested and unfragmented. As to the ego, Jung sees it as the centre of the field of conscious awareness, that small portion of the psyche that has detached itself from the greater whole and erroneously believes it represents the entire psyche (Jung, 1969).

If we now combine Fischer's understanding of ASCs, Jung's conception of the ego and the Self, and my post-materialist model of consciousness, we obtain the construct depicted in Figure 2. We can see that the Self is located in the subliminal realm, at the centre of the large triangle. This is meant to show that the Self is transcendent and represents the true centre of the psyche as a whole. As to the ego, it is located at the centre of the small triangle above the manifestation threshold, where it is holding together our field of conscious awareness. The arrow connecting the two indicates that the ego develops from the Self and is dependent on it, just as the entire manifested reality around us is the result of processes originating in the quantum world (c.f., the upward arrow going from the quantum to the classical world).

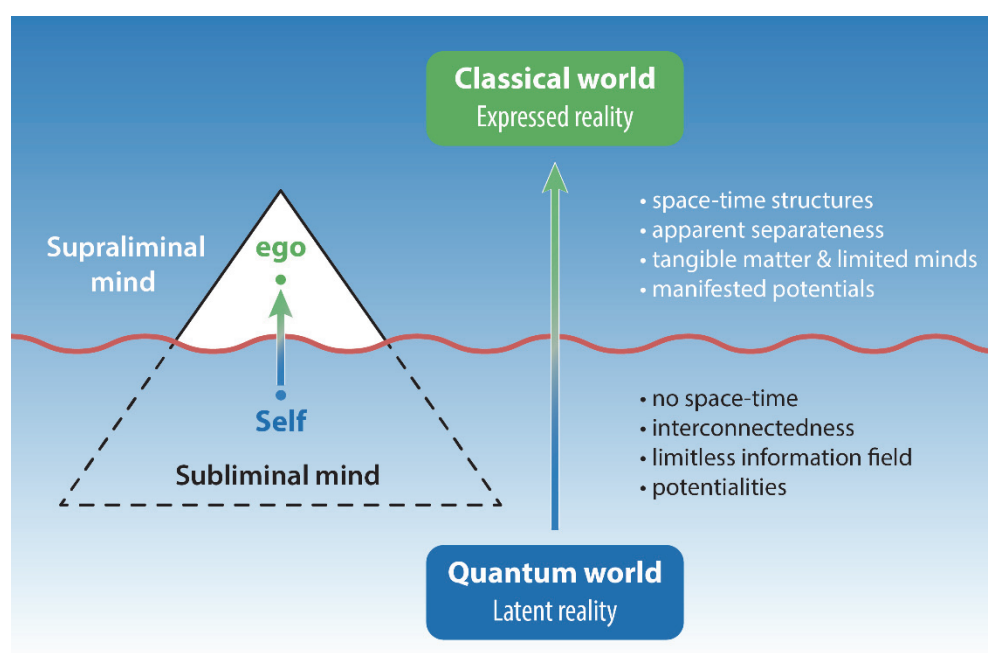


FIGURE 2 Post-materialist model of reality and human consciousness

In the context of Fischer's continuum of altered states (Section 2.2.2), I initially defined ASCs as "a departure from ego dominance that brings us closer to an experience of Self". By combining these ideas with my post-materialist model of consciousness, it now becomes possible to complement this preliminary definition with the notion of threshold permeability. Within this broader context, increased contact with the Self can be understood as a thinning of the boundary between the supraliminal and subliminal mind (i.e., more permeability). Conversely, a hardening of the ego and increased disconnection from the Self would correspond to a thickening of that same boundary (i.e., less permeability). In other words, ASCs can be defined as an alteration in ego-structure dominance caused by a change in threshold permeability. Depending on the direction of that change, the individual will end up being less or more in contact with the Self.

One interesting feature of such a model is its ability to explain the striking parallels between the properties of the quantum world and the reported

experiences of the Self. As we saw above, people who report having had a mystical experience typically talk about the transcendence of space and time, a sense of oneness, and a disappearance of the subject-object distinction. If the Self is located in the quantum world, and the quantum world is characterised by oneness and the absence of space-time structures, then the phenomenology of mystical experiences does not come as a surprise. Actually, based on this model, one can even contend that a mystical experience is not merely idiosyncratic or illusory, but something that brings us closer to the true nature of reality by offering us, so to speak, a momentary backstage peek.

2.4 Therapeutic Potential of the Self

There is generally widespread agreement among the various psychotherapeutic orientations regarding the importance of overcoming psychological resistance. This notion of resistance was initially introduced by Freud, who used it to describe how clients would often resist the emergence of unconscious material into conscious awareness (Freud, 1920). Therefore, resistance is connected to the ideas of avoidance, defence mechanisms, and repression. All these Freudian concepts are built around the common belief that something dangerous and frightening lurks within the unconscious, or at least something that our ego-consciousness perceives as such.

In this section, however, I would like to defend the idea that our unconscious also contains a very valuable and helpful component—the Self—and that a lot is to be gained from increasing our connection with it. My argument will revolve around two elements: the Jungian-inspired theories involving the Self and the lessons learned from the research done in psychedelic-assisted psychotherapy.

First of all, returning to the notion of resistance, this concept obviously applies to everything located in the subliminal mind. In other words, high levels of resistance exclude not only threatening but also desirable elements from our conscious awareness. As we have seen above, ASCs are able to increase the amount of subliminal information entering our awareness. They thus represent a way to circumvent the resistance strategies normally maintained by the ego. According to my model, this is achieved through increased threshold permeability and a corresponding reduction in the liminal stability required to maintain an assertive and dominant ego. As a result, ASCs lead to a weakening (or even temporary disappearance) of control by the ego.

Generally speaking, a reduction in ego dominance is a key element for accessing anything unconscious, including the Self. In fact, prior to Fischer, several other authors had already observed that ego-dissolution is a feature that accompanies mystical-type or peak experiences (James, 1902; Maslow, 1964). This dissolution seems to be necessary to access a deeper and wider reality beyond the mere personal and practical considerations typical of ego-consciousness. As

described in Figure 2, this wider reality can be understood as the quantum world, which is also where the Self would be located.

What is there to be gained from a closer and better contact with the Self? As I have already alluded to earlier, there is evidence supporting the idea that the Self has salutary properties from which we can all benefit, provided we manage to tap into them. More specifically, it would appear that the Self possesses its own inner wisdom and intelligence, and is able to guide us through all the challenges pertaining to psychological health and personal growth. This idea is very much emphasised by Jung (1969), for whom the Self contains the drive toward fulfilment and wholeness (or to use a Jungian term, individuation). Others have described the Self as an “intelligence in the unconscious” (Samuels, 2000, p. 408), or came to the conclusion that there are “wise, healing, and intentional forces within human consciousness beyond the limits of the everyday personality” (Richards, 2017, p. 329).

One line of evidence supporting these claims are the findings and accumulated knowledge from psychedelic-assisted psychotherapy. After most of the clinical research was interrupted for three decades following the multiplication of legal hurdles in the early 1970s, investigations into the benefits of psychedelics used within psychotherapy are currently undergoing a renaissance. In recent years, many studies have been published showing that psychedelic-assisted psychotherapy can safely and successfully be used to treat anxiety and depression (in connection with life-threatening diseases or otherwise), as well as post-traumatic stress disorder (Amoroso & Workman, 2016; Carhart-Harris et al., 2018; Gasser et al., 2014; Griffiths et al., 2016; Ross et al., 2016; Sanches et al., 2016).

It should be emphasised that all these studies closely follow the same therapeutic model developed and honed in the 1960s, with a strong focus on “set and setting” (Leary, Metzner, & Alpert, 1969). “Set” refers to the mind-set and physical state of the participant, and “setting” to the physical and social environment. A proper set and setting is achieved through the presence of the following elements: trained clinicians, careful screening of the participants, a safe environment, supportive conditions, the use of music for listening during the “trip”, and standard psychotherapy sessions before and after the psychedelic session(s), in order to guarantee adequate preparation and integration.

What distinguishes psychedelics from other chemical compounds is their unspecific action. Usually when people take a certain drug for a certain ailment, they expect a very specific result from that drug (e.g., pain relief from a pain-killer). Psychedelics, however, are unspecific in the sense that one cannot know in advance how the session will unfold and what will be its experiential content. The result is different from person to person and from session to session. Sometimes a person will be dealing mainly with psychodynamic conflicts, other times the experience might be purely abstract and aesthetic. At other times still, the person might encounter archetypal images or have a full-blown mystical experience as described above. This is why when talking about LSD, Stanislav Grof describes it as an “unspecific amplifier of mental processes that brings to

the surface various elements from the depth of the unconscious” (Grof, 2009, p. 6).

Despite this absence of specificity, decades of accumulated knowledge in psychedelic-assisted psychotherapy have shown that the content of a psychedelic session is never random. In fact, it seems to correspond exactly to the client’s current needs and ability to process new insights. By studying the content of several consecutive sessions of many different individuals, Grof noticed a clear continuity and progression between the sessions: “Rather than being unrelated and random, the experiential content seemed to represent a successive unfolding of deeper and deeper levels of the unconscious” (Grof, 2009, p. 20). Similarly, based on 25 years of clinical research with various psychedelics, William Richards states, “we have learned that there is a remarkable wisdom within the minds of most, if not all, persons”, adding that “[i]t is common after a session for a volunteer to say, ‘I didn’t experience what I wanted, but I experienced what I needed’” (Richards, 2017, p. 329).

As we can see, the fact that the content of psychedelic sessions is both unspecific yet tailor-made to the current needs of a specific person strongly suggests that there must exist some kind of unconscious or transpersonal agent guiding and structuring the whole process, and that this agent is independent from the wishes and decisions of the ego. This clearly lends support to the theory of the Self as described by Jung and others.

Furthermore, as the studies’ positive outcomes show, there is something undoubtedly therapeutic about surrendering to the Self through the help of psychedelics. In fact, several of the studies mentioned above reported that the depth and quality of the psychedelic experience was a predictor of therapeutic efficacy. For instance, Ross et al. (2016) and Griffiths et al. (2016) both found that higher scores on the Mystical Experience Questionnaire (MEQ 30)³ were associated with lower levels of anxiety and depression, and higher levels of meaningfulness, spiritual significance, and life satisfaction in the medium term. In other words, there appears to be a link between increased contact with the Self and positive life changes.

It should be noted that positive outcomes of the kind described above are not just limited to clinical populations. Comparable changes for the better have also been observed in healthy adults, with several studies showing that peak and mystical-type experiences induced by psychedelics are associated with long-term positive changes in attitudes, mood, behaviour, and well-being (Doblin, 1991; Griffiths et al., 2011; Klavetter & Mogar, 1967; MacLean, Johnson, & Griffiths, 2011).

Interestingly, these long-term positive changes in healthy adults are very similar to the ones reported by a majority of NDE survivors. NDEs are typically followed by persistent increases in openness, empathy, social skills, and life

³ The MEQ 30 is a validated instrument designed to assess the presence and magnitude of the features typical of mystical experiences. Its questions are structured around four factors: Mystical, Positive mood, Transcendence of time and space, and Ineffability (Barrett, Johnson, & Griffiths, 2015).

quality, as well as by heightened spirituality and a drastic reduction in the fear of death (van Lommel, van Wees, Meyers, & Elfferich, 2001). One plausible explanation is that NDEs share many of the core features of mystical-type experiences (Greyson, 2014), making them a naturally occurring alternative to chemically-induced mystical states. The fact that two very different paths lead to similar outcomes suggests that we are probably dealing with the same universal phenomenon, and that the end point is more important than the various paths leading to it.

3 HOW ARE ASCs INDUCED?

After providing a description and a model of ASCs, as well as discussing their therapeutic functions, it is now time to present the various ways of inducing ASCs. I already mentioned psychedelic-assisted psychotherapy and NDEs as being two situations favourable to the occurrence of mystical-type experiences, which are the most radical form of ASC (in the sense that they are the furthest from regular waking consciousness, as described in Figure 1).

ASCs can happen in two different ways: either spontaneously, or following identifiable physical and/or emotional events. The latter type can be further divided into two sub-categories, namely ASCs caused by involuntary triggers and ASCs induced in a purposeful manner. I will now briefly describe each of these contexts and then focus more specifically on the targeted use of ASCs, since this aspect is the most relevant for therapeutic applications.

3.1 Spontaneous Occurrence

Spontaneous occurrences of various ASCs are undoubtedly very common, but it is difficult to achieve a clear overall picture of their frequency, given their diversity, the cultural taboo surrounding some of these states, and the associated methodological challenges. However, certain ASCs have been studied in more depth and their occurrences extensively documented. This is, for instance, the case with the flow states mentioned earlier, particularly in the context of sports (Murphy & White, 1995). The conclusion of this research is that the flow state in sports largely occurs in a random and accidental fashion, even if attempts have been made to uncover the most favourable circumstances that lead to this enjoyable and desirable state (Jackson & Csikszentmihalyi, 1999).

Another sub-category of spontaneously occurring ASC that has been systematically researched is spontaneous spiritual experience, which would include the mystical-type experiences we have already discussed. Several surveys conducted in the US and the UK show around 35% of the respondents

typically reporting having had a religious or mystical experience, with the proportion steadily increasing since the 1960s (Hood, Hill, & Spilka, 2009). In the latest such survey conducted in the US, the number even reached 49% (Pew Research Center, 2009). It is unclear whether this is due to an actual increase in frequency or simply to a change in cultural acceptability, which might have resulted in more people openly admitting having had such an experience. Regardless, these numbers indicate that spontaneous spiritual experiences are in fact rather common, both in religious and secular contexts.

One specific example of a spontaneous mystical-type experience would be the case of Helen Bonny, the creator of GIM. At the age of 28, while playing the violin in front of the participants of a women's retreat, she was suddenly overtaken by her own music, becoming one with it. She started producing sounds of the most beautiful quality, no longer knowing if she was playing the instrument or if the instrument played her.

Midway through the short piece a radical and inexplicable event occurred. Suddenly the tone quality issuing from my violin changed in volume and texture. It was of incredible beauty. Although I have often prized myself on the quality and warmth of my tone, this was different. Far surpassing my best efforts, the tones soared with an ease and purity beyond the boundaries of remembered sound. My first shocked impulse was to stop playing. My second, which overcame it, was an intense desire to remain connected with this ongoing beauty. To do so, I methodically placed my fingers on the strings and drew the bow taking care not to vibrate or impress any interpretation of the continuing melodic line. Unimpeded, the marvelous flow of music continued despite my clumsy, wooden efforts. I was trembling when I finished, and as I sat down, began to shake even more violently. (Bonny, as cited in Clark, 2002, pp. 6-7)

This experience had a profound and life-long impact on her, and was actually the impetus behind the creation of GIM. In Bonny's own words,

the quality of the experience is as fresh and real today as when it happened over 50 years ago. . . . the depth of its impact has affected every aspect of my life – philosophy, belief systems, and professional motivation – and is the creative force behind the development of the Guided Imagery and Music procedure. (Bonny, as cited in Clark, 2002, p. 6)

What Bonny described has all the features of a peak experience, defined by Maslow (1964) as an ecstatic, blissful, and elevating experience where we are functioning effortlessly at our highest potential, while being completely mindful in the present moment, and perceiving an enhanced and unified form of reality. Most importantly, "[p]eaks come unexpectedly, suddenly they *happen* to us" (Maslow, 1962, p. 13).

3.2 Identifiable Physical and Emotional Factors

The second way to achieve an ASC is through the presence of physical and/or emotional factors that can be clearly identified. As I already mentioned above,

such ASCs can happen in two different ways. The first way is involuntarily, triggered by events that are part of normal human life. These could be for instance exhausting or painful diseases, physical traumas, childbirth, powerful sexual experiences, sleep and dreaming, bereavement, the loss of a job, or a series of disappointments. The second way is through the deliberate use of methods that are designed to produce ASCs and spiritual experiences. Unsurprisingly, these are very prominent in polyphasic cultures, where ASC-inducing techniques are used, among other things, in the context of rigorous spiritual practice (Shear, 2011), culture-specific initiation ceremonies (Johnston, 1977), and healing rituals (Jilek, 1989).

Knowing the exact circumstances leading to a certain ASC implies that the experience is to some extent controllable and repeatable, with the caveat that one should not mistake the induction procedure for the ASC itself. As Cardeña (2011) points out, there is a lot of conceptual confusion in the literature, with induction procedures often being conflated with their outcome, when in fact there is never any guarantee that a certain technique will induce a certain ASC. In reality, the same induction procedure might result in different ASCs (e.g., the non-specific effect of psychedelics), or the same ASC might be reached in different ways (e.g., psychedelics and NDEs both leading to mystical states). Therefore, it is important not to automatically assume a given ASC was experienced just because certain factors were present or a certain procedure was followed.

Having said that, the conditions antecedent to an ASC remain important and are well worth studying. Indeed, we know that the presence of certain factors does make particular ASCs more likely, and sometimes their occurrence can even be quantified. For instance, NDE research tells us that 10-20% of patients who survive a cardiac arrest will report having had an NDE (Parnia, Spearpoint, & Fenwick, 2007). Furthermore, specific induction techniques would not have been developed and perpetuated if they had proven useless. In other words, induction techniques exist because they significantly increase the probability of certain desirable ASCs occurring. It should also be mentioned that these procedures can be traced back as far as the Neolithic era, with hints that they were in existence already in the Palaeolithic (Ustinova, 2011).

In polyphasic and shamanistic cultures, the most common ASC-inducing methods are psychoactive substances, sleep deprivation, physical exhaustion, pain, meditation, fasting, respiratory manoeuvres, drumming, chanting, and dancing, used either alone or in various combinations (Price-Williams & Hughes, 1994; Winkelman, 2010). What all these methods have in common is to cause sensory alterations, albeit in three different ways. The first way is through the direct chemical action of a mind-altering substance. The two other ways involve either an increase or a decrease in external sensory input, and include all the other procedures listed above. In line with Fischer's map of ASCs (see Figure 1), these remaining induction methods can be divided into two types: those designed to cause hyperarousal and overstimulation, and those relying on hypoarousal and sensory deprivation. It should be noted that these sensory alterations are often accompanied by a corresponding increase or decrease in motor activity.

Some of these induction methods have been widely investigated using modern physiological measurement techniques such as electroencephalography, functional magnetic resonance imaging, and electrocardiography (Jovanov, 2011). This is especially the case for psychedelics and meditation, where an extensive literature exists regarding the distinct physiological changes that accompany these approaches. If we take meditation for example, although it is a generic term that involves different procedures and practices, some of its common physiological manifestations include more synchronised brain wave patterns, increased amplitude of slow (alpha and theta) brain waves, and a shift toward parasympathetic dominance (Jovanov, 2011; Winkelman, 2011).

It may be asked why the list of induction procedures provided above does not include hypnosis, which I briefly mentioned in Chapter 1 of this summary. I have excluded it because, as surprising as it may sound, its underlying mechanisms are still not very well understood. While hypnosis—and its predecessor mesmerism—have been used and studied in the West since the 18th century, practitioners and researchers are still debating whether hypnosis actually induces a discrete ASC with unique physiological changes (trance or dissociation theories), or whether it solely relies on suggestion and the wish to comply with the instructions (social cognitive theories; see Nash & Barnier, 2012). In the absence of any certainty, I decided not to include hypnosis when discussing ASC-inducing techniques.

Generally speaking, the fact that certain chemical, physical, and emotional triggers lead to ASCs is not surprising. As we saw in Section 2.2.1, any state of consciousness is characterised by a set of stabilised patterns involving sensations, perceptions, cognition, and emotions. Thus, it is to be expected that a disruption of the sensorimotor patterns corresponding to the state of daily routine would cause a shift to a different state of consciousness characterised by its own set of stabilised patterns. Once an ASC is achieved, its duration will depend on how long this newly-found stability can be sustained. If the new state is dependent on the execution of a specific activity (e.g., fasting) or the presence of an extraneous input (e.g., a psychoactive substance), once the activity stops or the input subsides, people usually return to their default state. In monophasic cultures, this default state would be “normal” ego-consciousness.

4 ASC AND IMPROVISATIONAL MUSIC THERAPY

4.1 Choice of an Induction Method

As can be seen from the wide range of ASC-inducing methods, humans everywhere and throughout history have been rather creative when it comes to developing, applying, and fine-tuning ways to purposefully alter their state of consciousness. Although the initial list seemed long, narrowing it down and choosing a suitable induction method to be used within improvisational music therapy proved to be easier than I initially thought. Upon closer examination, most of the existing methods did not fulfil the requirements and constraints of the context in which I wished to use them.

First of all, I needed an induction procedure that could be performed by most people and did not involve a long learning period. Second, the effects had to be sufficiently immediate that the addition of the procedure would not excessively prolong the total duration of the therapy session. Since a music therapy session usually lasts between 45 and 60 minutes, the chosen procedure could not exceed 15 minutes. Moreover, in order to facilitate empirical research and data collection, the effects needed to be reliable and measurable on the physiological level. Third, I wanted an induction procedure that would be affordable and easy to implement, so that it would be accessible to as many therapists and clients as possible. Lastly, the procedure had to be safe, ethical, legal, and culturally acceptable to a Western public.

Keeping all these criteria in mind, it rapidly became clear that respiratory manoeuvres would be the most suitable type of ASC-inducing procedure. Indeed, none of the other methods fulfilled all of the criteria: sleep deprivation, physical exhaustion, and pain would be considered unethical and dangerous; fasting takes time and preparation; psychedelics are currently not legally accessible outside certain clinical trials; meditation does not suit everyone and takes years of regular practice before sufficient mastery is achieved; as to drumming, chanting, and dancing, these activities typically require a ceremonial context and are usually applied much longer than 15 minutes before an ASC can be reached.

Besides, they might not be culturally neutral enough for every client. In addition, studies about trance induction through sound indicate that individual responses vary considerably and depend largely on personality and susceptibility to hypnosis (Fachner & Rittner, 2011). In other words, the effects of auditory driving did not appear sufficiently reliable and predictable.

On the other hand, respiratory manoeuvres (i.e., the purposeful manipulation of the way we breathe) seemed rather promising. Such techniques have many advantages over the other types of induction methods. First and foremost, they rely on a universal phenomenon with which every human is familiar (the breath). Consequently, they are straightforward to implement, and do not present any cultural challenge. Furthermore, most Westerners have already integrated the idea that there is a link between how we breathe and our health, for example through modern trends such as wellness, fitness, mindfulness, and yoga, or simply general health recommendations to which they might have been exposed. It should be added that in recent years, the use of breathing techniques has become increasingly common for the treatment of mental health issues and stress-related disorders such as depression, anxiety, post-traumatic stress disorder, and attention-deficit disorder (Brown, Gerbarg, & Muench, 2013). Thus, there already exists a cultural and therapeutic context that is favourable to the implementation of such methods. Finally, as we will see below, there are many breathing techniques available, covering the whole range from ergotropic to trophotropic arousal, making it possible to find a suitable technique for any situation or purpose.

4.2 Overview of Breathing Techniques

Before introducing the specific breathing intervention chosen for this doctoral research, I will first put it into context and provide an overview of existing breathing techniques. All these methods can be mapped on a spectrum that ranges from highly activating and stimulating at one end, to very calming and relaxing at the other end. In other words, they can be easily superimposed on Fischer's ASC continuum, where ASCs are organised according to their corresponding arousal level (see Figure 1).

Generally speaking, any breathing technique can be described in terms of variations of a small set of basic parameters. These parameters are the speed of the breath, the depth of the breath (i.e., the volume of air), and the presence or absence of pauses between inhalation and exhalation. Together, they create the breathing patterns typical for each technique. Two other distinguishing parameters (unrelated to the pattern itself) are whether the breathing happens through the nose and/or the mouth, and the main locus of the respiration (abdomen, middle chest, upper chest, or a combination of these). As a rule of thumb, the deeper and faster the breath is, the more activating and intense the method will be.

The list I am about to present is not exhaustive, but its members were chosen so as to cover the whole arousal spectrum. Four of these techniques belong to the age-old yoga tradition, while the other three are modern Western creations. All the yogic breathing exercises are collectively called pranayama, which translates as “extension and control of the breath/life force” (Iyengar, 1983). A thorough description of the four pranayama exercises presented here can be found in Iyengar (1983), along with 11 other pranayamas. Regarding the Western methods, I will provide separate references for each. A summary of the breathing techniques and their main features is shown in Table 1. Both in the table and in the list below, the techniques are ordered by arousal level, with the most intense and disruptive ones on top, and the most calming and pacific ones at the bottom.

- Bhastrika

Also known as “bellows breath”, Bhastrika consists of rapid successions of forceful exhalations and inhalations without holds or pauses. This is achieved by rapidly moving the abdomen and diaphragm, similarly to how blacksmiths blow their bellows. A series of forceful breaths is followed by one long and very deep breath. The result of this practice is an increase in alertness and energy levels.

- Breath of Fire

Breath of Fire is a technique very similar to Bhastrika, except that only the exhalations are forced, making it slightly less arousing and disruptive. Breath of Fire is an important part of Kundalini Yoga, where it is used to raise the so-called Kundalini energy up the spine. Practitioners and teachers often conflate this technique with an almost identical one, called Kapalbhati (“shining skull”).

Being on the activating end of the spectrum, Bhastrika and Breath of Fire are usually practised only for a short period of time (a few minutes), and interspersed with phases of normal breathing and rest. Because these two techniques are so intense and disruptive, they should be practised carefully. Brown and Gerbarg (2017) list the following contraindications: hypertension, respiratory conditions, recent surgery, seizure disorders, panic, post-traumatic stress disorder, flashbacks, dissociative disorder, and bipolar disorder.

- Holotropic Breathwork

Holotropic Breathwork is a method developed by Stanislav Grof and his wife Christina in the mid-1970s, as a substitute for psychedelic-assisted psychotherapy after the use of psychedelics became prohibited. It relies on purposeful hyperventilation, achieved by breathing deeper and faster than usual. This breathing pattern is maintained over a prolonged period of time (at least one hour), in combination with loud, rhythmic music and releasing bodywork performed onto the experiencer by a sitter (Grof & Grof, 2010). The method was designed to induce ecstatic states of consciousness, with the idea of using those states for healing and self-exploration. It is usually practised in large groups during weekend workshops.

The list of physical and emotional contraindications given to aspiring participants is as follows: cardio-vascular problems, hypertension, glaucoma, pregnancy, recent surgery, epilepsy, asthma, bipolar disorder, and paranoid personality disorder (Taylor, 1994). As one can see, it is quite similar to the list given above for Bhastrika and Breath of Fire.

- Rebirthing/Vivation

Rebirthing (Dowling, 2000) and its descendent Vivation (Leonard & Laut, 1990) are two methods created in the 1970s, with the aim of helping clients access painful, repressed issues and resolving them. They both consist of continuous breathing without pauses and holds between inhalation and exhalation. Fast and deep breathing plays an important role, but unlike Holotropic Breathwork, hyperventilation is not particularly encouraged. Rather, clients are taught to self-regulate and switch to a slower and shallower breath should the arising sensations and emotions be too strong or uncomfortable.

Although both methods were designed to foster the emergence, resolution, and integration of disturbing or painful emotions and sensations, the difference lies in their fundamental premise: Rebirthing specifically encourages the re-experience of birth trauma memories, while Vivation de-emphasises trauma and focuses instead on the ability to hold any painful material in awareness (whatever it might be), until it is resolved.

No explicit list of contraindications could be found in the literature concerning Rebirthing and Vivation. In an interview posted on the official Vivation website, Jim Leonard (the creator of the method) states “[t]here are absolutely no contraindications for Vivation—even very sick people can do it” (Leonard, 2002). However, one should keep in mind that, although the intensity of the effects can be self-regulated, both methods still belong to the excitatory techniques. To err on the side of caution, one might want to refer to the contraindications mentioned for the previous methods.

- Ujjayi

Ujjayi translates as “victorious breath”. It consists of slow breaths slightly deeper than normal, with the chest fully expanded at the end of the inhalation (but without inflating the abdomen). In addition, the throat should be slightly contracted, so as to create a sound similar to ocean waves. This type of breath is considered both calming and invigorating, with the ability to induce the feeling of confidence (hence “victorious”). It also leads to an increase in body temperature. Ujjayi is often practised in combination with Hatha Yoga postures.

- Dirga

This is the foundation of any pranayama exercise and is often the first breathing technique taught in yoga classes for beginners. It is a very deep and slow breath that has a calming and relaxing effect on the body and the mind. Dirga is also known as “three-part breath” or “complete breath” because it uses all the three parts of our respiratory apparatus (abdomen, middle chest, and

TABLE 1 Overview of breathing techniques, listed in descending order of intensity

Technique	Depth	Speed	Retention	i/e ratio	Location	Special features
Bhastrika	deep	fast	1 st phase: none 2 nd phase: hold	equal	abdomen	Forceful inhalation and exhalation; series of fast and deep breaths (1 st phase) followed by one slow and very deep breath (2 nd phase)
Breath of Fire (Kundalini Yoga)	natural (half-breath)	fast	none	normal-length inhalation, fast exhalation	abdomen	Forceful exhalations; short practice time (30 s to 3 min); cycles of nine intense breaths followed by three deep and relaxed breaths
Holotropic Breathwork	deep	fast	none	not specified	not specified	Encourages hyperventilation; use of loud & rhythmic music
Rebirth & Vivation	either deep or shallow	either fast or slow	none	unimportant	chest and/or abdomen (unimportant)	Clients are taught to self-regulate the depth and speed of the breath
Ujjayi (Hatha Yoga)	deep	slow	hold: short pause: optional (short if any)	equal	chest	Constriction of the throat ("resistance breathing"), production of sound
Dirga ("basic" pranayama)	deep	slow	both	usually equal	complete breath (abdomen, middle and upper chest)	
Resonance Frequency Breathing	natural (half-breath)	slow	none	40/60	abdomen	Aiming for the "resonance frequency" (around 6 breaths/min)
Buteyko	very shallow	slow	hold: short pause: very long	short inhalation, long exhalation	abdomen	

upper chest). During inhalations, the air fills first the abdomen, followed by the middle chest, until it reaches the upper chest. This sequence is then reversed during exhalations, ending with the abdomen being slightly drawn in. In pranayama, the breathing cycle is divided in four distinct phases (inhalation, pause, exhalation, hold). Once basic Dirga is sufficiently mastered, breath retention—known as kumbhaka—is introduced and practitioners are encouraged to progressively lengthen their pauses and holds.

- Buteyko

Buteyko is a breathing method developed in the 1950s by Konstantin Buteyko for the treatment of asthma. It is characterised by an extremely slow and shallow breath, with long pauses between each inhalation. The method is based on the proposition that the majority of the population is suffering from chronic hyperventilation, and that this over-breathing is the cause of many disorders and diseases (Yakovleva, Buteyko, & Novozhilov, 2016). While the method itself appears to be effective in alleviating certain symptoms related to asthma, so far there has been little support for the official underpinning theory, meaning its actual therapeutic mechanisms are still unknown (Bruton & Lewith, 2005).

Buteyko is generally considered safe for most people, but should be avoided when presenting with any of the following health conditions: current cancer treatments, type 1 diabetes, epilepsy, schizophrenia, uncontrolled hypertension, sickle cell anaemia, arterial aneurysm, recent heart attack, transplanted organs, uncontrolled hyperthyroidism, and renal failure (McKeown, 2004). Because it involves air shortage, an adapted, gentler form of the method should be used in case of pregnancy, type 2 diabetes, severe asthma, chronic obstructive pulmonary disease, migraines, anxiety, and depression (McKeown, 2004).

4.3 Resonance Frequency Breathing

After having delineated the spectrum of breathing techniques through specific examples, I will now introduce the technique chosen for inclusion in improvisational music therapy, namely resonance frequency breathing (RFB). First, I will describe the method and place it on the spectrum of existing techniques. Next, I will clarify the differences between RFB and closely-related methods. Then, I will explain the reasons for choosing RFB over other breathing interventions. Finally, I will present the potential benefits that can be expected from RFB when used in conjunction with improvisational music therapy.

4.3.1 Background and Features

RFB is the core element of a biofeedback method developed in the 1990s, known among other names as heart rate variability biofeedback (HRVB).⁴ RFB exploits the fact that our heart rate is directly influenced by our breathing pattern, with heart rate accelerating during inhalations and decelerating during exhalations. This cardiorespiratory coupling is always present, but its strength depends on our breathing rate. Research has shown that every individual has an ideal, personal breathing speed around 6 breaths/min where heart rate and respiration rate are in resonance, meaning where they are highly synchronised and potentiating each other (Vaschillo, Lehrer, Rische, & Konstantinov, 2002). When this happens, heart rate variability (HRV) reaches its maximum amplitude and the autonomic nervous system shifts to parasympathetic dominance, leading to a state of calm alertness. The aim of RFB is to use this phenomenon and encourage clients to breathe at their resonance frequency.

When practicing RFB, the depth of the breath should be kept natural while the speed is slowed down to the level of the resonance frequency. Furthermore, the breath is continuous, without any pauses between exhalation and inhalation. There are no known risks or contraindications associated with RFB (Eddie, Vaschillo, Vaschillo, & Lehrer, 2015), except the possible occurrence of hyperventilation, which—unlike Holotropic Breathwork—is not encouraged. Rather, clients are instructed to breathe more shallowly should they notice any uncomfortable signs of hyperventilation (e.g., light-headedness or tingling in the extremities). These characteristics place RFB on the calming end of the spectrum, somewhere between Dirga and Buteyko (but closer to Dirga).

The reason why I have given a distinct name to the chosen breathing intervention is because I have created a hybrid between the methods which rely on systematic biofeedback and those which use the same fixed breathing speed for everybody (usually 5 or 6 breaths/min). RFB neither involves any biofeedback, nor does it apply a standardised breathing speed. Instead, it manages to remain an individualised intervention while avoiding the additional complexity and costs created by biofeedback instrumentation.

This compromise is the result of an interesting property of the resonance frequency, namely that it remains largely stable in adults. When intra-individual variations do occur, they are minimal and typically never exceed 0.5 breaths/min (Vaschillo, Vaschillo, & Lehrer, 2006). Thus, I decided to capitalise on this property and simplify the method as follows: the client's resonance frequency is determined beforehand through a one-off breathing assessment (for a detailed description, see Lehrer, 2007), and in all the subsequent sessions, a simple breath pacer is used, set at the client's optimal speed. Consequently, the name "resonance frequency breathing" does not contain the term "biofeedback";

⁴ Other appellations found in the literature are resonance frequency feedback, resonant frequency biofeedback, respiratory sinus arrhythmia biofeedback, resonant breathing, and coherent breathing.

moreover, it emphasises the fact that people breathe at their resonance frequency instead of just a standard speed.

These alterations made to HRVB should not reduce the method's effectiveness and benefits. Indeed, there is evidence indicating that the most crucial element is to breathe at one's resonance frequency, because even a deviation of 1 breath/min already reduces the improvements in HRV, blood pressure, and mood (Steffen, Austin, DeBarros, & Brown, 2017). However, breathing with or without biofeedback does not appear to be such a determining factor (Wells, Outhred, Heathers, Quintana, & Kemp, 2012).

Another feature that distinguishes RFB from HRVB is the use of a specific inhalation/exhalation (i/e) ratio. In their published work, Vaschillo, Lehrer, and Gevirtz never explicitly mention which exact i/e ratio should be used during HRVB. The only instructions I managed to find are "[b]reathe out longer than you breathe in" (Lehrer, 2007, p. 240). Such a recommendation is not surprising, since exhalations stimulate the parasympathetic system, while inhalations activate the sympathetic system. As a result, low i/e ratios are more relaxing (Diest et al., 2014) and accompanied by higher vagal tone (Porges, 2007) compared to high i/e ratios. In the case of RFB, I opted for a fixed and predefined i/e ratio of 40/60, meaning inhalations last 40% and exhalations 60% of the breath cycle time.

4.3.2 Why RFB?

RFB has several characteristics that make it more suitable for music therapy than other breathing methods. First, it has very clear physiological correlates that can be easily measured using inexpensive equipment and common devices such as smartphones. This aspect is very valuable both for research purposes and for the implementation by music therapists. Second, it has immediate effects on the heart rate and the ANS, meaning even a short practice time is already beneficial. Third, it has very few risks and contraindications, unlike many of the breathing techniques presented above. Lastly, it has a track record of successful applications for various physical and emotional disorders, for example asthma, hypertension, chronic muscle pain, post-traumatic stress disorder, anxiety, and depression (for an overview, see Gevirtz, 2013).

4.3.3 Expected Benefits

Being on the trophotropic end of the spectrum, RFB—especially when practised punctually and briefly—will not induce any sudden and radical change in the person's state of consciousness. This is unlike the forceful and disruptive breathing methods on the ergotropic end, which are able to quickly break through existing ego patterns and lead the person into very unusual ASCs. In that sense, intense breathing methods are more transformative in the short term (but with the risk of being possibly too destabilising and threatening). Nonetheless, as we saw in Chapter 2, calming methods such as RFB also

encourage us to break away from our habitual and ego-driven thought patterns, albeit in a gentler and subtler way.

In the case of breathing methods based on trophotropic arousal, we know that their transformational potential becomes heightened when they are used in combination with physical and psychospiritual practices such as yoga or prolonged sitting contemplation. A possible explanation is that the two practices support each other and create a positive feedback loop. Therefore, a similar synergy effect can be expected from combining RFB and improvisational music therapy. Such an effect becomes all the more likely considering that both methods have very similar features and properties.

Regarding improvisational music therapy, three of its unique characteristics are to offer a non-verbal, non-cognitive way of expressing emotions, to provide an absorbing experience anchored in the present, and to allow the emergence of unconscious material (MacDonald & Wilson, 2014). As for RFB and closely related breathing methods, they have been shown to relax, reduce anxiety, and quiet the mind in the short term, and to increase people's emotional resilience in the longer term (Brown & Gerbarg, 2012; Goessl, Curtiss, & Hofmann, 2017; McCraty & Zayas, 2014). An additional effect—in line with the ideas presented in Section 2.3—is that in becoming temporarily less ego-driven while we perform RFB, we can more easily “hear” what the Self has to say and rely on its inner guidance.

Hence, it is reasonable to assume that when used in conjunction with improvisational music therapy, RFB will increase clients' sensitivity to inner physical and emotional processes, and give them better access to their inner world, especially repressed emotions and memories. At the same time, one can also expect RFB to support emotional regulation, thereby making it easier for clients to face difficult themes and issues.

Generally speaking, it seems logical that complementing psychotherapeutic work with an activity that rebalances the ANS would be beneficial. For instance, it is well-established that our mind-set and emotions influence our physiology, and in turn that our physiology affects our mind-set and emotions. This bi-directional relationship is commonly known as the mind-body connection (Littrell, 2008). Besides, many emotional and psychological disorders are accompanied by low HRV levels, which are indicative of chronic stress, low vagal tone, and a less resilient ANS. Therefore, I also hope that through the addition of RFB, clients with emotional disorders will find it easier to manage the intense and unpleasant feelings that might emerge during therapy.

5 STRUCTURE AND METHODS

The core of this dissertation consists of three single-case experimental studies employing RFB as a preparatory intervention at the beginning of the music therapy sessions, in alternation with a control intervention. The results of two of these studies are reported in separate publications (Articles 2 and 3), whereas the key results of the third study can be found in a summary article that synthesises the common findings of all three studies (Article 4). Furthermore, this core part is preceded by a theoretical article presenting a non-conventional model of human consciousness (Article 1), and followed by the protocol of an on-going randomised controlled trial (RCT) where RFB is being used for the first time on a larger scale (Article 5). Thus, these articles reflect the logical progression in the development and implementation of the initial idea behind this dissertation (might it be possible to improve improvisational music therapy by purposefully inducing a helpful type of ASC in the client?).

In fact, this dissertation illustrates quite well the process required for the development of a new therapeutic method or approach. First, I got an idea from examining another therapy method (GIM) and how ASCs are used in different cultures and contexts. Next, being dissatisfied with the conventional ways of explaining consciousness and its alteration, I devised my own model by integrating existing elements from various fields. Then, I looked into the most common methods for inducing ASCs, and chose one that looked suitable and promising (RFB). Finally, I tested RFB in an actual clinical context, first through a series of single-subject studies, and now in a larger trial where half the participants are beginning their music therapy sessions with RFB.

In terms of methods, single-subject experimental designs and the more traditional between-group designs both play an important and complementary role in the study of a new intervention, and in evidence-based practice in general (Byiers, Reichle, & Symons, 2012; Nezu & Nezu, 2008). Single-subject experimental designs allow researchers to go much more in depth, to better understand certain internal mechanisms, and to study the effect of a specific element on therapy processes. However, they do not allow the drawing of

general conclusions or the establishment of a link between the intervention and therapy outcomes. In order to generalise the findings and show that a certain therapeutic method leads to better outcomes, between-group designs are required. Conversely, since they are only focussed on outcome measures, between-group designs are not suitable for studying therapy processes or the internal mechanisms of a given therapeutic method.

6 OVERVIEW OF THE ARTICLES

6.1 Article 1

Objectives: This article aims at overcoming the limitations of the commonly accepted models used to explain human consciousness. While reviewing the available literature on consciousness and altered states of consciousness, it became obvious that there exist many well-documented phenomena that contradict the fundamental tenets of reductive materialism. Furthermore, there are valid reasons to believe that the materialist paradigm is in fact incorrect and would need to be replaced by a wider and more transcendent understanding of reality.

Results: I present a post-materialist model of mind-matter manifestation and consciousness, by integrating ideas from philosophy of mind, psychology, and quantum physics. This model has higher explanatory power than conventional models, because it can accommodate human experiences that are impossible to explain using a purely materialistic paradigm. Furthermore, it is more in line with the findings of modern physics.

Connection to the objectives of the dissertation: This theoretical article lays the groundwork for the rest of the dissertation, as it allows me to frame and define the notions of consciousness, altered states of consciousness, ego, and Self.

6.2 Article 2

Objectives: The goal of this exploratory study was to investigate the effects of RFB on emotional processes when used in the context of improvisational music therapy. The chosen intervention format involved starting every other therapy session with 10 minutes of RFB, in alternation with a control intervention

(listening to relaxation music). Since no prior knowledge was available regarding the actual benefits of RFB when combined with any form of psychodynamic therapy, we decided to start our investigation with a healthy client and look at multiple process variables (HRV, music features, facial expressions and verbal content).

Results: RFB had the expected relaxation effect while it was being performed, as demonstrated by the large increases in HRV. During the remaining time of the sessions, however, we observed the seemingly paradoxical situation where sessions starting with RFB were experienced as more stressful and tended to have a more negative emotional content than sessions starting with the control intervention. This effect was visible on the level of HRV and facial expressions in all the sessions, and supported by the verbal content of sessions 4 to 10. The music feature analysis did not yield any significant differences between the experimental and the control conditions.

Connection to the objectives of the dissertation: This study contributes to dissertation's objectives in three important ways. First, it serves as a proof of concept that RFB can be integrated into the practice of improvisational music therapy in the form of a short preparatory intervention at the beginning of the sessions. Second, it shows the kind of effects that can be expected from this integration in the case of a healthy client. Lastly, it confirms our hypothesis that RFB might, among other things, facilitate the emergence of difficult emotions.

6.3 Article 3

Objectives: In this further single-subject study, we continued our investigation of RFB and its effects when used as a prelude to improvisational music therapy. However, this time we recruited a client diagnosed with anxiety disorder and social phobia, in order to examine how the effects of RFB might differ with different client populations.

Results: During RFB itself, HRV levels were again substantially higher compared to the control intervention (a relaxing vibroacoustic programme). During the remaining 45 minutes of improvisational music therapy, the associations we found with RFB were specific to the therapy phase. This client's therapeutic process was divided in two phases of roughly equal length: one phase where the sessions became increasingly more difficult in terms of themes and emotions, followed by a phase where the sessions became gradually easier and more positive. Interestingly, the type of changes we observed in some of the variables went in opposite directions depending on the phase: during the difficult phase, certain aspects became easier after RFB, while during the easier phase, some aspects became more difficult after RFB.

Connection to the objectives of the dissertation: This study represents our first attempt at using RFB with a client diagnosed with an emotional disorder. It is therefore an important milestone in the development of this new therapeutic approach, and provides useful information regarding the types of effects that can be expected from RFB. In particular, the study shows that beyond the emergence of difficult emotions, RFB can also be associated with an easing of the emotional burden. This indicates that RFB might be an adaptive intervention whose effects change according to the client's current needs and challenges.

6.4 Article 4

Objectives: The aim of this article was to present a summary of the most salient results obtained in the three exploratory studies conducted so far (two with a healthy and one with a diagnosed client). At this stage, I thought it interesting to juxtapose the various findings and show the presence of some consistent patterns. Besides, since I had not reported the findings of the second study in a separate publication (only the first and the third; see Articles 2 and 3), this was also an opportunity to share at least some of the unpublished results.

Results: Since HRV measurements were the only methodological constant in all three studies, the joint analysis focussed on HRV variables. We found that one HRV parameter could be linked to RFB with a high level of confidence, namely HFnu (the high frequency component of the HRV power spectrum, expressed in normalised units). This link was visible during music improvisations but not during the phases of verbal exchange. More specifically, RFB was associated with more stressful improvisations in the two healthy clients, and less stressful improvisations in the diagnosed client. Furthermore, we found that talking and music-making were very different activities in terms of HRV, one of them being always experienced as more stressful than the other (the clients differing in terms of which activity they found more stressful).

Connection to the objectives of the dissertation: This synthesis article allows me to formulate a general model to explain why different clients would respond differently to the same relaxation-inducing intervention. The model is based on the concept of the window of tolerance used in trauma therapy. While the article does not tie it to my more complex model of ASCs, it remains perfectly compatible with it, as we will see in the next section. Generally speaking, this article is less technical and detailed than the previous ones, and more geared towards RFB's concrete application by music therapists. This aspect is important, as I want my research to be useful and implementable in clinical practice.

6.5 Article 5

Objectives: This article is the study protocol of an RCT begun in early 2018 at the University of Jyväskylä. In accordance with the conventional structure of study protocols, we describe the trial's hypotheses, its design, the chosen interventions, and the outcome measures.

General description: This new RCT is the follow-up of an earlier RCT, whose central finding was that integrative improvisational music therapy (IIMT) was more effective than standard care alone in the treatment of depression. The current trial's main goal is to determine whether the efficacy of IIMT could be further enhanced through the presence of two additional components: listening back at home to the improvisations created during the sessions, and starting each session with 10 minutes of RFB. All the participants are randomised into four groups: IIMT only, IIMT plus listening homework, IIMT plus RFB, and IIMT plus listening homework *and* RFB.

Connection to the objectives of the dissertation: Although this article does not involve any findings, I included it in the dissertation because it shows the next step in the study of RFB as a potential therapy enhancer. This relatively large RCT (68 participants) will make it possible to determine whether the use of RFB is connected to better therapy outcomes, which is something the three single-case studies conducted earlier were not designed to do.

6.6 Contribution to co-authored publications

For Articles 2 and 3, I was the main contributor to the study design, the data analysis and their interpretation (with the exception of the music features in Article 2), and the writing of the manuscripts. For Article 4, I played the main role in juxtaposing and synthesising the findings, as well as in writing the manuscript. For Article 5, I contributed to the study design and the writing of the manuscript, and played the main role in the development and implementation of the RFB component. Lastly, I created all the figures and tables presented in the five articles.

7 FINDINGS AND THEIR RELEVANCE

Article 1 shows that it is possible to formulate a coherent model of reality and human consciousness that is wider and more inclusive than conventional models rooted in materialism and classical physics. In so doing, it offers a framework able to accommodate a whole range of unusual and anomalous experiences that are in fact quite common. As we saw in Section 3.1, 49% of the American population report having had at least one religious or mystical experience (Pew Research Center, 2009). To give another example, a recent study investigating the nature and frequency of so-called paranormal experiences among the Finnish population concluded that they occurred in about 40% of the people (Honkasalo & Koski, 2017; for an English summary, see Coleman, 2018).

Still, despite being so common, experiences such as hearing voices, premonitory dreams, and visions of the departed (hearing or seeing dead loved ones) are usually not openly investigated and discussed. Clearly, the problem is not one of scarcity, but one of cultural and scientific acceptability. Moreover, because they are incompatible with the prevailing scientific world-view, such experiences are often seen as abnormal and pathologised. This is unfortunate, as it might not be the most constructive way of helping people who are wondering what is happening to them and seeking answers.

Taken together, Articles 2, 3, and 4 show that RFB used as a preparatory intervention does seem to have a beneficial effect on emotional processes during the rest of the therapy session, albeit in different ways. In Article 2, we saw how RFB was associated with a systematic increase of the client's stress levels because of the emergence of difficult emotions. Article 3, however, supports the idea that under certain circumstances, RFB can also be associated with a decrease in stress and emotional difficulty. These findings are interesting, as they indicate that RFB might be an adaptive intervention able to produce different effects in different clients and situations.

Should these effects be confirmed by future studies, it would mean that RFB has the intrinsic ability to positively contribute to the therapy process, by either challenging or supporting the client at the appropriate moment and in the right amount. To explain the results obtained so far, Article 4 introduces a tentative

model based on the concept of the window of tolerance used in trauma therapy. According to this concept, clients should remain inside their optimal arousal zone between hypo- and hyperarousal in order to benefit from therapy. When applied to RFB, it means that RFB would only lead to the emergence of difficult emotions in clients whose arousal levels are low enough, whereas it would have a calming effect in clients whose arousal levels are currently very high (see Article 4, Figure 4).

Such tailor-made and adaptive effects are not at all surprising when viewed within the larger context of ASCs as I defined them earlier. According to this definition, ASCs bring us closer to an experience of Self by temporarily weakening the influence of the rational mind and the ego. From that perspective, RFB can also be described as a technique that induces a state of enhanced receptivity to subliminal information. When in this more open state, the Self is better able to guide us towards wholeness and health by giving us exactly the insights and experiences that we need. In other words, the window of tolerance and my model of ASCs are both valid constructs for describing and explaining the observed associations involving RFB. The difference lies in the adopted perspective, the Self being a more abstract, psychospiritual, and transpersonal concept, while the window of tolerance is about emotions and physiology. However, both approaches are needed if we want to understand clients from a true biopsychosocial-spiritual perspective (Hatala, 2013).

In addition to the findings involving RFB, this dissertation has contributed to the development of a viable HRV methodology that can be used for research in music therapy. The main benefit of this methodology is to make it possible to analyse and compare therapy moments of different lengths. In contrast, the traditional method for short-term HRV analysis is designed for phases or tasks lasting, by convention, five minutes each. Such an approach is obviously not suitable for sessions of improvisational music therapy, whose moments of interest (e.g., the music improvisations) do not have any predefined or predictable length.

One accidental but highly relevant finding was the existence, in each of the three clients, of a systematic HRV difference between talking and music-making. For two of the clients, music-making was always more stressful than talking, while the opposite was true for the remaining client. The puzzling part is not so much that such a difference would exist—these are, after all, two different activities—but that it would consistently last for the entire duration of the therapy process. At this stage, it is unclear to what this persisting difference can be attributed, because the studies were not designed to investigate the matter further. One can only speculate that it is related to how the intrinsic qualities of each activity are experienced by the client. In any case, this finding supports the notion that improvisational music therapy is more versatile than verbal psychotherapy, because it offers clients an additional mode of expression that is qualitatively distinct from verbal communication.

8 LIMITATIONS AND FUTURE RESEARCH

One obvious limitation of the work presented here lies in its exploratory nature and the small scale of the included studies. Since the described effects involving RFB are based on only three individual therapy processes, they should be seen as provisional and not as a definitive account of how RFB works. Another limitation is the impossibility, at this stage, of drawing any conclusion regarding the effects of RFB on therapy outcomes. Given all the available information about the known benefits and effects of RFB, it stands to reason that adding it to improvisational music therapy should lead to better outcomes. The on-going RCT described in Article 5 will help answer this question. Another, closely-related question this trial will provide answers to is whether differences in treatment effects are clinically significant. This aspect is important, because a difference can be statistically significant without necessarily being useful or meaningful in clinical practice.

A further limitation that needs to be acknowledged is the lack of information concerning the persistence of the effects produced by RFB. It is indubitable that RFB has clear and immediate effects on HRV levels and parasympathetic activity while it is being practised, but how long do these effects last after the breathing has returned to normal? It is reasonable to assume that RFB's calming and mind-quieting effects carry over into the rest of the session, at least for a while. My educated guess is that the magnitude and length of this carry-over effect is probably quite variable anyway, with differences from person to person and from session to session.

One interesting alley that could be explored in future research is how therapists could benefit from using RFB for themselves, either during or before the therapy sessions. In their training, therapists are already taught certain self-clearing techniques meant to be used as a preparation before the beginning of a session. RFB might be a useful addition to this set of techniques. In terms of research questions, it would be interesting to investigate, for example, if RFB can help therapists maintain their empathic connection to the client, remain present, or better deal with counter-transference issues.

9 CONCLUSION

In the light of the evidence and arguments presented in this work, RFB appears to be a versatile and flexible intervention with positive physiological, emotional, and psychospiritual effects. Thus, it represents a promising breathing technique for the purpose of supporting the therapy process and, hopefully, achieving better therapy outcomes.

Practically speaking, RFB seems to be well-suited for introducing the idea of ASCs and working with them in improvisational music therapy. The West lacks familiarity with the whole notion of altered states, for what I have earlier suggested are socio-cultural and historical reasons. Therefore, one has to be culturally sensitive when deciding which ASC to induce in a client. RFB has the benefit of being a gentle induction method that produces a type of ASC not too far remote from the usual waking state, meaning the result is unlikely to be completely at odds with most clients' expectations and prior experiences.

Lastly, I hope this dissertation will encourage others to conduct research with a broader perspective on human beings, health and disease, and the world in which we live. I believe it is valuable to look beyond the edge of our consensus reality and question the assumptions that have accompanied us until now, provided we keep our head on our shoulders. Should we manage to do so, not only is there a lot to gain in terms of personal growth, but we would also contribute to a science that is ultimately more inclusive, more useful, and more engaging – in other words, a better science with a greater impact on society.

SUMMARY

This dissertation represents the development of a new therapeutic approach, from the initial idea, through its testing on a small scale, to its implementation in a randomised controlled trial. It also includes the examination and reformulation of some fundamental concepts connected to the initial idea, along with the introduction of a more comprehensive theoretical model.

The starting point was the realisation that, with a few exceptions, Western therapy methods do not make an active and targeted use of altered states of consciousness (ASCs), whereas non-Western healing modalities routinely include this natural human ability in their procedures. This raised the legitimate question of whether an already effective method like improvisational music therapy could be further enhanced with the addition of an ASC-inducing activity at the beginning of the sessions.

Before proceeding with the choice and application of a given induction method, I first examined the prevailing explanations of consciousness, and noticed they are based on a narrow understanding of reality, which makes them unable to account for a range of studied and documented phenomena pertaining to the human mind. Therefore, I devised a different and more satisfactory model of consciousness which combines ideas from philosophy of mind, modern physics, and psychology.

Next, I reviewed the most common methods for inducing ASCs and decided to focus on breathing techniques, because they appeared the most straightforward, universal, and acceptable. Among those, I chose a method known as resonance frequency breathing (RFB). It involves slow breathing at around six breaths/min, which leads to an immediate and substantial increase in heart rate variability. Through this effect on the heart, RFB has the ability to positively influence the autonomic nervous system, quiet the mind, and induce a state of calm alertness.

Then, I tested RFB in three single-case experimental studies with two healthy clients and one client diagnosed with anxiety disorder. The results showed that the sessions starting with RFB were characterised either by higher stress levels and more negative emotions, or by a reduction in arousal levels, depending on the type of client and the therapy phase. Thus, RFB appeared to have worked as an adaptive intervention, sometimes promoting the emergence of difficult themes and emotions, and at other times helping with the downregulation of excessive arousal.

These encouraging findings suggest that RFB might be a valuable addition to improvisational music therapy. Furthermore, the apparent ability of RFB to appropriately support the therapy process should theoretically result in better outcomes. This question is currently being investigated in a randomised controlled trial, where RFB is used alongside another additional component in an attempt to enhance the efficacy of improvisational music therapy for the treatment of depression.

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ORIGINAL PAPERS

I

MORE THAN MEETS THE EYE: TOWARD A POST-MATERIALIST MODEL OF CONSCIOUSNESS

by

Olivier Brabant, 2016

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MORE THAN MEETS THE EYE: TOWARD A
POST-MATERIALIST MODEL OF CONSCIOUSNESS



Olivier Brabant, MA

Commonly accepted models of human consciousness have substantial shortcomings, in the sense that they cannot account for the entire scope of human experiences. The goal of this article is to describe a model with higher explanatory power, by integrating ideas from psychology and quantum mechanics. In the first part, the need for a paradigm change will be justified by presenting three types of phenomena that challenge the materialistic view of consciousness. The second part is about proposing an alternative view of reality and mind–matter manifestation that is able to accommodate these

phenomena. Finally, the ideas from the previous parts will be combined with the psychological concepts developed by Frederic W. H. Myers. The result is a more comprehensive model of human consciousness that offers a novel perspective on altered states of consciousness, genius, and mental health.

Key words: Consciousness, Post-materialism, Mind–matter manifestation, Non-locality, Subliminal self

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It is time to relinquish scientific materialism and move on to transcendent interpretations of reality that will hopefully be more productive for understanding consciousness.

—Imants Barušs, *Beyond Scientific Materialism*^{1(p219)}

TIME FOR A NEW PARADIGM

Since the birth of modern science in the 17th century, materialism has firmly established itself as the dominant worldview and leading scientific assumption of the Western world. Materialism is the metaphysical position that physical matter is the primary reality and subjective experiences such as consciousness, thoughts, and feelings are only a by-product of material interactions. Consequently, one deeply-ingrained belief is that we presumably live in an objective reality made of hard and tangible matter. However, the scientific revolution that began in the early 20th century with the introduction of quantum mechanics is forcing us to reconsider this view.

Indeed, as soon as we enter the world of sub-atomic particles, all the stability and certainty that characterize the classical world suddenly vanish, and we are left with only uncertainty and unmanifested potentials. To quote the physicist Henry Stapp, “[R]eality is not made out of any material substance, but rather out of events (actions) and potentialities for these events to occur.”^{2(pp26–27)} An additional lesson learned from quantum mechanics is that the classical world as a whole represents a narrowed-down version of the quantum world, a limited selection from an

underlying field of countless possibilities. As stated by Niels Bohr during a conversation with Werner Heisenberg in 1927, “The objective world of nineteenth-century science was, as we know today, an ideal, limiting case, but not the whole reality.”^{3(p88)}

By demonstrating the existence of a broader and hidden reality underlying our everyday reality, physicists were subsequently confronted with the problem of having to explain how these two realms interact. The traditional view has been to avoid this problem altogether, by considering the microscopic and macroscopic worlds as completely separate, effectively partitioning reality into two non-overlapping realms, each following its own rule book (quantum physics versus classical physics). On the face of it, the use of distinct rule books appears justified, as the features of the microscopic world (oneness, indeterminism, uncertainty, non-locality, interconnectedness, and time symmetry) seem incompatible with the features of the macroscopic world (multiplicity, determinism, quasi-certainty, locality, apparent separateness, and unidirectional arrow of time).

However, recent findings in the new field of quantum biology⁴ strongly suggest that quantum phenomena are actually much more relevant for our everyday lives than we previously thought. For instance, plants seem to be able to optimize the transportation of energy obtained through photosynthesis by using quantum superposition to “test” all the possible pathways simultaneously, and retroactively choosing the most efficient one.⁵ There is also evidence suggesting that migrating birds possess in their eyes a photochemical mechanism based on quantum entanglement that allows them to sense the orientation of Earth’s magnetic field.⁶ These findings indicate that the separation between quantum and classical world is far from being clear-cut and impermeable.

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Given all these developments in physics and biology, it is surprising that, for the most part, we are still tacitly holding on to outdated assumptions to explain reality and conduct science. A better starting point would be to integrate the fact that the fundamental nature of reality is non-physical and governed by rules that differ from the rules governing our macro-level reality, thus allowing for a redefinition of the relationship between mind and matter. This would constitute the framework of a post-materialist approach, as defined in the “Manifesto for a post-materialist science.”⁷

The reluctance to adopt a post-materialist paradigm is especially problematic for consciousness studies, because reducing mind to matter only allows us to explain a limited range of human experiences. Indeed, materialism leads us to regard the human mind as an epiphenomenon of brain activity—a simple by-product of neurons firing—with no ability to be a causal agent in its own right. However, if the theory that the brain produces consciousness were correct, then it should be impossible for certain experiences and phenomena to occur.

As we will see in the next part, there exists at least three types of phenomena which directly challenge this theory. The first type is probably the most accepted of the three, and concerns the numerous situations where the mind is able to influence the body. The second type includes all the known cases where more awareness or consciousness is accompanied by less (or no) brain activity. Finally, the last type includes all the instances where information acquisition appears to happen “outside” the brain.

MIND-OVER-BODY INFLUENCES

Over the past few decades, a growing amount of mind-over-body influences have been documented. Some of them involve physical changes resulting from voluntarily directing our attention and focus. We know for example that meditation can induce physical changes in the brain^{8,9} and directly affect the expression of genes.^{10,11} Some other studies have shown that simply holding a belief can be conducive to physical changes. For instance, in a study humorously entitled “Mind over milkshakes,”¹² Crum et al. found that the amount of ghrelin (a hunger-regulating peptide) produced in the gut did not depend on the objective caloric content of the consumed milkshakes, but on what the participants *believed* this content to be.

The best-documented phenomenon related to the power of belief is probably the placebo effect,¹³ which refers to positive physiological changes triggered by the expectation of a therapeutic benefit. No less impressive is its malevolent equivalent, namely the nocebo effect. Its most extreme manifestation is the phenomenon known in anthropological literature as “voodoo death.”¹⁴ Also called “taboo death”¹⁵ or “psychogenic death,”¹⁶ these terms refer to the phenomenon of sudden death brought about by the firm belief in the hopelessness of a given situation. Typically, voodoo death can occur when people think they have been cursed or lost their soul, or after having broken a social taboo that irremediably transforms them into outcasts. Interestingly, this process can be easily reversed, as evidenced by the

numerous reports of people close to death following a hex, who promptly recover when the spell is broken by something or someone deemed more powerful.^{15(chap5),17}

As shown by the previous examples, the hypothesis that the human mind should be considered causally ineffective or even entirely illusory not only conflicts with our everyday experience, it is being refuted by a plethora of intention-based and belief-based phenomena, the most radical one being the mind's ability to cause the demise of the body.

WHEN LESS IS MORE

Because of the assumption that consciousness, cognition, and subjective experiences are produced by the brain, neuro-imaging studies are usually designed to detect an increase in brain activity, not a decrease. Especially during the first decade following the introduction of functional magnetic resonance imaging (fMRI) in the early 1990s, the prevailing methodology consisted in subtracting functional images of the brain at rest from images taken during a task, with the difference representing activity increases.

However, in the late 1990s, some researchers¹⁸ started to perform the opposite contrast (control minus task), and discovered that certain tasks were systematically accompanied by an activity *decrease* in specific brain areas. Raichle and Snyder¹⁹ explicitly called this fact a “problem” for neuroscience, because it challenges the usual role and functions attributed to the brain. However, such a problem can still be accommodated by materialism, as long as brain deactivation in some areas is accompanied by activation in some other areas.

The true challenge begins when an increase in mental activity occurs with no brain activation anywhere. Such an astonishing outcome was reported for example by Carhart-Harris et al.²⁰ in a study investigating the effects of psilocybin (a psychedelic compound found in “magic mushrooms”). To their surprise, the psychedelic experience, with all its intense and vivid imagery, was accompanied by a widespread decrease in brain activity and connectivity, and *not a single area of increase*. Even more surprising was the inverse relationship between brain activity and subjective experience: the lower the brain activity, the more intense the experience reported by the participant.

Needless to say, under materialism, such findings are highly counter-intuitive. As the theory goes, if conscious experiences are produced by the brain, then a more intense experience must correlate with a corresponding activity increase somewhere in the brain. However, in this specific study, the authors made the exact opposite discovery (no activation whatsoever, and a negative correlation between brain and mind). But the challenge does not end here.

In the previous example, although brain activity did not increase, there was presumably enough activity present to enable what is known as the neural correlates of consciousness (NCC). Neuroscience calls NCC the minimal neuronal activity and mechanisms that are sufficient to give rise to conscious experience. Under that threshold, any form of conscious experience is deemed impossible. However, the NCC hypothesis is no longer tenable when considering what

is arguably the most radical disconnect between brain and mind, namely the numerous cases of near-death experience (NDE) reported by survivors of cardiac arrest.

Although NDEs can occur in connection with other life-threatening situations or medical conditions, what makes the context of cardiac arrest particularly interesting is the fact that the survivors were clinically dead for a certain period of time, yet 10–20% of them vividly remember having had a profound subjective experience.²¹ The most typical features of NDEs are positive emotions, an awareness of being dead, an encounter with deceased relatives, moving through a tunnel, seeing a bright light, an out-of-body experience, and a life review.^{22,23}

Many biological explanations of NDEs have been suggested, such as anoxia (absence of oxygen supply), hypercarbia (elevated levels of carbon dioxide), massive endorphin release, and altered temporal lobe functioning.²² However, if the various physiological changes that occur during cardiac arrest are indeed causing NDEs, how come NDEs are only happening in 10–20% of the cases? Other authors have pointed out that the proposed psychophysiological explanations do not account for the entire phenomenology of NDEs, at best certain features, and even here the similarities appear contrived.^{24(chap6)}

The strongest objection to the various biological explanations is the fact that NDEs happen at a time when the brain is at best heavily impaired, and at worst non-functioning. Both are times when, according to modern neuroscience, there should not be any awareness, cognitive process or memory formation whatsoever. But empirical data shows that memory formation does occur during NDEs, and that these memories appear to be reliable and very stable over time.^{25,26} Even more astonishingly, a great majority of near-death experiencers report levels of mental clarity that are *equal or superior* to those of their normal waking state, as well as faster thinking.^{24(chap6)}

One major challenge affecting NDE research is the difficulty in establishing an accurate time-line of the events. Did the NDE indeed occur while the person was clinically dead (i.e., while having no measurable brain activity)? Alternatively, could it have happened just before clinical death or right after resuscitation, when the brain was at least partly functional? If the latter were always true, then materialists could still claim that there might exist a brain-based explanation. However, corroborated reports^{27–29} of patients remembering detailed events that really occurred while they were clinically dead suggest that—at least in those cases—some form of consciousness must have existed during those events.

Evidently, the findings of NDE research glaringly contradict the tenets of (materialist) neuroscience. To summarize, it would appear that our mind can exist—at least for a short while—separately from our brain, and at the same time experience a form of enhanced awareness. Such findings lend support to the so-called filter theories,³⁰ whereby the brain should be seen as having more an eliminative than a productive function, filtering out most of what could theoretically be perceived or remembered.

NEW INFORMATION BEYOND THE BRAIN

In this part, I would like to challenge the widespread notion^{31(chap5)} that new ideas or solutions necessarily result from combining and reorganizing existing knowledge obtained from prior experience. A good place to start would be to consider the mind-boggling skills displayed by people with savant syndrome.

Savant syndrome is a rare condition where developmental disabilities co-exist alongside prodigious skills in very specific areas, usually music, mathematics, and calendar calculations.³² The fact that such extraordinary skills are accessible to some people raises the question of whether these abilities are potentially present in all of us, and what could be done to tap into them. But even more fundamentally, the great mystery surrounding savant syndrome is to explain *how they do it*. Although some skills could indeed be explained by postulating the existence of enhanced forms of known brain functions, certain skills clearly defy such explanations. The case of Daniel Tammet will serve to illustrate this point.

Daniel Tammet is a high-functioning autistic savant with prodigious language-learning and mathematical skills. He is also gifted with a form of synesthesia that makes him perceive each number as a specific shape, texture, and color. In his eloquent autobiography, he describes how he performs calculations using the shapes that populate his mental world. It is important to stress that Daniel Tammet does not actually perform calculations in the traditional sense. As baffling as it may sound, the right answers just *appear* to him, effortlessly and almost instantly. “When multiplying, I see the two numbers as distinct shapes. The image changes and a third shape emerges—the correct answer. The process takes a matter of seconds and happens spontaneously. It’s like doing maths without having to think.”^{33(pp4-5)}

In other words, Daniel Tammet’s brain is not merely a number-crunching supercomputer. Rather, he appears to have access to another realm of information from where he simply retrieves the correct mathematical answers. Moreover, his case is far from being unique. If we examine all the known cases of autistic savants with prodigious mathematical skills that have been documented since the 19th century, some recurrent features are the instantaneity of the process, the absence of voluntary effort, and an unawareness of how the correct answer is obtained.^{24(chap7),32}

Another striking example of knowledge or information seemingly obtained from “outside” the brain are all the documented cases of people who know things they never learned or were never exposed to. As illustrated by Treffert,³⁴ this phenomenon is not limited to savant syndrome, but can also occur in people with no co-existing disability. He mentions the case of Jay Greenberg, a musical prodigy who asked for a cello at the age of two, immediately knew how to play it, and soon after started writing down musical compositions. By the age of 12, Jay had already composed five full-length symphonies, and his fifth Symphony was subsequently recorded by the London Symphony Orchestra. It should be added that Jay’s parents are not musical, and that he had never been exposed to any music instrument in his early childhood.

What makes this case very relevant to our discussion is the fact that Jay Greenberg is not composing music in the traditional sense. In an interview for the *60 Minutes* television program,³⁵ he describes how musical pieces appear fully-formed in his head—sometimes several pieces simultaneously—and that he just needs to write them down, without ever having to make any corrections afterward. Similar to Daniel Tammet and his mathematical answers, it seems that Jay Greenberg is simply “downloading” finished musical pieces into his mind.

Again, this way of composing music, albeit rare, is certainly not unique. A similar type of inspiration has been reported by other famous composers, such as Johannes Brahms, who stated that “not only do I see distinct themes in the mind’s eye, but they are clothed in the right forms, harmonies, and orchestration. Measure by measure the finished product is revealed to me when I am in those rare inspired moods.”^{36(p21)} Such a composition process, apart from being unconventional, obviously raises the question of the actual source of the music. The possibility that music might sometimes be *received* by the human mind instead of being produced by it hints at the existence of an information realm located outside the physical brain, thus posing a further challenge to materialist models of human consciousness.

AN ALTERNATIVE TO MATERIALISM

As we have seen, the conventional approach where the brain produces consciousness ($A \Rightarrow B$) is not able to account for a wide range of human experiences. Therefore, a better model should regard all the already established neural correlates as nothing else but pure correlations, and not imply any unidirectional causality. The best way to achieve this is to assume the existence of an underlying third factor causing *both* ($C \Rightarrow A, B$), with A and B being only different aspects of C (Figure 1).

In this model, mind and matter are not viewed as two interacting substances, but as *correlated projections* from a common ground located in the quantum world. Such a view

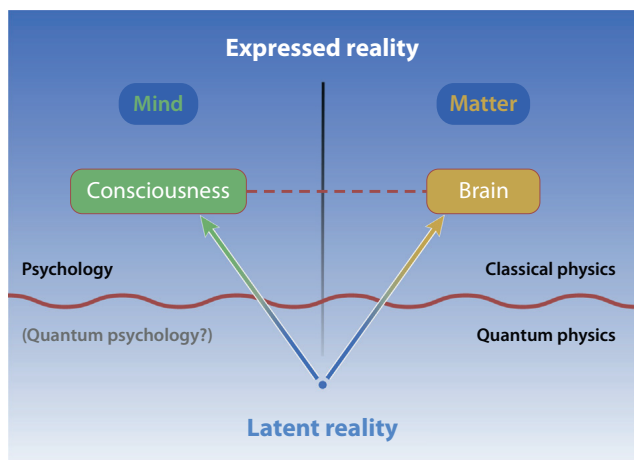


Figure 1. Proposed model of mind–matter manifestation. The fuzziness of the separation between quantum and classical world is symbolized by a line that is wavy instead of straight.

has been extensively elaborated upon by physicist David Bohm, for whom “mind and matter are not separate substances,” but “different aspects of one whole and unbroken movement.”^{37(p14)} He gave the name “implicate order” to this fundamental substrate out of which the “explicate order” (our macro-level reality) unfolds. Bohm envisaged the implicate order as a non-local and unified field containing what he called “active information,” whose purpose is to guide the manifestation of physical and mental processes.³⁸ Active information would thus serve as a bridge between the mental and physical sides of reality, seen by Bohm as inseparable.

In accordance with these ideas, the latent reality could be defined as a non-local and self-organizing field of potentialities, where information is being constantly added to and retrieved from. In other words, the ground stuff of the universe should not be seen as a concrete and immutable “thing,” but as a *process* that involves a pool of information constantly reorganizing itself, waiting to take shape and manifest (it is literally “in-formation”). According to Stapp, “Each subjective experience injects one bit of information into this objective store of information, which then specifies, via known mathematical laws, the relative probabilities for various possible future subjective experiences to occur.”^{39(p268)}

This bidirectional exchange of information could be compared to a giant feedback loop that constantly modifies the probability of any potential event to occur, the general rule being that the more something has already happened, the more likely it is to happen again. In other words, at the core of our psychophysical reality, we find a mechanism of repetition and reinforcement that ultimately leads to something highly stable and predictable. However, nothing is truly permanent, and something that appears very stable now can suddenly or progressively become less so.

Before proceeding further, it is important to realize that the process of mind–matter manifestation described above is far from being a minority view. On the contrary, these ideas are progressively becoming more understood and accepted, as can be seen from the *Potsdam Manifesto 2005*^{*}:

The immaterial, information-bearing, pre-living interconnections prevailing in the micro-world are only indirectly operative on the meso-level of our world of experience. Usually they average out and, in this “diffused” form, express themselves in the familiar, “classical” behavior of inanimate nature.... Animate nature draws its ability for continued, creative differentiate and cooperative integration from its “pre-living” (microphysically recognizable) primordial ground, whose “information”, through instabilities, rises enhanced into the meso-sphere, where it unfolds in more intense and richer form. The “pre-living” realm thus organizes itself in the complex variety of our “higher” bio-ecological vibrancy, as we encounter it in everyday life.^{40(p63)}

This manifesto was written under the patronage of the Federation of German Scientists (VDW), and signed by more than 130 scientists and personalities from around the world.

* The Potsdam Manifesto was meant to commemorate the famous Russell–Einstein–Manifesto of 1955, which was a call for a new way of thinking that would guarantee world peace.

When taken together with the “Manifesto for a post-materialist science,”⁷ it would appear that we are indeed on the verge of a long-overdue paradigm shift, in the sense of Thomas Kuhn’s theory of scientific revolutions.⁴¹

It is noteworthy that many physicists have chosen to describe the primordial ground stuff with terms usually reserved for the human mind, such as proto-consciousness,⁴² mindful universe,² self-aware universe,⁴³ and mental universe.⁴⁴ Such concepts are somewhat misleading, as they give the impression that the latent reality is conscious in the same way a human is conscious. What all these authors are actually saying is that the fundamental level of reality is *of the nature* of consciousness. To avoid any confusion, I believe it is important to bypass people’s anthropocentric tendencies and choose a less ambiguous terminology. Consequently, from this point on, I will only use the terms “consciousness” and “mind” in relationship to humans. Furthermore, I will use “consciousness” in the sense of “awareness” and “experiential stream of everyday consciousness.” As to “mind,” it encompasses everything the person is presently aware of, as well as all the things that could potentially enter consciousness but currently do not.

The next step is to describe what elements pertaining to human consciousness and individual psyches could actually be located in the quantum world, and to propose a mechanism explaining the information exchange between the visible, expressed reality and the invisible, potential reality. In order to do so, I will use the ideas and terminology developed by Frederic W. H. Myers in the late 19th century, and combine them with the contemporary scientific concepts presented above.

SUBLIMINAL AND SUPRALIMINAL

Although initially trained as a philologist and classicist, Myers devoted the last two decades of his life to empirical research in psychology. During this time, he thoroughly investigated a wide range of human experiences—from the most common to the strangest and most unusual ones—with a view to developing a theory of the human mind that would explain and accommodate all of them. This led him to propose an interesting alternative to the commonly accepted division in conscious and unconscious parts, which has been popularized by Sigmund Freud’s psychoanalytic theory.⁴⁵

Instead of opposing conscious to unconscious mental content, Myers prefers using the notions of supraliminal and subliminal. According to him, the supraliminal would be the equivalent of our “normal” waking consciousness, whereas the subliminal represents our larger and latent self, of which the supraliminal self is only a stabilized extract.^{24(chap2)} He defines the subliminal self as “a more comprehensive consciousness, a profounder faculty, which for the most part remains potential only so far as regard the life of earth, but from which the consciousness and the faculty of earth-life are mere selections.”^{46(p13)}

We encounter again the idea that the manifested, supraliminal reality is always the result of a narrowing-down of something larger. Furthermore, this topology implies the existence of a barrier or threshold: above it, we find what is

being expressed now and has entered waking consciousness; under it, we find what is not currently expressed but could potentially be, given the right circumstances. As we can see, Myers is in fact inadvertently and precociously applying to human consciousness the above-mentioned principles of mind–matter manifestation.

It is important to add that in Myers’ view, although it appears to us as being mostly stable, this threshold is actually in a state of subtle flux and shifting equilibrium. Under certain circumstances, the “liminal stability” might change, suddenly allowing the expression of a higher or lower amount of subliminal content than usual. According to Myers, an “instability of the psychological threshold”^{46(p53)} can have various outcomes, depending on the amount of emergence and submergence from/to the subliminal.

In the case of a narrowing of consciousness, which could be described as a loss of threshold permeability or a higher-than-usual “down-draught”^{46(p53)} from the supraliminal into the subliminal, a person might for example develop symptoms of what used to be called hysteria, nowadays known as conversion disorder.⁴⁷ The most common symptoms would be a dissociated personality, loss of memory, insensibility to pain (local or general), paralysis, and blindness, but without there being any apparent physical cause. Applying Myers’ ideas, conversion disorder can be understood as someone’s consciousness not fully manifesting out of the subliminal and partly desynchronizing with its physical counterpart (the corresponding body), leading to a loss of awareness of what the body is doing.

Conversely, when the threshold becomes more permeable than usual—the equivalent of an expansion of consciousness—, new information can enter our awareness and formerly unexpressed abilities or ideas might suddenly emerge. Myers talks about an “uprush”^{46(p53)} from the subliminal into the supraliminal, and if a person can fully reap the benefits of this process, then typically that person would be called a genius. Indeed, genius could be defined as the ability to utilize a wider range of subliminal information and not become unsettled or overwhelmed in the process of doing so.

MODEL OVERVIEW

Once it has become clear that the informational ground stuff is the ultimate source of both the world’s material structures and the experiences of sentient beings within it, nothing speaks against attempting to unify quantum physics and psychology. On the contrary, it even becomes a scientific necessity. Actually, such a reconciliation has already been suggested by psychologist Carl Jung and physicist Wolfgang Pauli in the late 1940s, whose collaboration led to a philosophical proposition known nowadays as the Pauli-Jung conjecture.⁴⁸

As we have seen, the fundamental notion underlying the proposed model is the idea that mind and matter arise from the same unitary source, of which they represent two complementary aspects. This approach makes it possible to merge the thresholds partitioning consciousness and physical reality into one. From that point of view, the threshold described by Myers can be equated with the separation

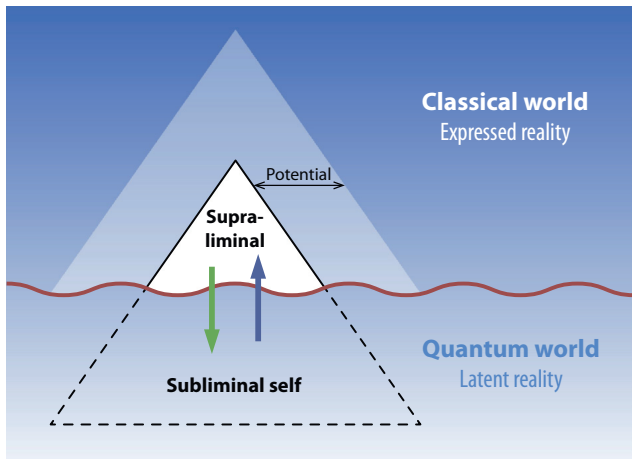


Figure 2. Individual human mind, whose expressed part (supra-liminal self) is seen as a stabilized extract from an underlying realm of psychophysical potentialities (subliminal self).

between quantum and classical reality. Should we accept these premises, then the logical conclusion is that our subliminal mind resides in the quantum level of reality and therefore shares all of its properties, whereas manifested consciousness functions within the laws of classical physics.

Using Figure 1 as a starting point, human consciousness could be depicted by adding a triangle, as seen in Figure 2. The tip of the triangle represents the supra-liminal self, whereas the part below the manifestation threshold represents the subliminal self. If we duplicate the triangle and place a copy of it above the threshold, then the distance between the smaller triangle (supra-liminal self) and the larger triangle (subliminal self) represents the currently unexpressed potential.

As for the upward and downward arrows, they illustrate the idea of a constant information exchange between the supra-liminal and subliminal realms. This exchange is required to obtain the feedback loop mentioned earlier, whereby information patterns are constantly being extracted, modified and reinforced. Thus, the two arrows represent the two functions of the subliminal self, which is to be an informational blueprint (upward arrow) as well as an information collector (downward arrow).

The term “information collector” highlights the idea that every individual experience leaves a trace on the subliminal level, where it remains forever stored. Such a view is actually not new, but has already been expressed in the mid-19th century by Gustav Fechner, pioneer in experimental psychology and father of psychophysics. He postulated the existence of “a great reservoir in which the memories of earth’s inhabitants are pooled and preserved, and from which, when the threshold lowers or the valve opens, information ordinarily shut out leaks into the mind of exceptional individuals among us.”^{49(p135)}

As to the concept of “informational blueprint,” it bears many similarities to the hypothesis of morphic fields, which can be defined as patterns of information that shape psychophysical reality by guiding the manifestation process.⁵⁰ Similarly to quantum fields, they work probabilistically and

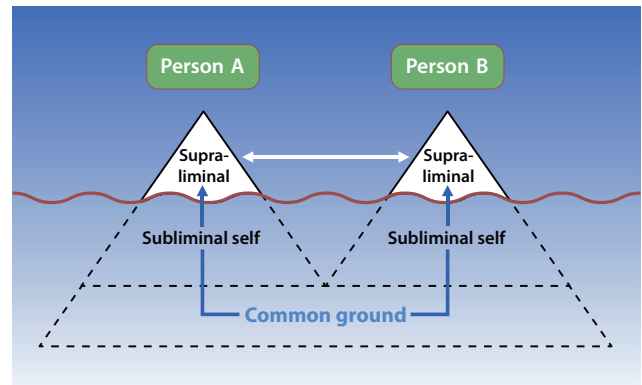


Figure 3. Interconnectedness of seemingly separate individual consciousnesses. The arrows represent the two possible modes of information exchange and acquisition.

modify the indeterminism of the system they influence. One of the theoretical properties of morphic fields is to be strengthened by previous activations, thus making further manifestations of the same kind more easy and likely. At the same time, by storing information of what has already happened, morphic fields would constitute a form of collective memory.

Until now we have been talking about the consciousness of a single individual. How would this model handle the simultaneous presence of several individuals and explain their interaction? On the supra-liminal level, individual consciousnesses would appear as separate entities that have to rely on the five senses to exchange information. However, each subliminal self could be seen as being connected through a common ground, similarly to islands that appear separate above the water but are actually connected through the bottom of the ocean (Figure 3). The dashed lines in Figure 3 are meant to signify that the subliminal information belonging to one specific individual is concurrently collective information potentially accessible from anywhere by anybody. In that sense, what I call here “common ground” has many similarities with Carl Jung’s concept of the collective unconscious.⁵¹

Assuming that everything on the subliminal/quantum level is characterized by oneness, interconnectedness, and non-linear space–time, it then becomes possible for the subliminal mind to have access to information beyond the normal range of the senses, and not be dependent on the brain in order to do so. This would offer an explanatory framework for the phenomena presented above, as well as for other phenomena considered until now as anomalous by mainstream science, such as extrasensory perception (psi). It should also be noted that similar models of information acquisition and mind–matter interaction have already been proposed in the past, for instance the M^5 model developed by Jahn and Dunne.⁵²

IMPLICATIONS

Undoubtedly, should the model of consciousness presented above become widely accepted, it would profoundly change the way we relate to each other and to the world around us.

It would also revolutionize the way we understand health and disease, and lend legitimacy to holistic healing modalities, still largely seen as an inferior type of medicine. In particular, it would offer a new and useful perspective on altered states of consciousness (ASC) and mental health.

Indeed, in a healthy adult, the threshold separating supraliminal and subliminal self has become largely stable and only changes punctually and in a predictable manner, as illustrated by the daily cycle of waking, dreaming, and deep sleep. However, we also have access to a wide number of non-ordinary states of consciousness, some being enjoyable, desirable, and useful, while others are considered distressful, dangerous, and taboo. As explained by Charles Tart,⁵³ every human culture selects and reinforces certain states of consciousness, while rejecting and inhibiting others, thus extensively shaping and limiting the type of experience an adult member of this society will be able or allowed to have.

This is precisely what makes geniuses and prodigies so exceptional: they have a natural and easy access to a certain type of subliminal information (individual and/or collective), while most people can only access that information sometimes, either randomly or after having purposefully entered an ASC. The latter would be the case of shamans, who use specific consciousness-altering rituals in order to initiate a vision quest or a shamanic journey, from which they expect to gain new knowledge that will be useful to their community.

To summarize, any change in state of consciousness can be defined as a change in threshold permeability. The actual question then becomes, what kind of information or pattern comes through or disappears, and in what amount? Therefore, changes in liminal stability are in themselves neither good nor bad. Whether such a change is experienced as pathological or beneficial ultimately depends on when it happens, how often, the level of control over it, and the advantages or disadvantages derived from it. Another important factor is the way the experience is framed and contextualized by the culture we live in.^{54,55}

This last point is in line with cognitive models of psychosis,^{56,57} whereby the outcome of anomalous or psychotic-like experiences ultimately depends on how they are understood and appraised by the person having them. Such a perspective is supported by the many similarities that have been observed between the early symptoms of schizophrenia and the ASC induced by psychedelics in healthy individuals,⁵⁸ or more generally by the fact that every pathological ASC also has a non-pathological equivalent.⁵⁹

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II

FAVOURING EMOTIONAL PROCESSING IN IMPROVISATIONAL MUSIC THERAPY THROUGH RESONANCE FREQUENCY BREATHING: A SINGLE-CASE EXPERIMENTAL STUDY WITH A HEALTHY CLIENT

by

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Favouring emotional processing in improvisational music therapy through resonance frequency breathing: a single-case experimental study with a healthy client

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Abstract:

Resonance frequency breathing (RFB) is a form of slow breathing at around six breaths/min, whose immediate effects are to substantially increase heart rate variability (HRV) and to reduce stress levels. Since RFB has already been successfully used on its own to treat various emotional disorders, we wanted to evaluate its effect on emotional processing when used as a preparatory intervention in improvisational music therapy. To do so, we performed a single-subject experimental study with a healthy participant. We hypothesised that RFB would serve both as an emotional catalyst and emotional regulator, the actual outcome depending on the client's current issues and needs. The study consisted of 10 music therapy sessions, with the breathing intervention used at the beginning of every other session, in alternation with a control intervention. The data collection focussed on HRV during talking and music-making, emotion and abstraction levels in verbal content, body language, and a set of music features extracted from the client's improvisations. Our results show that the sessions starting with RFB were characterised by higher stress levels and the expression of more negative emotions, without it leading to hyperarousal and integration problems.

Keywords:

Improvisational music therapy, resonance frequency breathing, heart rate variability, stress, emotions

1. Background

Since the introduction of modern Psychotherapy Process Research (PPR) in the 1950s, a wealth of reliable evidence has accumulated with the aim of answering the fundamental question “How does (psycho)therapy work?” In the process of doing so, numerous important treatment aspects have been identified and weighed in terms of their contribution to therapeutic change. Some of the most consistent aspects across theoretical orientations appear to be the role of the therapist (therapist effects), the quality of the therapeutic alliance, and the presence of emotional arousal and processing (McAleavey & Castonguay, 2015).

In the present study, the focus is on emotional processing. Although several theories and definitions have been proposed over the years (Auszra, Greenberg, & Herrmann, 2013), we will apply the ideas developed by Greenberg and Pascual-Leone (2006), and define emotional processing as the following three-step process. First, there needs to be emotional arousal and activation. Second, the client must be able to acknowledge, allow, and tolerate these emotions. This happens through emotional regulation, which is about finding the middle ground between avoidance and over-engagement with emotions (Sloan & Kring, 2007). Lastly, the emotional experience has to be explored and reflected upon, for example, through symbolisation and meaning-making. This definition would apply to any form of emotion-focused, experiential therapy, which includes music therapy (Pellitteri, 2009).

When looking at the literature, one recurrent finding is that emotional processing plays a key role in achieving a positive therapeutic outcome. The general idea is that more emotional processing leads to better outcomes, the opposite being true in the case of high avoidance levels (Hayes, Beevers, Feldman, Laurenceau, & Perlman, 2005; Pos, Greenberg, & Warwar, 2009). In other words, psychotherapy is more likely to be successful if clients express their feelings and are able to face their issues, which Hunt (1998) aptly summarised by saying “the only way out is through.” Consequently, any adjunct intervention able to favour emotional processing should be considered a useful addition to the main therapy method.

The idea of preparing the client for more productive work is not new, as evidenced by the widespread use in psychotherapy of various mental imagery and relaxation techniques (Pagnini, Manzoni, Castelnovo, & Molinari, 2013; Singer, 1974). The use of preliminary relaxation is also the norm in certain music therapy methods, for example in Guided Imagery and Music (GIM), where every session starts with a visualisation/relaxation exercise aimed at inducing a slightly altered state of consciousness (ASC). In GIM, the induction of an ASC is considered a prerequisite for successfully journeying through the music and exploring the deeper realms of our psyche (Bruscia & Grocke, 2002). However, with the exception of GIM, most music therapy methods do not systematically include a specific preparatory intervention at the beginning of each session.

Our interest in ASCs and their potential therapeutic benefits led us to investigate existing induction methods, with the idea of finding one intervention that could be used in improvisational music therapy, similarly to what is being done in GIM. We were looking for something safe, short, effective, affordable, and easily implementable by any therapist. The range of procedures developed throughout human history is quite wide: we find for example the ingestion of psychoactive plants, fasting, sensory deprivation, overstimulation, special breathing techniques, dancing, and drumming,

used either separately or in combination (Winkelman, 2010). However, many of these methods were not suitable, because they would either be considered dangerous or unethical, take too much time, or be difficult to fit into a Western cultural context.

As a result, we decided to focus on breath-based interventions, since breathing is a universal phenomenon whose targeted manipulation has a long history of use as a therapeutic tool. One of the oldest examples would be the Indian practice of pranayama yoga and its well-documented effect on autonomic functioning (Jerath, Edry, Barnes, & Jerath, 2006; Pal, Velkumary, & Madanmohan, 2004). But breathing techniques have also become increasingly popular in the West, as can be seen by their growing use for the treatment of various emotional and stress-related disorders (Brown, Gerbarg, & Muench, 2013). Furthermore, music therapists are already familiar with certain breathing interventions, meaning that the introduction of a new method should not pose any conceptual or practical problem.

The existing breathing interventions used in music therapy can be classified into three main types. The first type consists in giving verbal instructions for breath modification as part of a relaxation induction, accompanied or followed by music listening. In this category, we find for example Progressive Muscle Relaxation (PMR), countdown inductions, and autogenic-type inductions (Grocke & Wigram, 2007). The second type consists in giving explicit breathing cues through live or recorded music, generally with the aim of helping clients achieve slower and deeper breathing. This has been done for example in the context of burn care, with the therapist using music-reinforced relaxation to facilitate PMR and music-based imagery (Prensner, Yowler, Smith, Steele, & Fratianne, 2001). The third type is indirect and includes all the interventions based on singing. Indeed, deeper and slower breathing naturally happens whenever we sing. This principle has been developed into specific vocal holding techniques that can be used in music psychotherapy to overcome for example early traumas or attachment issues (Austin, 2001).

Our search for a suitable intervention eventually led us to a form of slow and regular breathing, borrowed from a method called Heart Rate Variability Biofeedback (HRVB). HRVB is relying on the fact that we can directly influence our heart rate through our breathing pattern, which will consequently affect our emotional state and level of arousal. Research into cardiorespiratory coupling has demonstrated that for each person, there exists an optimal breathing speed where the amplitude of heart rate oscillations is maximised, typically at around 6 breaths per minute (Vaschillo, Lehrer, Rishe, & Konstantinov, 2002). This maximisation of Heart Rate Variability (HRV) is accompanied by a shift of the autonomic nervous system towards parasympathetic (rest-and-digest) dominance, resulting in increased levels of calmness and relaxation.

Additionally, when people breathe at their optimal speed, they achieve a state called physiological coherence, where heart, respiratory, and blood pressure rhythms become highly synchronised (Lehrer & Gevirtz, 2014). Because of the resulting amplification effect and synchronisation between several physiological systems, this optimal frequency has been dubbed the “resonance frequency.” Thus, we will henceforth refer to this type of breathing as Resonance Frequency Breathing (RFB).

In terms of applications, RFB possesses a wide range of benefits. When used on its own, RFB has been shown to enhance creativity and artistic skills (Raymond, Sajid, Parkinson, & Gruzelier, 2005), reduce stress (Sutarto, Wahab, & Zin, 2012), and increase people’s ability for emotional regulation

(McCraty & Zayas, 2014). It has also been successfully applied in the treatment of various physical and emotional disorders, such as asthma, hypertension, irritable bowel syndrome, anxiety disorders, and depression (for an overview, see Gevirtz, 2013). One specific feature of RFB is that it leads to calm alertness, a state where the person feels both relaxed *and* energised. This is unlike other relaxation techniques, where relaxation might be accompanied by increased sleepiness (J. C. Smith et al., 2000). Surprisingly, RFB has rarely been used in combination with other therapies, despite its ease of use, simplicity, inexpensiveness, and proven efficacy.

In the light of all these facts, we concluded that RFB would constitute a very suitable complement to improvisational music therapy. Indeed, one of the core characteristics of music improvisations is to facilitate the expression of difficult or repressed emotions by bypassing the need for verbal communication (MacDonald & Wilson, 2014). We, therefore, hypothesised that the addition of RFB would support and enhance the benefits that clients already derive from improvisational music therapy, for example by helping them regulate the difficult emotions that might arise during improvisations. This, in turn, should have a measurable effect on HRV, verbal content, and musical expression.

More specifically, in terms of emotional processing, we postulated that RFB would have two distinct and opposite effects: it would ease the already existing negative emotions (leading to less arousal), and also favour the emergence of new or repressed emotions (leading to more arousal). What ultimately happens in the client would then depend on the nature of the client's issues. According to this hypothesis, someone in a permanent state of hyperarousal (e.g. because of anxiety disorder or post-traumatic stress disorder) would benefit mainly in terms of stress reduction. On the other hand, someone with a higher tolerance threshold would be more likely to experience difficult emotions that are normally not expressed.

This double-effect hypothesis is very relevant for music therapy in general, since music therapists are not only dealing with clients presenting emotional disorders, but also with healthy clients interested in self-development and self-actualisation (Ahonen & Houde, 2009). It would, therefore, be important to apply RFB to healthy and unhealthy clients alike, in order to test whether the effects of RFB indeed depend on the person's current needs and emotional situation. In the absence of any prior study on RFB combined with improvisational music therapy, we decided to first use the method with healthy clients, before applying it to clients diagnosed with specific disorders.

On a more general level, studying the effect of adjunct methods is justified by the fact that music therapists anyway have to choose a session opening method, such as relaxation or an initial discussion for example. Since they are an integral part of the therapy, these opening methods have an influence on the overall effectiveness of music therapy. However, the impact of session structure is something that is not much researched in music therapy. We believe it is important to investigate the role of session structure and its various elements, in order to fine-tune the whole “package.” Having a good and suitable session opening might be especially crucial in short therapy processes, where the time spent in the working phase is limited and would thus benefit from being optimised.

2. Method

2.1 Study design

The goal of our study was to compare the effect of an experimental intervention (RFB) with the effect of a control intervention, using an alternating treatments design. The participant was a 26-year-old female student with no formally diagnosed mental health issue. The control intervention consisted in sitting still while listening to relaxation music. During that time, the client was allowed to breathe freely; the only instruction we gave her was to mentally count her exhales in groups of four. RFB was used every other session, in alternation with the control intervention, so that the client would be compared to herself.

The whole process comprised 10 weekly sessions, every session starting with either 10 min of RFB or 10 min of relaxation, followed by 45 min of music therapy. Odd-numbered sessions started with RFB (i.e. session 1, 3, 5, 7, and 9), whereas even-numbered sessions (2, 4, 6, 8, and 10) started with relaxation. During the entire length of the sessions, the client was wearing a heart rate monitor (for more information, see below). The sessions were filmed with non-intrusive audiovisual equipment. Written consent was obtained from the client regarding the filming of the sessions, and the fact that the collected material would be used for teaching and/or research purposes.

2.2 Resonance frequency breathing (RFB)

In order to keep the experimental intervention as straightforward and uncomplicated as possible, we decided not to implement the whole HRVB procedure. This would have required that the client be fed back data in real time about his/her heart and respiration rate while performing RFB. Instead, we relied on the fact that the resonance frequency of an adult remains largely stable, the main influencing factors being gender and body height (Lehrer & Gevirtz, 2014). This allowed us to determine the resonance frequency only once at the beginning, and then use a simple breath pacer to cue the client during the sessions starting with RFB.

The client's resonance frequency was determined by using the iteration protocol described by Lehrer (2007, Chapter 10), whereby six different breathing speeds in the neighbourhood of 6 breaths/min were consecutively tested (7, 6.5, 6, 5.5, 5, and 4.5 breaths/min). After 4 min of data collection at each of these speeds, we computed and compared the HRV power spectra of each measurement, based on the last 3 min of data (for the detailed HRV methodology, see below). The optimal speed was defined as the speed that yielded the highest spectral peak in the vicinity of 0.1 Hz. In this specific case, the client's resonance frequency was 6.5 breaths/min, corresponding to a spectral peak at 0.108 Hz.

When using RFB, another important aspect to consider besides the breathing speed is the inhalation/exhalation (i/e) ratio. Generally speaking, we know that HRV is higher when exhalations last longer than inhalations (Strauss-Blasche et al., 2000). Furthermore, in a study investigating specifically the effect of the i/e ratio when breathing at 6 breaths/min (Diest et al., 2014), participants reported more relaxation, positive energy, stress reduction, and mindfulness with a low i/e ratio (exhales > inhales), compared to a high i/e ratio (inhales > exhales). In the present study, the i/e ratio was set to 40/60, meaning that inhalation lasted 3.7 s and exhalation 5.5 s.

Both the resonance frequency assessment and the RFB intervention were performed in the same way. Every time, the client was seated in front of a screen and asked to follow the auditory and visual cues of a respiratory pacing programme. The client was given the following breathing instructions: to use abdominal breathing, to breathe in through the nose and out through the mouth with pursed lips, and to keep the breathing shallow and natural so as to avoid hyperventilation. The breathing intervention was well-received by the client and did have the expected maximisation effect on HRV (see the Results). However, despite the difference in physiological response between RFB and relaxation, it should be noted that the client did not report any difference in terms of perceived relaxation effect.

2.3 Music therapy

Regarding the music therapy part, the chosen model was Integrative Improvisational Music Therapy (IIMT), which is a model that was developed at the University of Jyväskylä, Finland, and successfully used for the treatment of depression in a randomised controlled trial (Erkkilä et al., 2011). In IIMT, clients are encouraged to express themselves musically in order to explore their thoughts, memories, emotions, and inner conflicts. The therapist is playing together with the client, thus creating a shared musical experience. A typical session consists of two alternating phases: an improvisation phase—with its focus on imagery, associations, and symbolism—and a verbal phase where themes are discussed and reflected upon (Erkkilä, Punkanen, & Fachner, 2012).

The music improvisations were performed either on a djembé drum or on a malletKAT Pro. The malletKAT Pro is a MIDI controller that has the same key layout as a marimba, and is played using one or two mallets. In this specific study, it was set to emulate the sound of a vibraphone. When improvising together, client and therapist were facing each other and playing the same type of instrument. Both the djembés and malletKATs were connected to a computer running Logic Pro (version 10.2), which enabled us to record the improvisations in the form of audio data (from the djembés) and MIDI data (from the malletKATs).

3. Data collection and analysis

Regarding the data collection and its subsequent analysis, we opted for a multi-method quantitative approach, whereby the music therapy sessions were analysed from four different angles: HRV, session transcripts, video material, and music features. The methodology was quantitative in the sense that each data source produced numerical data that would then be analysed statistically and compared. This type of data triangulation is a powerful methodology, because it enables the researchers to cross-validate and strengthen the findings obtained from each individual data source (Flick, 2004). HRV data for example would be more difficult to interpret without any information about the corresponding real-life events. Similarly, observational or descriptive data can greatly benefit from the addition of objective information such as physiological data.

3.1 Heart rate variability (HRV)

3.1.1 Data acquisition and pre-processing

Heart rate data were acquired using a Suunto Memory Belt, which is the chest strap component of the Suunto t6 heart rate monitor. The Memory Belt has a 1000 Hz sampling rate (i.e. 1 ms accuracy),

and it has been shown to be reliable when compared to a 5-lead electrocardiogram system (Weippert et al., 2010). Data pre-processing and analysis were performed with version 2.2 of Kubios, an HRV analysis software developed at the University of Eastern Finland (Tarvainen, Niskanen, Lipponen, Ranta-aho, & Karjalainen, 2014).

Since data were obtained from a young healthy adult with only occasional abnormal heartbeats, we relied on Kubios' automatic detection and correction feature to remove artefacts. Kubios performs artefact correction on the basis of five sensitivity thresholds. Each threshold defines how much a beat-to-beat interval must deviate from the local average before being considered abnormal, with a range from “very low” (0.45 sec) to “very strong” (0.05 sec). Following detection, unwanted heartbeats are automatically replaced using a cubic spline interpolation method. After examining the data for ectopic beats and other artefacts, we selected the minimum sensitivity level needed to get rid of the artefacts without affecting the rest of the data.

Furthermore, before performing the HRV analysis, long-term trends corresponding to very slow fluctuations were systematically removed using the smoothness priors approach, with a λ value of 500 (Tarvainen, Ranta-aho, & Karjalainen, 2002). This approach is roughly equivalent to applying a high-pass filter, where the chosen λ value determines the cut-off frequency (in this case, $500 \approx 0.035$ Hz). Detrending has two benefits: it removes unwanted information from the data and renders the heart rate signal more stationary, which is a prerequisite for accurately performing a power spectral analysis (Magagnin et al., 2011).

3.1.2 *Chosen metrics*

In the time domain, we calculated the standard deviation of all N-N (beat-to-beat) intervals (SDNN), and the root mean square differences of successive N-N intervals (RMSSD). SDNN is a measure of overall HRV variance, whereas RMSSD represents the amount of short-term variability.

In the frequency domain, we performed a power spectral analysis using the Fast Fourier Transform (FFT) algorithm, with a data interpolation rate of 4 Hz. We thus obtained power values for the following frequency bands: very low frequency (VLF, 0-0.04 Hz), low frequency (LF, 0.04 – 0.15 Hz), and high frequency (HF, 0.15 – 0.4 Hz). However, since the inclusion of VLF in the analysis of short-term measurements is problematic (Task Force, 1996), we only focused on LF and HF. Because the results produced by a power spectral analysis are typically not normally distributed, we applied a logarithmic transformation (natural log, ln) to the absolute values of LF and HF. We also converted those absolute values to normalised units (nu) in order to obtain the relative power distribution between LF and HF (in proportion to the total power minus the VLF component).

Under normal circumstances, HF is a marker of vagal tone and parasympathetic activity (Task Force, 1996; Thayer, Yamamoto, & Brosschot, 2010), with high HF indicating that the parasympathetic branch of the autonomic nervous system is dominant (low physiological arousal). There is, for example, strong evidence suggesting that the practice of meditation results in an increase of (relative) HF power (An, Kulkarni, Nagarathna, & Nagendra, 2010; Krygier et al., 2013; Wu & Lo, 2008). Conversely, low HF would typically be the result of stress and anxiety (Cohen et al., 1998; Schwarz, Schächinger, Adler, & Goetz, 2003).

Contrary to HF, LF is rather difficult to interpret. Indeed, it has now been established that LF is not an index of pure sympathetic activity, but a mix of sympathetic, parasympathetic, and baroreflex

influences (Shaffer, McCraty, & Zerr, 2014). This interpretation issue makes it problematic to use LF/HF as an index of sympathovagal balance (Reyes del Paso, Langewitz, Mulder, van Roon, & Duschek, 2013), which is why we decided not to report this ratio, although it is still widely used in the literature. Besides, LF/HF is anyway redundant information with LFnu and HFnu, these three measures being mathematically equivalent and displaying a curvilinear relationship (Heathers, 2014).

3.1.3 *Segmentation and averaging*

Conventional HRV studies usually take place in a very controlled environment, with all the participants performing the exact same task during a predefined amount of time. Typically, if the researchers are interested in short-term HRV, they will use 5-minute data segments, in accordance with the recommendations of the Task Force of the European Society of Cardiology and the North American Society of Pacing (1996).

However, such an approach is not suitable for IIMT. Indeed, music improvisations are by definition unique and spontaneous creations that can last any amount of time, from a few minutes to the entire length of the session. The same applies to the moments of verbal exchange. In order to adequately capture all the moments of interest occurring in a therapy session, we needed a methodology flexible enough to be applied to data segments of varying length, while providing enough precision and reliability.

First of all, recent studies have demonstrated that many of the commonly-used HRV metrics remain reliable in short-term measurements lasting less than 5 min (Salahuddin, Cho, Jeong, & Kim, 2007; A.-L. Smith, Owen, & Reynolds, 2013). However, when performing a power spectral analysis, a minimum of 2 min is required for accurately capturing both the LF and HF components of heart rate oscillations (Berntson et al., 1997). Furthermore, a general rule for HRV measurements is that one should only compare data segments of equal length (Task Force, 1996). Taking all these facts into account, we decided to use exclusively 2-minute data segments in our analysis.

In order to achieve the desired flexibility, we used the approach suggested and validated by Rivecourt et al. (2008). The authors showed how the average of several overlapping 2-minute segments can be used to reliably estimate the mean spectral values of a longer data segment. Therefore, we chose a methodology based on the averaging of multiple 2-minute segments, with a segment overlap of 50%. This enabled us to analyse therapy moments of any length—provided that they lasted at least 2 min—with a time resolution of 1 min, as determined by the amount of segment overlap. SDNN and RMSSD were calculated together with the spectral values, using the same averaging method.

3.2 Text and video materials

The content analysis of the therapy sessions focused on the client, and took into account both the verbal and non-verbal communication occurring between client and therapist. The two data sources used in the analysis were the video recordings and transcripts of the therapy sessions. Although these typically constitute the source material of qualitative research, in this study we opted for a quantitative approach, in order to allow proper juxtaposition and comparison with the other (purely numerical) data sources.

Verbal interactions were analysed with the help of the CM software (version 4.3), a computer-based text analysis tool developed by Mergenthaler (1996, 2008). This automated tool was designed to identify emotion-abstraction patterns in session transcripts, in accordance with the Therapy Cycle Model (TCM; see Mergenthaler, 1996). The TCM and related software are school-independent, meaning they are applicable to a wide range of psychotherapeutic approaches, provided there is sufficient verbal content to be analysed.

To perform the analysis, CM relies on two thematic dictionaries¹, one for affective language (emotion words) and another for conceptual language (abstract words). When applied to session transcripts, it measures the density of emotion and abstract words in a given text unit, resulting in a frequency distribution for each category. Furthermore, the identified words are given a valence label: positive (A) or negative (B) for emotion words, and positive (C), negative (D), or neutral (E) for abstract words. By combining the positive and negative words of both categories, two new categories are created that reflect the valence of the overall emotional tone (ET): positive ET (A + C) and negative ET (B + D).

In the present study, each therapy session was first transcribed according to the transcription standards defined by Mergenthaler and Stinson (1992). The application of these standards is required for the CM software to properly analyse the text. We then performed a corpus analysis of all the 10 sessions, each session representing one unit of analysis. The results gave us the relative frequency of each of the four categories mentioned above (Emotion, Abstraction, Positive ET, and Negative ET).

Using the video material as the data source, we also focused on one specific aspect of non-verbal communication, namely on an idiosyncratic form of smiling. Indeed, while watching the video recordings, we noticed that the client tended to exhibit a type of tense and bitter smile whenever the discussion became emotionally challenging. Consequently, we created the category Negative Smile and counted its relative occurrence in each session. The result was expressed as a proportion of the total session duration.

3.3 Music features

For the music analysis, we only used data extracted from the client's malletKAT improvisations. Indeed, malletKAT improvisations were performed in every session except one, whereas djembé improvisations only took place in six sessions out of ten, making them too infrequent to be included in a comparative experiment. There was a total of 11 malletKAT improvisations, the client performing usually one improvisation per session, except in sessions 1 and 8 where she performed two. All the improvisations were analysed separately. Their average length was 10 min 28 sec, the shortest improvisation lasting 3 min 20 sec and the longest 40 min 37 s.

In order to access the numerical data contained in the MIDI files and run descriptive statistics, we first converted each MIDI file into Comma-Separated Value (.csv) text files. For each improvisation, we then extracted the following information: the lowest note played (*note_min*), the highest note played (*note_max*), how hard each note was played (*velocity*), and how many notes were played (*number*). Velocity is a way of measuring the volume of a note, since the harder we hit a key, the

¹ For more information on the development of these dictionaries, see Mergenthaler (1996).

louder the note. In MIDI data, pitch and velocity information is represented as a number ranging from 0 to 127 (in the case of pitch, 0 is C1 and 127 is G9, whereas for velocity, 0 is the softest possible keystroke and 127 the hardest). Regarding the amount of notes, it is based on the total number of note onsets.

The analysis itself focussed on the notes' range (*note_min*, *note_max*), the amount of total variation in pitch (*note_SD*), the amount of total variation in dynamics (*velocity_SD*), and the amount of notes played (*number*). Additionally, we also looked at how long the improvisations were (*length*).

4. Results

The four data sources were first analysed separately, using independent samples *t*-tests to compare the means obtained under condition 1 (RFB) and under condition 2 (relaxation). We then performed a correlation analysis to identify possible associations between the data sources. For an overview of all the metrics included in the analysis, as well as the corresponding measurement units, see Table 1.

Table 1. Measurement units

HRV	
SDNN, RMSSD	ms
LF, HF	ms ² , log transformed (natural log, ln)
LFnu	normalised units: LF / (total power - VLF)
HFnu	normalised units: HF / (total power - VLF)
HR	beats/min
Content analysis	
Emotion, Abstraction, Positive ET, Negative ET	% of total amount of words in the session
Negative smile	% of total session duration
Music features	
velocity_SD, note_SD, note_min, note_max	MIDI value (0-127)
length	s
number	number of notes

As can be seen from Table 2, during the initial intervention, RFB produced significantly higher levels of SDNN (overall HRV) than the relaxation intervention, which was to be expected. Additionally, there was a stronger concentration of spectral power in the LF band during RFB than during relaxation, both in absolute terms (LF) and relative terms (LFnu). This was also an expected result, since one characteristic of RFB is to produce a spectral peak around the resonance frequency (0.108 Hz), which is located in the LF band. As a side note, this co-occurrence of high HRV and a massive increase in LF power should be seen as an exception that only happens when performing RFB. Indeed, when breathing normally, increased relaxation would typically be accompanied by increased HF power (absolute and/or relative), since HF is the usual marker of parasympathetic activity under normal circumstances.

Table 2. Results of t-test for HRV measures

	Initial intervention						95% CI for Mean Difference	<i>t</i>	<i>df</i>	<i>p</i>	<i>d</i> ^c
	RFB			Relaxation							
	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>					
Initial intervention											
SDNN	104.06	20.78	5	67.46	11.22	5	12.25, 60.95	3.47**	8	.008	2.45
RMSSD ^a	76.03	23.40	5	64.57	12.76	5	-16.03, 38.94	0.96	8	.365	
LF	9.07	0.37	5	7.39	0.58	5	.97, 2.38	5.49**	8	.001	3.88
HF	6.92	0.66	5	7.35	0.48	5	-1.27, .42	-1.16	8	.278	
LFnu ^b	87.82	4.93	5	52.00	18.91	5	12.66, 58.99	4.10*	4.54	.011	3.85
HFnu ^b	12.16	4.92	5	47.96	18.88	5	-58.92, -12.67	-4.10*	4.54	.011	3.85
HR	66.90	3.47	5	66.68	5.39	5	-6.39, 6.83	0.08	8	.941	
Malletkat impros^d											
SDNN	46.30	8.63	6	54.98	13.06	5	-23.51, 6.15	-1.32	9	.218	
RMSSD	61.43	15.78	6	73.79	15.40	5	-33.75, 9.02	-1.31	9	.223	
LF	6.58	0.32	6	6.48	0.62	5	-.55, .76	0.36	9	.729	
HF	6.18	0.58	6	6.78	0.49	5	-1.34, .13	-1.85	9	.098	
LFnu	60.55	4.50	6	42.50	4.97	5	11.60, 24.51	6.33**	9	<.001	4.22
HFnu	38.92	4.55	6	56.89	4.66	5	-24.27, -11.67	-6.45**	9	<.001	4.30
HR	58.85	2.68	6	56.98	1.69	5	-1.27, 5.01	1.34	9	.212	
Verbal interaction											
SDNN	81.05	15.01	5	80.02	11.99	5	-18.78, 20.84	0.120	8	.907	
RMSSD	79.59	18.36	5	85.68	15.07	5	-30.58, 18.41	-0.573	8	.582	
LF	8.02	0.34	5	7.82	0.34	5	-.29, .70	0.943	8	.373	
HF	7.65	0.43	5	7.82	0.33	5	-.73, .39	-0.708	8	.499	
LFnu	58.76	7.01	5	49.99	2.94	5	.94, 16.61	2.58*	8	.033	1.82
HFnu	41.17	6.99	5	49.94	2.93	5	-16.58, -.94	-2.58*	8	.032	1.82
HR	63.40	2.27	5	62.54	4.18	5	-4.05, 5.76	0.403	8	.697	

^a Values were not normally distributed. A Mann-Whitney *U* test confirmed the non-significance of the result ($U = 7, p = .251$).

^b Equal variances not assumed (Levene's test was significant with $p < .05$).

^c Formula used to calculate the effect size (Cohen's *d*): $2 |t| / \sqrt{df}$

^d Each malletKAT improvisation was considered separately. There was one such improvisation per session, except for session 6 (no malletKAT improvisation), and sessions 1 and 8 (two improvisations each).

* $p < .05$, ** $p < .01$

Regarding the effects of RFB on the rest of the music therapy session, significant effects were found for LFnu and HFnu, both during verbal interaction and malletKAT improvisations (see Table 2). In both cases, RFB was followed by higher LFnu and lower HFnu, compared to sessions starting with relaxation. As indicated above, lower HFnu can be interpreted as lower parasympathetic activity. In other words, the client was apparently experiencing more stress and negative emotions during the sessions starting with RFB, and this effect was visible while talking and improvising. We found no significant difference between conditions 1 and 2 in the remaining HRV measures (see Table 2).

The idea that sessions starting with RFB were emotionally more challenging for the client was corroborated by the findings of the content analysis. Indeed, there was a statistically significant difference in Negative Smile between conditions, with more Negative Smile in sessions starting

with RFB (see Table 3). Furthermore, when considering sessions 4-10, the amount of emotional words was systematically higher after RFB than after relaxation, and the overall emotional tone also tended to be more negative after RFB, but the latter result only approached statistical significance ($p = .062$). Here are a few examples of the difficult topics that emerged: disappointment, frustration, panic, fear, feeling empty inside, and feeling trapped.

Table 3. Results of t-test for the content analysis (verbal and non-verbal interaction)

	Initial intervention						95% CI for Mean Difference	<i>t</i>	<i>df</i>	<i>p</i>	<i>d</i> ^b
	RFB			Relaxation							
	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>					
All sessions											
Emotion	5.40	1.04	5	4.43	0.50	5	-.22, 2.17	1.88	8	.097	
Abstraction	5.47	1.13	5	6.33	1.14	5	-2.51, .79	-1.20	8	.264	
Positive ET	3.63	1.01	5	3.69	0.71	5	-1.34, 1.21	-0.12	8	.908	
Negative ET ^a	2.26	1.02	5	1.30	0.35	5	-.29, 2.21	1.98	4.94	.106	
Negative Smile	1.86	0.78	5	0.68	0.57	5	.17, 2.18	2.70*	8	.027	1.91
Sessions 4 to 10											
Emotion	5.84	0.80	3	4.45	0.58	4	.07, 2.72	2.70*	5	.043	2.42
Abstraction	6.18	0.81	3	6.15	1.22	4	-2.08, 2.14	0.04	5	.971	
Positive ET	3.78	1.37	3	3.49	0.63	4	-1.65, 2.24	0.39	5	.712	
Negative ET	2.65	1.01	3	1.41	0.31	4	-.09, 2.58	2.39	5	.062	
Negative Smile	2.23	0.84	3	0.53	0.54	4	.38, 3.02	3.31*	5	.021	2.96

The results are all relative values, i.e. percentage of total amount of words (for verbal content), and percentage of total session duration (for Negative Smile).

^a Equal variances not assumed (Levene's test was significant with $p < .05$).

^b Formula used to calculate the effect size (Cohen's *d*): $2 |t| / \sqrt{df}$

* $p < .05$

Interestingly enough, Positive ET did not display any significant difference between conditions, which means that positive and negative emotional tone should be seen as two independent dimensions, rather than two ends of the same spectrum. This result is in line with findings from mood research, where negative affect and positive affect have been found to be two largely independent dimensions (Watson, Clark, & Tellegen, 1988). As to the presence of conceptual language, there was no difference either between RFB and relaxation. Instead, starting from session 3, we observed a steady increase of abstract content, independently of the initial intervention (see Figure 1).

In terms of correlations involving the content analysis and HRV measures during verbal interaction, we found a negative relationship between Emotion and HFnu ($r = -0.64$, $p = .048$, $n = 10$), indicating that higher emotional content was accompanied by higher levels of stress. No further correlations were found between the remaining measures of verbal/non-verbal content and HRV

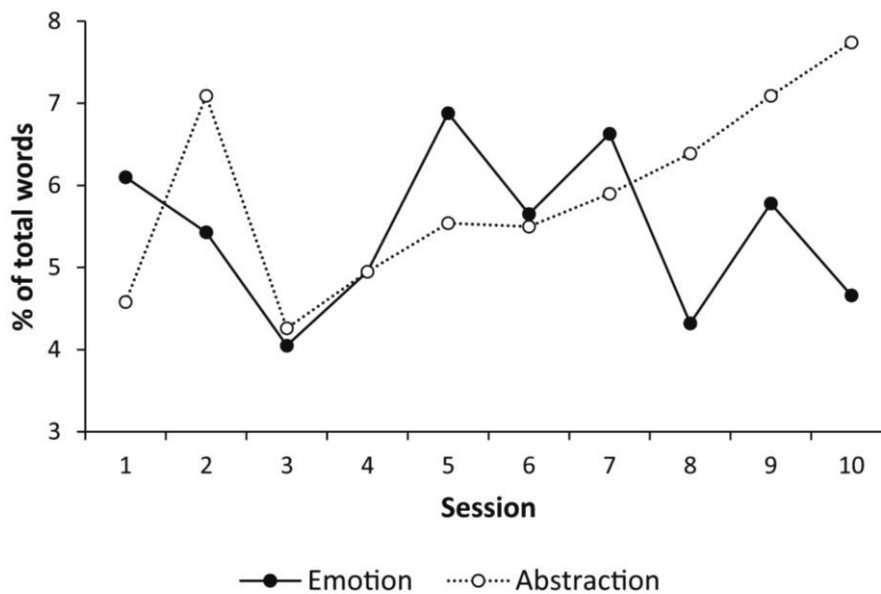


Figure 1. Emotional and abstract content in the client’s verbal expression.

during verbal interaction. However, we found a positive correlation between Negative Smile and Negative ET ($r = 0.68, p = .03, n = 10$), which became especially strong in the second half of the therapy process ($r = 0.97, p = .007, n = 5$; see Figure 2). This finding strengthens our hypothesis that the non-verbal event we called Negative Smile is indeed linked to the expression of negative emotions in this particular client.

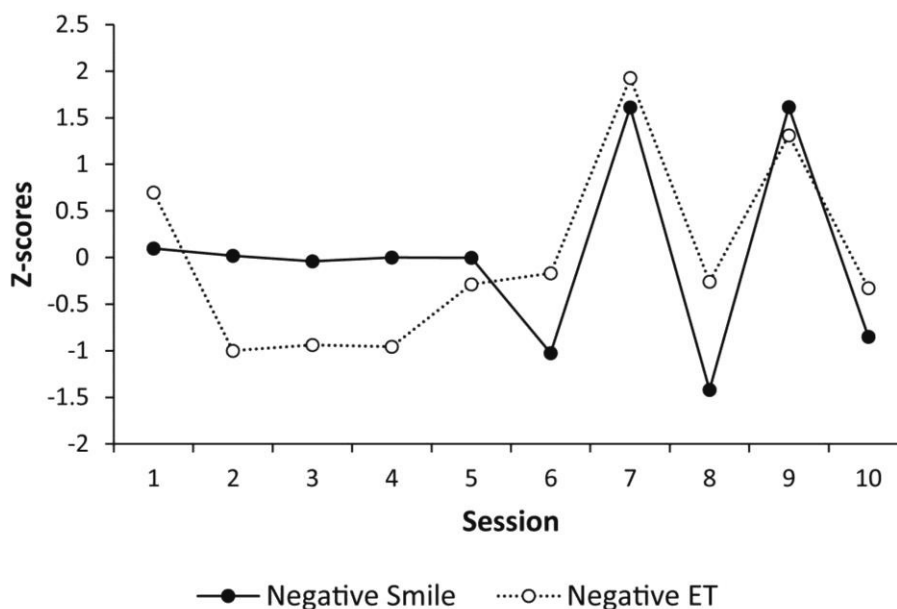


Figure 2. Comparison between the amount of negative smile and negative emotional tone.

Turning now our attention to the music features of the malletKAT improvisations, no music feature displayed any statistically significant difference between conditions 1 and 2. There was, however, one noteworthy correlation involving *velocity_SD* and HRV during improvisations: *velocity_SD*

correlated negatively with HFnu, meaning that increased stress levels (low HFnu) were accompanied by more variation in dynamics (i.e. volume levels were less constant). The detailed results of this correlation analysis can be found in Table 4.

Table 4. Correlation coefficients between music features (malletKAT) and HRV (malletKAT)

		HRV measures						
		SDNN	RMSSD	LF (ln)	HF (ln)	LFnu	HFnu	HR
Music features								
velocity_SD	<i>r</i>	-.36	-.41	.16	-.32	.62*	-.61*	.59
note_SD	<i>r</i>	.12	.00	.52	.20	.37	-.37	.24
note_min	<i>r</i>	.17	.15	-.46	-.11	-.42	.41	-.40
note_max	<i>r_s</i>	.15	.32	.50	.02	.24	-.24	.16
length	<i>r_s</i>	-.01	.05	.50	.14	.04	-.04	.20
number	<i>r_s</i>	-.10	.06	.43	-.05	.34	-.34	.35

n = 11 for all analyses.

Each malletKAT improvisation was considered separately

**p* < .05

Table 5. Correlation coefficients between music features (malletKAT) and verbal/non-verbal content

		Content analysis				
		Emotion	Abstraction	Positive ET	Negative ET	Negative Smile
Music features						
velocity_SD	<i>r</i>	.57	-.57	.43	.01	.20
note_SD	<i>r</i>	.74*	-.51	.76*	.03	.38
note_min	<i>r</i>	-.47	.45	-.80**	.25	-.23
note_max	<i>r_s</i>	.52	-.63	.68*	-.27	.36
length	<i>r_s</i>	.28	-.24	.83**	-.67†	-.12
number	<i>r_s</i>	.70*	-.59	.72*	-.10	.22

n = 9 for all analyses.

Session averages were used for the malletKAT improvisations.

p* < .05, *p* < .01, †*p* = .05

Furthermore, we found several significant correlations between the music features of the malletKAT improvisations played in a given session and the emotional content of the verbal exchange that took place in that same session. As shown in Table 5, when emotional content increased, the client played more notes and used a wider range of notes. When Positive ET increased, the client played longer, used more notes and a wider range of notes, and both the lower and higher register expanded. Lastly, when Negative ET increased, the client played shorter improvisations.

5. Discussion

The purpose of this study was to investigate the effects of resonance frequency breathing (RFB) on autonomic functioning, emotional processing, and musical expression during improvisational music therapy. Because of the ability of RFB to dramatically increase HRV in the short term, and given its successful implementation in the treatment of various emotional disorders, we hypothesised that the

addition of RFB would be beneficial to the therapy process.

The results showed that RFB, as an initial intervention, did have an effect that distinguished it from relaxation, both immediately and during the music therapy session that followed. This effect was visible in the HRV data, as well as in the verbal and non-verbal content. As expected, RFB increased relaxation levels while it was being performed, with higher HRV during RFB compared to music listening. However, during the rest of the session, RFB was followed by reduced parasympathetic activity (more stress) while talking and improvising, more emotional content while talking, and more negative smiling. We also found a trend towards more negative emotional tone after RFB.

The fact that the client was experiencing more stress in the sessions starting with RFB might appear paradoxical, given the relaxation effect that we would expect from RFB. To solve this apparent paradox, it is important to distinguish what happened during the breathing from what happened afterwards. During the breathing itself, RFB did have the expected relaxation effect. As to the rest of the session, we should keep in mind that the participant was a healthy client with no emotional disorder. As we explained in our hypotheses, one of the effects we expected from RFB was the emergence of negative emotions, which in turn would lead to more arousal. Our triangulation approach confirmed that the increased stress was indeed connected with more difficult emotional topics. This can be considered a good thing from a therapeutic perspective, provided of course that the client was able to handle the increased stress levels. So the question is, was it a problem for the client to confront her issues and be more stressed while doing so?

Based on the results presented here, we believe the answer is no. Indeed, the fact that the client expressed and explored these emotions together with the therapist indicates that she was able to face these emotions and “stay” with them. In other words, appropriate emotional regulation did take place alongside the emotional activation. Additionally, we saw that the relative amount of conceptual language steadily increased from the third session onwards, which indicates that she was able to verbally process the negative emotions that emerged during therapy.

However, one thing we cannot know for certain is the extent to which RFB actually *increased* the client’s window of tolerance, or whether this window remained unchanged. Indeed, it might be that the amount of negative arousal just happened to take place inside the client’s usual boundaries, without there being any improvement in flexibility and tolerance. Although prior studies indicate that RFB does have a positive effect on emotional regulation (McCraty & Zayas, 2014), in the absence of direct measurements, this last point remains an open question.

Another question that remains unanswered is the duration of the effect that can be attributed to RFB. Was the RFB intervention influencing the entire music therapy session that followed, or only a part of it? We know from existing studies that a carry-over effect does exist, at least on HRV and in the short term. For example, Karavidas et al. (2007) and Zucker et al. (2009) both reported increased SDNN during the 5-minute resting period immediately following RFB, when compared to the pre-intervention resting period. However, we do not know how long this beneficial effect on HRV actually lasts, and what would be the factors responsible for intra- and inter-individual variations.

Anyway, in the case of RFB used as a preparatory intervention within music therapy, the question of carry-over effect cannot be answered satisfactorily by studying only the impact on HRV at rest.

Indeed, in our proposed model (RFB followed by IIMT), the client is not resting but actively engaged in therapy, which is arguably a rather different activity. Actually, given the characteristics and common qualities of RFB and IIMT, we would like to propose that the two methods are in fact supporting each other, with IIMT not only maintaining but also amplifying the process initiated by RFB. If such is indeed the case and a positive feedback loop is created, it would mean that the effects of RFB can be sustained for the entire length of the therapy session.

Regarding the effects of RFB on HRV, we only found significant differences between conditions in relative HRV measures (LFnu and HFnu), and none in absolute measures (SDNN, RMSSD, LF, HF). This is very likely due to the fact that in the same individual, natural variations in absolute HRV measures can be quite strong from one recording to the next, typically between 10 and 30% (Sandercock, Bromley, & Brodie, 2005). Therefore, a true effect might not be detected if the difference in absolute HRV measures following an intervention is lower than this natural intra-individual variability. Because they are expressed in the form of ratios and proportions, relative HRV measures are obviously not affected by this problem.

From the four data sources under investigation, only the music features did not display systematic fluctuations that could be attributed to the preparatory intervention. We did find, however, a link between certain music features and HRV levels during the corresponding improvisations, as well as with the emotional valence of the verbal interaction taking place in the same session. To summarise, when positive emotional tone increased, the client used a wider range of notes and played longer improvisations. Moreover, when she was calmer, improvisations were more monotonous and stable in terms of loudness. Quite obviously, further studies with a similar set-up are required in order to find out whether these associations are generalisable beyond this specific client.

The findings of the present study are in line with the hypothesis that healthy clients will experience increased stress levels during therapy as a result of RFB, conceivably because they possess a higher tolerance threshold than clients with emotional disorders. However, in order to truly test whether the effects of RFB are adaptative and dependent on the client's needs, it would be necessary to conduct further studies with more participants, including client groups having a specific diagnosis. Indeed, although the results seem promising, it is not possible at this stage to make any strong statement or to generalise the findings to a larger population.

Lastly, besides studying the effects of RFB on therapy processes, it would also be useful to add outcome measures and investigate whether these effects are clinically relevant. If the positive effects on emotional processing are confirmed and a clear link to better therapeutic outcomes can be established, it would open the possibility for more effective and shorter therapy, as well as reduced healthcare costs.

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III

THE EFFECT OF RESONANCE FREQUENCY BREATHING WHEN USED AS A PREPARATORY EXERCISE IN MUSIC PSYCHOTHERAPY: A SINGLE-CASE EXPERIMENTAL STUDY OF A CLIENT WITH ANXIETY DISORDER

by

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Research Article

The effect of resonance frequency breathing when used as a preparatory exercise in music psychotherapy: A single-case experimental study of a client with anxiety disorder



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ABSTRACT

This study aimed at evaluating the possible benefits of starting Integrative Improvisational Music Therapy (IIMT) sessions with 10 min of Resonance Frequency Breathing (RFB), a type of slow breathing known to be beneficial for stress reduction and emotional regulation. A client diagnosed with anxiety disorder and social phobia attended 12 IIMT sessions. Using an alternating treatments design, RFB was systematically alternated with a control intervention (Vibroacoustic Therapy, VAT). Therapy processes were assessed through the Session Evaluation Questionnaire (SEQ) and the continuous measurement of Heart Rate Variability (HRV), a biomarker of autonomic nervous system response. RFB was consistently accompanied by higher HRV and followed by lower Arousal, when compared to VAT. The music psychotherapy process displayed two phases, with the first being emotionally more challenging than the second. In the first phase, the high frequency HRV component (HFnu) during music improvisations and Positivity scores were comparatively higher in sessions starting with RFB, whereas in the second phase, post-session Smoothness and Positivity were comparatively lower after RFB. The therapy outcome was positive, with marked symptom improvements. RFB appeared to have functioned as an adaptive intervention, modulating the emotional difficulty of the sessions according to the therapy phase and the client's current needs.

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Background

Music psychotherapy is a form of arts therapy that uses music as a primary mode of expression within a psychotherapeutic context. Therapeutic change is achieved through a systematic process of intervention, based on musical experiences and the client-therapist relationship. Historically, music therapy has its roots in psychoanalysis and psychodynamic therapy (Bruscia, 1998). Although this legacy is still important, more recent theoretical influences include resource-oriented approaches (Rolvsvjord, 2010), as well as supportive psychotherapy, which integrates psychodynamic, cognitive-behavioural, and interpersonal models (Winston, Rosenthal, & Pinsker, 2011).

The present study focuses on a model called Integrative Improvisational Music Therapy (IIMT), originally developed at the University of Jyväskylä, Finland. The key principle of IIMT is the

synergistic alternation of verbal and music-making phases, with the idea of exploiting the specific benefits offered by each of these activities. Typically, the creation of free music improvisations (together with the therapist) helps clients express their difficult emotions and inner conflicts in a novel, symbolic, and non-threatening form, whereas the verbal phases serve the purpose of reflecting upon and processing the themes that emerged during music-making (Erkkilä, Punkanen, & Fachner, 2012). In terms of efficacy and clinical relevance, this model was used in a randomised controlled trial and shown to be more effective than standard care alone in the treatment of depression and co-morbid anxiety (Erkkilä et al., 2011).

In an attempt to develop IIMT further, we wanted to find out whether the efficacy of the model could be enhanced by the addition of a short cardiorespiratory intervention at the beginning of the sessions. Generally speaking, breathing practices are already being used for the treatment of various emotional and stress-related disorders (Brown, Gerbarg, & Muench, 2013). It is for example well-known that autonomic arousal can be reduced with slow breathing methods such as pranayama yoga (Jerath, Edry, Barnes, & Jerath, 2006; Pal, Velkumary, & Madanmohan, 2004). However, these methods are still largely used on their own, although they

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could easily be integrated into psychotherapy, where their relaxation effects could serve as a facilitator (Gerbarg & Brown, 2016; Pagnini et al., 2013).

The intervention used in this study is known as Resonance Frequency Breathing (RFB), which is the central component of a method called heart rate variability biofeedback (Lehrer & Gevirtz, 2014). RFB consists in slow, paced breathing at around six breaths/min, with the actual optimal speed needing to be determined on an individual basis. When people breathe at their resonance frequency, Heart Rate Variability (HRV) is maximised and heart, respiratory, and blood pressure rhythms become highly synchronised (Vaschillo, Lehrer, Rishé, & Konstantinov, 2002). This has the immediate effect of shifting the Autonomic Nervous System (ANS) toward parasympathetic (rest-and-digest) dominance, leading to a state of calm alertness (Gerbarg & Brown, 2016). The fact that RFB makes people feel both relaxed and energised distinguishes it from other relaxation techniques, where relaxation might be accompanied by increased sleepiness (Smith et al., 2000).

In terms of applications, RFB has proven to be beneficial in three broad areas. First, it can promote general well-being, by reducing stress (Sutarto, Wahab, & Zin, 2012) and increasing people's ability for emotional regulation (McCraty & Zayas, 2014). Second, in the area of performance enhancement, RFB has been shown to improve cognitive performance (Prinsloo et al., 2011), sport performance (Paul & Garg, 2012), and artistic skills (Raymond, Sajid, Parkinson, & Gruzelier, 2005). Lastly, RFB has also been successfully applied in the treatment of various physical and emotional disorders, for example asthma (Lehrer, 2012), hypertension (Lin et al., 2012), chronic muscle pain (Hallman, Olsson, von Schéele, Melin, & Lyskov, 2011), anxiety disorder (Reiner, 2008), and depression (Karavidas et al., 2007). Thus, RFB appears to have the necessary qualities to potentially support and enhance the benefits that people already derive from music psychotherapy.

Nevertheless, RFB is still predominantly used as a stand-alone intervention, with very few attempts at combining it with other therapy methods. This is surprising, given its ease of use, inexpensiveness, and positive track record. Some exceptions do exist that involve using RFB alongside cognitive behavioural therapy (e.g. Reiner, 2008), but only as an additional or parallel intervention. Given the absence of pre-existing literature on the integration of RFB into psychotherapy, we widened our scope and considered any kind of relaxation method used as a preparatory intervention.

The few studies that we found involved hypnosis (Kirsch, Montgomery, & Sapirstein, 1995), mindfulness-based stress reduction (Weiss, Nordlie, & Siegel, 2005), and relaxation training (Goldfarb, Fuhr, Tsujimoto, & Fischman, 1987). Taken collectively, they indicate that the addition of some form of relaxation resulted in better outcomes and/or shorter therapy processes, which is in itself a very encouraging finding. Unfortunately, these studies focused only on outcome measures, thus shedding little to no light on how the adjunct intervention supported the mechanisms and mediators responsible for the observed therapeutic change.

There exists, however, one recent single-case study where RFB was integrated into music psychotherapy, in an attempt to support emotional processes (Brabant, Solati, Letulé, Liarmakopoulou, & Erkkilä, 2017). In that study, 10 min of RFB were applied at the beginning of every other session, in alternation with a control intervention (music listening). Paradoxically, RFB was consistently followed by *higher* stress levels during the rest of the session, because of the emergence of more negative emotions. The absence of integration problems led the authors to conclude that the temporary stress increases remained within the so-called therapeutic window of tolerance (Siegel, 1999). One should add that the client was a healthy client, meaning that the observed effects do not necessarily apply to a clinical population. The obtained results were in line with the outcome of a study on emotional regulation dur-

ing social interaction (Butler, Wilhelm, & Gross, 2006). The authors found that healthy women who displayed higher HRV during a slow-breathing task also experienced and expressed more negative emotions during conversations about an upsetting film.

From the point of view of psychotherapy, well-tolerated emotional activation and processing is something good and desirable, since in most theoretical orientations, working through one's issues is seen as essential for achieving a positive therapeutic outcome. However, with clients who are unable to down-regulate or whose default mode is constant hyperarousal, to further increase stress levels during therapy would obviously be counter-productive. On the contrary, such clients would rather benefit from a reduction in stress levels. This would allow them to stay (or return) inside their window of tolerance, which is a prerequisite for good client-therapist interaction and successful emotional processing (Ogden & Minton, 2000; Siegel, 1999).

As shown in previous studies, RFB has the ability to quickly reduce stress levels by instantly shifting the ANS toward parasympathetic dominance. Therefore, we hypothesised that RFB would have two main effects when used in a psychotherapeutic context. First of all, it would open the client up and facilitate the emergence of repressed negative emotions, which might lead to a temporary increase in stress levels (Brabant et al., 2017). This effect would mainly occur in clients having a high-enough tolerance threshold and sufficient self-regulation abilities. Secondly, through its relaxation effect, RFB would also ease the emotional burden of pre-existing negative emotions, resulting in reduced stress levels. This second effect would be especially visible in clients who are in a permanent state of hyperarousal (e.g. because of post-traumatic stress disorder). Although these postulated effects work in opposite directions, by expectedly occurring in the right amount and at the appropriate moment, both would in fact support and facilitate the client's work during therapy.

In the present study, our main objective was to expand on the findings by Brabant et al. (2017) and investigate the effects of RFB on a client formally diagnosed with an emotional disorder, in order to better understand the effects that can be expected with clients presenting specific pathologies. More specifically, we sought to answer the following research questions. Does the use of RFB as a prelude to music psychotherapy have a visible and positive impact on emotional processes? Do any observable effects differ depending on the type of client?

Concretely, in the case of a client with anxiety disorder, we hypothesised that the use of RFB would primarily decrease the perceived difficulty of the sessions, and that these difficulty decreases would also be accompanied by higher HRV levels during music-making and/or verbal interaction. Moreover, in addition to the effects attributable to the breathing exercise, we expected the results to display a trend corresponding to the changes and improvements that naturally happen during the course of therapy. Lastly, should the client indeed experience positive changes during our study, we reasonably assumed that the effects of RFB would adapt and change accordingly, possibly even leading to increased arousal and difficulty, similarly to what Brabant et al. (2017) observed in their study with a healthy client.

Method

Study design

We performed a single-subject study with an alternating treatments design, so as to compare the effect of RFB to the effect of a control intervention. The chosen control intervention was Vibroacoustic Therapy (VAT), which consists in applying low-frequency sound waves to the client's body through speakers or transduc-

ers placed in special armchairs and mattresses. VAT is a form of receptive music therapy that can be used for example to treat hypertension, muscle spasticity, stress, and anxiety (Grocke & Wigram, 2007). Although the efficacy of VAT still needs to be established through systematic studies (Punkanen & Ala-Ruona, 2012), the nature of the method made it nonetheless a credible alternative to RFB, thus increasing the likelihood that the client would have an equal level of expectation towards both interventions. Furthermore, the client was unaware of our research question, and we presented both interventions as having the same purpose (relaxation).

The study consisted of 12 weekly sessions, always taking place on the same day and at the same time. Every session started with either 10 min of RFB or 10 min of VAT, followed by 45 min of improvisational music psychotherapy in the form of IIMT. The two treatment conditions were systematically alternated in consecutive order, starting with the vibroacoustic treatment in the first session. In other words, VAT was used in all the odd-numbered sessions (1, 3, 5, 7, 9, and 11), while RFB was used in all the even-numbered sessions (2, 4, 6, 8, 10, and 12).

The client was a 35-year-old female diagnosed with anxiety disorder and social phobia. She had undergone cognitive psychotherapy in the past, but it was the first time she tried music psychotherapy. Her formal music education consisted in some basic training in classical piano playing. As for the therapist, she was a certified music therapist holding a Bachelor's in Music Therapy from the ArtEZ School of Music, Enschede, the Netherlands. Prior to the study, she received adequate training in the principles and methods of IIMT.

It should be noted that the client was taking paroxetine, an antidepressant of the selective serotonin reuptake inhibitor (SSRI) class that is commonly prescribed for social phobia. SSRIs have been associated with reduced HRV levels, both in depressed and non-depressed people (O'Regan, Kenny, Cronin, Finucane, & Kearney, 2015). However, this effect is generally considered modest, unlike other types of antidepressants (Kemp et al., 2010; Licht et al., 2008). This was anyway not a major issue, since the client served as her own control and the medication dosage remained unchanged during her participation in our study.

The music improvisations were performed either on a djembe drum (traditional West-African drum) or on a malletKAT Pro, the latter being set to emulate the sound of a vibraphone. The malletKAT Pro is a Musical Instrument Digital Interface (MIDI) controller that has the same key layout as a marimba, and is played using one or two mallets. Although it is an electronic instrument, the keys of the malletKAT are pressure-sensitive, allowing for changes in dynamics and volume levels. In accordance with the IIMT model, whenever they improvised together, client and therapist were facing each other and playing the same type of instrument.

Regarding the data collection, the client was wearing a heart rate monitor in the form of a chest strap during the entire length of the sessions. The questionnaires and rating scales used in this study were administered through a desktop computer located in the music therapy room. Moreover, the sessions were filmed with non-intrusive audiovisual equipment. Written consent was obtained from the client regarding the filming of the sessions, and the fact that the collected material would be used for research purposes.

For the analysis, we chose to focus on the working phase of the therapy, and therefore excluded the first and last session, leaving us with a total of 10 sessions (five in each condition). This is sufficient with regard to the requirements defined by the What Works Clearinghouse, whereby a minimum of five observations per phase are needed to meet the standards for single-case research designs (Kratochwill et al., 2010). To evaluate the results, we mainly relied on visual data inspection. In addition, whenever a change was sys-

tematic and visible in all 10 sessions, we complemented the visual analysis with a statistical comparison of the means obtained under each condition. Since the study design consisted of the systematic alternation of two conditions, we were particularly interested in the presence of clear zigzag patterns in the data. If present, such patterns would be indicative of a possible functional relationship between the preparatory intervention and the measured variables.

Interventions

Vibroacoustic therapy (VAT)

VAT was administered with a Next Wave Physioacoustic PRO therapy chair. Unlike the more basic MX version, the PRO version allows the use of custom-made programs, in addition to the 16 preset programs. The Next Wave therapy chairs received 510(k) clearance from the U.S. Food and Drug Administration (FDA) as class II medical devices (clearance number: K905256). The medical claims allowed by the FDA are tension relief, increase of blood circulation, and pain relief.

In the present study, we used a shortened version (10 min) of a pre-existing relaxation program. Its detailed parameters can be found in Table A1. During the VAT treatment, the chair's footrest was inclined at 45° upward, whereas the backrest was inclined at 45° backward. While VAT was on-going, the client kept her eyes closed and the therapist sat next to her in silence.

Resonance frequency breathing (RFB)

In order to simplify the procedure, RFB was performed without any biofeedback instrumentation. Instead, we relied on the fact that in an adult person, the resonance frequency remains largely stable (Vaschillo, Vaschillo, & Lehrer, 2006). We therefore determined the client's resonance frequency only once at the beginning. In subsequent sessions, we relied on that information to cue her with a visual breath pacer set at her optimal speed.

To determine the client's resonance frequency, we followed the iteration method developed by Lehrer (2007, Chapter 10). This method consists in testing six different breathing speeds (7, 6.5, 6, 5.5, 5, and 4.5 breaths/min) and then identifying the speed that produces the highest HRV level. The latter is done by comparing the HRV power spectra obtained with each speed, and finding the measurement with the highest spectral peak in the vicinity of 0.1 Hz. Indeed, when performing RFB, the entire HRV power spectrum concentrates around the frequency corresponding to the breathing speed (6 cycles/min = 0.1 Hz). In the case of our client, her optimal breathing speed was exactly 6 breaths/min.

Besides the breathing speed, another factor to consider is the inhalation/exhalation (i/e) ratio. There are repeated findings indicating that longer inhalations than exhalations reduce HRV by activating the sympathetic branch of the ANS, whereas longer exhalations than inhalations increase HRV through parasympathetic activation (Porges, 2007; Strauss-Blasche et al., 2000). In a study specifically investigating the effect of the i/e ratio when breathing at 6 breaths/min, Diest et al. (2014) found that a low i/e ratio (exhalation > inhalation) induced higher levels of mindfulness, positive energy, and relaxation compared to a high i/e ratio (inhalation > exhalation). For the present study, we chose a ratio of 40/60 without pauses, meaning inhalations lasted 4 s and exhalations 6 s.

The client performed RFB while sitting on the VAT chair, with the chair turned off and the back- and footrest in an upright position. The breathing cues were given by a free app called Paced Breathing (LLC, 2015), installed on an Android tablet. We asked her to follow the visual breathing cues while holding the tablet in front of her. She was given the following breathing instructions: to use abdominal breathing, to breathe in through the nose and out through the mouth with pursed lips, and to keep the breathing shallow and

natural so as to avoid hyperventilation. Similarly to the other intervention, when the client was performing RFB, the therapist sat next to her in silence.

Process measures

Session evaluation questionnaire (SEQ; Stiles, 1980; Stiles & Snow, 1984)

The SEQ is a self-report instrument designed to evaluate the client's post-session mood, as well as the impact of each session, as perceived by the client. Its latest version consists of 21 seven-point bipolar adjective scales, regrouped to form the following independent dimensions: Positivity and Arousal for the client's affective state, Depth and Smoothness for the session evaluation. In doing so, the SEQ is following the circumplex model of emotion (Russell, 1980), whereby all emotions are mapped onto a two-dimensional space, with one dimension representing valence (positive-negative) and the other one representing arousal (activation-deactivation).

Regarding the Depth dimension, it simultaneously expresses the idea of session potency (powerful-weak) and value (valuable-worthless). As to the Smoothness dimension, it expresses whether the session was experienced as relaxed and comfortable, or rather as tense and distressing. A complete list of the adjective pairs can be found in Table A2.

The SEQ was administered at the end of each session. In addition, we also administered the mood scales (Positivity and Arousal) at the beginning of the sessions, immediately following the relaxation intervention. This enabled us to compare post-session scores to pre-session scores, and also to measure the subjective effect of the relaxation interventions on the client's affective state.

Outcome measures

Hospital anxiety and depression scale (HADS; Snaith, 2003)

The HADS is a self-report instrument used to assess anxiety and depression in a non-psychiatric adult population. It consists of two sub-scales (anxiety and depression) with seven items each, scored from 0 to 3. The HADS was administered one week before the first therapy session and then again one week after the last session.

Brief social phobia scale (BSPS; Davidson et al., 1991, 1997)

The BSPS is an observer-rated instrument designed to assess the typical symptoms of social phobia. It consists of three sub-scales (fear, avoidance, and physiological arousal), and comprises a total of 18 items rated on a five-point scale. The first two sub-scales assess to what extent certain social situations are being feared and avoided, whereas the last sub-scale measures the intensity of physical symptoms when in social situations, such as blushing or trembling. Similarly to the HADS, the BSPS was administered one week before the beginning and one week after the end of therapy.

HRV measures

Chosen indices

In the time domain, we calculated SDNN (the standard deviation of all beat-to-beat intervals) and RMSSD (the root mean square of successive beat-to-beat interval differences). SDNN is a measure of overall HRV (i.e. how much the ANS responds), whereas RMSSD is a measure of short-term HRV (i.e. how quickly the ANS responds). We also reported average heart rate (HR). In the frequency domain, we calculated the spectral power of LF (low frequency, 0.04–0.15 Hz) and HF (high frequency, 0.15–0.4 Hz) using the Fast Fourier Transform algorithm (data interpolation rate: 4 Hz). We also computed total power (TP), which includes all the cycli-

cal components responsible for HRV up to 0.4 Hz.¹ The results in the frequency domain were log transformed (natural log, ln), so as to guarantee the normality of their distribution. Furthermore, we also calculated the relative power distribution between LF and HF by converting the absolute values to normalised units (nu).² Since their mathematical equivalence makes LFnu and HFnu redundant information (Burr, 2007), we only reported HFnu.

In terms of interpretation, HF is an indicator of vagal tone and parasympathetic activity, low HF corresponding to a reduced parasympathetic influence. In other words, low HF typically accompanies high physiological arousal, for instance when experiencing stress and anxiety (Cohen et al., 1998; Schwarz et al., 2003). LF, however, cannot be unambiguously interpreted, as it is the combined result of sympathetic, parasympathetic, and baroreflex influences (Shaffer, McCraty, & Zerr, 2014).

One notable fact is that all the HRV indices in a given domain have an equivalent in the other domains, to which they are highly correlated ($r > 0.9$). We know for example from existing studies that SDNN and TP tend to correlate very highly, and so do RMSSD and HF (Kleiger, Stein, & Bigger, 2005; Shaffer et al., 2014; Task Force, 1996). Even if these correlations were established through 24-h electrocardiogram recordings, we expected to find similar correspondences in the present study.

Segmentation and averaging

In typical HRV studies, all participants perform the same pre-defined task in the same amount of time, and researchers analyse their data in 5-min segments, which is the standard for short-term analyses (Task Force, 1996). Such an approach is not applicable to music therapy, where moments of interest (e.g. a specific music improvisation) are unpredictable and can last anything between a few minutes to the entire length of the session. We therefore needed a methodology that would remain accurate and reliable when applied to data segments of different lengths, especially to very short ones lasting less than five minutes.

Studies investigating the reliability of HRV indices for ultra-short segments have demonstrated that SDNN and RMSSD remain reliable with segments lasting only 30 s (Munoz et al., 2015; Salahuddin, Cho, Jeong, & Kim, 2007). Nevertheless, a minimum of two minutes is required for accurately capturing LF and HF, the idea being that at least 10 cycles of the lowest frequency should be present in the data when performing a power spectral analysis (Berntson et al., 1997). We therefore settled for two-minute segments, which thus became the minimum length an event needed to be considered for analysis. For any therapeutic moment lasting longer than two minutes, we averaged multiple overlapping 2-min segments (overlap: 50%). Indeed, the averaging of short overlapping segments is a reliable way of estimating the mean spectral values of a longer data segment (Rivecourt, Kuperus, Post, & Mulder, 2008). The time-domain indices were calculated alongside the frequency-domain indices using the same averaging method.

Data acquisition and pre-processing

Data acquisition was performed with a Suunto Memory Belt, which is a self-contained and autonomous chest strap able to record R–R intervals without the use of an external receiver such as a wrist watch or a mobile phone. The Memory Belt has an accuracy of 1 ms, and it can reliably substitute itself to standard electrocardiogram systems (Bouillod, Cassirame, Bousson, & Tordi, 2015; Weippert et al., 2010). Data pre-processing and analysis was

¹ TP = VLF + LF + HF, with VLF: very low frequency (0–0.04 Hz), LF: low frequency (0.04–0.15 Hz) and HF: high frequency (0.15–0.4 Hz).

² LFnu = LF [ms²] / (TP [ms²] – VLF [ms²]) and HFnu = HF [ms²] / (TP [ms²] – VLF [ms²]). This is roughly equivalent to LFnu = LF / (LF + HF) and HFnu = HF / (LF + HF).

performed with version 2.2 of Kubios, a freely available HRV analysis tool (Tarvainen, Niskanen, Lipponen, Ranta-aho, & Karjalainen, 2014).

Data pre-processing consisted of two steps. First, we removed abnormal heartbeats and noise-based artifacts with Kubios' automatic detection and correction feature. This was done by selecting the minimum sensitivity level needed for Kubios to detect all unwanted artifacts while leaving the rest of the data untouched. Once detected, artifacts were automatically replaced using a cubic spline interpolation method. We then detrended the data using smoothness priors ($\lambda = 500$), which rendered the heart rate signal more stationary through the removal of unwanted long-term trends (Tarvainen, Ranta-aho, & Karjalainen, 2002). Stationarity of HRV data is a prerequisite for time- and frequency-domain analyses; in its absence, results are more likely to overestimate the contribution of the ANS' sympathetic branch (Magagnin et al., 2011).

Results

The results are presented here in the following order: immediate effects on HRV of the preparatory interventions, mood ratings, session ratings, HRV during the rest of the session (with a distinction between verbal exchange and music improvisations), and outcome measures. The detailed numerical results can be found in the Appendix, in Tables A2 and A3. It should be noted that we only included the malletKAT improvisations in our analysis of the music-making moments. The reason behind was that the malletKAT was played in every session, whereas the client used the djembe in only half the sessions, making the djembe improvisations unsuitable for comparison.

Before proceeding to the results as such, we would first like to provide a brief overview of the therapy process in terms of thematic and emotional content, as this will create a context for the interpretation of these results. After looking at the addressed topics and emotional tone of each session, it became clear that the therapy process had two distinct phases. Session 2–7 were characterised by the expression of mainly negative emotions (stress, nervousness, social phobia, anger), whereas session 8–11 were more resource-oriented, with a stronger focus on solutions and positive emotions (being social, feeling strong, being disinhibited). These two phases happened spontaneously and were not in any way planned or initiated by the therapist. Rather, all the themes that emerged throughout the therapy process were suggested by the client.

HRV during the preparatory interventions

After examining the immediate effects of the preparatory intervention on HRV measures, we found that RFB consistently increased the levels of overall HRV, as indexed by the level of total power (TP). This increase was quite substantial when compared to the levels achieved during VAT. As can be seen in Fig. 1, the zigzag pattern was very pronounced, and the difference in TP after RFB ($M = 8.71$, $SD = 0.13$) versus after VAT ($M = 6.43$, $SD = 0.22$) was statistically highly significant, with $t(8) = 20.11$, $p < 0.001$, Cohen's $d = 12.62$. To give the reader a point of comparison, the average TP level for the rest of the session across all sessions was 7.33 ($SD = 0.58$).

As expected, these high levels in TP were driven by strong increases in LF power, while HF did not display any systematic difference between interventions (see Fig. 1). It is important to add the following word of caution: one should see these results as being specific to the practice of slow breathing, and not apply the usual interpretation criteria used for the frequency domain. Indeed, under normal breathing circumstances, increased relaxation would

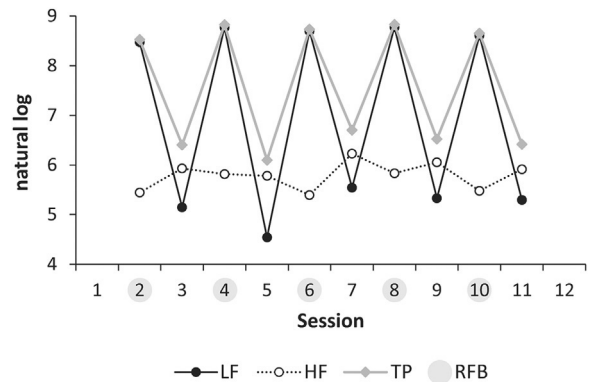


Fig. 1. HRV during the preparatory intervention. LF and HF are the two main components of TP.

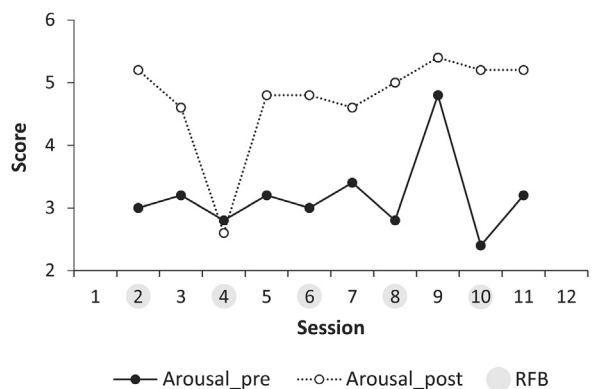


Fig. 2. Client's Arousal scores on the SEQ (pre- and post-session).

typically manifest through higher HF and not higher LF. However, as we saw in the introduction, one of the characteristics of RFB is to cause a power concentration around the resonance frequency. This frequency happens to be located in the LF band, hence the atypical HF results obtained here.

Mood ratings

The arousal levels reported by the client immediately following the preparatory intervention confirmed the existence of a link between RFB, high HRV, and increased relaxation. If we look at Fig. 2, we see a clear zigzag pattern in Arousal_pre scores, with pre-session arousal levels systematically lower after RFB ($M = 2.8$, $SD = 0.24$) than after VAT ($M = 3.54$, $SD = 0.65$). This difference was statistically significant, with $t(8) = -2.369$, $p < 0.05$, Cohen's $d = 1.51$. In other words, the results show that the breathing intervention had a stronger relaxation effect than the vibroacoustic intervention, and this difference was visible both in the physiological data and in the self-reported arousal levels.

Regarding the Arousal_post scores, the results indicated that the client was always more aroused at the end of the sessions, compared to the beginning of the sessions. The only exception was session 4, where the Arousal_post score was unusually low (see Fig. 2). Unlike Arousal_pre, there was no zigzag pattern with Arousal_post, meaning no association was found between the preparatory interventions and the post-session arousal levels. If we ignore the two scores strongly deviating from the rest of the data (session 9 for Arousal_pre and session 4 for Arousal_post), neither measure displayed any systematic trend over time.

The interpretation of these arousal scores needs to be modulated with the results of the positivity ratings. Indeed, Fig. 3 indicates that—except for sessions 9 and 11—the client ended the sessions

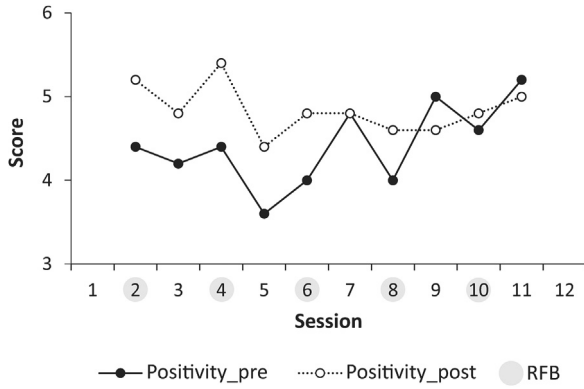


Fig. 3. Client's Positivity scores on the SEQ (pre- and post-session).

feeling more positive than when she started them. This means that the client would typically leave the therapy room feeling both more aroused and more positive compared to the beginning of the session. The two exceptions visible at the end of the therapy process are not caused by a sudden decrease in Positivity_post, but by ever-increasing Positivity_pre scores starting from session 7.

In terms of difference between conditions, the positivity ratings displayed clear differences in only half of the sessions, making them non-systematic. However, when they occurred, consistent differences were visible in either the first or the second therapy phase. As shown in Fig. 3, there was a zigzag pattern with a slight downward trend in both Positivity_pre and _post scores from session 2–6. Both positivity scores were higher in sessions starting with RFB, compared to sessions starting with VAT. Then, starting from session 7, the Positivity_post curve became almost flat, whereas Positivity_pre began an upward trend and reversed its zigzag pattern (less positive after RFB, compared to VAT). It is also worth noticing that until Positivity_pre started its upward trend in session 7, both positivity curves followed each other very tightly, displaying almost parallel fluctuations relative to one another.

Session ratings

Turning our attention now to the session ratings, no systematic pattern was visible in the Depth scores, except for a slight downward trend (see Fig. 4). However, a noteworthy fact was that the session with the highest Depth score (session 4) was also the session with the highest Positivity_post score (see Fig. 3), the lowest Arousal_post score (see Fig. 2), and the highest level of SDNN during improvisations (see Fig. 6). In other words, the session rated as the most powerful and valuable had the following unique characteristics: the client was the least stressed during improvisations, and

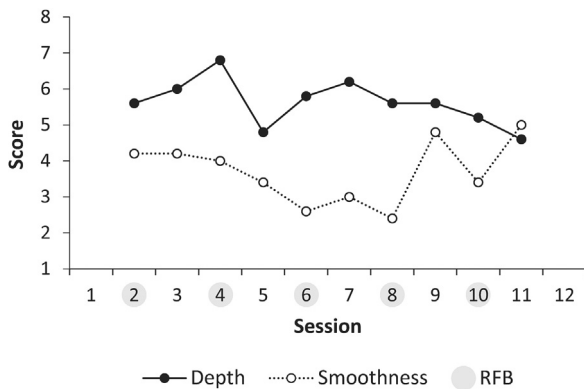


Fig. 4. Client's Depth and Smoothness scores (both post-session).

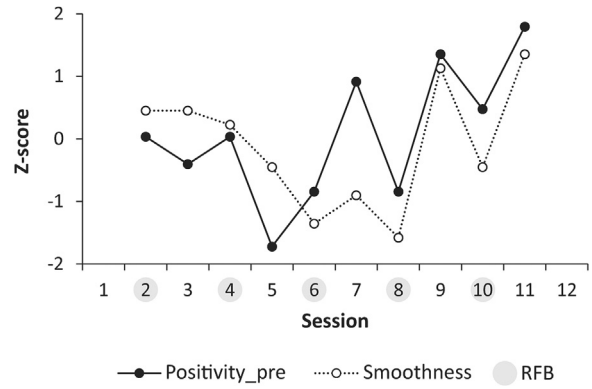


Fig. 5. Comparison of Positivity_pre and Smoothness scores (after transformation into standard scores).

she left the room feeling the calmest and the most positive, compared to all the other sessions. We know from the psychometric properties of the SEQ that Depth and Positivity usually tend to be positively correlated (Stiles et al., 1994), so this association found in session 4 between Depth and Positivity_post is in itself not surprising. However, when taken as a whole, our data did not display any significant association between these two variables ($r=0.48$, $p=0.16$, $n=10$).

As to the Smoothness scores, they were characterised by an overall U-shaped trend, with a decrease until session 8, followed by an increase until the last session. Furthermore, the upward part featured a zigzag pattern, with the two sessions starting with RFB rated lower in smoothness than the two sessions starting with VAT. One notable fact is the strong parallelism between the Smoothness and Positivity_pre scores, especially after session 7 when both curves began their zigzag pattern (see Fig. 5 for a joint representation of these curves). It is also worth mentioning that for these two scores, the beginning of the upward trend and the zigzag pattern corresponded to the second phase of the therapy process, when the sessions were more positive and resource-oriented. In other words, once this qualitative shift occurred, the client started the sessions in an increasingly positive mood, and she experienced the sessions as more and more smooth.

HRV during the rest of the session

Moving on to the HRV results, we first would like to mention a general finding regarding the difference between music-making and talking: throughout the whole therapy process, malletKAT improvisations were always more stressful than verbal interaction, as can be seen in Fig. 6 (overall HRV was always lower during impro-

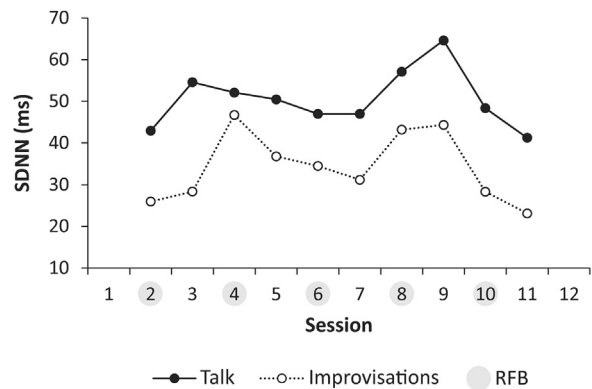


Fig. 6. HRV during talking and music improvisations (SDNN).

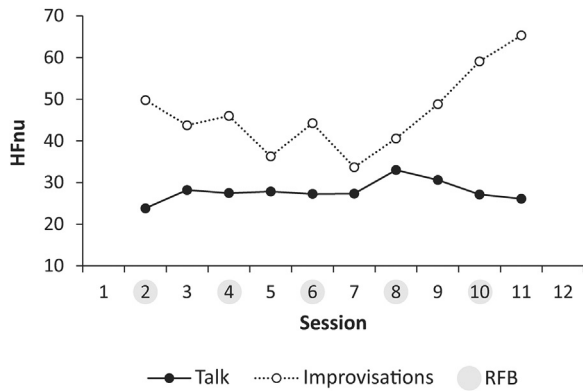


Fig. 7. HRV during talking and music improvisations (HFnu).

visations than during talking). This difference was visible in all the absolute HRV measures reported in this study (SDNN, RMSSD, LF, HF, and TP), the only exceptions being RMSSD and HF in session 4. Such a finding is very interesting, because it supports the idea that music-making and verbal interaction are really two distinct activities in terms of their emotional qualities and therapeutic functions.

Trend-wise, the SDNN levels for both talking and improvising did not have any clear or systematic trend, neither did they display any of the zigzag patterns identified in the other measurements. However, as can be seen in Fig. 7, the plotting of HFnu during improvisations did reveal the presence of a U-shaped trend as well as a zigzag pattern. Both the downward phase and the zigzag pattern lasted from session 2–7, followed by a steep and constant increase until session 11. Again, similarly to Positivity_pre and Smoothness, the turning point corresponded to the beginning of the second phase in the therapy process, when the thematic and emotional contents shifted to something more positive. As to HFnu during talking, the curve remained very flat and trendless across the 10 sessions.

Before finishing with the HRV results, we would like to add an important clarification about Figs. 6 and 7. On the face of it, it might appear that these two figures are contradicting each other, because in Fig. 6 the Improvisation curve is consistently below the Talk curve, whereas it is above the Talk curve in Fig. 7. One has to keep in mind that these two figures are not directly comparable, because one is about an absolute HRV measure (SDNN), whereas the other one is about a relative HRV measure (HFnu). While it is true that both LF and HF did decrease during improvisations compared to the moments of verbal exchange (similarly to SDNN), LF always decreased more than HF, causing the relative amount of HF (HFnu) to be systematically higher during improvising than during talking. In other words, the counter-intuitive results presented in Figs. 6 and 7 are not spurious, but the consequence of using normalised units. This also means that Fig. 7 should not be used to compare talking and improvising inside each session, but only to compare the same activity across sessions.

Outcome measures

A pre-post comparison of the outcome measures indicated that the client experienced an improvement in both her anxiety and social phobia symptoms. As shown in Table 1, her anxiety score on the HADS dropped from 12 to 8, which corresponded to a shift from a moderate to a mild anxiety, a score of 8 being actually at the limit between mild and normal (0–7: normal, 8–10: mild, 11–14: moderate, 15–21: severe). The results of the BSPS were slightly more mixed, with a marginal increase of avoidant behaviour (+2 points), accompanied by a reduction in fear levels (–3 points) and an even stronger decrease in physiologic symptoms (–5 points). All in all,

Table 1 Outcome measures.

	Pre	Post	Δ
HADS			
Anxiety ^a	12	8	–4
Depression ^a	0	2	+2
BSPS			
Fear ^b	24	21	–3
Avoidance ^b	18	20	+2
Physiologic ^c	9	4	–5

HADS: Hospital Anxiety and Depression Scale, BSPS: Brief Social Phobia Scale.

^a 0–7: normal, 8–10: mild, 11–14: moderate, 15–21: severe.

^b Range: 0–28.

^c Range: 0–16.

based on the outcome measures, it appears that these 12 sessions of improvisational music therapy were beneficial to the client, which she orally confirmed during the last session (“I’m much more confident these days than I used to be”, “I have really enjoyed this”, “I think this has helped me very much”, “It has been very relieving to show my feelings”, “I got new views”).

Summary

The findings presented above were of three types. The first type was variables displaying a systematic difference between the two experimental conditions across the entire therapy process (HRV during the preparatory intervention and Arousal_pre levels). The second type was variables with non-systematic differences visible in only one half of the sessions (HFnu during improvisations, Smoothness, and Positivity_pre and .post). Lastly, we also had variables that did not display any difference between conditions (Arousal_post, Depth, all absolute HRV indices during the rest of the session, and HFnu during talking). For an overview of the findings, we refer the reader to Table 2.

It is worth noticing that the variables with systematic differences were all related to the execution of the preparatory intervention, whereas the variables with partial or non-systematic differences all had to do with the rest of the session (i.e. the music psychotherapy part as such). Another relevant finding was that when variables displayed a consistent difference in only part of the sessions, this part was either the first (more difficult) phase or the second (easier) phase of the therapy process. Moreover, three of the

Table 2 Overview of the findings in process measures.

Systematic difference between conditions		
	Observed difference	
HRV during preparatory intervention ^a	higher during RFB	
Arousal_pre	lower right after RFB	
Non-systematic difference during at least half of the therapy		
	Type of change	
	Higher in the more difficult (1st) phase	Lower in the more easy (2nd) phase
HFnu (impro)	✓	–
Smoothness	–	✓
Positivity_pre	✓	✓
Positivity_post	✓	–
No difference, neither systematic nor partial		
Arousal_post		
Depth		
Absolute HRV indices		
HFnu (talk)		

^a All HRV indices (absolute and relative), except HF.

latter variables (HFnu during improvisations, Smoothness, and Positivity_pre) displayed a U-shaped trend (easy-difficult-easy), with the turning point (session 8) corresponding to the passage from the first to the second therapy phase.

Interestingly enough, in each of these two phases, the direction of the observed change was consistent between the variables (see Table 2). In the first phase, although they displayed a downward trend, HFnu (impro), Positivity_pre, and Positivity_post were all comparatively higher after RFB. In other words, while things were getting progressively more difficult (until session 7), certain aspects of the client's experience were nonetheless easier in sessions starting with RFB. Conversely, once things started to become easier, Smoothness and Positivity_pre began an upward trend while remaining comparatively lower in sessions starting with RFB. Taken together, these results point to the existence of two different effects of RFB that were opposite in nature and seemed to depend on the therapy phase.

Discussion

The goal of this study was to investigate to what extent emotion-based processes could be facilitated and supported during Integrative Improvisational Music Therapy (IIMT) by starting the sessions with a tailor-made breathing exercise called Resonance Frequency Breathing (RFB). The second objective was to better understand the specific ways in which RFB might affect clients with emotional disorders.

When looking at the findings as a whole, certain interesting patterns emerged among the positive results. One pattern was that for variables displaying consistent differences in only one therapy phase, the direction of the change (increase/decrease) and the moment of its appearance (first phase/second phase) were in line with our initial hypothesis regarding the effects of RFB. Indeed, we postulated that RFB would have a double function: it would serve as an emotional regulator and reduce arousal levels in case of hyperarousal, while also being a catalyst of difficult emotions, thus temporarily increasing stress levels. The latter, however, would only happen if people are able to cope with these emerging negative emotions.

Should our hypothesis be correct, we would logically expect the effects of RFB to vary not only from person to person, but also within a person, depending on the current phase of the therapy process. As we saw in our results, this was indeed the case: in the phase dominated by negative emotions, certain aspects became easier after RFB (higher HFnu during improvisations and higher pre/post Positivity), whereas in the second, smoother phase, other aspects became more difficult in sessions starting with RFB (lower Smoothness and Positivity_pre). It should be noted that the presence of a U-shaped course—such as the one we found in three of the variables—is typical for therapy methods involving emotional exploration and expression. Moreover, this pattern (easy-difficult-easy) is usually linked with good therapeutic outcomes (Watson & Bedard, 2006), as was indeed the case in the present study.

Generally speaking, due to the nature of psychotherapy, the unavoidable presence of cumulative changes from session to session means that sequential observations in a single subject are bound to be autocorrelated (i.e. non-independent). This is considered an issue in Single-Subject Experimental Designs (SSEDs), especially when performing statistical analyses (Borckardt et al., 2008). However, one advantage of psychotherapy research is that we can predict the patterns that characterise successful and unsuccessful therapy courses, such as the U-shaped trend mentioned above. It means that these known, non-random patterns can easily be identified and factored in when performing the data analysis, thus greatly minimising the problem of autocorrelation. Naturally, how easy it is to distinguish between expected patterns and treat-

ment effects also depends on the chosen study design. Had we opted for an AB design instead of an alternating treatments design (e.g. six sessions starting with VAT followed by six sessions starting with RFB), it would have been impossible to tell the intervention effects from the natural course of therapy.

Obviously, in terms of internal validity and confidence in the cause-effect relationship, the present study does not allow us to make any claim about a causal link between RFB and changes observed in only part of the therapy process. However, the results are internally consistent and support our theory that the effects of RFB are adaptive, meaning that they follow the client's current emotional needs. Moreover, this theory is corroborated by the findings of Brabant et al. (2017), who used a similar set-up, but with a healthy client and a different control intervention (listening to relaxation music instead of VAT). In that study, the client experienced more stress after RFB, in accordance with the hypothesis that someone with a higher tolerance threshold would see the emergence of difficult emotions that were normally not expressed. In sum, given the evidence available so far, the hypothetical *modus operandi* of RFB could be summarised as follows: with RFB, the difficult becomes easier, and the easy becomes more difficult.

Another noteworthy pattern was that variables presenting a systematic difference throughout the entire therapy process were all directly connected to the practice of RFB. Two important conclusions can be drawn from this. Firstly, the immediate effects of RFB on HRV appear to be quite strong and reliable, since all (bar one) HRV indices were systematically and markedly higher during RFB, compared to VAT. However, the fact that a clear and consistent differential effect was found for RFB while it was being performed is not surprising. Indeed, to our knowledge, its ability to instantly and dramatically maximise HRV is unrivalled. Therefore, we did not expect VAT to even come close in terms of HRV increase.

Consequently, a more important question would be, how did RFB and VAT compare in terms of achieved relaxation? Indeed, although perceived stress levels usually correlate with objective stress levels as measured through HRV, this has not been necessarily true in every study (Hynynen, Konttinen, Kinnunen, Kyröläinen, & Rusko, 2011; Riese, Van Doornen, Houtman, & De Geus, 2004). Therefore, one should not exclude the possibility of sometimes finding a disconnect between the two. This was, however, not the case in our results. According to the pre-session arousal scores, the client was systematically calmer immediately after RFB, which means that RFB had a stronger relaxation effect than VAT. Thus, our second conclusion is that RFB was superior to VAT both in terms of HRV increase and relaxation, at least in the 10-min format used in the present study. As a side note, when VAT is being used as the main intervention, the typical length of a VAT session is 20–40 min (Grocke & Wigram, 2007; Lehtikoinen, 1997), so the results reported here are not necessarily representative of the effects that can be achieved with the vibroacoustic method.

Naturally, the really interesting results are not the ones involving the immediate effects of RFB, but its effects on the rest of the session. One of the merits of the present study is to shed some light on the nature of these effects and the differences that can be expected depending on the client population. However, two aspects that remain elusive are the intensity and actual duration of these effects. In other words, does RFB have an impact on the entire session or only a part of it? Furthermore, are the effects constant while they last or do they progressively fade?

The current study was not designed to address these issues, and existing research only focused on short-term effects visible in HRV (Karavidas et al., 2007; Zucker et al., 2009). In both studies, SDNN was higher in the 5-min resting period immediately following RFB, compared to the resting period preceding RFB. While they demonstrate the existence of a carry-over effect (at least on HRV), the time period under consideration (5 min) is too short to allow any

extrapolation to an entire therapy session, whose typical length is 45–60 min. Anyhow, these findings are not directly relevant for therapists, whose clients did not come to rest but to be actively involved in therapeutic work. This distinction is important, as our findings show that during therapy, RFB might not always lead to increased relaxation, but also to higher stress levels. In other words, when RFB is applied as a preparatory intervention within psychotherapy, increased HRV (i.e. less stress) is not a reliable indicator of persisting carry-over effects.

At this point, given the state of our knowledge, we can only formulate a theory regarding the intensity and duration of any carry-over effect produced by RFB. The following theory is based on the common properties of IIMT and RFB, and thus only applies to therapy methods involving symbolic and spontaneous expression through an art form. We would like to propose that the intrinsic qualities of music-making, being similar to the ones of RFB, support and sustain the emotional opening process that is initiated by RFB. Indeed, one of the key features of music improvisations is to help clients with the expression of difficult emotions, by offering them a non-verbal form of communication (MacDonald & Wilson, 2014). This is similar to the postulated effects of RFB, which are to facilitate the emergence of negative emotions, while at the same time making this confrontation bearable. Consequently, it is quite possible that RFB may be impacting the entire session, through the creation of a self-sustaining feedback loop between RFB and the music-making activities.

Regarding the use of HRV measurements as a source of objective physiological data within psychotherapy research, the present study illustrates how relative HRV indices are an important complement to absolute indices. Indeed, we found a systematic difference in absolute indices only when the measured effect was strong and obvious, meaning during the breathing exercise itself. As soon as the effects became smaller and more subtle (i.e. during the rest of the session), the only HRV index displaying a difference between conditions was HFnu, which is a relative index. It is worth mentioning that the same phenomenon was reported by Brabant et al. (2017), who only found statistical differences in HFnu and LFnu, and none in the absolute HRV indices (breathing intervention aside).

One likely explanation is that absolute HRV indices typically display strong intra-individual variations from one recording to the next, an expected minimum of 10–30% being the norm (Pinna, 2007; Sandercock, Bromley, & Brodie, 2005). Consequently, natural variations in HRV might mask the effect of an intervention, if that effect is smaller than these natural variations. However,

changes in absolute HRV that are masked by natural variations might remain visible in LFnu and HFnu, because these normalised indices minimise the effect of changes in total HRV spectral power. As a result, when used in repeatability studies, LFnu and HFnu typically have much smaller coefficients of variation compared to their non-normalised counterparts (Burr, 2007).

Because our study only involved a single subject, it is of course impossible to generalise the findings to a larger population. In order to do so, RFB would need to be tested in a randomised controlled trial comparing a treatment group to a control group. Such a design would also make it possible to properly assess the impact of RFB on outcome measures, which is something our current study did not allow either. However, it is important to stress that SSEDs play a valuable role within the framework of evidence-based practice. Because of their inherent flexibility and focus on causal relationships, SSEDs are ideal for developing new therapeutic methods and evaluating their efficacy prior to their application in parallel group designs (Byiers, Reichle, & Symons, 2012).

We are aware that for this new therapeutic approach to easily translate to clinical practice, the HRV methodology that we used in conjunction with RFB would have to be simplified. One readily available solution would be to substitute smartphone technology for the more professional heart rate monitors and electrocardiogram systems. Indeed, it has nowadays become possible to measure heart rate quite accurately by placing a finger on the phone's camera (Coppetti et al., 2017). Although not necessarily suitable for research purposes, the smartphone option constitutes a viable and convenient alternative for therapists who wish to use RFB with their clients.

To conclude, the results presented here are promising enough to warrant further studies, in the form of SSEDs as well as larger between-group comparisons. Should the supporting effects of RFB be confirmed and their clinical relevance established, therapists might have a new tool at their disposal to cost-effectively, safely, and easily enhance the effectiveness of therapy, which would have the added benefit of potentially reducing healthcare costs through shorter therapy processes.

Acknowledgement

This work was supported by a personal grant from the Jenny and Antti Wihuri Foundation (to the first author).

Appendix A.

Table A1
Settings of the Physioacoustic chair.

Step	Length ^a	Freq. ^b	Scan ^c	Speed ^d	Cycles ^e	Action ^f	Strength ^g	Neck ^h	Back ^h	Thighs ^h	Legs ^h
1	2	40.06	0	0	0	1	3	3	4	6	6
2	2	39.06	0	0	0	1	3	3	4	6	6
3	2	34.27	0	0	0	1	3	3	4	6	6
4	2	44.64	0	0	0	1	3	3	4	6	6
5	2	40.06	0	0	0	1	3	3	4	6	6

^a Minutes.

^b Hertz.

^c Fluctuation range around the central frequency (0 = no fluctuation).

^d Speed of the fluctuation around the central frequency (range: 0–99).

^e How fast the wave moves up and down the chair (range: 0–99).

^f Direction of the wave (1 = from the legs to the head).

^g Overall strength (range: 0–9).

^h Individual strength of various parts of the chair (range: 0–9).

Table A2
Results of the Session Evaluation Questionnaire (SEQ).

	Session										M	SD
	2	3	4	5	6	7	8	9	10	11		
Mood evaluation												
Positivity_pre	4.4	4.2	4.4	3.6	4	4.8	4	5	4.6	5.2	4.42	0.49
Positivity_post	5.2	4.8	5.4	4.4	4.8	4.8	4.6	4.6	4.8	5	4.84	0.30
Arousal_pre	3	3.2	2.8	3.2	3	3.4	2.8	4.8	2.4	3.2	3.18	0.64
Arousal_post	5.2	4.6	2.6	4.8	4.8	4.6	5	5.4	5.2	5.2	4.74	0.80
Session evaluation												
Depth	5.6	6	6.8	4.8	5.8	6.2	5.6	5.6	5.2	4.6	5.62	0.65
Smoothness	4.2	4.2	4	3.4	2.6	3	2.4	4.8	3.4	5	3.70	0.89

Adjective pairs that constitute the four scales of the SEQ: Positivity: happy-sad, angry-pleased, uncertain-definite, confident-afraid, friendly-unfriendly; Arousal: wakeful-sleepy, moving-still, calm-excited, slow-fast, energetic-peaceful, quiet-aroused; Depth: valuable-worthless, shallow-deep, full-empty, weak-powerful, special-ordinary; Smoothness: difficult-easy, relaxed-tense, unpleasant-pleasant, rough-smooth, comfortable-uncomfortable.

Table A3
Heart Rate Variability (HRV) measures.

	Session										M	SD
	2	3	4	5	6	7	8	9	10	11		
Prep. intervention												
HR	73.90	69.30	70.02	60.23	68.81	63.65	69.95	61.56	64.83	70.84	67.31	4.46
SDNN	70.52	25.24	82.89	22.78	79.21	29.52	83.75	27.69	75.88	25.33	52.28	27.87
RMSSD	38.88	23.93	49.43	27.17	45.94	28.87	49.24	29.69	46.73	23.96	36.38	10.73
LF	8.47	5.15	8.77	4.54	8.69	5.54	8.77	5.33	8.60	5.30	6.92	1.86
HF	5.44	5.93	5.82	5.78	5.39	6.23	5.83	6.06	5.48	5.91	5.79	0.27
TP	8.52	6.40	8.82	6.10	8.74	6.70	8.83	6.52	8.65	6.42	7.57	1.22
HFnu	4.64	67.49	5.16	76.72	3.62	65.80	5.07	67.10	4.29	64.10	36.40	33.73
Talk												
HR	74.33	70.58	70.14	65.54	70.13	72.83	69.13	66.77	65.76	72.97	69.82	3.07
SDNN	42.93	54.57	52.09	50.47	46.96	46.96	57.10	64.63	48.34	41.22	50.53	6.96
RMSSD	31.72	43.37	40.50	41.75	36.79	36.11	47.54	55.91	40.02	30.49	40.42	7.51
LF	7.15	7.55	7.35	7.40	7.21	7.27	7.54	7.83	7.29	7.05	7.36	0.23
HF	5.95	6.58	6.29	6.39	6.18	6.23	6.79	6.97	6.26	5.95	6.36	0.33
TP	7.48	7.94	7.76	7.80	7.60	7.64	8.00	8.26	7.67	7.43	7.76	0.25
HFnu	23.83	28.20	27.47	27.85	27.27	27.36	33.01	30.62	27.14	26.12	27.89	2.47
Improvisations												
HR	72.31	72.99	69.69	63.28	67.20	70.30	69.79	63.54	64.67	68.59	68.24	3.47
SDNN	25.94	28.34	46.71	36.81	34.48	31.19	43.18	44.32	28.30	23.09	34.24	8.28
RMSSD	25.03	25.36	42.26	35.91	28.33	25.82	38.25	45.02	27.12	24.26	31.74	7.86
LF	5.66	5.88	6.92	6.55	6.37	6.34	6.92	6.65	5.52	5.00	6.18	0.64
HF	5.66	5.61	6.76	5.98	6.13	5.67	6.54	6.60	5.90	5.63	6.05	0.44
TP	6.41	6.52	7.64	7.03	7.10	6.76	7.49	7.39	6.55	6.20	6.91	0.50
HFnu	49.79	43.75	45.98	36.27	44.24	33.68	40.60	48.83	59.10	65.32	46.76	9.69

HR: heart rate (beats/min), SDNN: standard deviation of all beat-to-beat (NN) intervals (ms), RMSSD: root mean square of successive beat-to-beat interval differences (ms), LF: low frequency (natural log), HF: high frequency (natural log), TP: total power (natural log), LFnu: low frequency (normalised units), HFnu: high frequency (normalised units).

All values are session means, obtained through the averaging of multiple overlapping 2-min segments (50% overlap).

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IV

ENHANCING IMPROVISATIONAL MUSIC THERAPY THROUGH THE ADDITION OF RESONANCE FREQUENCY BREATHING: COMMON FINDINGS OF THREE SINGLE-CASE EXPERIMENTAL STUDIES

by

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Enhancing improvisational music therapy through the addition of resonance frequency breathing: Common findings of three single-case experimental studies

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Abstract

One core characteristic of active music therapy is the facilitation of emotional expression through the creation of music improvisations. In an attempt to further develop this approach, we created an enhanced form of integrative improvisational music therapy by including 10 minutes of resonance frequency breathing (RFB) at the beginning of the sessions. RFB is a type of slow-breathing known for its ability to reduce stress and support emotional regulation. This paper summarizes the common findings of three single-case experimental studies and introduces a provisional model to explain the observed effects of RFB. During the breathing itself, all three clients (two of them healthy and one diagnosed with anxiety disorder) displayed significantly higher relaxation levels compared to the control intervention, as seen through their level of heart rate variability (HRV), a measure of autonomic nervous system response. We also found an association between RFB and the high frequency HRV component (HFnu) during music-making, with the two healthy clients presenting lower HFnu after RFB, whereas the opposite was true for the diagnosed client. Lastly, talking and music-making proved to be two very different activities in terms of HRV, each client perceiving one of them as systematically more stressful than the other. RFB appears to be an adaptive intervention providing either emotional upregulation or downregulation depending on the client's needs, while keeping arousal levels inside the window of tolerance. Between-group studies would be required to determine whether the addition of RFB also leads to better therapeutic outcomes.

Keywords:

improvisational music therapy; resonance frequency breathing; emotional regulation; heart rate variability; process measures.

Introduction

Because of the intrinsic ability of music to elicit and express emotions, emotional processes can rightly be considered the core element behind the dynamics of change within music therapy (Pellitteri, 2009). This is especially true in improvisational music therapy, whose specificity is to offer an alternative to verbal communication by allowing clients to express difficult or repressed emotions through musical improvisations (MacDonald & Wilson, 2014). In that sense, improvisational music therapy belongs to the larger family of experiential, emotion-focused, and psychodynamic therapy methods.

We already know from existing research that the facilitation of a client's emotional experience and expression is connected to more positive outcomes in therapeutic approaches based on psychodynamic principles (Diener, Hilsenroth, & Weinberger, 2007). One general and recurrent finding in the psychotherapy literature is that clients who face and process their emotions more—especially during mid-therapy—will also improve more (Greenberg & Pascual-Leone, 2006; Missirlian, Toukmanian, Warwar, & Greenberg, 2005; Watson & Bedard, 2006). It logically follows that whatever a therapist can do to facilitate constructive emotional processing represents a therapy enhancement that should lead to a better outcome.

Building on this idea, we developed a new therapeutic approach wherein clients start their session of improvisational music therapy with 10 minutes of a slow-breathing intervention known as resonance frequency breathing (RFB). This breathing intervention has been specifically chosen for its known ability to support emotional regulation by instantly and reliably reducing stress levels (Goessl, Curtiss, & Hofmann, 2017). However, since RFB is typically used as a stand-alone intervention, no prior knowledge was available regarding its effects when used as a preparatory intervention within psychotherapy or music therapy. We therefore decided to conduct three exploratory studies to investigate the possible benefits of combining RFB and improvisational music therapy.

The aim of this article is to present the common findings of these three exploratory studies and offer a tentative model to explain the results. More specifically, we wanted to answer the following two research questions. RQ1: Does RFB used as a session prelude have any measurable effects on emotional processes and stress levels during improvisational music therapy? RQ2: To what extent are any observed changes associated with RFB therapeutically useful and relevant?

Key Concepts

Heart rate variability and health

Our heart rate is never constant, but fluctuates on a beat-to-beat basis. The magnitude of this

fluctuation is known as heart rate variability (HRV). HRV is the result of the interplay between the two branches that constitute the autonomic nervous system (ANS), namely the sympathetic (fight-or-flight) and parasympathetic (rest-and-digest) branch (McCorry, 2007). Typically, stress and anxiety are accompanied by an increased influence of the sympathetic branch, leading to reduced levels of HRV. Conversely, when a person feels calm, happy, and relaxed, the parasympathetic branch is dominant, which translates into an increase in HRV (Shaffer, McCraty, & Zerr, 2014).

A person's capacity for emotional regulation is directly dependent on the flexibility of the ANS and the way it responds to changing situational demands (Appelhans & Luecken, 2006). Among other things, a more resilient ANS means higher HRV at rest (Fabes & Eisenberg, 1997), shorter recovery time from stress (Weber et al., 2010), and greater social well-being (Kok & Fredrickson, 2010). Generally speaking, when considering HRV, high values are always more desirable than low values. Indeed, medical research has established that reduced HRV is connected to an increased risk of disease and all-cause mortality (Dekker et al., 2000). In particular, low HRV serves as a good predictor for cardiovascular diseases and cardiac events (Tsuji et al., 1996). On the psychological level, reduced HRV has been shown to accompany emotional disorders such as panic disorder, post-traumatic stress disorder, anxiety disorders, and depression (Alvares, Quintana, Hickie, & Guastella, 2016).

The role of respiration

Breathing interventions have an effect on autonomic arousal because of the intimate connection that exists between heart rate and respiration, whereby heart rate increases during inhalation and decreases during exhalation. This natural variation in heart rate that accompanies breathing is called respiratory sinus arrhythmia, and its intensity is proportional to the amount of parasympathetic activity (Appelhans & Luecken, 2006). The existence of this cardiorespiratory coupling means that we can directly influence our heart rate through our breathing pattern, which will consequently affect our emotional state and level of arousal.

In other words, any breathing intervention able to increase respiratory sinus arrhythmia will automatically make the ANS shift towards parasympathetic dominance, resulting in increased calmness and positivity. This effect on autonomic functioning is well-known and has been observed with numerous techniques employing deep and slow breathing, for example pranayama yoga (Jerath, Edry, Barnes, & Jerath, 2006; Pal, Velkumary, & Madanmohan, 2004). Moreover, it should be noted that breathing interventions have become increasingly common for the treatment of various psychological and stress-related disorders (for an overview, see Brown, Gerbarg, & Muench, 2013).

Resonance frequency breathing

Research into cardiorespiratory coupling has demonstrated that for each person there exists an

optimal breathing speed where the amplitude of heart rate oscillations is maximized (Vaschillo, Lehrer, Rische, & Konstantinov, 2002). Typically, this maximization of HRV is achieved at around 6 breaths per minute. When plotting the corresponding heart rate pattern (with time on the X-axis and heart rate on the Y-axis), we obtain a very smooth, high-amplitude curve resembling a sine wave. In comparison, the heart rate curve during normal breathing tends to be more chaotic and jagged, with a much lower amplitude. To illustrate this difference, Figure 1 shows the heart rate curve of the same client under two different breathing conditions (10 min of RFB vs. 10 min of relaxation with normal breathing).

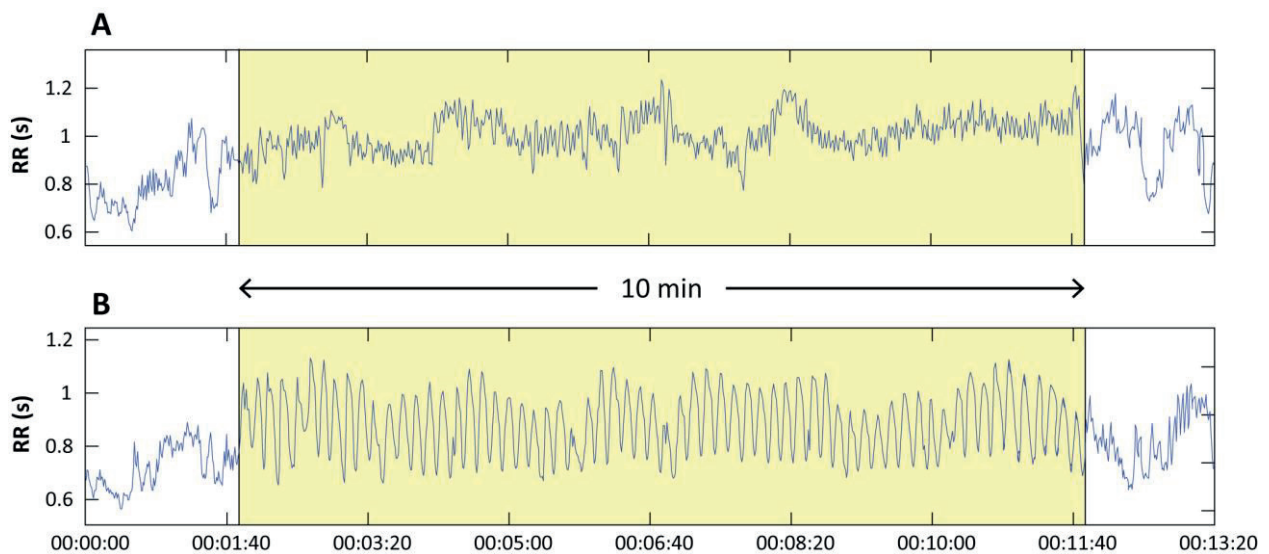


Figure 1. Example of heart rate (RR intervals) during normal breathing (A) and RFB (B).

Besides the maximization of HRV, another physiological effect of RFB is to synchronize heart, respiratory, and blood pressure rhythms. The specific breathing rate or frequency that produces this combined amplification and synchronization effect is known as the “resonance frequency.” When an oscillatory system is rhythmically stimulated at the system’s resonance frequency, the oscillations are not only maintained but also amplified, hence the name of the breathing method. One useful property of this resonance frequency is that it remains stable in adults, the main influencing factors being body height and blood volume. Age and weight, for example, do not seem to influence it, nor does prolonged practice of RFB (Lehrer & Gevirtz, 2014).

RFB is generally considered a safe intervention with no known risks or contraindications (Eddie, Vaschillo, Vaschillo, & Lehrer, 2015). The only issue that might arise while performing RFB is hyperventilation, recognizable by feelings of dizziness. Indeed, when people are asked to breathe more slowly, they often tend to breathe deeper, causing a drop in the level of carbon dioxide in the blood. This is why it is important to tell clients not to breathe too deeply and to breathe more shallowly should they notice any sign of hyperventilation.

Since its introduction in the 1990s, RFB and its more elaborate implementation in the form of heart rate variability biofeedback have been successfully applied to treat a wide range of health conditions, from physical disorders such as asthma and chronic muscle pain, to psychological disorders such as anxiety and depression (for an overview, see Gevirtz, 2013). However, as mentioned above, these applications usually involved using RFB in isolation or as a complement to standard care, without attempting to combine it synergistically with another therapy method. One exception is a recent study where a form of breathing biofeedback similar to RFB was integrated into trauma-focused cognitive behavioral therapy (TF-CBT), and compared to TF-CBT without biofeedback (Polak, Witteveen, Denys, & Olf, 2015). The authors hypothesized that the breathing intervention might help clients better handle the stress increases during the exposure parts, resulting in larger symptom reduction. Although the outcome was in fact similar in both groups, the biofeedback group displayed faster symptom reduction, which suggests that the addition of the breathing intervention may represent an improvement over TF-CBT alone.

Improvisational music therapy

Music therapy is a broad and versatile field encompassing many different approaches and models. The methods most regularly used are improvising, composing, performing, music listening, and verbalization. Improvisational music therapy refers to approaches that rely essentially on the creation of music improvisations together with the therapist (Bruscia, 1987). As opposed to improvisations played by trained musicians as part of a specific genre, improvisations in music therapy do not necessarily result in “proper” music, since the focus is more on the creation process, with an emphasis on spontaneity and self-expression.

Most of the differences between the existing models of improvisational music therapy derive from the clinical setting and the client population for which they were designed. For instance, some are meant to be used on a one-on-one basis with children presenting developmental disorders (James et al., 2015), while others are designed for group therapy with normally-functioning adults (Skewes, 2002). However, because of their inherent flexibility, most models can easily be adapted to different clients and contexts. In practice, all the models for individual therapy use a common set of techniques and activities, categorized by Wigram (2004) as follows: mirroring, matching, empathic confirmation or reflection, stabilization (grounding, holding, and containing), dialoguing, modeling, and accompanying.

In terms of health-promoting mechanisms, MacDonald and Wilson (2014) identified four unique characteristics of music improvisations: 1) the ability to facilitate the emergence of unconscious material, 2) the provision of an absorbing and creative experience unfolding in the present, 3) the interactive and social nature of the process, and 4) the possibility to express emotions in a non-verbal way. These characteristics are thought to be largely responsible for the

positive results obtained with improvisational music therapy in the treatment of clients experiencing neurological damage, emotional disorders, and developmental disorders involving communication difficulties (MacDonald & Wilson, 2014).

The specific model used in our three exploratory studies was integrative improvisational music therapy (IIMT). IIMT is mainly informed by psychodynamic theories, but it also contains elements borrowed from supportive psychotherapy and resource-oriented approaches (Erkkilä, Ala-Ruona, Punkanen, & Fachner, 2012). So far, it has mainly been used for individual therapy with adults presenting with emotional disorders. Similar to other improvisational models, IIMT does not require the client to possess any particular music training. The only prerequisites are the capacity for abstract thinking and the presence of sufficient language skills to discuss the improvisations.

In a nutshell, IIMT encourages clients to express themselves musically through the creation of free improvisations together with the therapist. These improvisations and their related themes, emotions, and associations are then discussed verbally. The alternation between musical and verbal moments is seen as the key element behind the therapeutic benefits derived from IIMT. In terms of effectiveness, a previous randomized controlled trial has shown that IIMT was more effective than standard care alone in the treatment of depression and co-morbid anxiety, with higher response rates in the IIMT group and effects that were clinically significant (Erkkilä et al., 2011).

Method

Our three consecutive studies were focused on developing and testing a new therapeutic concept, with each study capitalizing on the findings of the previous one(s). They were thus exploratory in nature and conducted with a certain degree of variation, mainly with regard to the control intervention, the type of client, and the assessment instruments. However, as we will see in the following sections, they presented enough methodological consistency and overlap to warrant a juxtaposition of their results.

Design

Each study was a single-case experimental study following an alternating treatments design (Byiers, Reichle, & Symons, 2012). All the sessions, across the three studies, had the same structure. They started with 10 minutes of a preparatory intervention (RFB or control) followed by 45 minutes of IIMT. Furthermore, the experimental conditions (RFB or control) were systematically alternated (ABABAB...). In this type of research design, participants serve as their own control and causal inferences can be made if a change in the experimental condition is systematically accompanied by a clear and consistent change in the dependent variables (Shadish, Cook, & Campbell, 2002). The only differences in terms of structure were the control

intervention used, the order of the conditions, and the overall length of the therapy processes. In Study 1, music-listening was the control intervention, whereas vibroacoustic therapy (VAT) was used in Study 2 and 3. Although different in nature, the two control interventions were chosen for their ability to provide relaxation, making them suitable alternatives to RFB. Regarding the conditions' alternation, Study 1 began with RFB in the first session, while Study 2 and 3 began with the control intervention. As to the overall length, Study 1, 2, and 3 comprised 10, 18, and 12 sessions respectively.

Despite this difference in length, there were enough observations in each condition to meet the standards for single-case research designs identified by What Works Clearinghouse, whereby a minimum of five repetitions of the alternating sequence are required (Kratochwill et al., 2010). Besides, since each study comprised an even number of sessions, the total number of sessions in each condition was always balanced.

Generally speaking, the reason why we decided to test RFB against an active control intervention was threefold. First, we did not want to keep the client idle for 10 minutes. Second, to keep the session structure consistent, we wanted these preliminary 10 minutes to always be about relaxation, whatever the experimental condition. Third, offering a credible alternative to RFB made it possible to present all the preparatory interventions as having the same purpose (relaxation), thus minimizing the risk of the clients having divergent expectations.

Matching the expectation levels between treatment and control is an aspect often neglected in intervention research. In its absence, placebo effects are not sufficiently controlled for, which reduces the confidence in any causal efficacy attributable to the treatment (Boot, Simons, Stothart, & Stutts, 2013). Although the choice of adequate controls is especially crucial in treatment efficacy studies and systematic reviews (Karlsson & Bergmark, 2015), applying this principle to our single-case exploratory studies can only strengthen their internal validity.

Participants

The three participants (called henceforth Client 1, 2, and 3) were young females in their 20s or 30s. Client 1 and 2 had no diagnosis or major mental health issues, while Client 3 was diagnosed with anxiety disorder and social phobia. The clients also differed in terms of cultural background, with Client 1 and 3 being of European background and Client 2 of Chinese background. Client 1 and 2 were recruited among the students of the University of Jyväskylä, Finland, while Client 3 was referred to the research project by a local psychotherapist familiar with music therapy. All the clients agreed to the terms of the study and signed an informed consent form stipulating that the therapy sessions would be filmed and the collected data used for research purposes. The studies fully complied with the ethical guidelines of the University of Jyväskylä that were in place at the time of the data collection.

Setting

The therapy sessions took place on a weekly basis at the University of Jyväskylä, Finland, in the music therapy clinic of the Department of Music, Art and Culture Studies. The music therapy clinic is equipped with various analogue and digital music instruments, as well as with non-intrusive microphones and video cameras. The three therapy processes were conducted by three different therapists, all of whom were in the final year of the Master's Degree Program in Music Therapy offered at the University of Jyväskylä. Being part of the same program, they all received the same training in clinical improvisation techniques, as well as in the principles and methods of the IIMT model.

Procedure

RFB was performed in the same way across all three studies. Before the beginning of the therapy process, we met each client individually and conducted a breathing assessment to determine their resonance frequency. This was done by testing six different breathing speeds ranging from 7 to 4.5 breaths/min, in accordance with the iteration method described by Lehrer (2007). An optimal breathing speed is understood to be the one that produces the highest level of HRV, as established through power spectral analysis of the heart rate signal.

After having determined each client's optimal breathing speed, we used that information to provide individualized breathing cues in the sessions starting with RFB. The breathing cues were given by a breathing app running on an Android tablet that the client would hold in front of her while sitting in an upright position. In addition to being set to the correct breathing speed, the app would deliver visual and auditory cues at an inhalation/exhalation (i/e) ratio of 40/60—meaning that exhalations lasted longer than inhalations. This aspect is important because low i/e ratios have been shown to induce higher HRV levels than high i/e ratios (Diest et al., 2014).

Vibroacoustic therapy (VAT) is an intervention that consists of the application of low-frequency sound waves onto the body through speakers placed inside an armchair or mattress (Punkanen & Ala-Ruona, 2012). VAT is often used as a stand-alone intervention to treat pain, muscle spasticity, stress, and anxiety (Grocke & Wigram, 2007). We administered VAT with the help of a Next Wave Physioacoustic PRO therapy chair. This apparatus received 510(k) clearance from the U.S. Food and Drug Administration as a class II medical device (clearance number: K905256). In the two cases involving VAT (Study 2 and 3), we used the same pre-existing relaxation program for 10 min.

As to the music-listening intervention used in Study 1, it consisted of listening to 10 minutes of new-age style relaxation music while counting one's breaths in groups of four. Similar to VAT, we chose this intervention because targeted music listening is known to relieve stress and anxiety, both in healthy participants (Gäbel, Garrido, Koenig, Hillecke, & Warth, 2017) and

patients waiting to be hospitalized (Hamel, 2001).

Every time a preparatory intervention was being administered (RFB, VAT, or music-listening), the therapist sat next to the client in silence in order to monitor the client but not interfere with the intervention. Furthermore, it should be noted that VAT and music-listening did not involve any targeted manipulation of the breathing pattern. Instead, we encouraged the clients to breathe normally.

In accordance with the IIMT model, the music therapy component of each session consisted of verbal phases alternating with music improvisation phases. All the improvisations were performed either on a West-African djembe drum or a malletKAT Pro. The malletKAT Pro is a pressure-sensitive MIDI controller with the same key layout as a marimba, and it is played using one or two mallets. It also features a sustain pedal that functions like the sustain pedals typically found on pianos. In IIMT, client and therapist are facing each other during improvisations and will generally play together using the same type of instrument. This enables the therapist to more effectively mirror, ground, accompany, or challenge the client, depending on the clinical technique chosen by the therapist.

Measures

The cases were compared from the point of view of HRV, as heart rate data were the only type of data collected and analyzed in a similar way in all three participants. We reported elsewhere on the video analysis, session transcript analysis, and music feature extraction used in Study 1 (Brabant, Solati, Letulè, Liarmakopoulou, & Erkkilä, 2017), and the session evaluation questionnaire used in Study 3 (Brabant, van de Ree, & Erkkilä, 2017).

Beat-to-beat intervals were collected using a Suunto Smart Belt, which is a chest strap monitor that has been shown to be reliable when compared to regular electrocardiogram systems (Bouillod, Cassirame, Bousson, Sagawa, & Tordi, 2015). The Smart Belt functions completely autonomously, in the sense that it can store beat-to-beat intervals in its internal memory instead of having to transmit them to an external receiver. This eliminates the risk of data loss because of transmission problems. The clients were wearing a Smart Belt in each session, for the entire duration of the session.

Data processing and analysis were performed with Kubios HRV (version 2.2), an advanced software for HRV analysis (Tarvainen, Niskanen, Lipponen, Ranta-aho, & Karjalainen, 2014). Data were first pre-processed. This consisted of systematic artifact removal and detrending. Time and frequency domains were then analyzed. For interested readers, a more detailed description of the HRV methodology can be found elsewhere (Brabant, Solati, et al., 2017).

Regarding the choice of HRV indices, we based our study comparison on the following

metrics: RMSSD (the root mean square of successive beat-to-beat interval differences), HF (high frequency; the spectral power of the high-frequency component responsible for HRV), LF (low frequency; the spectral power of the low-frequency component responsible for HRV), TP (total power; the spectral power of all the cyclical components responsible for HRV). In addition, we also included LFnu and HFnu, which are LF and HF expressed in normalized units (nu).¹ In terms of interpretation, RMSSD and HF are both measures of short-term HRV that reflect vagal tone, the vagus nerve being the main contributor to parasympathetic activity (Laborde, Mosley, & Thayer, 2017). LF, on the contrary, is not easily interpretable, as it is the result of the interplay between sympathetic, parasympathetic, and baroreflex activity (Heathers, 2014). As to TP, it is a measure of overall HRV and expresses how much the ANS responds. Lastly, LFnu and HFnu can be understood as the relative value of LF and HF in proportion to TP, since VLF becomes negligible after detrending the data.

Data analysis procedures

As we saw, IIMT involves the alternation between musical and verbal moments during sessions. These two modes of communication are arguably very different in terms of their aesthetic, cognitive, emotional, physiological, cultural, and social dimensions. Therefore, we decided to distinguish between music improvisation and verbal exchange when conducting the analysis. The first 10 minutes of each session were analyzed separately as well, since the preparatory interventions constituted a distinct additional activity that was neither music-making nor talking.

With the help of the video recordings, we first identified the moments of preparatory intervention, music-making, and talking, and then calculated three separate session averages for all the HRV metrics described above. The music moments included in the analysis were only the malletKAT improvisations because this instrument was used in every session (bar one), whereas the djembe was only used intermittently. This had the added benefit of making the improvisations more comparable within and across clients, since they all involved one and the same instrument.

Heart rate data were analyzed through visual analysis, which remains the most common method used in single-case experimental designs (Smith, 2012). When performing a visual analysis, the data points of each variable are first plotted and then inspected for changes in level, trend (i.e., slope), and variability (Byiers et al., 2012). Since our study design involved the systematic alternation of two experimental conditions, we were on the lookout for clear and pronounced zigzag patterns. If present, such patterns would point towards the existence of an association between RFB and the measured HRV indices. One exception were the HRV indices of the preparatory interventions, for which we performed a statistical analysis of the means

¹ LFnu = LF/(TP – VLF) and HFnu = HF/(TP – VLF), with VLF (very low frequency) corresponding to all the cyclical components below LF.

obtained in each condition. Indeed, we knew RFB would have a strong, immediate, and systematic effect on HRV compared to the control interventions because the latter were not designed to maximize HRV. Thus, instead of plotting each HRV index separately and performing a visual analysis, we compared the effects of the preparatory interventions using *t*-tests and presented the results in a single table.

Results

As expected, overall HRV was substantially higher during RFB for all three clients, and these gains were mainly driven by strong increases in low frequency (LF). Indeed, compared to the control interventions, the difference in HRV levels was statistically significant for total power (TP), LF, and low frequency in normalized units (LFnu) for all three clients (see Table 1). The systematic decrease in high frequency (HF) during RFB is due to the fact that RFB concentrates most of the spectral power around the breathing frequency, which is located in the LF band (0.04 – 0.15 Hz) when breathing at around six breaths/min (6 cycles per min = 0.1 Hz). Consequently, when performing RFB the spectral power that would normally be located in HF temporarily moves into LF.

Table 1. *t*-test results for HRV measures during the preparatory intervention

	RFB			Control			95% CI for Mean Difference	<i>t</i>	<i>df</i>	<i>p</i>	<i>d</i> ^c
	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>					
Client 1											
TP	9.22	0.39	5	8.32	0.39	5	.33, 1.46	3.65**	8	.006	2.58
LF	9.07	0.37	5	7.39	0.58	5	.97, 2.38	5.49**	8	.001	3.88
HF	6.92	0.66	5	7.35	0.48	5	-1.27, .42	-1.16	8	.278	
LFnu ^b	87.82	4.93	5	52.00	18.91	5	12.66, 58.99	4.10*	4.54	.011	3.85
Client 2											
TP	8.00	0.45	9	6.07	0.55	9	1.43, 2.43	8.20**	16	<.001	4.10
LF	7.94	0.44	9	5.23	0.49	9	2.23, 3.17	12.25**	16	<.001	6.12
HF	4.72	0.67	9	5.27	0.63	9	-1.19, .10	-1.78	16	.094	
LFnu ^b	95.80	1.11	9	49.08	6.51	9	41.69, 51.75	21.21**	8.46	<.001	14.58
Client 3											
TP	8.63	0.24	6	6.44	0.20	6	1.90, 2.47	17.16**	10	<.001	10.85
LF	8.58	0.23	6	5.18	0.34	6	3.02, 3.77	20.18**	10	<.001	12.76
HF	5.43	0.44	6	6.01	0.16	6	-1.00, -.15	-3.01*	10	.013	1.91
LFnu	95.70	0.85	6	31.28	4.52	6	59.68, 69.15	34.28**	5.35	<.001	29.63

^b Equal variances not assumed (Levene's test was significant with $p < .05$).

^c Formula used to calculate the effect size (Cohen's *d*): $2 |t| / \sqrt{df}$

* $p < .05$, ** $p < .01$

When looking at the 45 minutes of music therapy following the preparatory intervention, HFnu during music-making was the only HRV index that displayed uninterrupted sequences of systematic ups and downs corresponding to the alternation of the two conditions. As shown in Figure 2, HFnu during malletKAT improvisations was systematically associated with the practice of RFB, either throughout the entire therapy process (Study 1) or during a significant part of it (Study 2 and 3). Interestingly enough, no systematic pattern across studies was found for HRV levels during verbal exchange. Such an association was only visible in Study 1, where HFnu during talking displayed a similar sequence to HFnu during improvisations (see Brabant, Solati, et al., 2017).

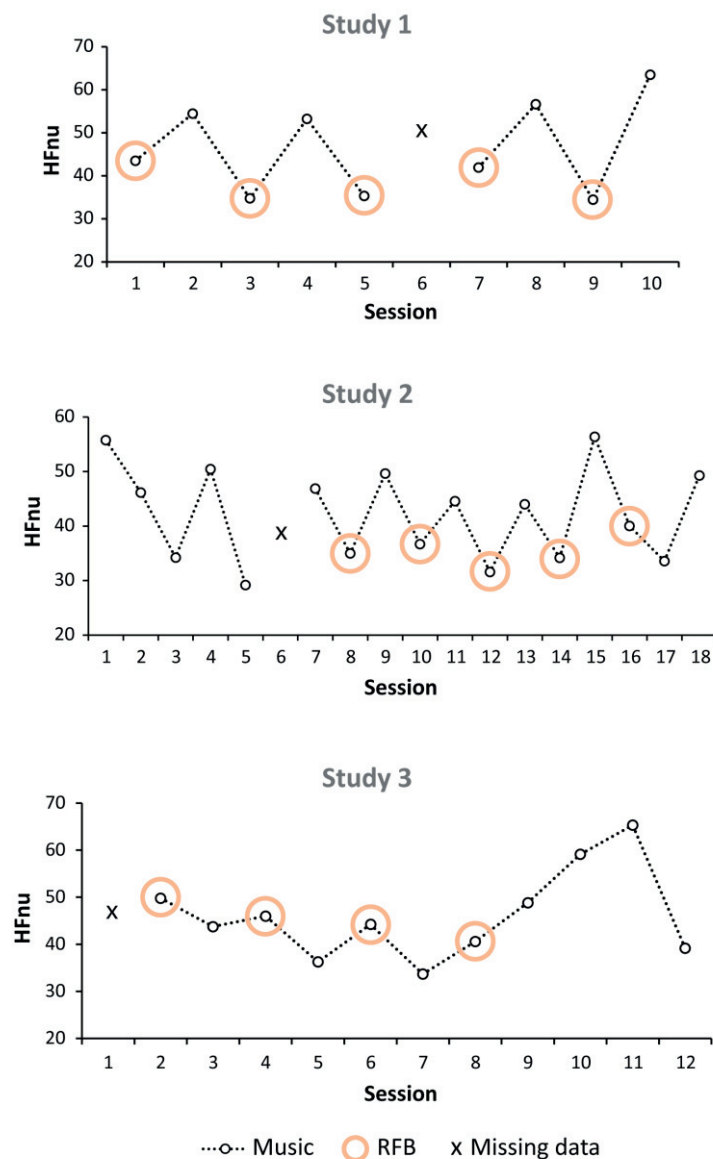


Figure 2. HFnu during music improvisations.

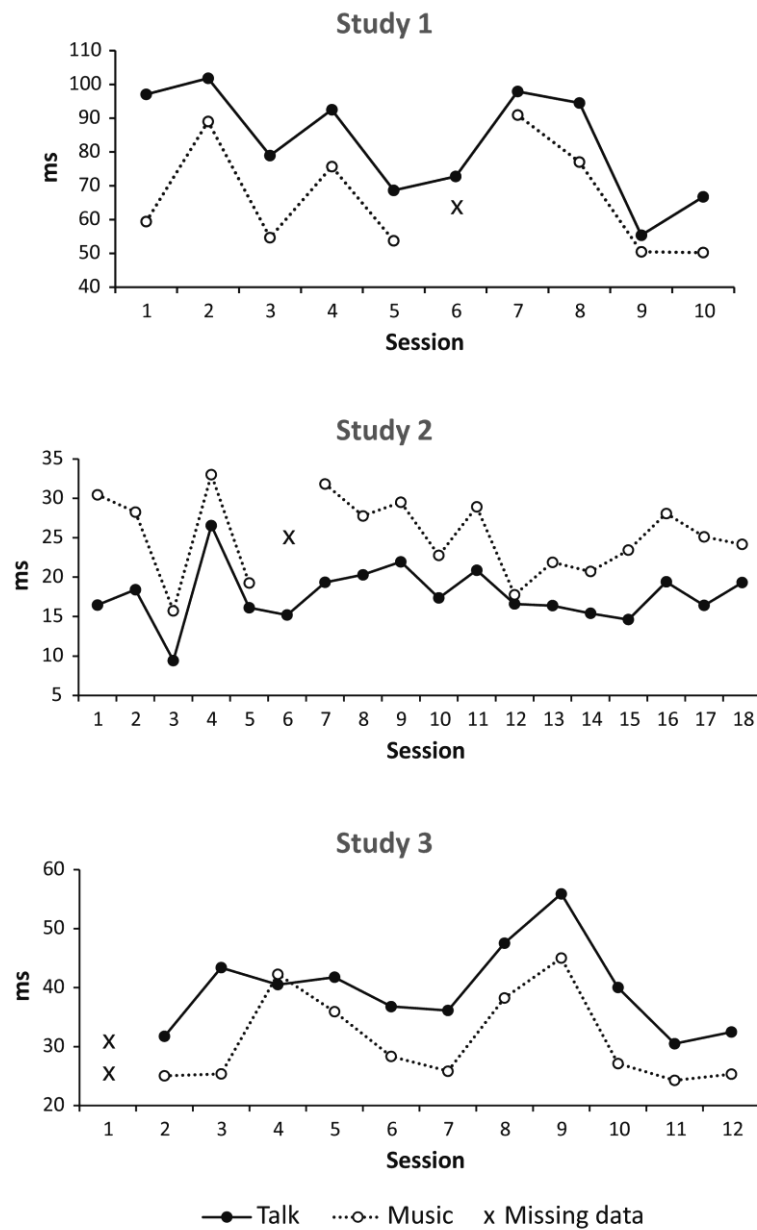


Figure 3. HRV levels (RMSSD) during talking and music-making.

An additional finding was that the direction of the change in HFnu differed depending on the client. With the two healthy clients (Study 1 and 2), HFnu was lower in sessions starting with RFB, which indicated that the clients were most likely experiencing higher levels of negative arousal during the music improvisations that followed RFB. On the contrary, for the client diagnosed with anxiety disorder (Study 3), HFnu was higher after RFB, but only during the first half of the therapy process. This phase also happened to be identified as the more difficult phase of the therapy (Brabant, van de Ree, & Erkkilä, 2017). Therefore, it would appear that as

emotional processes were more difficult, the improvisations played after RFB were nonetheless comparatively easier than the other improvisations played in that same phase. In the second half of the therapy process, no association was found between RFB and HFnu during improvisations (see Figure 2).

The HRV analysis of the moments of verbal exchange and music improvisation revealed that these two activities had distinct HRV signatures, with one being systematically more stressful than the other. Interestingly, the clients differed in terms of which activity they found more stressful. As can be seen in Figure 3, RMSSD during improvisations was systematically lower than during verbal exchange for Client 1 and 3, which means that music-making was perceived by them as more stressful than talking. The opposite was true for Client 2, for whom music-making was *less* stressful than talking. It is worth emphasizing that for all three clients, these differences remained consistent throughout the entire therapy process independently of its length or the preparatory intervention being used.

Obviously, this last finding is not directly related to the use of any preparatory intervention, since the observed differences in RMSSD remained unaffected by the alternation in the experimental conditions. Nonetheless, we deemed it worth mentioning, as it represents not only important information about the role played by music in improvisational music therapy, but also about the intrinsic differences between music-making and verbal expression.

Discussion

The main findings derived from the three studies were as follows. First, it appeared that RFB had a presumptive effect on autonomic arousal during malletKAT improvisations, as evidenced by the systematic changes in the relative power distribution between LF and HF (i.e., HFnu). Second, this effect was visible in an unbroken series of sessions that encompassed either the entire therapy process (Study 1) or a substantial part of it (Study 2 and 3). Lastly, RFB was followed either by decreased levels of HFnu (Study 1 and 2) or increased levels of HFnu (Study 3).

In reflecting upon these findings, one might wonder why during IIMT, HFnu was the only HRV metric associated with the presence or absence of RFB. We attributed this to the fact that HFnu is a relative index, whereas all the other indices are raw, absolute values. Absolute HRV indices tend to display strong natural variations from one measurement to the next (Pinna, 2007), both between people (inter-individual variability) and within the same person (intra-individual variability). This means that if a presumed intervention effect is smaller than these naturally occurring variations, it might be masked by them and become undetectable through visual inspection and statistical analysis.

Relative indices, on the other hand, are much less sensitive to random variations in overall

HRV because they are expressed as proportions of overall HRV. Consequently, they tend to have lower coefficients of variation compared to absolute indices (Burr, 2007). However, their downside is the ambiguity and uncertainty surrounding their interpretation. Indeed, among the HRV indices chosen for the analysis, only RMSSD and HF have a clearly defined and non-controversial physiological origin (Laborde et al., 2017). As we saw above, both are an expression of parasympathetic activity and vagal tone, with higher levels of RMSSD and HF corresponding to more parasympathetic activity (i.e., lower stress levels).

Given the ambiguity surrounding HFnu, the safest way to proceed would be to interpret this metric within the context of data triangulation, where it can be compared to other physiological, psychological, or behavioral measures. For instance, in Study 1, we found that lower HFnu was related to the presence of more negative emotions during talking and more negative facial expression (Brabant, Solati, et al., 2017). A similar association was found in Study 3, where HFnu and session smoothness were following the same high-low-high curvilinear trend (Brabant, van de Ree, & Erkkilä, 2017). For the purpose of this discussion, we will therefore assume that HFnu can be interpreted in the same way as HF, with lower HFnu indicating higher stress levels and emotional difficulty, and vice versa.

Although it is of course too early to make any strong claims regarding the existence of systematic and generalizable effects of RFB on emotional processes during music therapy, we nonetheless would like to propose a tentative model to explain the results obtained so far. This model is based on the assumption that HFnu can serve as a reliable indicator of stress levels and emotional difficulty.

We propose that RFB has two main effects when used within music therapy (and possibly creative arts therapies in general). First, it opens clients up, allowing them to better access and express emotions that usually remain unexpressed. Second, it helps clients manage difficult emotions by reducing stress levels in case of excessive arousal. In other words, we believe RFB functions both as a catalyst and a regulator, deepening and supporting the emotional processes already occurring during music therapy. Assuming that these two effects are always simultaneously at work, their joint result will differ depending on the client and the emotional issues currently at hand. For example, someone whose stress level is already excessively elevated because of a pre-existing emotional disorder may benefit from stress reduction (cf., Study 3), whereas clients with a lower arousal baseline (cf., Study 1 and 2) will experience temporary stress increases because of the normally unexpressed emotions evoked through the process. Although the resulting HRV changes proceed in opposite directions, in both cases they are actually beneficial to the therapy process because the changes correspond to what the clients are able to manage. We thus see RFB as an adaptive intervention whose outcome is always an expression of the clients' current emotional needs.

To better understand this last point, it may be useful to apply the concept of “window of tolerance” (Ogden & Minton, 2000; Siegel, 1999). Originally developed within the context of trauma therapy, a window of tolerance refers to the zone of optimal arousal where emotions can be tolerated and information integrated. If arousal levels become too high, clients enter a state of hyper-arousal, characterized by panic, fight-or-flight reactions, hyper-vigilance, and disorganized cognitive processing. Conversely, at the other end of the spectrum, clients might enter a state of hypo-arousal, whose typical manifestations are numbness, passivity, and disabled cognitive processing (see Figure 4). In both cases, therapeutic work is not possible. Thus, for therapy to proceed optimally and be successful, the therapist must ensure that the client remains or returns inside the window of tolerance.

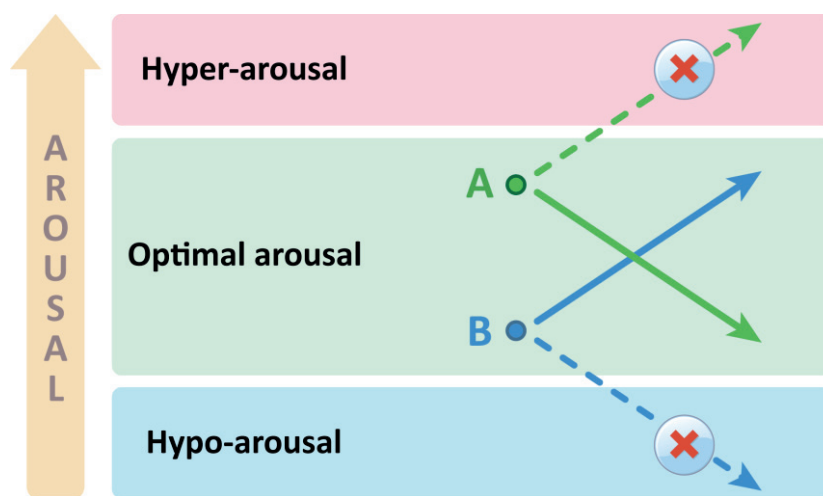


Figure 4. Window of tolerance model applied to RFB.

Applying these ideas to our results, it comes as no surprise that Client 1 and 2 would experience decreases in HFnu (i.e., increased arousal), whereas Client 3 would display HFnu increases (i.e., decreased arousal). As illustrated in Figure 4, it would be counter-productive for Client A to become even more stressed through RFB, because he or she would be entering the hyper-arousal zone. Instead, what such a client needs is a reduction in stress levels (downward arrow). The opposite is true for Client B, whose default arousal level is lower than in Client A. Such a level would be typical for healthy individuals presenting low amounts of fear and anxiety. For such clients, further reducing arousal levels would be unhelpful, as it would lead them into the hypo-arousal zone. However, punctual increases in arousal (e.g., because of the processing of negative emotions) is unproblematic, since Client B will still remain inside his/her regulatory boundaries.

While we are not aware of any research specifically addressing the impact of RFB on emotional processes during therapy, we found corroborating evidence to support our model in a study on emotional regulation during social interaction (Butler, Wilhelm, & Gross, 2006). In that

study, healthy women first underwent temporary parasympathetic activation through a slow-breathing exercise, then negative emotions were induced with an upsetting film, and finally the women were asked to talk in pairs about their emotional experience. The authors found that the participants with higher HRV levels during the breathing task also experienced and expressed more negative emotions during the conversations. This is very much the same pattern as the one we found for our healthy clients in Study 1 and 2, with HRV data showing that music-making was emotionally more difficult (lower HFnu) in sessions starting with the breathing intervention (higher HRV). Butler et al. (2006) further support our hypothesis by speculating that their results would probably have shown the opposite relationship if their participants had presented emotional disorders or pathologically high levels of stress. In such a scenario, the authors would have expected a decrease in negative emotional reaction instead of an increase (similarly to the first therapy phase in Study 3).

The last finding we need to discuss is the systematic HRV difference between talking and music-making that was found in all three clients. The inter-individual differences regarding which activity was perceived as more stressful could not be attributed to the clients' clinical status, as Client 1 (generally healthy) and Client 3 (diagnosed) presented the same HRV pattern, with music-making systematically more stressful than talking. However, we believe that one possible explanation might be found in the clients' cultural background. Indeed, the only client for whom talking was more stressful than improvising was Client 2, who was also the only client with a Chinese background.

Chinese culture tends to distinguish itself from European culture in terms of verbal communication. For example, addressing issues in a direct and straightforward manner is considered impolite in China (Scarborough, 1998). When it comes to personal problems and emotional issues, they are usually not discussed openly, as this might be interpreted as a sign of weakness and lead to loss of face (Myler & Tong, 2008). Another important cultural feature is the idea that the interests of others come before one's own interests. Consequently, there is a strong focus on affective self-control and the displaying of what Zhong (2011) calls "surface harmony". In this context, it is not surprising that music, with its symbolic and non-verbal qualities, would offer the client more expressive freedom and be experienced as less stressful than talking.

Assuming that our two European clients were representative examples of how Western clients would typically react to music therapy, the findings presented here can be interpreted in two different ways. The observed increase in stress levels during music-making could simply be due to the fact that the activity is unusual compared to talking, especially for clients with little or no musical training. However, if this were indeed the case, we would expect the difference between talking and improvising to diminish with time, under the influence of a learning or habituation effect. As can be seen in Figure 3, this was not the case in our studies.

A second explanation is that the difference in stress levels are due to the intrinsic qualities of music as an expressive medium. This explanation is more compatible with the observed stability in the HRV differences, since intrinsic qualities would, by definition, remain unchanged. The higher stress levels during music-making compared to talking support the idea that music provides clients with better access to clinically-relevant emotions. Assuming that these emotions were predominantly difficult and negative, this might explain the lower RMSSD levels observed during music improvisations.

On a more general level, these findings lend support to something that music therapists have implicitly known for a long time—that music-making has specific qualities that clearly distinguish it from verbal interaction. Better understanding these qualities is fundamental for raising the profile of music therapy and highlighting its uniqueness in relation to purely verbal forms of psychotherapy.

Summary

The common findings of our three exploratory studies provide preliminary empirical support for the beneficial influence of RFB on emotional processes during therapy. Furthermore, they offer music therapists new and valuable information about the differences between verbal and musical expression. With regard to our research questions, we did find a link between RFB and a specific HRV parameter during music improvisations (RQ1). This link pointed towards either increased or decreased emotional difficulties depending on the type of client and the therapy phase. Thus, RFB appeared to function as an individualized and adaptive intervention (RQ2). Our proposed model based on the notion of window of tolerance explains why different clients would respond differently to a relaxation-inducing intervention such as RFB.

Limitations and future research

Although single-subject experimental designs are very useful for examining new treatment approaches prior to engaging in larger between-group studies (Borckardt et al., 2008; Byiers et al., 2012), they do not allow the drawing of conclusions beyond the individuals being studied. In other words, it is not possible at this point to know whether the findings from our three participants can be generalized. This is especially true in the case of RFB, whose effects appear to depend on the type of client and their current needs. Therefore, in order to better understand and anticipate the type of effects that can be expected from RFB, further research involving different client populations would be required.

Because the three cases presented here were focused only on therapy processes, another question that remains open is the actual improvement that RFB can provide in terms of therapy outcome. It is reasonable to assume that RFB should have a positive impact on outcome

measures, but this does not necessarily mean the effect is clinically significant. To answer this question, outcome-oriented trials using a parallel group design would need to be conducted. Trials of this kind already exist in the literature (see, e.g., Goessl et al., 2017), but they usually involve RFB used as a stand-alone intervention in addition to standard care and not RFB conceived as an integral part of a specific psychotherapy method.

Implications and practical recommendations

RFB appears to be a promising addition to music therapy, with the apparent ability to prepare clients for deeper therapeutic work. In the light of the existing evidence, we encourage clinicians to start integrating RFB into their practice of music therapy. Together with the additional knowledge derived from large randomized controlled trials, this might eventually lead to the establishment of a valid and innovative therapy model characterized by better outcomes as well as shorter therapy durations.

For music therapists who would like to start implementing RFB, the main hurdle is the technical equipment and know-how required to perform the initial breathing assessment. Fortunately, it is nowadays no longer necessary to invest in heart rate monitors or electrocardiogram systems, as heart rate can be measured reasonably accurately through smartphone sensors and cameras, in combination with dedicated apps. Some of these apps are also able to analyze HRV, making it theoretically possible to perform the entire breathing assessment using only smartphone technology.

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V

**ENHANCING THE EFFICACY OF INTEGRATIVE
IMPROVISATIONAL MUSIC THERAPY IN THE TREATMENT
OF DEPRESSION: STUDY PROTOCOL FOR A RANDOMIZED
CONTROLLED TRIAL**

by

Jaakko Erkkilä, Olivier Brabant, Suvi Saarikallio, Esa Ala-Ruona,
Martin Hartmann, Nerdinga Letulè, Monika Geretsegger & Christian Gold
(under peer-review)

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